MARTINA CREEK RESTORATION PROJECT
FINAL DESIGN

PROJECT PARTNERS

TROUT UNLIMITED
111 NORTH HIGGINS AVENUE, SUITE 500
MISSOULA, MONTANA 59802

WESTWATER CONSULTANTS, INC.
1112 CATHERINE LANE
CORVALLIS, MONTANA 59828

USDA FOREST SERVICE
LOLO NATIONAL FOREST
FORT MISSOULA, BUILDING 24
MISSOULA, MONTANA 59804

GEUM ENVIRONMENTAL CONSULTING, INC.
307 STATE STREET
HAMILTON, MONTANA 59870

PROJECT DESCRIPTION

MARTINA CREEK IS A TRIBUTARY TO NINEMILE CREEK IN THE MIDDLE CLARK FORK RIVER WATERSHED APPROXIMATELY 20 MILES WEST OF MISSOULA, MONTANA. SIMILAR TO THE MAINSTEM NINEMILE CREEK, MARTINA CREEK HAS BEEN SIGNIFICANTLY IMPACTED BY HISTORICAL MINING ACTIVITIES THAT ALTERED THE MORPHOLOGY AND LANDSCAPE OF THE LOWER VALLEY. RECORDS INDICATE THAT A PLACER GOLD BOOM OCCURRED ON NINEMILE CREEK BETWEEN 1874 AND 1977 AND MINING WITH DRAGLINES, DREDGES, HYDRAULIC HOSES AND SLUICING CONTINUED ON PRIMARY TRIBUTARIES SUCH AS MARTINA CREEK THROUGH THE LATE 1904S.

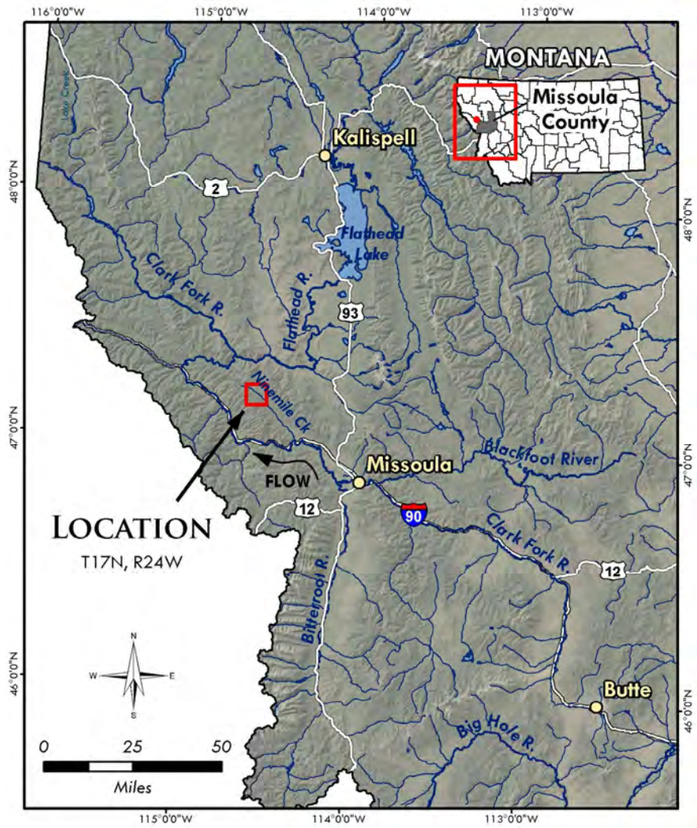
IN 2009, TROUT UNLIMITED IN COLLABORATION WITH THE MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY, MISSOULA COUNTY AND THE LOLO NATIONAL FOREST, INITIATED A PLANNING PROCESS TO EVALUATE RESTORATION FEASIBILITY AND ALTERNATIVES ON A SIX MILE REACH OF NINEMILE CREEK COMMONLY REFERRED TO AS HOUSUM PLACER, A PRIVATE MINING CLAIM. MARTINA CREEK IS A TRIBUTARY TO NINEMILE CREEK IN THE REACH AND INCLUDES APPROXIMATELY 1,000 FEET OF CHANNEL. SIMILAR TO OTHER TRIBUTARIES IN THE NINEMILE CREEK DRAINAGE, THE HISTORICAL CHANNEL WAS EXCAVATED AND HYDRAULICALLY MINED RESULTING IN IMPAIRED AQUATIC HABITAT, GEOMORPHIC, AND FISH HABITAT CONDITIONS.

THIS DESIGN DESCRIBES A RESTORATION PLAN FOR MARTINA CREEK AND ADDRESSES PRIMARY LIMITING FACTORS AND IMPAIRMENTS RELATED TO PAST MINING PRACTICES.

GENERAL NOTES

1. CONTOUR INTERVAL IS NOTED ON DRAWINGS.
2. SLOPES DESIGNATED AS 2:1, 1.5:1, ET CETERA, ARE THE RATIOS OF HORIZONTAL DISTANCE TO VERTICAL DISTANCE.
3. DIMENSIONS ARE GIVEN IN FEET AND TENTHS OF A FOOT.
4. TOPOGRAPHY AND CROSS SECTION GROUND LINES ARE BASED ON SURVEY WORK PERFORMED FROM JULY TO SEPTEMBER 2013 AND 2012 LIDAR DATA WAS CREATED IN OCTOBER 2011 AND PROVIDED BY TROUT UNLIMITED. ALL LIDAR DATA WAS COORDINATED BY RDG.
5. ALL EXISTING CONDITIONS ARE TO BE VERIFIED IN THE FIELD PRIOR TO CONSTRUCTION AND ANY ADJUSTMENTS TO THE DRAWINGS SHALL BE MADE AS DIRECTED BY THE ENGINEER.
6. EXISTING PRIVATE IMPROVEMENTS, WHICH LIE WITHIN THE CONSTRUCTION LIMITS, UNLESS OTHERWISE NOTED WILL BE REMOVED BY THE OWNER PRIOR TO CONSTRUCTION, OR ABANDONED IN PLACE.
7. PROTECT ALL TREES AND LAND AREAS NOT LOCATED WITHIN THE PROJECT CONSTRUCTION, STAGING OR EARTHWORK LIMITS. EXERCISE CARE IN AREAS NOT SO MARKED TO AVOID UNNECESSARY DAMAGE TO NATURAL VEGETATION.
8. THE PROJECT SPONSOR IS RESPONSIBLE FOR COMPLYING WITH ALL PERMITS AND EASEMENTS INCLUDING ALL FEDERAL, STATE, COUNTY, AND LOCAL PERMIT CONDITIONS.
9. EXCAVATION, TRENCHING, SHORING, AND SHIELDING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR PERFORMING THE WORK, THESE DRAWINGS ARE NOT INTENDED TO PROVIDE MEANS OR METHODS OF CONSTRUCTION.
10. EXCAVATION SHALL MEET THE REQUIREMENTS OF OSHA 29 CFR PART 1926, SUBPART P, EXCAVATIONS. ACTUAL SLOPES SHALL NOT EXCEED THE SLOPES AS INDICATED ON DRAWINGS.
11. ALL EXCAVATORS AND BULLDOZERS SHALL BE EQUIPPED WITH MACHINE GRADE GPS ((L1/L2/GLONASS)). CONSTRUCTION AREAS WILL BE STAKED OUT PRIOR TO CONSTRUCTION USING SURVEY GRADE GPS (L1/L2/GLONASS).
12. ENGINEER WILL PROVIDE SURVEY CONTROL AND GRADING SURFACES FOR EQUIPMENT WITH GPS MACHINE CONTROL CAPABILITY. ENGINEER SHALL PROVIDE PRIMARY SURVEY STAKING AND LAYOUT FOR CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO REPLACE ALL DAMAGED, LOST OR DISPLACED STAKES.
13. VERTICAL TOLERANCE FOR CONSTRUCTION COMPLIANCE WILL BE 0.3 FEET. HORIZONTAL TOLERANCE WILL BE 1.0 FEET.
14. CONTRACTOR SHALL CONFIRM QUANTITIES. REPORTED VOLUMES ARE NEATLINE AND DO NOT INCLUDE ADJUSTMENTS FOR COMPACTION OR OTHER FACTORS.

NINEMILE VICINITY MAP



LEGAL DESCRIPTION: SW 1/4, T17N, R24W, S15

DRAWING INDEX

RIVER DESIGN GROUP, INC.
236 Wisconsin Avenue Whitefish, MT 59937
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COVER PAGE

NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-15-14	NW	DESIGN	JM
3	8-01-14	NW	DESIGN	JM/GP

PROJECT NUMBER
RDG-13-094

SHEET NUMBER

1.0

PROJECT GOALS AND ALTERNATIVES CONSIDERED

THE GOALS OF THIS PROJECT ARE TO: 1) REHABILITATE STREAM, FLOODPLAIN AND HILLSLOPE PROCESSES IMPAIRED BY PREVIOUS PLACER MINING OPERATIONS; 2) PROMOTE AQUATIC HABITAT CONDITIONS THAT SUPPORT ALL LIFE STAGES OF FISH; 3) RE-ESTABLISH FISH PASSAGE CONDITIONS AND FLUVIAL CONNECTIVITY WITH UPSTREAM AND DOWNSTREAM REACHES; AND 4) INCORPORATE TO THE GREATEST EXTENT FEASIBLE, HISTORICAL CHANNEL FEATURES.

TWO CHANNEL ALIGNMENT ALTERNATIVES WERE INVESTIGATED INCLUDING: 1) ALTERNATIVE A: MAINTAINING MARTINA CREEK IN ITS CURRENT ALIGNMENT; AND 2) ALTERNATIVE B: RELOCATING MARTINA CREEK TO ITS HISTORICAL CHANNEL CORRIDOR. ALTERNATIVE 2 HAS BEEN SELECTED AND WILL LOCATE MARTINA CREEK IN A HISTORICAL CHANNEL THAT FLOWS TO THE EAST OF THE EXISTING DREDGE HOLE. THIS ALTERNATIVE WILL ROUTE AND CONSOLIDATE STREAMFLOWS IN THE HISTORICAL CHANNEL AND RE-ESTABLISH THE MARTINA CREEK CONFLUENCE WITH NINEMILE CREEK APPROXIMATELY 300 FEET DOWNSTREAM FROM THE EXISTING CONFLUENCE.

THIS ALTERNATIVE WILL ALSO ROUTE THE CHANNEL THROUGH EXISTING MATURE VEGETATION PROVIDING IMMEDIATE FLOODPLAIN AND RIPARIAN FUNCTION; AND ELIMINATE THE NEED FOR IMPROVING SOIL CONDITIONS AND ACTIVE REVEGETATION. WITH ALTERNATIVE 2, THE OPTION TO FILL THE DREDGE HOLE WILL BE PURSUED AT A LATER DATE IN CONJUNCTION WITH IMPLEMENTATION OF RESTORATION ACTIONS ON THE MAIN STEM NINEMILE CREEK.

RESTORATION TREATMENTS

RESTORATION TREATMENTS WOULD BE NATIVE-MATERIALS BASED AND INCLUDE THE USE OF ONSITE ALLUVIUM, COARSE WOOD, AND VEGETATION CUTTINGS. STREAMBANKS WOULD BE TREATED WITH LARGE WOOD STRUCTURES (SHEET 5.0) AND VEGETATED WOOD AND BRUSH FASCINES (SHEET 5.1). THE INTENT OF THESE STREAMBANK STRUCTURES IS TO PROVIDE SHORT-TERM STREAMBANK PROTECTION AND STABILIZATION IN ORDER TO GROW MATURE RIPARIAN VEGETATION. THE TREATMENTS ALSO PROVIDE ROUGHNESS AND NEAR-BANK AQUATIC HABITAT COMPLEXITY.

WHERE NECESSARY TO MEET STABILITY OBJECTIVES, THE CHANNEL STREAMBED WOULD BE RECONSTRUCTED USING ON-SITE ALLUVIUM. THE INTENT OF THE CONSTRUCTED CHANNEL STREAMBED (SHEET 5.2) IS TO FORM RIFFLE AND POOL HABITAT UNITS, DIVERSIFY FLOW PATTERNS AND HYDRAULICS, PROVIDE ENERGY DISSIPATION, AND CREATE AQUATIC HABITAT. LOG AND ROCK STEP POOL STRUCTURES (SHEET 5.3) WOULD BE USED TO PROVIDE VERTICAL CHANNEL STABILITY AND CREATE STEP-POOL MORPHOLOGY THROUGHOUT THE RECONSTRUCTED CHANNEL PROFILE.

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SITE PLAN

NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-12-14	NW	DESIGN	JM

PROJECT NUMBER
RDG-13-094

SHEET NUMBER
2.0

EXISTING DREDGE HOLE TO BE FILLED AND RECLAIMED DURING SUBSEQUENT RESTORATION PHASES ASSOCIATED WITH THE MAINSTEM NINEMILE CREEK.

EXISTING ALIGNMENT

SETBACK TERRACE

3905'

3900'

3895'

STA 4+50
BEGIN CONSTRUCTION

REACH 1

REACH 2

FLOW

REACH 2

REACH 3

NINEMILE CREEK

FLOW

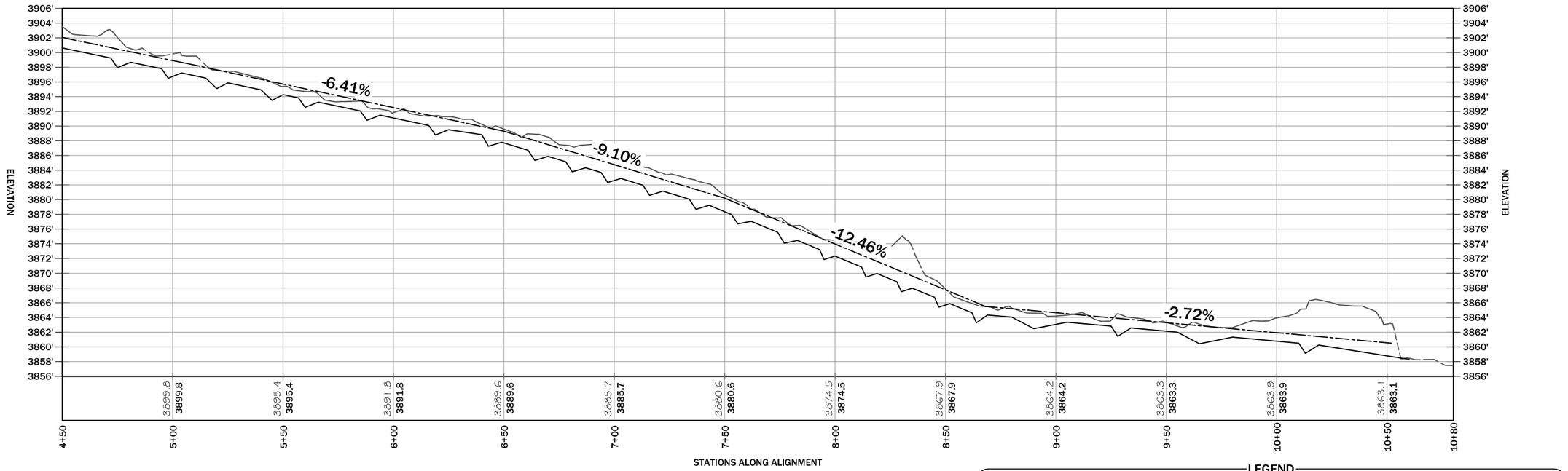
STA 10+55
END CONSTRUCTION

PLAN VIEW

0' 25' 50'

LEGEND

- LARGE WOOD STRUCTURE
- VEGETATED WOOD AND BRUSH FASCINE
- CONSTRUCTED RIFFLE
- STEP POOL



LEGEND
EXISTING GROUND ELEVATION | DESIGN BANKFULL | FINISHED GRADE

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PLAN AND PROFILE

NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-12-14	NW	DESIGN	JM

PROJECT NUMBER
RDG-13-094

SHEET NUMBER

3.0

REACH 1
CHANNEL DATA

STATION	FEATURE	TOP OF BANK ELEVATION (FT)	THALWEG ELEVATION (FT)
4+50	RIFFLE	3902.02	3900.62
4+72	RIFFLE	3900.64	3899.24
4+75	POOL	3900.45	3897.95
4+81	RIFFLE	3900.07	3898.67
4+95	RIFFLE	3899.20	3897.80
4+98	POOL	3899.01	3896.51
5+04	RIFFLE	3898.63	3897.23
5+15	RIFFLE	3897.93	3896.53
5+20	POOL	3897.61	3895.11
5+25	RIFFLE	3897.29	3895.89
5+25	RIFFLE	3897.29	3895.89
5+40	RIFFLE	3896.33	3894.93
5+40	RIFFLE	3896.33	3894.93
5+45	POOL	3896.01	3893.51
5+50	RIFFLE	3895.69	3894.29
5+57	RIFFLE	3895.25	3893.85
5+60	POOL	3895.06	3892.56
5+66	RIFFLE	3894.67	3893.27
5+85	RIFFLE	3893.46	3892.06
5+88	POOL	3893.27	3890.77
5+94	RIFFLE	3892.89	3891.49
6+16	RIFFLE	3891.48	3890.08
6+19	POOL	3891.29	3888.79
6+25	RIFFLE	3890.91	3889.51
6+40	RIFFLE	3889.95	3888.55
6+43	POOL	3889.76	3887.26
6+49	RIFFLE	3889.37	3887.97
6+61	RIFFLE	3888.28	3886.88
6+64	POOL	3888.01	3885.51
6+70	RIFFLE	3887.46	3886.06
6+78	RIFFLE	3886.73	3885.33
6+81	POOL	3886.46	3883.96
6+87	RIFFLE	3885.91	3884.51
6+94	RIFFLE	3885.27	3883.87
6+97	POOL	3885.00	3882.50
7+03	RIFFLE	3884.45	3883.05
7+13	RIFFLE	3883.54	3882.14
7+16	POOL	3883.27	3880.77
7+22	RIFFLE	3882.72	3881.32
7+34	RIFFLE	3881.63	3880.23
7+37	POOL	3881.35	3878.85
7+43	RIFFLE	3880.81	3879.41
7+53	RIFFLE	3879.56	3878.16
7+56	POOL	3879.19	3876.69
7+62	RIFFLE	3878.44	3877.04
7+74	RIFFLE	3876.95	3875.55
7+77	POOL	3876.57	3874.07
7+83	RIFFLE	3875.82	3874.42
7+93	RIFFLE	3874.58	3873.18
7+95	POOL	3874.33	3871.83
8+00	RIFFLE	3873.71	3872.31
8+12	RIFFLE	3872.21	3870.81
8+14	POOL	3871.96	3869.46
8+19	RIFFLE	3871.34	3869.94
8+28	RIFFLE	3870.22	3868.82
8+30	POOL	3869.97	3867.47
8+35	RIFFLE	3869.35	3867.95
8+45	RIFFLE	3868.10	3866.70
8+47	POOL	3867.85	3865.35
8+52	RIFFLE	3867.23	3865.83
8+62	RIFFLE	3865.99	3864.59
8+64	POOL	3865.74	3863.24
8+69	RIFFLE	3865.60	3864.30

REACH 2
CHANNEL DATA

STATION	FEATURE	TOP OF BANK ELEVATION (FT)	THALWEG ELEVATION (FT)
8+79	RIFFLE	3865.33	3864.03
8+80	RIFFLE	3865.30	3864.00
8+85	POOL	3865.17	3862.57
8+90	RIFFLE	3865.03	3863.73
9+05	RIFFLE	3864.62	3863.32
9+25	RIFFLE	3864.08	3862.78
9+28	POOL	3864.00	3861.40
9+34	RIFFLE	3863.83	3862.53
9+55	RIFFLE	3863.26	3861.96
9+65	POOL	3862.99	3860.39
9+80	RIFFLE	3862.58	3861.28
10+10	RIFFLE	3861.77	3860.47
10+13	POOL	3861.69	3859.09
10+19	RIFFLE	3861.52	3860.22
10+60	RIFFLE	3860.41	3858.30

REACH 1
STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE
4+50	4+72	C	CR
4+50	4+72	L	VWBF
4+50	4+72	R	VWBF
4+70	4+80	L	LWS
4+80	5+17	L	VWBF
4+80	5+15	R	VWBF
4+81	4+95	C	CR
4+95	4+98	C	SP
5+04	5+15	C	CR
5+15	5+25	R	LWS
5+25	5+33	C	CR
5+25	5+40	R	VWBF
5+25	5+40	R	VWBF
5+33	5+36	C	SP
5+36	5+40	C	CR
5+40	5+50	L	LWS
5+50	5+59	C	CR
5+50	6+16	R	VWBF
5+50	6+15	L	VWBF
5+59	5+62	C	SP
5+68	5+85	C	CR
5+85	5+88	C	SP
5+94	6+16	C	CR
6+15	6+25	L	LWS
6+25	6+40	C	CR
6+25	6+75	L	VWBF
6+25	6+75	R	VWBF
6+40	6+43	C	SP
6+49	6+61	C	CR
6+61	6+64	C	SP
6+70	6+78	C	CR
6+78	6+81	C	SP
6+87	6+94	C	CR
6+94	6+97	C	SP
7+03	7+13	C	CR
7+13	7+16	C	SP
7+22	7+34	C	CR
7+34	7+37	C	SP
7+43	7+53	C	CR
7+53	7+56	C	SP
7+62	7+74	C	CR
7+74	7+77	C	SP
7+83	7+93	C	CR
7+93	7+95	C	SP
8+00	8+12	C	CR
8+12	8+14	C	SP
8+19	8+28	C	CR
8+28	8+30	C	SP
8+35	8+45	C	CR
8+45	8+47	C	SP
8+52	8+62	C	CR
8+62	8+64	C	SP

REACH 2
STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE
8+69	8+80	C	CR
8+70	8+80	L	VWBF
8+80	8+90	L	LWS
8+90	9+55	L	VWBF
9+05	9+25	C	CR
9+05	9+60	R	VWBF
9+25	9+28	C	SP
9+34	9+55	C	CR
9+60	9+70	R	LWS
9+70	10+55	R	VWBF
9+80	10+10	C	CR
9+80	10+50	L	VWBF
10+10	10+13	C	SP
10+19	10+60	C	CR

STRUCTURE DESCRIPTION	ABBREVIATION	DRAWING SHEET
LARGE WOOD STRUCTURE	LWS	5.0
VEGETATED WOOD AND BRUSH FASCINE	VWBF	5.1
CONSTRUCTED RIFFLE	CR	5.2
STEP POOL	SP	5.3

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DATA SHEET

NO.	DATE	BY	DESCRIPTION	CHK
1	7-12-14	NW	DESIGN	JM

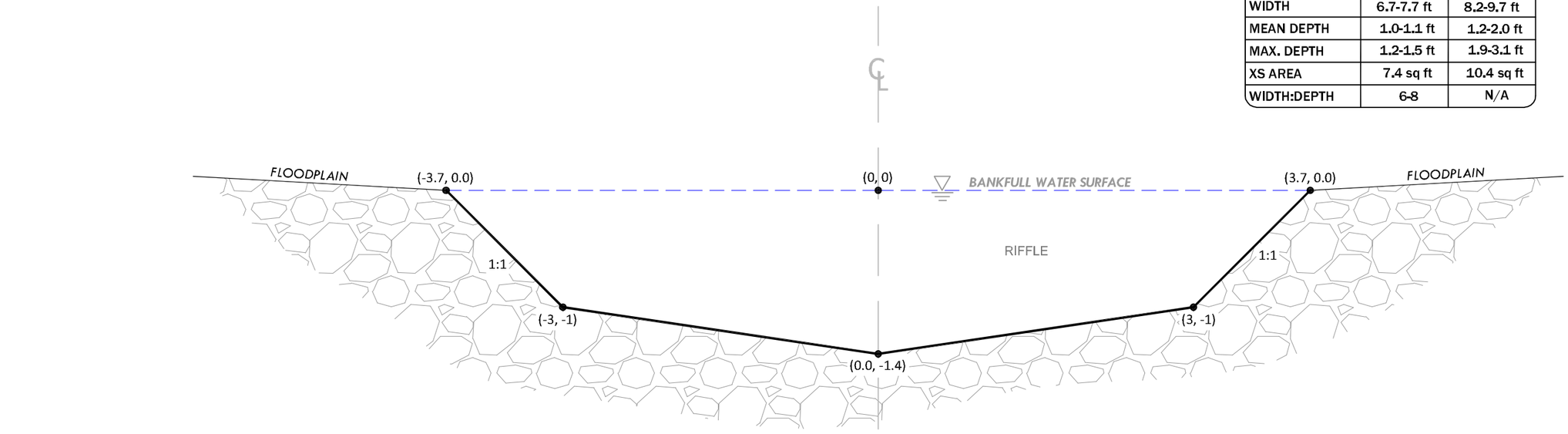
PROJECT NUMBER
RDG-13-094

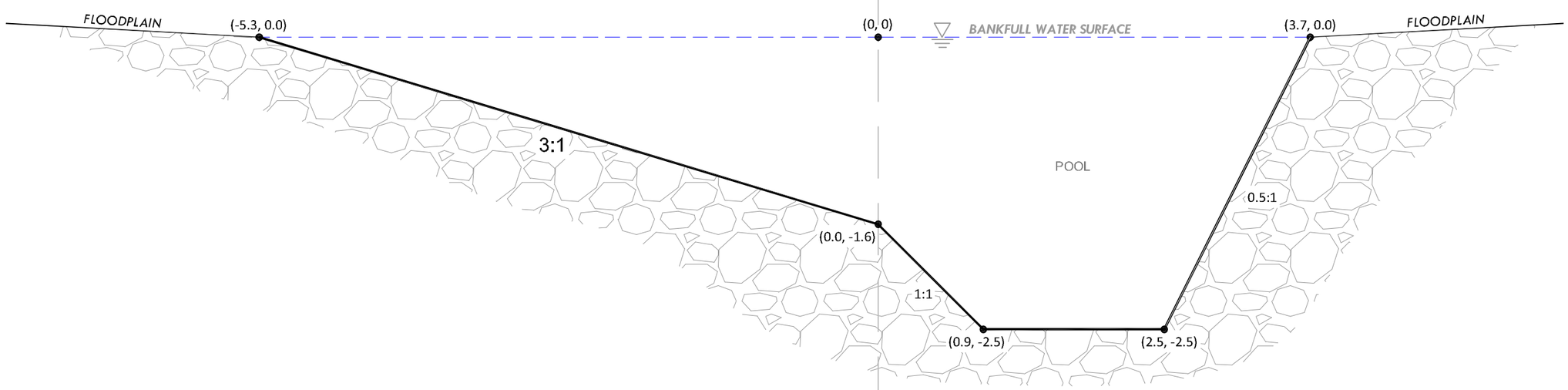
SHEET NUMBER

3.1

STATION 4+50 TO 6+50

BANKFULL CHANNEL DESIGN CRITERIA		
STREAM TYPE	B3-B4a	
DISCHARGE	35 CFS	
VALLEY SLOPE	0.069 FT/FT	
SINUOSITY	1.09	
CHANNEL SLOPE	0.064 FT/FT	
	RIFFLE	POOL
WIDTH	6.7-7.7 ft	8.2-9.7 ft
MEAN DEPTH	1.0-1.1 ft	1.2-2.0 ft
MAX. DEPTH	1.2-1.5 ft	1.9-3.1 ft
XS AREA	7.4 sq ft	10.4 sq ft
WIDTH:DEPTH	6-8	N/A





CHANNEL CROSS SECTIONS
TYPICAL
0' 0.5' 1'

NOTE: COORDINATES ARE REFERENCED FROM TOP OF BANK CENTERLINE

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DESIGN CROSS SECTION DIMENSIONS REACH 1

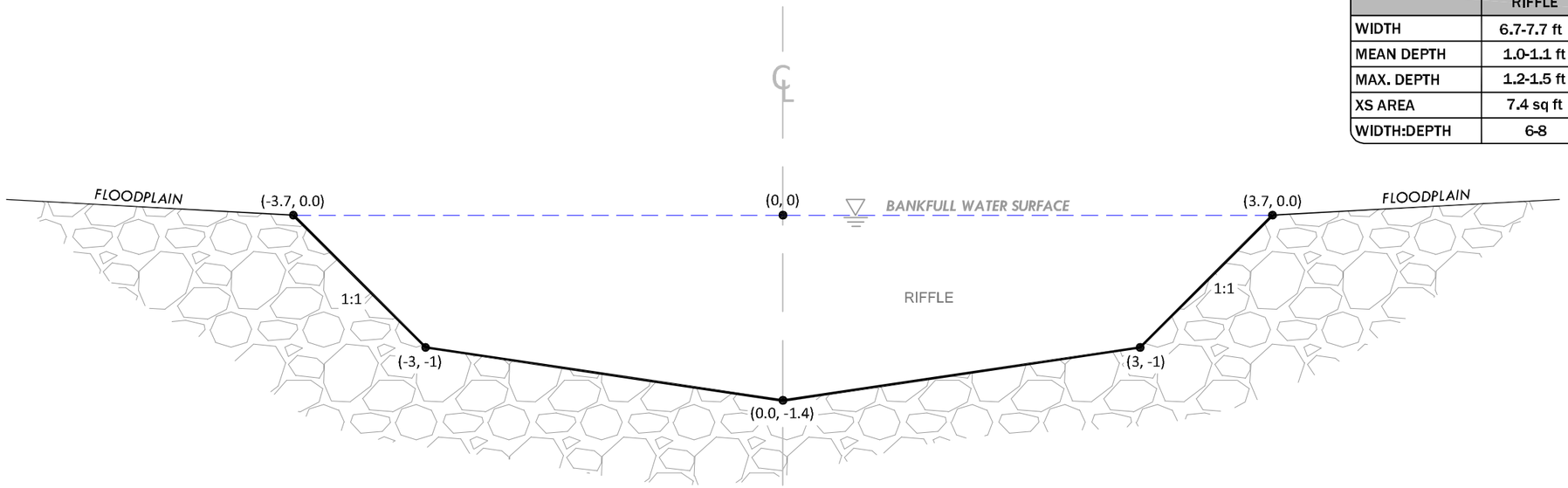
NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-15-14	NW	DESIGN	JM

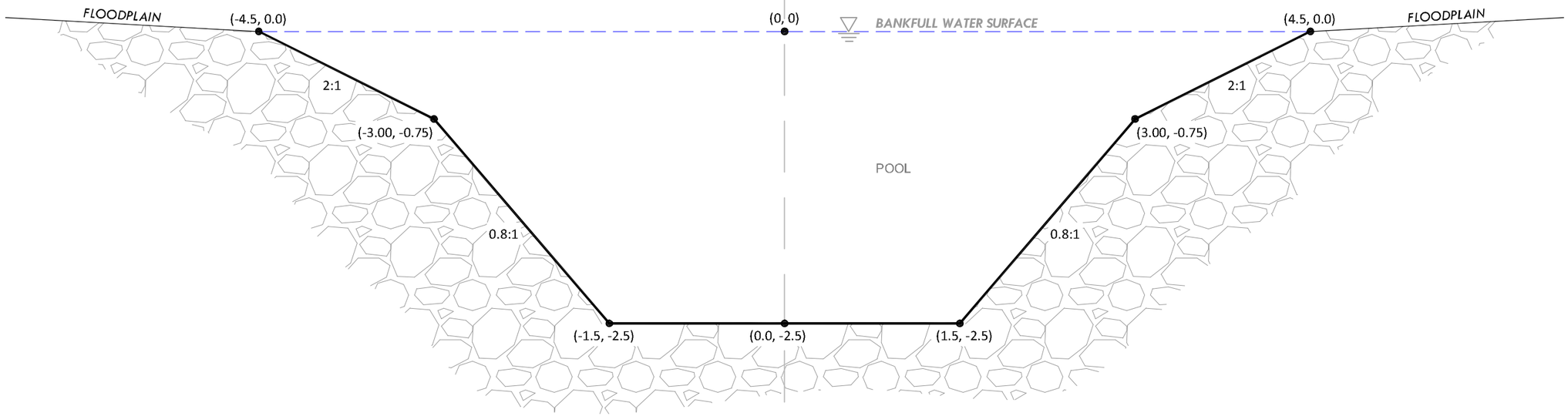
PROJECT NUMBER
RDG-13-094

SHEET NUMBER
4.0

STATION 6+50 TO 8+70

BANKFULL CHANNEL DESIGN CRITERIA		
STREAM TYPE	A3	
DISCHARGE	35 CFS	
VALLEY SLOPE	0.092 - 0.12 FT/FT	
SINUOSITY	1.02	
CHANNEL SLOPE	0.091 - 0.12 FT/FT	
	RIFFLE	POOL
WIDTH	6.7-7.7 ft	8.2-9.7 ft
MEAN DEPTH	1.0-1.1 ft	1.2-2.0 ft
MAX. DEPTH	1.2-1.5 ft	1.9-3.1 ft
XS AREA	7.4 sq ft	10.4 sq ft
WIDTH:DEPTH	6-8	N/A





CHANNEL CROSS SECTIONS
TYPICAL
0' 0.5' 1'

NOTE: COORDINATES ARE REFERENCED FROM TOP OF BANK CENTERLINE

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DESIGN CROSS SECTION DIMENSIONS REACH 2

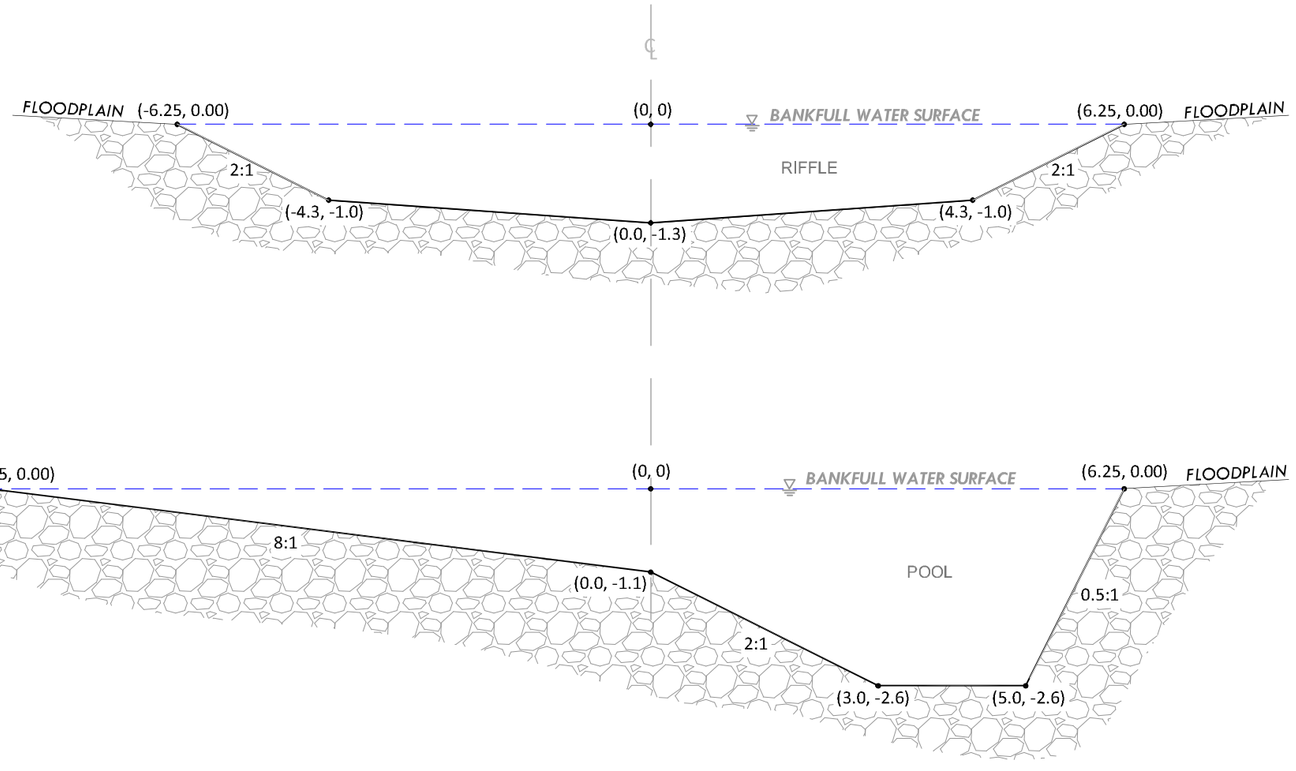
NO.	DATE	BY	DESCRIPTION	CHK
1	6-4-15-14	NW	PRELIMINARY DESIGN	JM
2	7-15-14	NW	DESIGN	JM

PROJECT NUMBER
RDG-13-094

SHEET NUMBER
4.1

STATION 8+70 TO 10+50

BANKFULL CHANNEL DESIGN CRITERIA		
STREAM TYPE	B4	
DISCHARGE	35 CFS	
VALLEY SLOPE	0.032 FT/FT	
SINUOSITY	1.2	
CHANNEL SLOPE	0.027 FT/FT	
	RIFFLE	POOL
WIDTH	12-13 ft	11.2-16.2 ft
MEAN DEPTH	0.9-1.0 ft	0.8-1.2 ft
MAX. DEPTH	1.2-1.5 ft	1.8-3.4 ft
XS AREA	12 sq ft	16.8 sq ft
WIDTH:DEPTH	12-14	N/A



CHANNEL CROSS SECTIONS
TYPICAL
0' 1' 2'

NOTE: COORDINATES ARE REFERENCED FROM TOP OF BANK CENTERLINE

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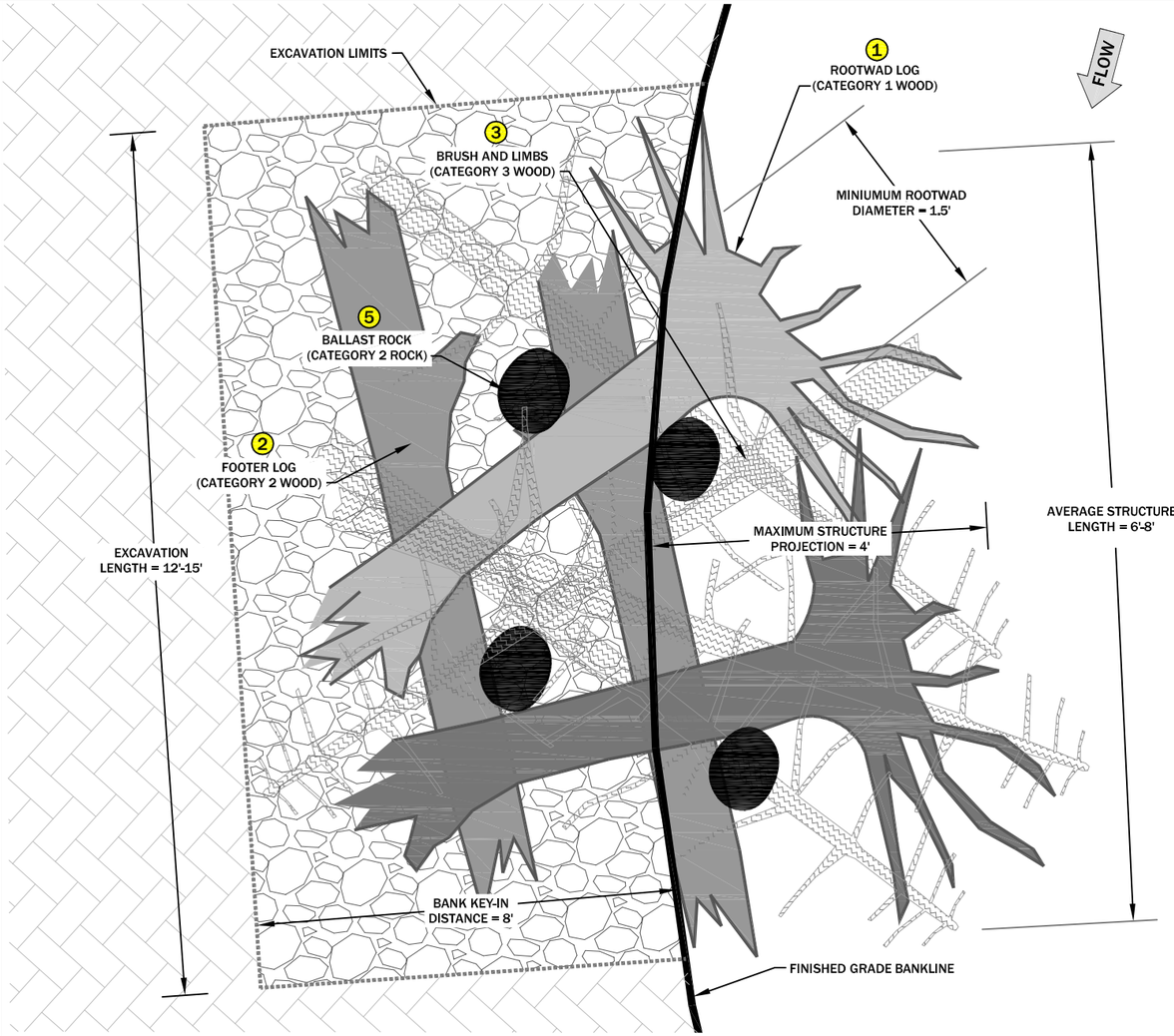
DESIGN CROSS SECTION DIMENSIONS REACH 3

NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-15-14	NW	DESIGN	JM

PROJECT NUMBER
RDG-13-094

SHEET NUMBER
4.2



LARGE WOOD STRUCTURE PLAN VIEW

NTS

DESIGN INTENT

THE INTENT OF THE LARGE WOOD STRUCTURE IS TO PROVIDE SHORT-TERM STREAMBANK PROTECTION AND STABILIZATION BY RE-DIRECTING FLOW AWAY FROM THE CHANNEL MARGINS, DISSIPATING ENERGY, REDUCING NEAR-BANK STRESS, AND MAINTAINING LATERAL SCOUR POOLS. THE STRUCTURE ALSO PROVIDES BANK STRENGTH TO SUPPORT RIPARIAN VEGETATION ESTABLISHMENT ALONG OUTSIDE MEANDER STREAMBANKS. THE STRUCTURE INCORPORATES SEVERAL TIERS OF BRUSH AND WOOD TO INCREASE CHANNEL MARGIN ROUGHNESS AND PROVIDE NEAR-BANK AQUATIC HABITAT COMPLEXITY. THE STRUCTURE INCLUDES A CONSTRUCTED TOE TO PROVIDE STREAMBANK STABILITY FOR DESIGN EVENT NEAR-BANK SHEAR STRESS CONDITIONS. THE STRUCTURE IS USED IN A SEQUENCE WITH OTHER STREAMBANK STRUCTURES AND IS NOT USED AS A STAND-ALONE TREATMENT.

THE LARGE WOOD STRUCTURE IS USED IN AREAS OF HIGH SHEAR STRESS ALONG THE CHANNEL PLANFORM, SPECIFICALLY OUTSIDE MEANDER STREAMBANKS ALONG POOL AND RUN CHANNEL UNITS. OVER TIME, THE STRUCTURE WILL ACCUMULATE ADDITIONAL COARSE WOOD AND DEFORM AS THE CHANNEL MIGRATES ACROSS THE FLOODPLAIN.

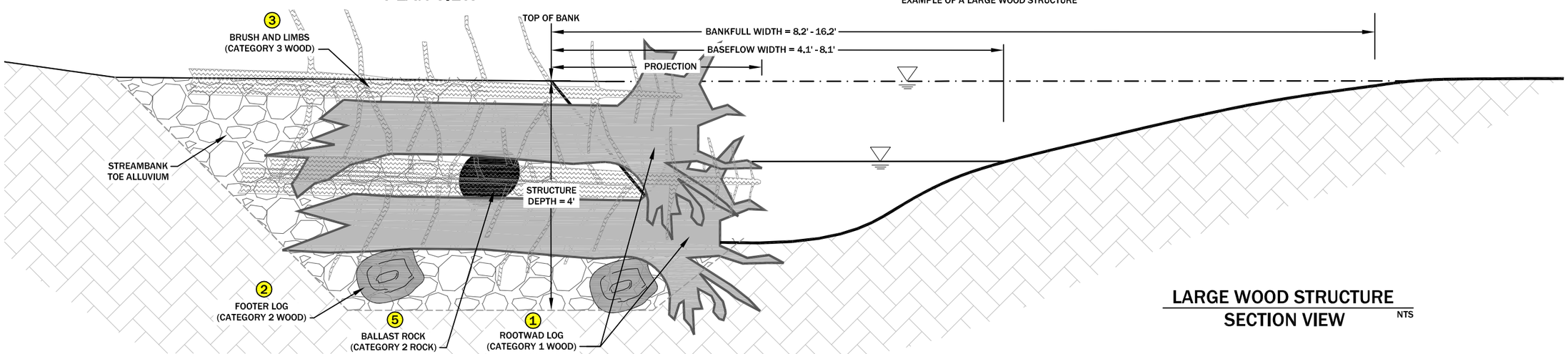
NOTES ON LARGE WOOD STRUCTURE INSTALLATION

1. EXCAVATE TO THE EXCAVATION LIMITS. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. INSTALL TWO FOOTER LOGS (CATEGORY 2 WOOD) AT THE BASE OF THE EXCAVATED TRENCH AT THE ORIENTATIONS NOTED IN PLAN VIEW. FOOTER LOGS SHALL PROJECT NO GREATER THAN 2 FT. BEYOND THE FINISH GRADE BANK LINE. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.
3. INSTALL TWO ROOTWAD LOGS (CATEGORY 1 WOOD) INTERSECTING BOTH FOOTER LOGS AT THE ORINETATION NOTED IN PLAN VIEW. THE UPSTREAM ROOTWAD SHALL NOT PROJECT INTO THE CHANNEL AND SHALL BE FLUSH WITH THE FINISHED BANK LINE. THE DOWNSTREAM ROOTWAD SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE.
4. BACKFILL TRENCH WITH STOCKPILED MATERIAL UP TO THE TOP OF THE FOOTER LOGS. BACKFILL SHALL BE BUCKET COMPACTED. PLACE CATEGORY 1 ROCK WHERE ROOTWAD LOGS INTERSECT FOOTER LOGS.
5. INSTALL BRUSH AND LIMBS (CATEGORY 3 WOOD) AT APPROXIMATE 45° ANGLE TO ROOTWAD STEMS. BRUSH AND LIMBS SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE.
6. BACKFILL TRENCH WITH STOCKPILED MATERIAL UP TO THE TOP OF THE ROOTWAD LOGS. BACKFILL SHALL BE BUCKET COMPACTED. PLACE CATEGORY 1 ROCK WHERE ROOTWAD LOGS INTERSECT LOWER ROOTWAD LOGS.
7. INSTALL DEFLECTOR LOGS (CATEGORY 2 WOOD) AT APPROXIMATE 45° ANGLE TO ROOTWAD STEMS. DEFLECTOR LOGS SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.
8. PLACE AND BUCKET COMPACT STOCKPILED MATERIAL TO THE FINISHED BANK LINE. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.

EXAMPLE OF A LARGE WOOD STRUCTURE

MATERIAL SCHEDULE (PER STRUCTURE)

		DIAMETER (IN)	LENGTH (FT)	ROOTWAD	LIMBS	QUANTITY
1	CATEGORY 1 WOOD	12-18	10	YES	NO	2
2	CATEGORY 2 WOOD	6-12	6	YES	NO	2
3	CATEGORY 3 WOOD	<6	6	OPTIONAL	YES	4
5	CATEGORY 1 ROCK	12-18				4



LARGE WOOD STRUCTURE SECTION VIEW

NTS

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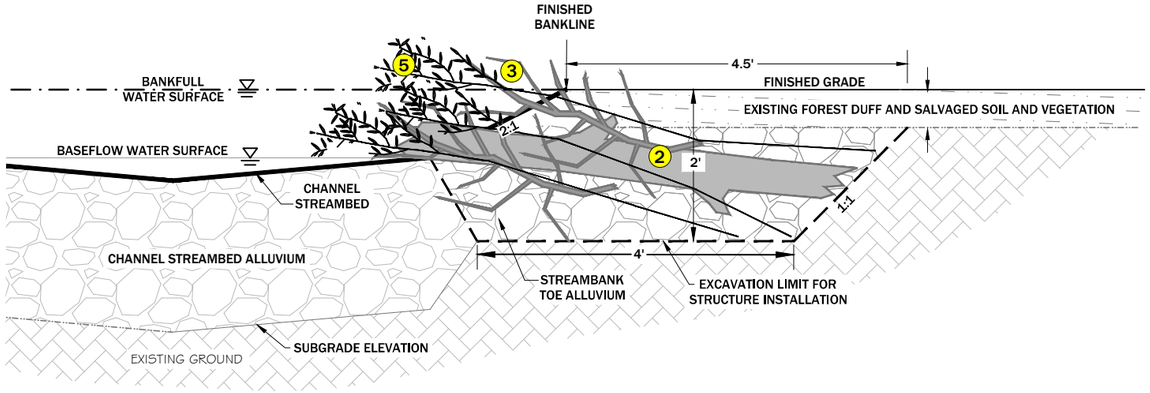
LARGE WOOD STRUCTURE

NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-15-14	NW	DESIGN	JM

PROJECT NUMBER
RDG-13-094

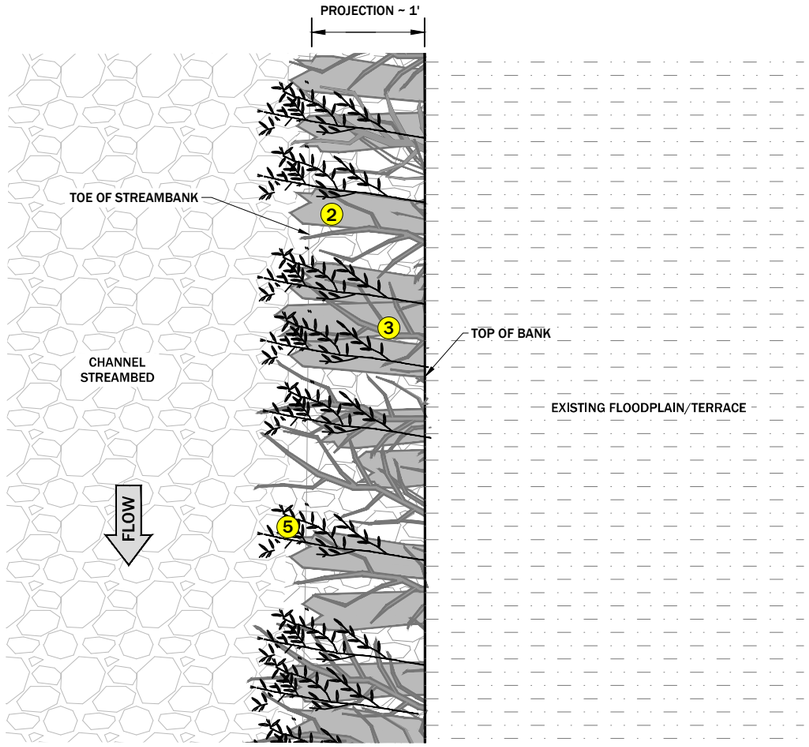
SHEET NUMBER

5.0



VEGETATED WOOD AND BRUSH FASCINE
PLAN VIEW

0' 1' 2'



VEGETATED WOOD AND BRUSH FASCINE
SECTION VIEW

0' 1' 2'

DESIGN INTENT

THE INTENT OF THE VEGETATED WOOD AND BRUSH FASCINE STRUCTURE IS TO PROVIDE SITE CONDITIONS DIRECTLY ALONG THE CHANNEL BOUNDARIES (STREAMBANKS) THAT ARE SUITABLE FOR GROWING RIPARIAN VEGETATION. THE VEGETATED WOOD AND BRUSH FASCINE STRUCTURE PROVIDES BANK STRENGTH IN THE SHORT-TERM UNTIL MATURE RIPARIAN VEGETATION ESTABLISHES AND PROVIDES LONG-TERM STREAMBANK STABILITY. THE STRUCTURE ALSO PROVIDES CHANNEL MARGIN ROUGHNESS AND NEAR-BANK AQUATIC HABITAT COMPLEXITY. THE STRUCTURE IS USED IN A SEQUENCE WITH OTHER STREAMBANK STABILIZATION STRUCTURES AND IS NOT USED AS A STAND-ALONE TREATMENT.

NOTES ON VEGETATED WOOD AND BRUSH FASCINE INSTALLATION

1. EXCAVATE TO THE EXCAVATION LIMITS AS SHOWN. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. PREPARE THE BASE OF THE STRUCTURE BY PLACING STREAMBANK TOE ALLUVIUM FROM THE BASE OF THE EXCAVATION DEPTH/BOTTOM OF EXCAVATION TO WITHIN 1.0-FT. OF FINISHED GRADE.
3. CATEGORY 2 AND CATEGORY 3 WOOD, STREAMBANK TOE ALLUVIUM, AND (6) TO EIGHT (8) FT. DORMANT WILLOW CUTTINGS AT A DENSITY OF 5 PER LINEAR FT. SHALL BE PLACED IN ALTERNATING LAYERS AND BUCKET COMPACTED AS IT IS CONSTRUCTED. WILLOW CUTTINGS SHALL SLOPE AT AN APPROXIMATE 2:1 SLOPE AS SHOWN IN SECTION VIEW. STEMS MAY OVERLAP. THE CUT ENDS SHALL BE PLACED AT THE BASE OF THE SLOPES WITH THE UN-CUT ENDS EXTENDING BEYOND THE EDGE OF THE SOIL LIFT OR TRENCH SO THAT APPROXIMATELY ONE-THIRD OF THE TOTAL CUTTING LENGTH IS EXPOSED BEYOND THE FRONT EDGE OF THE BASE.
4. THE UPSTREAM AND DOWNSTREAM ENDS OF THE STRUCTURE SHALL TRANSITION SMOOTHLY INTO ADJACENT STREAMBANK STRUCTURES TO MINIMIZE EROSION, FLANKING, AND BANK FAILURE. STRUCTURE ENDS MAY BE STABILIZED WITH ADDITIONAL CATEGORY 1 ROCK AS DIRECTED BY ENGINEER.
5. AFTER INSTALLATION OF THE VEGETATED WOOD AND BRUSH FASCINE, BACKILL THE STRUCTURE WITH STOCKPILED MATERIAL TO FINISHED GRADE AND BUCKET COMPACT. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.

STREAMBANK TOE ALLUVIUM GRADATION (PER LINEAR FOOT)

SIZE (INCHES)	PERCENT PASSING	REPRESENTATIVE SIZE CLASS
12	100	D100
7	80 - 90	D84
6	45 - 55	D50
4	30 - 40	D35
2	10 - 20	D15

MATERIAL SCHEDULE (PER LINEAR FOOT)

	ITEM	QUANTITY
2	CATEGORY 2 WOOD	0.3
3	CATEGORY 3 WOOD	0.4
5	RIPARIAN CUTTINGS	5

EXAMPLE OF A CONSTRUCTED VEGETATED WOOD AND BRUSH FASCINE

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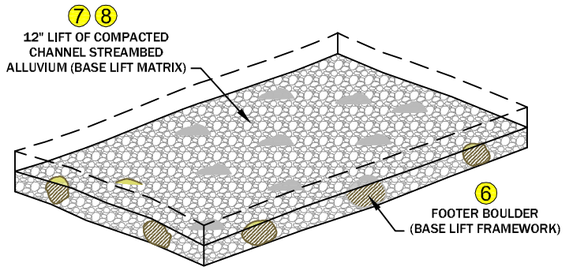
VEGETATED WOOD AND BRUSH FASCINE DETAIL

NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-15-14	NW	DESIGN	JM

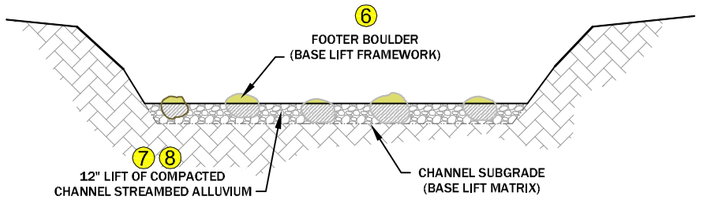
PROJECT NUMBER
RDG-13-094

SHEET NUMBER

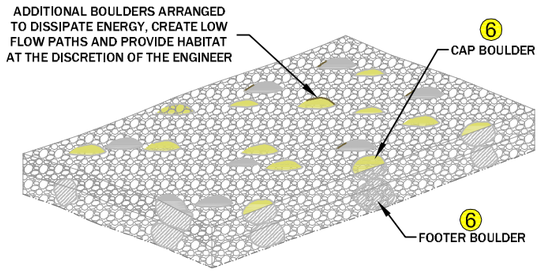
5.1



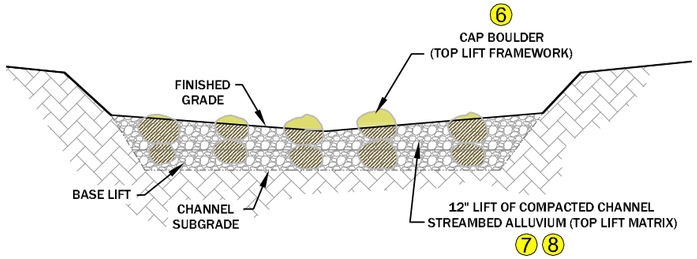
BASE LIFT INSTALLATION
3-D VIEW NTS



BASE LIFT INSTALLATION
SECTION VIEW NTS



TOP LIFT INSTALLATION
3-D VIEW NTS



TOP LIFT INSTALLATION
SECTION VIEW NTS

DESIGN INTENT

THE INTENT OF THE CONSTRUCTED RIFFLE IS TO PROVIDE A STABLE CONSTRUCTED SURFACE COMPRISED OF NATIVE AND IMPORTED (WHEN NECESSARY) SUBSTRATE. THE ENGINEERED FILL IS USED TO INCREASE THE RIVER CHANNEL BED ELEVATION AND IS TYPICALLY CONSTRUCTED TO FORM RIFFLE, RUN, AND GLIDE HABITAT UNITS. THE FILL COMPOSITION INCLUDES THREE PRIMARY SUBSTRATE CLASSIFICATIONS INCLUDING GRAVELS, COBBLES, BOULDERS, AND FINES. GRAVELS AND COBBLES FORM THE ENGINEERED FILL MATRIX. BOULDERS PROVIDE SCOUR RESISTANCE, INFLUENCE LOW FLOW STREAM FLOW PATTERNS AND HYDRAULICS, AND CREATE HABITAT. FINES ARE WASHED INTO THE MATRIX MATERIAL TO SEAL THE STREAMBED TO REDUCE PERCOLATION LOSSES AND BED MATERIAL MOVEMENT. BOULDERS PROTRUDE FROM THE ENGINEERED FILL SURFACE TO PROMOTE DIVERSE FLOW PATHS, PROVIDE ENERGY DISSIPATION, AND CREATE AQUATIC HABITAT.

NOTES ON CONSTRUCTED CHANNEL STREAMBED INSTALLATION

1. PRIOR TO CONSTRUCTION OF THE CHANNEL STREAMBED, ENGINEER SHALL VERIFY CHANNEL SUBGRADE ELEVATIONS. CHANNEL SUBGRADE SERVES AS THE FOUNDATION FOR THE CONSTRUCTED CHANNEL STREAMBED.
2. CONTRACTOR SHALL STOCKPILE CHANNEL ALLUVIUM PER SPECIFICATIONS NOTED ON THE DRAWING.
3. PREPARE THE BASE LIFT FRAMEWORK. CONTRACTOR SHALL PLACE 12-INCH TO 18-INCH CHANNEL ALLUVIUM (FOOTER BOULDERS) ON THE SURFACE OF THE CHANNEL SUBGRADE AS INDICATED ON THE DRAWING.
4. PREPARE THE BASE LIFT MATRIX. AFTER THE BASE LIFT FRAMEWORK IS PREPARED AND INSPECTED BY ENGINEER, PLACE 0.08-INCH TO 12-INCH CHANNEL ALLUVIUM (BASE LIFT MATRIX) IN BASE LIFT AND WASH FINES INTRO STREAMBED TO CREATE A MATRIX SURROUNDING BASE LIFT FRAMEWORK. CHANNEL ALLUVIUM SHALL BE PLACED TO THE FULL COURSE THICKNESS IN LIFTS OF 12-INCHES. INDIVIDUAL COURSES SHALL BE BUCKET COMPACTED.
5. PREPARE THE TOP LIFT FRAMEWORK. CONTRACTOR SHALL PLACE 12-INCH TO 18-INCH CHANNEL ALLUVIUM (CAP BOULDERS) IN CONTACT WITH THE FOOTER BOULDERS. CAP ROCKS SHALL BE SET AND ORIENTED 0.5-FT. UPSTREAM OF THE FOOTER ROCK WITH NO LESS THAN 50% OF THE CAP BOULDER SURFACE AREA IN CONTACT WITH THE FOOTER BOULDER. DUE TO THE INHERENT VARIABILITY IN MATERIALS, CAP ROCK ELEVATIONS SHALL BE ADJUSTED TO ASSURE BOULDER PROTRUSION ABOVE FINISH GRADE IS NO GREATER THAN 0.5-FT.
6. PREPARE THE TOP LIFT MATRIX. AFTER THE TOP LIFT FRAMEWORK IS PREPARED AND INSPECTED BY ENGINEER, PLACE 0.08-INCH TO 12-INCH CHANNEL ALLUVIUM (TOP LIFT MATRIX) IN TOP LIFT AND WASH FINES INTRO STREAMBED TO CREATE A MATRIX SURROUNDING TOP LIFT FRAMEWORK. CHANNEL ALLUVIUM SHALL BE PLACED TO THE FULL COURSE THICKNESS IN LIFTS OF 12-INCHES TO FINISHED GRADE. INDIVIDUAL COURSES SHALL BE BUCKET COMPACTED.

MATERIAL SCHEDULE
(PER LINEAR FOOT)

	ITEM	DIAMETER (IN)	QUANTITY
6	CATEGORY 1 ROCK	12-18	0.5 EA
7	CATEGORY 2 ROCK	6-PLUS	0.25 CY
8	CATEGORY 3 ROCK	6-MINUS	0.25 CY

NOTE: PRIOR TO INSTALLATION ALL LARGE COBBLE AND BOULDERS SHALL BE SALVAGED FROM EXISTING CHANNEL.


CHANNEL SUBGRADE


TOP LIFT MATRIX


BASE LIFT MATRIX


TOP LIFT MATRIX WITH FRAMEWORK


TYPICAL CONSTRUCTED CHANNEL STREAMBED


TYPICAL CONSTRUCTED CHANNEL STREAMBED

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CONSTRUCTED CHANNEL STREAMBED DETAIL

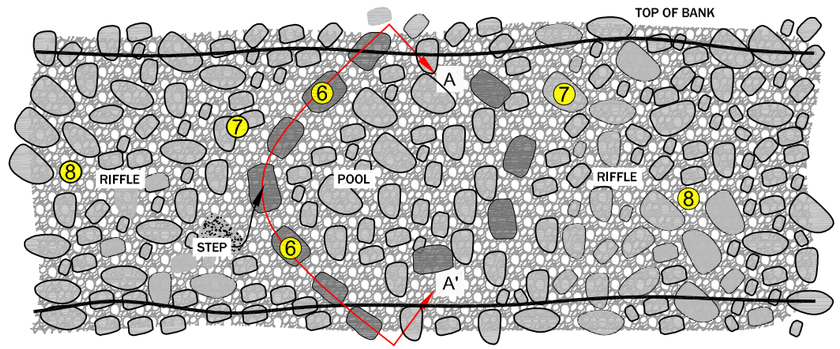
NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-15-14	NW	DESIGN	JM

PROJECT NUMBER
RDG-13-094

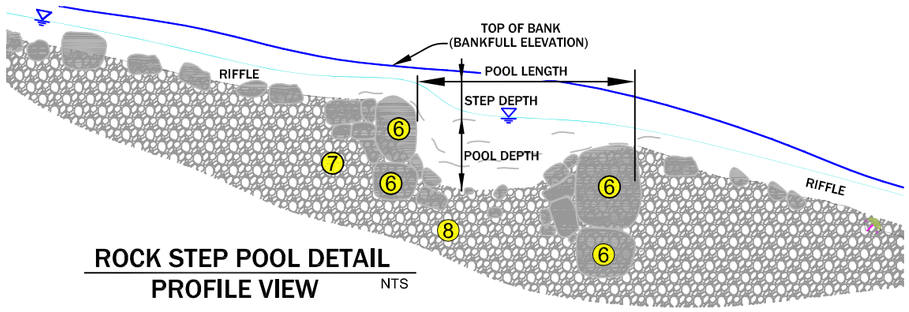
SHEET NUMBER
5.2

DESIGN INTENT

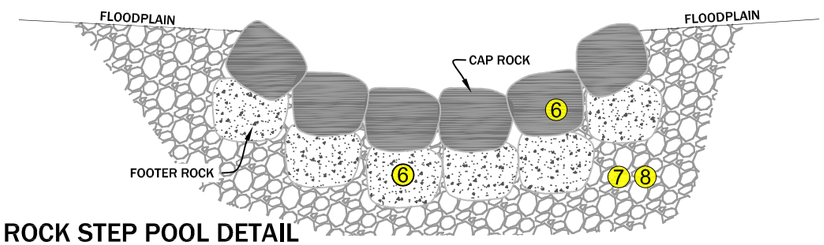
THE INTENT OF THE STEP POOL STRUCTURE IS TO PROVIDE VERTICAL CHANNEL STABILITY FOR ENTRENCHED TO MODERATELY ENTRENCHED STREAM TYPES EXHIBITING AVERAGE GRADIENTS GREATER THAN TWO PERCENT. THE STRUCTURES ARE DESIGNED TO EMULATE THE MORPHOLOGICAL CHARACTERISTICS OF NATURALLY-OCCURRING STEP POOL DOMINATED CHANNELS AND BEDFORMS, INCLUDING ALTERNATING GRADE CONTROL STEPS AND PLUNGE POOLS. VELOCITY AND ENERGY DISSIPATION ARE CONTROLLED BY STEP SPACING WHICH IS INVERSELY PROPORTIONAL TO SLOPE AND DIRECTLY RELATED TO BANKFULL WIDTH. STEP HEIGHT IS DESIGNED TO MAINTAIN UPSTREAM FISH PASSAGE AT ALL FLOW LEVELS WHEREBY STEP HEIGHT IS TYPICALLY LIMITED TO 0.5 FEET OR THE VERTICAL JUMPING CAPABILITY OF THE TARGET FISH SPECIES AND AGE CLASSES.



ROCK STEP POOL DETAIL
PLAN VIEW NTS



ROCK STEP POOL DETAIL
PROFILE VIEW NTS



ROCK STEP POOL DETAIL
SECTION A - A' NTS

MATERIAL SCHEDULE (PER STRUCTURE)

	ITEM	DIAMETER (IN)	QUANTITY
6	CATEGORY 1 ROCK	12-18	14
7	CATEGORY 2 ROCK	6-PLUS	0.5 CY
8	CATEGORY 3 ROCK	6-MINUS	0.5 CY

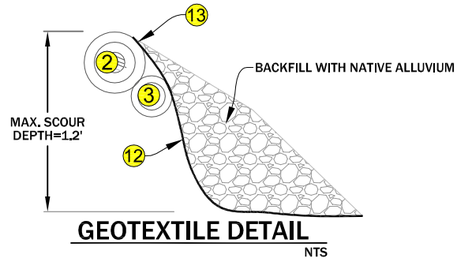
EXAMPLE OF A CONSTRUCTED ROCK STEP POOL STRUCTURE

CONSTRUCTION NOTES

1. PRIOR TO CONSTRUCTION, ENGINEER SHALL VERIFY FLOODPLAIN AND CHANNEL STREAMBED ELEVATIONS PER GRADING PLAN.
2. CONTRACTOR SHALL STOCKPILE WOOD AND ROCK PER SPECIFICATIONS NOTED ON THE DRAWING.
3. EXCAVATE TO THE EXCAVATION LIMITS. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
4. INSTALL VANE LOGS (CATEGORY 2 WOOD) AT THE FLOODPLAIN TIE-IN LOCATIONS AND TO THE ORIENTATIONS NOTED ON THE DRAWING. VANE LOGS SHALL BE PLACED ON CHANNEL ALLUVIUM AND THE ROOTWADS SHALL BE EMBEDDED INTO THE STREAMBANK A MINIMUM OF 2-FT. RELATIVE TO FINISHED BANK LINE.
5. ORIENT VANE LOGS IN CONTACT WITH THE CHANNEL STREAMBED AS SHOWN ON THE DRAWING. EMBED VANE LOG TIPS INTO THE CHANNEL STREAMBED A MINIMUM OF 3-FT. SLOPING AT AN ANGLE NO GREATER THAN 6% RELATIVE TO FLOODPLAIN ELEVATION. VANE LOG TIPS SHALL BE A MINIMUM OF 1-FT. BELOW THE CHANNEL STREAMBED FINISHED GRADE.
6. INSTALL BACKER LOGS (CATEGORY 3 WOOD) ON THE UPSTREAM SIDE OF THE VANE LOGS AS SHOWN ON DRAWING. BACKER LOGS SHALL BE FLUSH WITH THE VANE LOGS AND EXTEND FROM THE FLOODPLAIN TIE-IN LOCATIONS TO THE TIPS OF THE VANE LOGS.
7. INSTALL CATEGORY 1 ROCK UPSTREAM AND DOWNSTREAM OF THE STREAMBANK TIE-IN LOCATIONS AND VANE LOG TIPS. ROCK SHALL BE IN CONTACT WITH VANE LOGS AND BACKER LOGS TO PROVIDE BALLAST AND TO PREVENT THE STRUCTURE FROM SHIFTING WHILE THE STRUCTURE IS BACKFILLED.
8. ATTACH NON-WOVEN GEOTEXTILE FABRIC TO VANE LOGS AND EXTEND VERTICALLY TO THE MAXIMUM DEPTH OF THE POOL CHANNEL CROSS-SECTION ON THE UPSTREAM SIDE OF THE STRUCTURE, AS SHOWN ON DRAWING. BACKFILL VANE LOGS WITH EXCAVATED CHANNEL STREAMBED ALLUVIUM TO CHANNEL STREAMBED FINISHED GRADE.
9. REGRADE UPSTREAM AND DOWNSTREAM CHANNEL STREAMBED FINISHED GRADE ELEVATIONS. IF EXCESS MATERIAL IS SIDECAST IN POOL DURING CONSTRUCTION, CONTRACTOR SHALL RE-EXCAVATE POOL TO THE DESIGN DIMENSIONS AS DIRECTED BY THE ENGINEER.

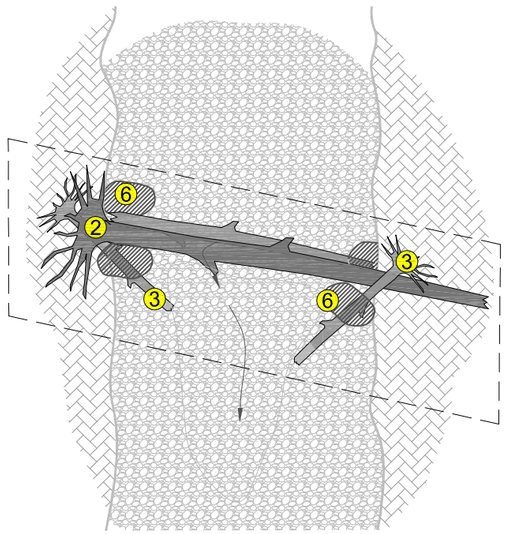
MATERIAL SCHEDULE (PER STRUCTURE)

	ITEM	DIAMETER (IN)	LENGTH (FT)	ROOTWAD	LIMBS	QUANTITY
6	CATEGORY 1 ROCK	12-18				5
2	CATEGORY 2 WOOD	6-12	6	YES	NO	2
3	CATEGORY 3 WOOD	<6	6	OPTIONAL	YES	2
12	LF OF FILTER FABRIC		12.5 X 360 - ROLL			14
13	RING SHANK NAILS	3/8	0.5			20

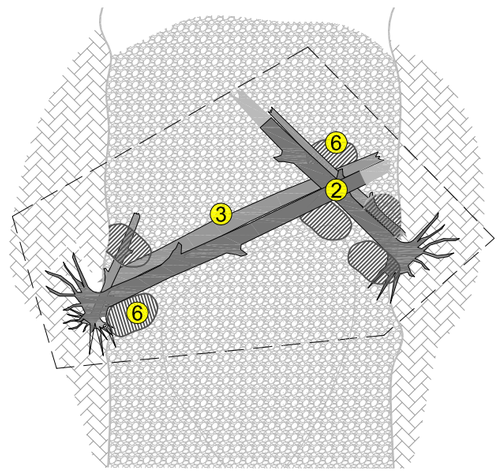


GEOTEXTILE DETAIL
NTS

EXAMPLE OF A CONSTRUCTED LOG STEP POOL



TYPICAL LOG STEP POOL
PLAN VIEW NTS



TYPICAL LOG STEP POOL
PLAN VIEW NTS

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STEP POOL DETAIL

NO.	DATE	BY	DESCRIPTION	CHK
1	04-15-14	NW	PRELIMINARY DESIGN	JM
2	7-15-14	NW	DESIGN	JM

PROJECT NUMBER
RDG-13-094

SHEET NUMBER
5.3

Category	Item	Quantity	Units	Diameter	Length	
Wood	Category 1 Wood	12	ea	12 in - 18 in	10 ft	
	Category 2 Wood	227	ea	6 in - 12 in	6 ft	
	Category 3 Wood	305	ea	< 6 in	6 ft	
	Riparian Cuttings	3,310	ea	0.25 in	6 ft	
Category	**Item**	**Quantity**	**Units**	**Diameter**	**Quantity**	**Units**
Rock	Category 1 Rock	402	ea	12 in - 18 in	60	yd^3
	Category 2 Rock	97	yd^3	> 6 in		
	Category 3 Rock	97	yd^3	< 6 in		
Category	**Item**	**Quantity**	**Units**			
Miscellaneous	8oz Amoco ProPex4553 Nonwoven Needlepunched (felt Geotextile) (Lf)	112	lf			
	20d Ringshank Nails w/washers (#)	160	ea			
	Channel Cut	234	yd^3			
	Berm Fill	285	yd^3			

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MATERIALS LIST

NO.	DATE	BY	DESCRIPTION	CHK
1	7-15-14	NW	DESIGN	JM

PROJECT NUMBER
RDG-13-094

SHEET NUMBER

6.0