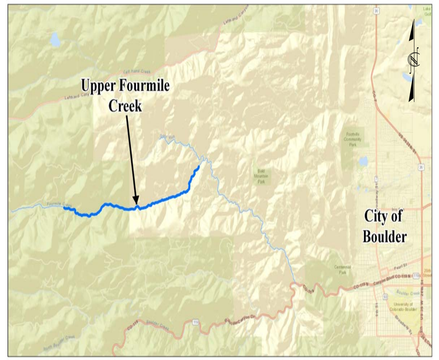
STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
CO	138366	1	22

UPPER FOURMILE CREEK STREAM RESTORATION

LOCATION: FOURMILE CANYON DRIVE

TYPE OF WORK: 30% STREAM RESTORATION PLANS



VICINITY MAP

INDEX OF SHEETS

1 ..... TITLE SHEET
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GENERAL NOTES
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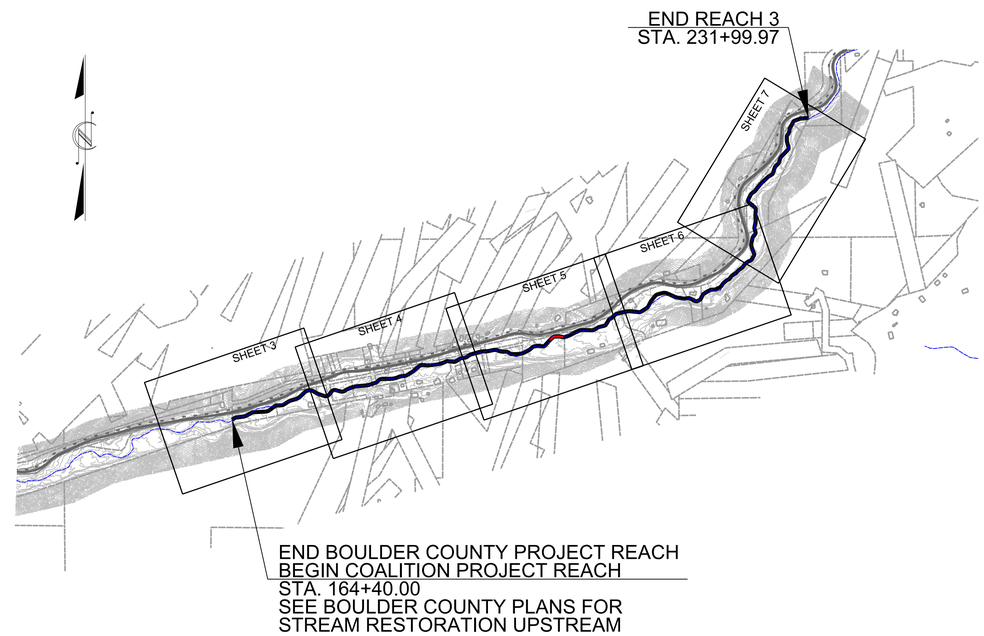
X-1 - X-3 ..... CROSS SECTION SHEETS
11 - 12 ..... REVEGETATION PLAN SHEETS



No.	DATE	DESCRIPTION	BY	APPROVED

PROJECT: 138366 UPPER FOURMILE CREEK

GRAPHIC SCALES

20 0 20 40
PLANS

50 0 50 100
PROFILE (HORIZONTAL)

10 0 10 20
PROFILE (VERTICAL)

PRELIMINARY DESIGN DATA

		REACH 1	REACH 2	REACH 3
DESIGN REACH LENGTH (ft)	=	8310	5290	8600
BANKFULL XSEC AREA (sq ft)	=	27.5	29.0	32.5
BANKFULL WIDTH (ft)	=	22.5	22.5	24.0
BANKFULL DEPTH (ft)	=	1.22	1.29	1.36
W/D RATIO	=	18.4	17.5	17.7
DRAINAGE AREA (sq mi)	=	11.2	13.8	15.9

PREPARED FOR

BOULDER COUNTY
DEPARTMENT OF TRANSPORTATION

Boulder County

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TBD
LETTING DATE:

LUCAS BABBITT, PE, CFM
PROJECT ENGINEER

PROJECT ENGINEER

SIGNATURE: *P.E.*

BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	1A

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STREAM CONVENTIONAL SYMBOLS

- STREAM REALIGNMENT REQUIRED AS A RESULT OF ROADWAY IMPROVEMENTS
- EXISTING STREAM ALIGNMENT
- BANKFULL CHANNEL EXTENTS
- EXISTING PROPERTY BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- EXISTING STRUCTURE / HOMES
- EXISTING ROAD CROSSING
- PROPOSED ROAD CROSSING
- POOL
- ROCK CROSS VANE
- CONSTRUCTED RIFFLE
- CONVERGING BOULDER CLUSTER
- ROCK J-HOOK
- ROCK STEP POOL
- BOULDER BANK PROTECTION
- LOG STEP POOL
- LOG VANE
- ROOT WAD
- LOG J-HOOK
- TOE WOOD BANK PROTECTION
- FLOODPLAIN DEBRIS REMOVAL
- FLOODPLAIN AND WETLAND RESTORATION
- EXISTING CHANNEL FILL
- EMBANKMENT RECONSTRUCTION

**NOTE: ALL ITEMS ABOVE MAY NOT BE USED ON THIS PROJECT

GENERAL NOTES

1. THE CONTRACTOR IS REQUIRED TO INSTALL INSTREAM STRUCTURES USING A EXCAVATOR OR EQUIVALENT WITH A HYDRAULIC THUMB OF SUFFICIENT SIZE TO PLACE BOULDERS, LOGS, AND ROOTWADS.
2. WORK IS BEING PERFORMED AS AN ENVIRONMENTAL RESTORATION PLAN. THE CONTRACTOR SHOULD MAKE ALL REASONABLE EFFORTS TO REDUCE SEDIMENT LOSS AND MINIMIZE DISTURBANCE OF THE SITE WHILE PERFORMING THE CONSTRUCTION WORK.
3. CONTRACTOR SHALL CALL UTILITY NOTIFICATION CENTER OF COLORADO 2 - BUSINESS DAYS IN ADVANCE BEFORE DIGGING, GRADING, OR EXCAVATION FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.
4. PROPOSED CHANNEL ALIGNMENT IS INTENDED TO CAUSE MINIMAL DISTURBANCE TO THE EXISTING TREES AND VEGETATION. THE ON-SITE ENGINEER RESERVES THE RIGHT TO MAKE FIELD-FIT CHANGES TO THESE PLANS AND DETAILS TO FURTHER REDUCE DISTURBANCE.
5. NO FIELD FIT CHANGES SHALL BE MADE WITHOUT ENGINEER BEING PRESENT ON-SITE AND WITHOUT THEIR CONCURRANCE.
6. THIS IS A PRELIMINARY PLAN SET THAT WAS COMPLETED TO EVALUATE MAJOR DESIGN FEATURES PRIOR TO ADVANCING TO THE DESIGN-BUILD PHASE. CONSTRUCTION SHALL NOT BEGIN, OR CONTINUE, WITHOUT ENGINEER BEING PRESENT. AS SUCH, THE ENGINEER RESERVES THE RIGHT TO MAKE DESIGN MODIFICATIONS TO IMPROVE STREAM FUNCTION AND/OR CONSTRUCTABILITY. MODIFICATIONS COULD INCLUDE, BUT ARE NOT LIMITED TO, GRADING MODIFICATIONS, CHANGE IN MATERIAL TYPE, CHANGE IN MATERIAL SIZE, CHANGE IN MATERIAL PLACEMENT, ETC.
7. CONSTRUCTION SHALL BEGIN AT THE UPSTREAM END OF THE PROJECT AT STA 10+00 AND CONTINUE TO THE DOWNSTREAM END AT STA 231+99.97 IN ORDER TO AVOID DAMAGING PREVIOUSLY COMPLETED WORK.
8. THE CONTRACTOR SHALL CONFIRM THE RECEIPT OF ALL NECESSARY PERMITS AND APPROVALS BEFORE THE START OF CONSTRUCTION.
9. THE CONTRACTOR SHALL CONDUCT THEIR OPERATIONS IN SUCH A WAY THAT THE AREA OF DISTURBANCE IS MINIMIZED. ALL EXISTING TREES, SHRUBS AND VEGETATION SHALL BE PROTECTED UNLESS OTHERWISE NOTED ON THE DRAWINGS. NO TREES SHALL BE REMOVED WITHOUT APPROVAL FROM LANDOWNER, ENGINEER, BOULDER COUNTY, AND FOURMILE CREEK COALITION.
10. FOR ALL SITE GRADING, SMOOTH, PARABOLIC TRANSITIONS SHALL BE MADE BETWEEN CHANGES IN SLOPE.
11. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR PROVIDING STABLE EXCAVATIONS AND TEMPORARY SLOPES AND FOR SATISFYING ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS.
12. CONSTRUCTION OF THE PROPOSED WORK WILL TAKE PLACE WITHIN THE CHANNEL AND WATER CONTROL MEASURES WILL BE REQUIRED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ACCEPTANCE AND CONTROL OF DRAINAGE WATER FROM AREAS ADJACENT TO FOURMILE CREEK AND ITS TRIBUTARIES INCLUDING STORMWATER OUTFALLS. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ESTABLISHING MEANS AND METHODS OF GROUND AND SURFACE WATER CONTROL APPROPRIATE FOR CONSTRUCTION IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT DRAWINGS AND SPECIFICATIONS AND ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS AND ALL PERMITS.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING AND MAINTAINING IN CONTINUOUS OPERATION, ALL EXISTING STRUCTURES, NOT ALL POTENTIALLY IMPACTED STRUCTURES MAY BE SHOWN ON THE DRAWINGS AND IT IS THE CONTRACTOR'S RESPONSIBILITY TO IDENTIFY AND PROTECT ALL STRUCTURES INCLUDING BUT NOT LIMITED TO STREETS, CURB AND GUTTER, BRIDGE PIERS AND ABUTMENTS, CREEK BANK PROTECTION OF VARIOUS TYPES, CREEK DROP STRUCTURES, SIGNS, PEDESTRIAN WALKS, RETAINING WALLS AND FENCING. IN THE EVENT THAT A STRUCTURE OR UTILITY IS DAMAGED DURING CONSTRUCTION THE CONTRACTOR SHALL IMMEDIATELY NOTIFY BOULDER COUNTY IN WRITING AND MAKE REPAIRS IN ACCORDANCE WITH BOULDER COUNTY REQUIREMENTS.
14. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE STANDARDS OF BOULDER COUNTY UNLESS SPECIFICALLY DETAILED OTHERWISE ON THESE PLANS AND ASSOCIATED SPECIFICATIONS.
15. THE CONTRACTOR SHALL MAINTAIN AT THE SITE AT ALL TIMES ONE SIGNED COPY OF THE PROJECT DRAWINGS AND SPECIFICATIONS, ONE COPY OF BOULDER COUNTY STANDARDS, AND ONE COPY OF ALL REQUIRED PERMITS.
16. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PREPARING AND SUBMITTING AS-BUILT DRAWINGS TO BOULDER COUNTY.
17. THE CONTRACTOR SHALL PREPARE AND MAINTAIN THE STORMWATER MANAGEMENT PLAN AND OBTAIN THE NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT THROUGH THE COLORADO DEPARTMENT OF PUBLIC HEALTH (CDPHE).
18. THE CONTRACTOR SHALL PROVIDE DAILY ON-SITE SURVEY CONTROL TO THE LEVEL OF DETAIL REQUIRED TO EVALUATE CONSTRUCTION VERSUS THESE DESIGN PLANS.

GROUND COORDINATE TABLE:

PT#	NORTHING	EASTING	ELEVATION	DESCRIPTION
101	261,783.79	36,974.73	6,631.9	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
102	258,761.96	34,659.17	6,736.8	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
103	257,798.11	31,262.07	6,863.0	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
104	256,690.26	26,485.44	7,075.7	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
105	256,656.41	21,945.65	7,262.6	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
106	256,739.56	17,285.07	7,443.4	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
107	256,847.51	10,921.26	7,694.9	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP

NOTES:

1. THE BASIS OF COORDINATES FOR THIS MAP IS THE NORTH AMERICAN DATUM OF 1983-2011 (NAD 83 (2011)) U.S. SURVEY FEET, BASED LOCALLY UPON THE DAVID EVANS AND ASSOCIATES, INC. CONTROL POINT DEA CP 104 FOR GROUND COORDINATE SCALE FACTOR DETERMINATION.
2. THE BASIS OF ELEVATIONS FOR THIS MAP IS THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88), BASED LOCALLY UPON THE CP 107. ELEVATIONS COMPUTED FROM A NGS OPUS SOLUTION REPORT USING A FOUR (4) HOUR OCCUPATION DATA SET AT DEA CP 107.
3. TO MODIFY GROUND CONTROL TO COLORADO STATE PLANE NORTH ZONE; ADD 1,000,000 FEET TO NORTH COORDINATE, ADD 3,000,000 FEET TO EAST COORDINATE AND MULTIPLY BY 1/CFS (COMBINED SCALE FACTOR = 1/1.000373101 = 0.999627038.
4. FIELDWORK FOR CONTROL WAS COMPLETED NOVEMBER 2013.
5. SET 18" LONG #5 REBAR w/1-1/4" OUTSIDE DIAMETER ORANGE PLASTIC CAP MARKED "DEA INC" AT ALL CONTROL POINTS UNLESS OTHERWISE NOTED, SEE GROUND COORDINATE TABLE ABOVE.

NOTICE:

ACCORDING TO COLORADO LAW YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN THREE YEARS AFTER YOU FIRST DISCOVERED SUCH DEFECT. IN NO EVENT MAY ANY ACTION BASED UPON ANY DEFECT IN THIS SURVEY BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.

19. THE PROJECT ENGINEER SHALL BE ON-SITE DURING CONSTRUCTION TO HELP INTERPRET DESIGN PLANS.
20. THE PROPOSED PLANS WERE BASED ON NOVEMBER 2013 LiDAR INFORMATION AND NOT DETAILED SURVEY DATA. AS A RESULT, EXISTING TOPOGRAPHY INFORMATION SHOWN ON THIS PLAN SET IS APPROXIMATE ONLY AND ACTUAL CONDITIONS MAY VARY.
21. FLOOD DEBRIS REMOVAL IS PART OF THIS PROJECT AND CONSISTS OF WOODY MATERIAL AND ALLUVIUM. THE LOCATION AND QUANTITY OF FLOOD DEBRIS REMOVAL HAS NOT BEEN DETERMINED. FLOOD DEBRIS REMOVAL WILL BE DETERMINED BY THE ENGINEER DURING CONSTRUCTION.
22. SOME SECTIONS OF CREEK HAVE BEGUN, AND WILL CONTINUE TO HEAL AND WILL NOT REQUIRE RESOTRATION. THESE LOCATIONS HAVE BEEN IDENTIFIED ON THE PLANS. THESE LOCATIONS WILL BE IDENTIFIED BY ENGINEER DURING CONSTRUCTION.
23. ROADWAY CENTERLINE AND EDGES SHOWN ON PROPOSED PLANS ARE APPROXIMATE.
24. THE CONTRACTOR WILL WORK WITH THE ENGINEER TO IDENTIFY ALLUVIUM AND FLOODPLAIN DEBRIS TO BE REMOVED.
25. THE CONTRACTOR WILL WORK WITH RESIDENTS TO IDENTIFY ACCESS POINTS.
26. MINE TAILINGS EXIST THROUGHOUT THE PROJECT SITE. IN THE EVENT THAT MINE TAILINGS ARE ENCOUNTERED THE CONTRACTOR SHALL NOTIFY BOULDER COUNTY AND REFERENCE COLORADO DIVISION OF MINING RELCLAMATION AND SAFETY PROCEDURE FOR MANAGING HAZARDOUS MATERIALS.
27. IT IS ANTICIPATED THAT BOULDERS WILL BE HARVESTED FROM THE PROJECT SITE OR FROM A NEARBY LOCATION AS DIRECTED BY THE ENGINEER. BOULDERS SHALL BE RELATIVELY FLAT ON EITHER SIDE IN THE SAME DIMENSION, PREFERABLY THE LONG DIMENSION.

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BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	2

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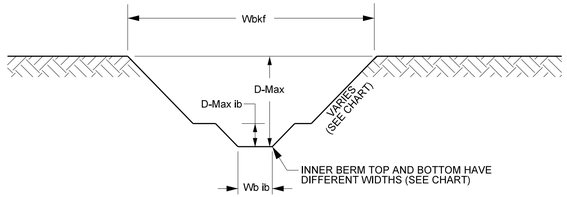
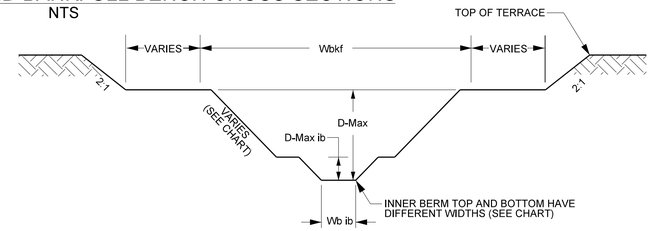
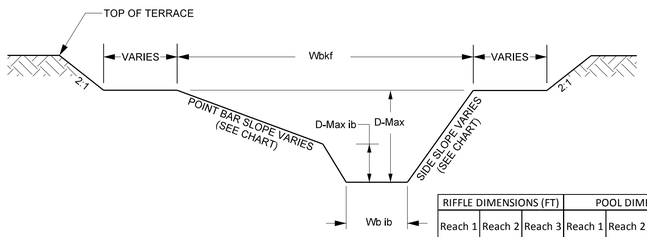
TYPICAL RIFFLE, POOL, AND BANKFULL BENCH CROSS SECTIONS
NTS



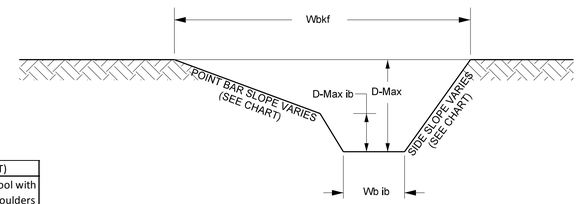
RIFFLE A-A



RIFFLE WITH BANKFULL BENCH



POOL B-B



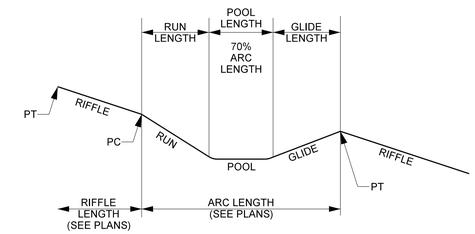
POOL WITH BANKFULL BENCH

RIFFLE DIMENSIONS (FT)			POOL DIMENSIONS (FT)				
Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Pool with Boulders	
22.5	22.5	24.0	23.5	24.0	25.0	25.0	WIDTH BANKFULL (Wbkf)
1.2	1.3	1.4	1.4	1.4	1.6	1.5	AVERAGE DEPTH (D)
1.9	2.0	2.1	2.5	2.7	2.9	2.7	MAXIMUM DEPTH (D-Max)
18.4	17.5	17.7	17.3	17.2	15.8	16.9	WIDTH TO DEPTH RATIO (Wbkf/D)
3.0	3.0	3.0	1.0	1.0	1.0	2.0	SIDE SLOPE
2.9	2.9	2.5	2.3	1.6	2.0	2.3	INNER BERM SIDE SLOPE
27.5	29.0	32.5	32.0	33.5	39.5	36.9	BANKFULL XSEC AREA
2.4	2.1	2.4	-	-	-	-	INNER BERM BENCH WIDTH (Wbnch)
10.5	10.5	11.5	10.3	9.7	11.0	12.0	INNER BERM WIDTH TOP (W ib)
6.5	6.5	7.5	6.0	6.0	6.5	6.0	INNER BERM WIDTH BOTTOM (Wb ib)
0.5	0.5	0.6	1.1	1.2	1.3	1.1	INNER BERM AVERAGE DEPTH (D ib)
0.7	0.7	0.8	1.3	1.4	1.5	1.4	INNER BERM MAX DEPTH (D-max ib)
20.3	20.3	18.8	9.1	8.1	8.5	11.2	INNER BERM W/D RATIO (W ib/D ib)
5.4	5.4	7.0	11.7	11.6	14.3	12.9	INNER BERM AREA (A ib)

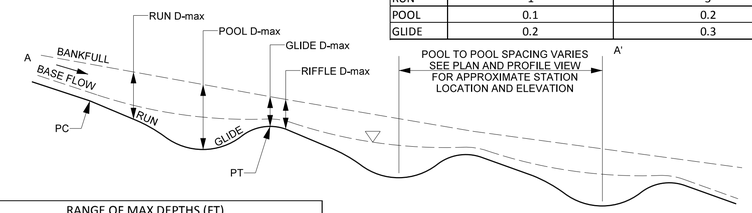
NOTES:

1. DURING CONSTRUCTION CORNERS OF DESIGN CHANNEL WILL BE ROUNDED AND A THALWEG WILL BE SHAPED PER DIRECTION OF ENGINEER.
2. POOL SHOWN ABOVE IS RIGHT BANK POOL ONLY.

TYPICAL PROFILE
NTS

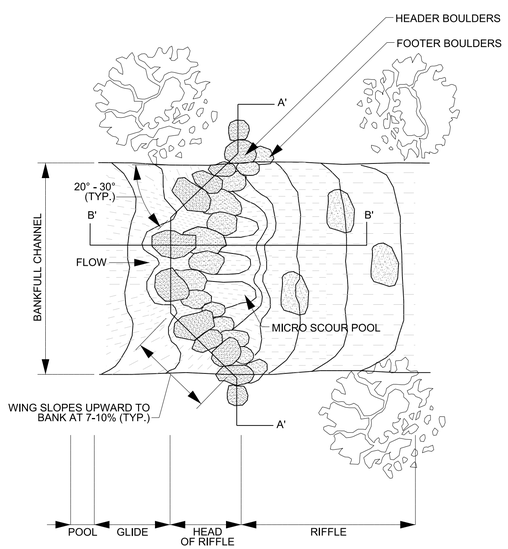


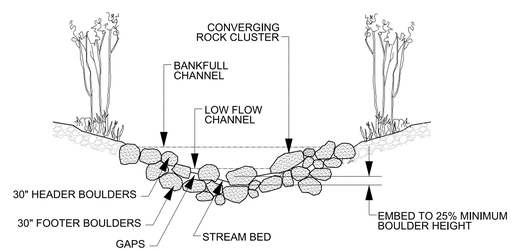
STREAM FACET	RANGE OF FACET SLOPE RATIOS	
	RATIO OF AVG. SLOPE TO FACET SLOPE	
	AVG. WATER SURFACE SLOPE VARIES BY REACH (SEE PLANS)	
	MIN	MAX
RIFFLE	SEE PLANS & PROFILE	
RUN	1	3
POOL	0.1	0.2
GLIDE	0.2	0.3



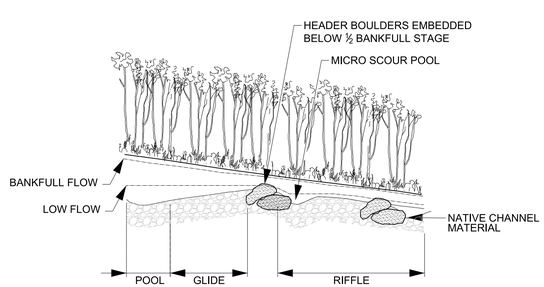
STREAM FACET	RANGE OF MAX DEPTHS (FT)					
	REACH 1		REACH 2		REACH 3	
	MIN	MAX	MIN	MAX	MIN	MAX
RIFFLE	1.9		2.0		2.1	
RUN	1.9	2.2	2.0	2.3	2.1	2.5
POOL	2.2	2.5	2.3	2.7	2.5	2.9
GLIDE	1.5	1.8	1.6	1.9	1.7	2.0

CONVERGING BOULDER CLUSTER
NTS



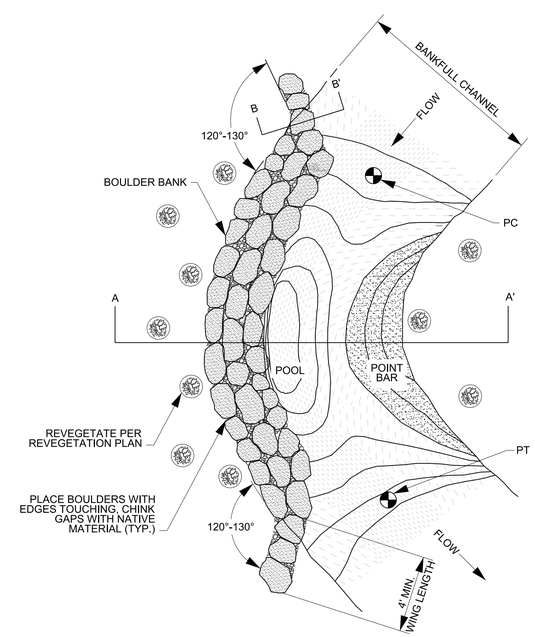


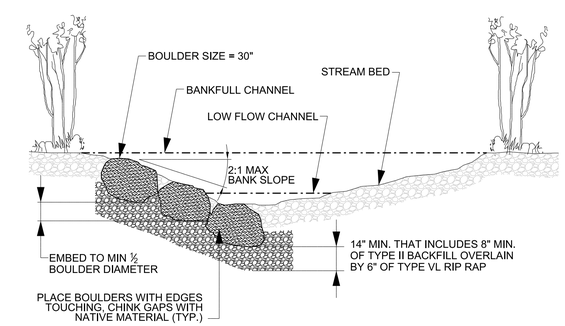
CROSS SECTION A - A'



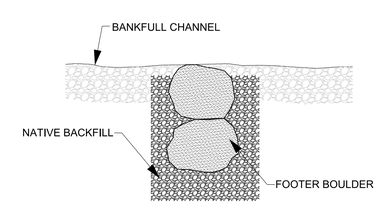
PROFILE B - B'

BOULDER BANK PROTECTION
NTS





CROSS SECTION A - A'



CROSS SECTION B - B'

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BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	2A

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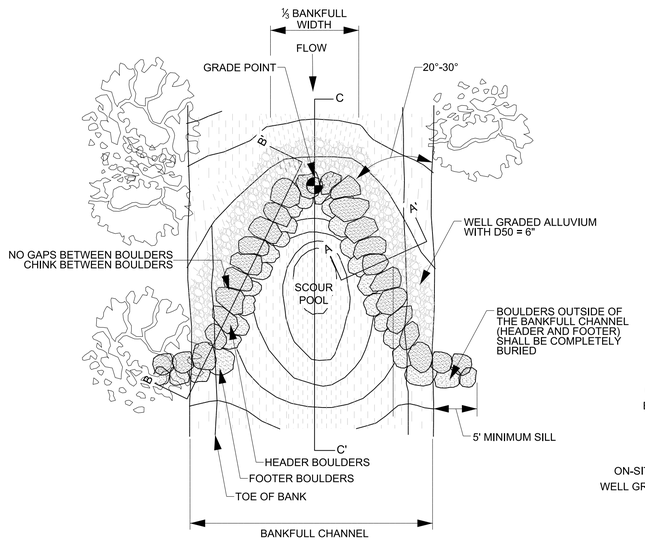
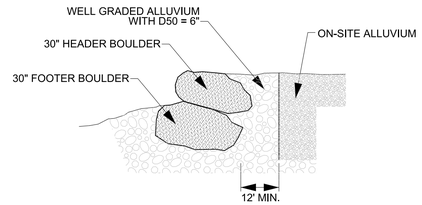
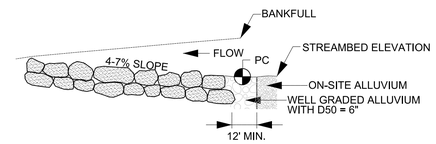
ROCK CROSS VANE
NTS

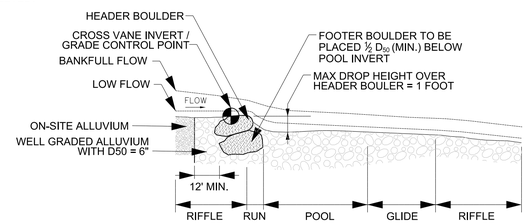




CROSS SECTION A - A'

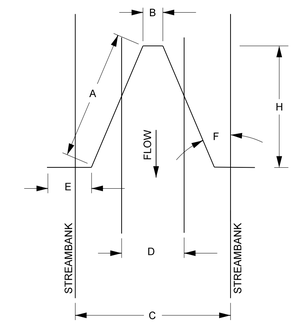


CROSS SECTION B - B'



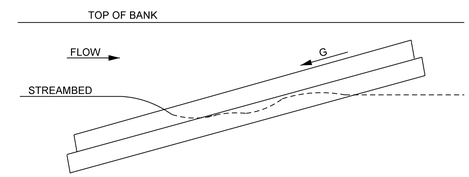
PROFILE C - C'

CROSS VANE TYPICAL
NTS



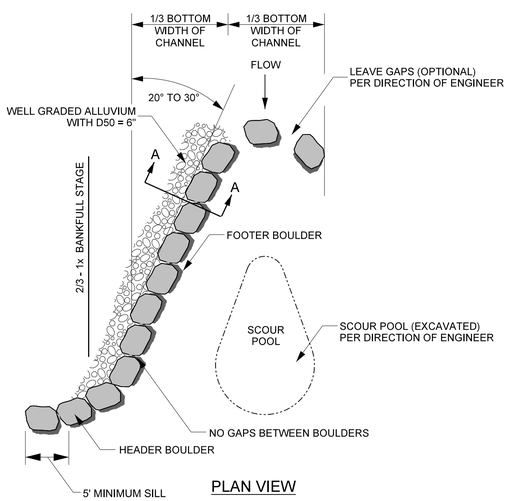
PLAN VIEW

		REACH 1	REACH 2	REACH 3
A	VANE ARM LENGTH	20.1 ft	20.1 ft	21.5 ft
B	INVERT LENGTH	7.4 ft	7.4 ft	7.9 ft
C	BANKFULL WIDTH	22.5 ft	22.5 ft	24.0 ft
D	BOTTOM WIDTH	10.5 ft	10.5 ft	11.5 ft
E	SILL LENGTH	5.0 ft	5.0 ft	5.0 ft
F	VANE ARM ANGLE	22.0 ft	22.0 ft	22.0 ft
G	VANE ARM SLOPE	0.1 ft	0.1 ft	0.1 ft
H	STRUCTURE LENGTH	18.7 ft	18.7 ft	19.9 ft

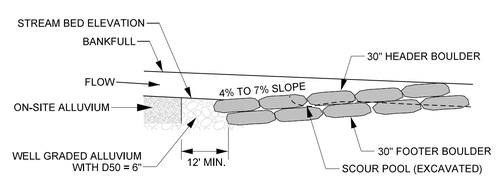


PROFILE VIEW

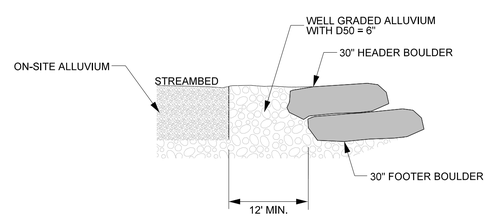
BOULDER J-HOOK VANE
NTS



PLAN VIEW



PROFILE VIEW

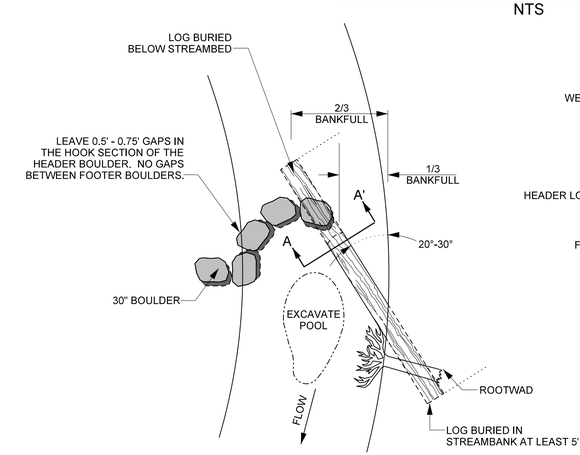


SECTION A - A

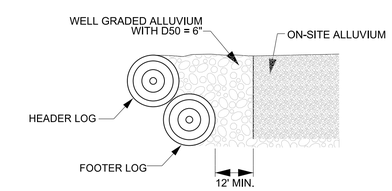
NOTES FOR ALL VANE STRUCTURES:

1. DIG A TRENCH BELOW THE BED FOR FOOTER BOULDERS AND PLACE FILL ON UPSTREAM SIDE OF VANE ARM, BETWEEN THE ARM AND STREAMBANK.
2. START AT BANK AND PLACE FOOTER BOULDERS FIRST AND THEN HEADER (TOP) BOULDER.
3. CONTINUE WITH STRUCTURE, FOLLOWING ANGLE AND SLOPE SPECIFICATIONS.
4. AN EXTRA BOULDER CAN BE PLACED IN SCOUR POOL FOR HABITAT IMPROVEMENT.
5. USE HAND PLACED STONE TO FILL GAPS ON UPSTREAM SIDE OF HEADER AND FOOTER BOULDERS.
6. AFTER ALL STONE BACKFILL HAS BEEN PLACED, FILL IN THE UPSTREAM SIDE OF THE STRUCTURE WITH ON-SITE ALLUVIUM TO THE ELEVATION OF THE TOP OF THE HEADER BOULDER.

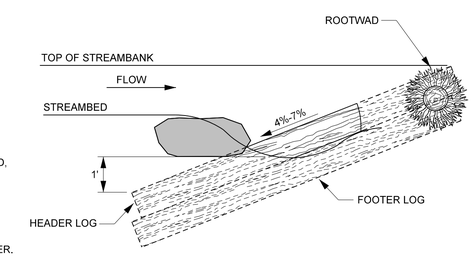
GRADE CONTROL LOG J-HOOK VANE
NTS



PLAN VIEW



SECTION A - A'



PROFILE VIEW

NOTES:

1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
4. BOULDERS SHOULD BE PLACED ON TOP OF HEADER LOG FOR ACHORING.
5. HEADER BOULDERS TO BE PLACED 0.5 TO 0.75 FEET APART.
6. TRANSPLANTS CAN BE USED INSTEAD OF ROOWADS, PER DIRECTION OF ENGINEER.

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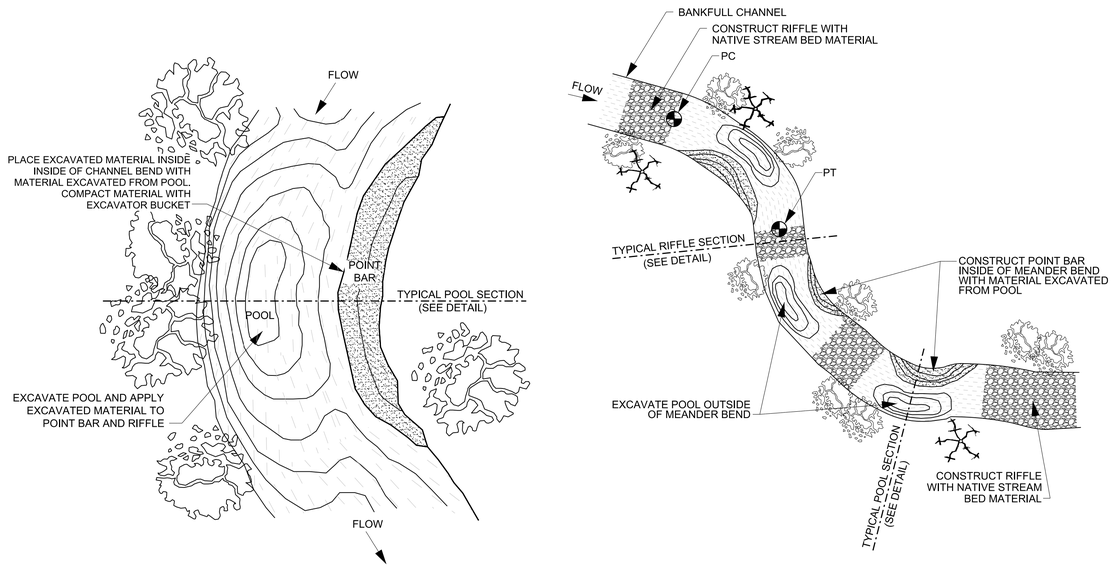
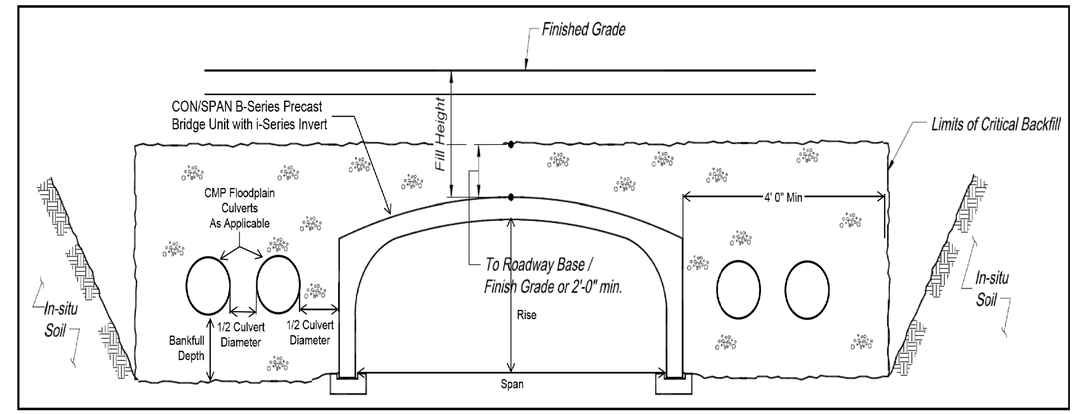
CONSTRUCTED POOL AND POINT BAR

NTS



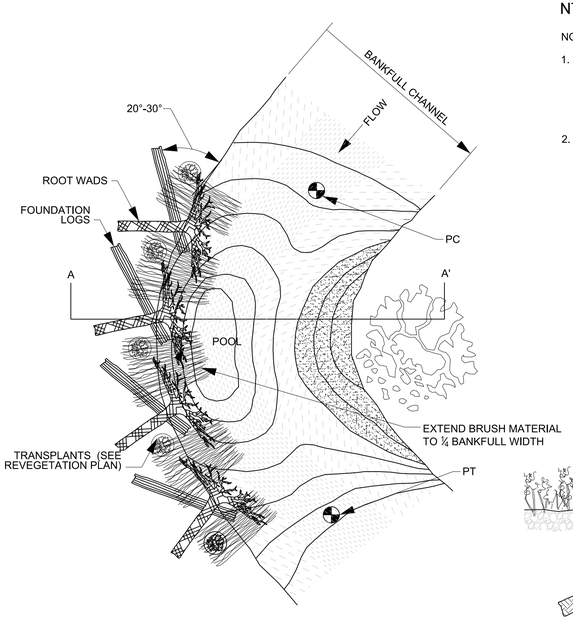
PROPOSED CROSSING STRUCTURE TYPICAL

NTS



ROOT WADS

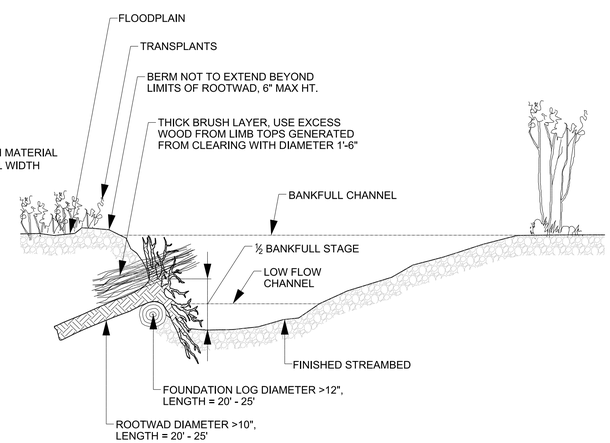
NTS



PLAN VIEW

NOTES:

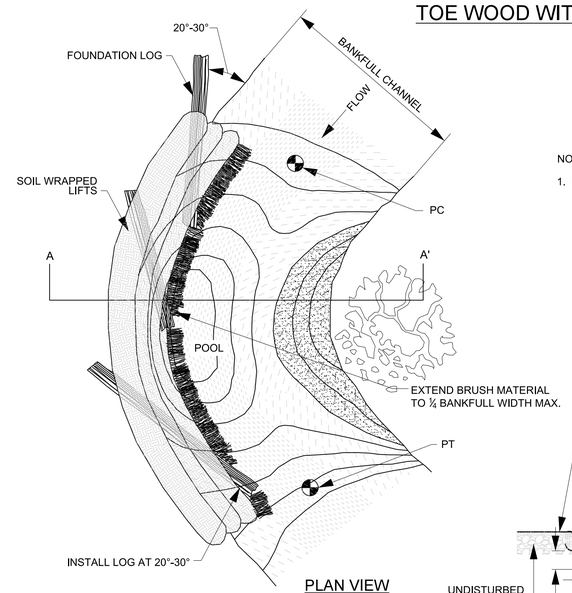
1. IF THE ROOT WAD CANNOT BE DRIVEN INTO THE BANK OR THE BANK NEEDS TO BE RECONSTRUCTED, THE TRENCHING METHOD SHOULD BE USED. THIS METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. IN THIS CASE, A FOOTER LOG SHOULD BE INSTALLED UNDERNEATH THE ROOT WAD IN A TRENCH EXCAVATED PARALLEL TO THE BANK AND BELOW THE STREAMBED. ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS.
2. BANK PROTECTION SHALL BE EXTENDED A MINIMUM OF 10 FEET UPSTREAM OF PC 10 FEET DOWNSTREAM OF PT UNLESS OTHERWISE NOTED.



CROSS SECTION A - A'

TOE WOOD WITH SOIL WRAPPED LIFT

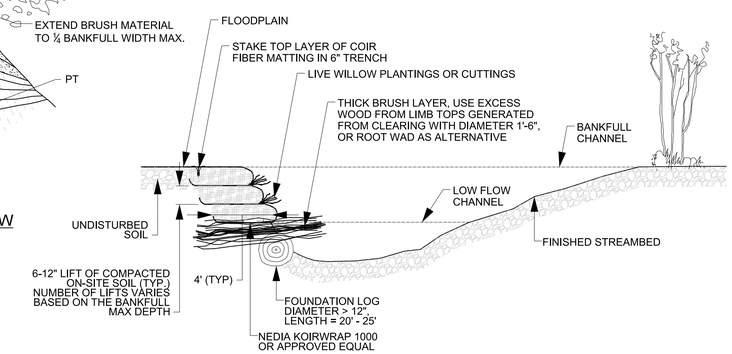
NTS



PLAN VIEW

NOTES:

1. BANK PROTECTION SHALL BE EXTENDED A MINIMUM OF 10 FEET UPSTREAM OF PC 10 FEET DOWNSTREAM OF PT UNLESS OTHERWISE NOTED.



CROSS SECTION A - A'

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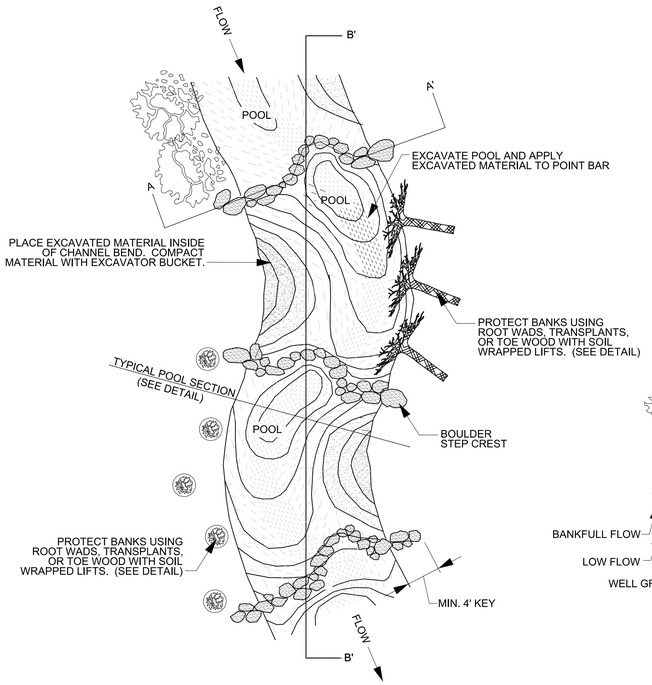
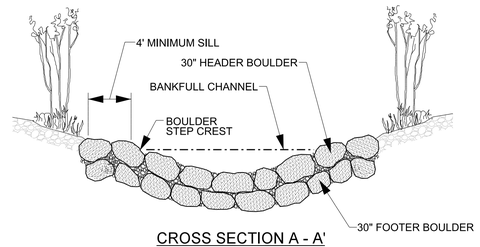
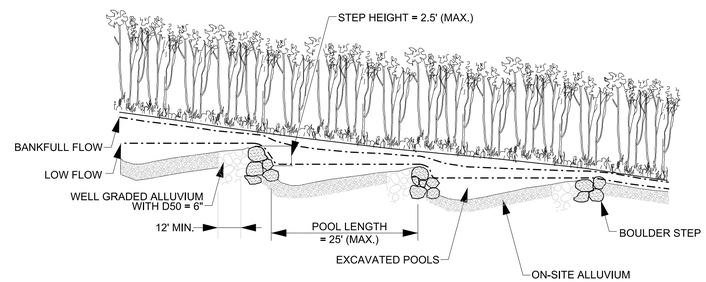
ROCK STEP POOL

NTS





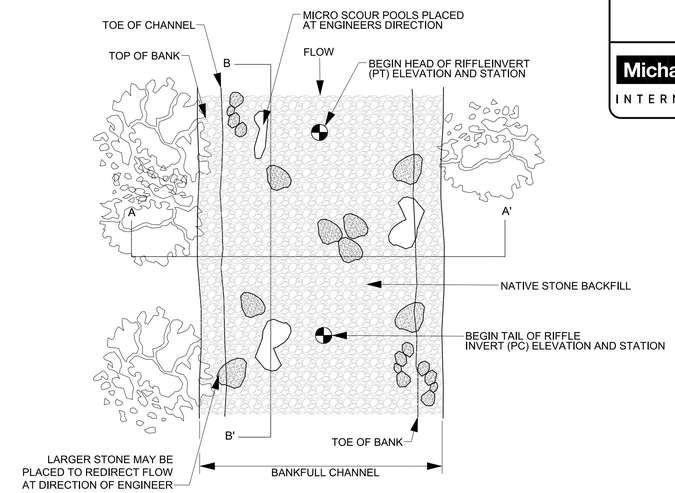
CROSS SECTION A - A'



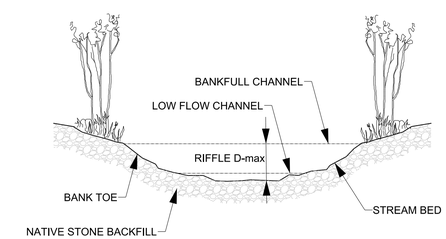
CROSS SECTION B - B'

CONSTRUCTED RIFFLE

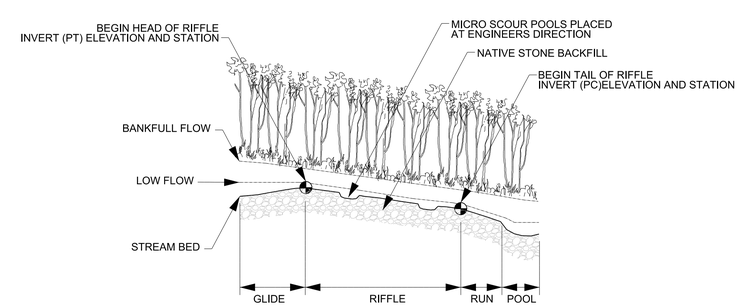
NTS



PLAN VIEW



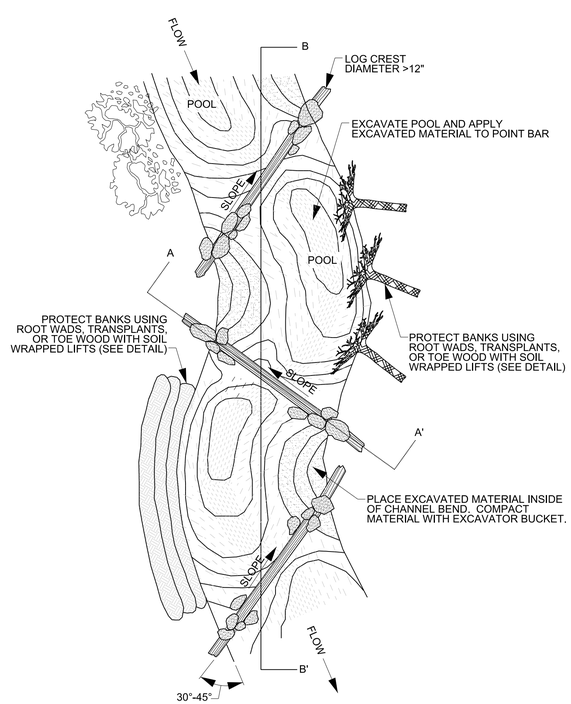
CROSS SECTION A - A'

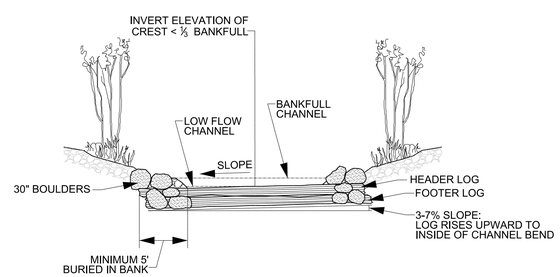


PROFILE B - B'

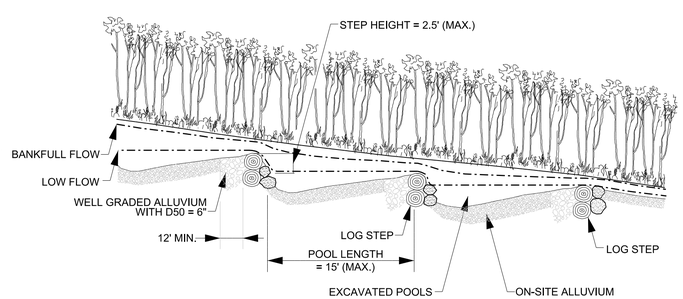
ROCK AND LOG STEP POOL

NTS





CROSS SECTION A - A'



CROSS SECTION B - B'

NOTES:

1. UNDERCUT CHANNEL BED ELEVATION AS NEEDED TO ALLOW FOR LAYERS OF STONE TO ACHIEVE FINAL GRADE.
2. INSTALL STONE BACKFILL, COMPACTED TO GRADE.
3. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, SMOOTH, AND CONCAVE, WITH THE ELEVATION OF THE BED 0.2 FT DEEPER IN THE CENTER THAN AT THE EDGES.
4. NOT ALL RIFFLE LOCATIONS SHOWN ON PLANS NEED TO BE COMPLETELY RECONSTRUCTED, SOME JUST NEED TO BE RESHAPED.

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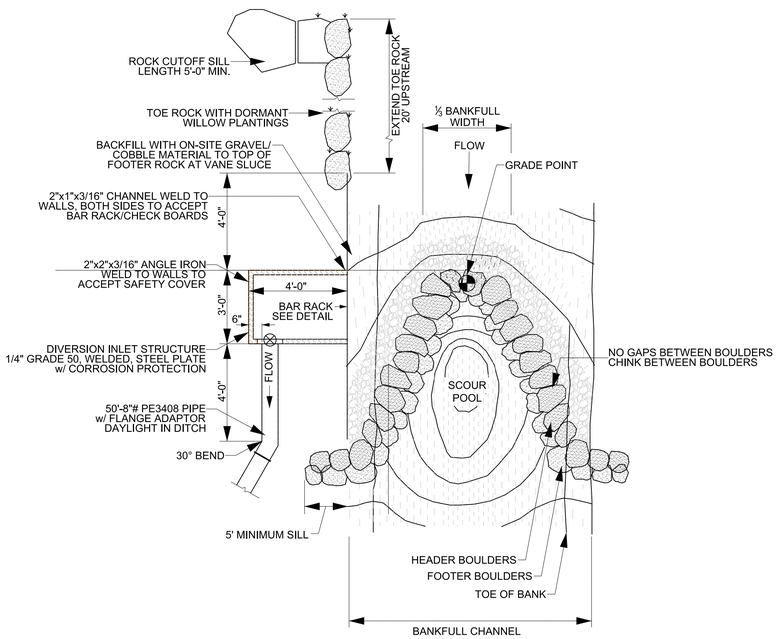
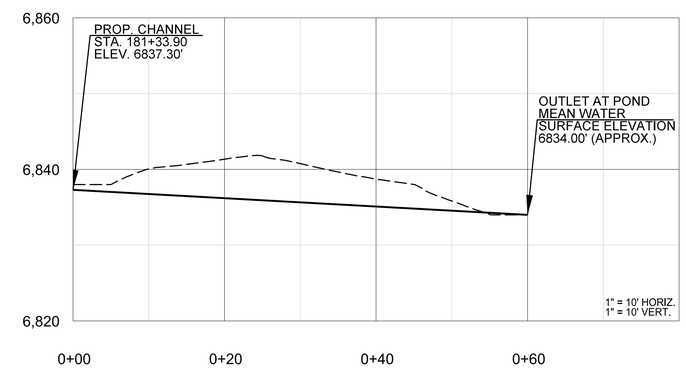
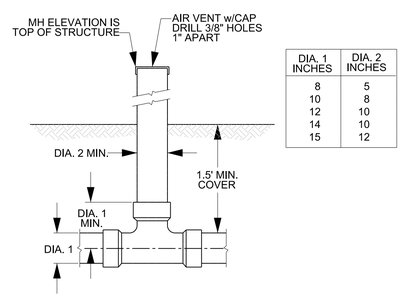
DIVERSION DETAIL

NTS



DIVERSION 1

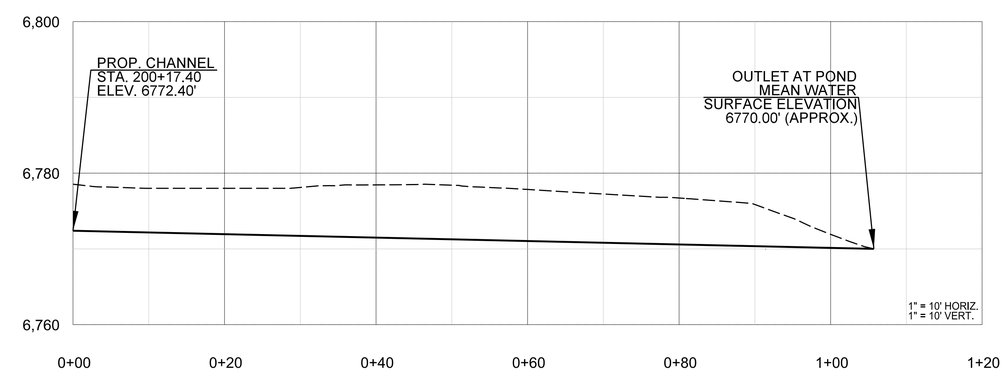


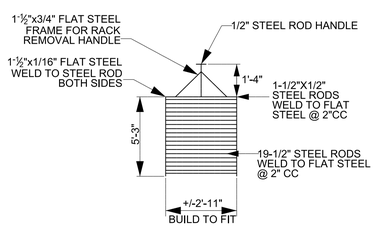


DIA. 1 INCHES	DIA. 2 INCHES
8	5
10	8
12	10
14	10
15	12

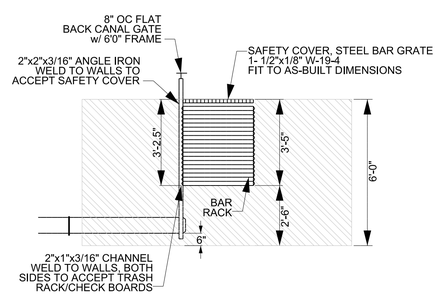
OPEN AIR VENT

DIVERSION 2





BAR RACK DETAIL



SECTION A-A

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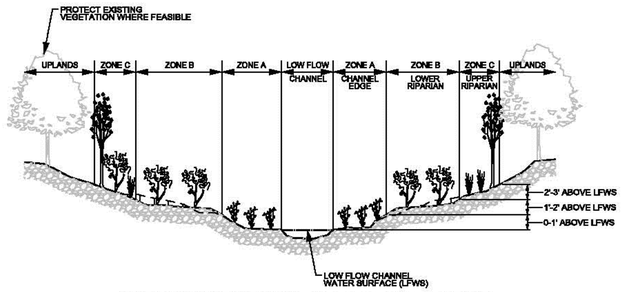
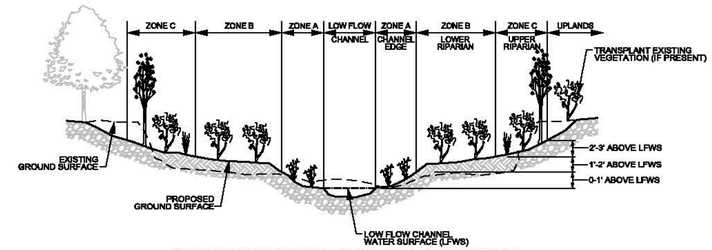
Treatment 1: Restoration Approach for Partially Healed, Overwidened, and Aggraded Reaches

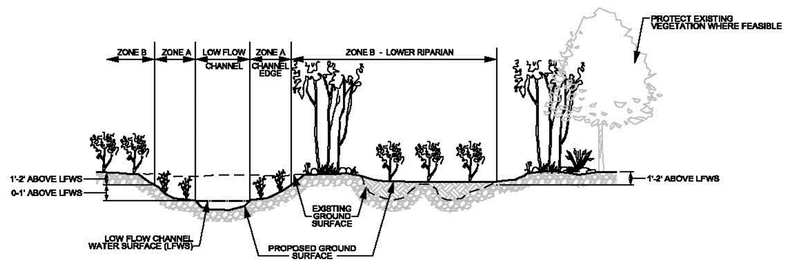
NTS



PARTIALLY HEALED REACHES : SEE TABLE 1 FOR PLANT LIST



OVERWIDENED REACHES : SEE TABLE 1 FOR PLANT LIST



AGGRADED REACHES - CHANNEL RELOCATION : SEE TABLE 1 FOR PLANT LIST

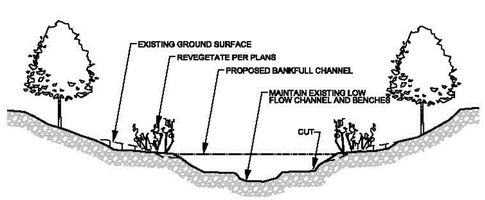
NOTES:
IN REACHES WHERE ROCK GREATER THAN 2 INCH IN DIAMETER COMPRISES OVER 50 PERCENT OF THE CHANNEL BANK MATERIAL, LIVE PLANT MATERIAL (TRANSPLANTS, CONTAINERIZED STOCK, AND CUTTINGS) WILL BE INSTALLED BY USING EQUIPMENT TO EXCAVATE A TRENCH AT THE EDGE OF THE APPROXIMATE BANKFULL CHANNEL. THE BOTTOM OF THE TRENCH WILL CORRESPOND TO THE APPROXIMATE ELEVATION OF THE LOW FLOW CHANNEL WATER SURFACE. THE PLANT MATERIAL WILL BE PLACED INTO THE TRENCH, BACKFILLED, AND LIGHTLY COMPACTED. WILLOW AND COTTONWOOD CUTTINGS MAY BE COMPLETELY BURIED (HORIZONTALLY OR VERTICALLY), BUT ALL OTHER LIVE PLANT MATERIALS WILL BE PLACED UPRIGHT SO THAT AT LEAST ONE-THIRD OF THE PLANT IS ABOVE GROUND (SEE TABLE 5 FOR PLANT LIST).

NOTES:
IF CHANNEL DEGRADATION HAS LEFT EXISTING RIPARIAN VEGETATION ABOVE ITS SUITABLE HEIGHT, THE EXISTING VEGETATION WILL BE TRANSPLANTED TO THE APPROPRIATE ELEVATION ABOVE THE LOW FLOW CHANNEL WATER SURFACE: 0-1' FOR HERBACEOUS WETLAND VEGETATION AND 1'-3' FOR WETLAND/RIPARIAN WOODY VEGETATION.

PARTIALLY HEALED RESTORATION APPROACH

NTS

NOTE: TYPICAL RESTORATION APPROACHES APPLY TO WORK AT RIFFLE SECTIONS ONLY.

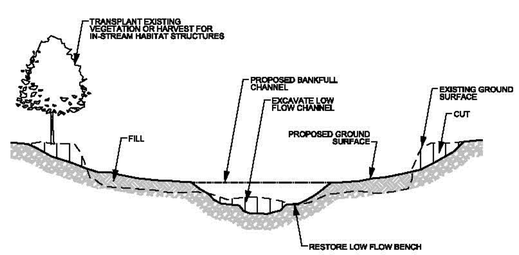


PARTIALLY HEALED REACHES

OVERWIDENED REACH RESTORATION APPROACH

NTS

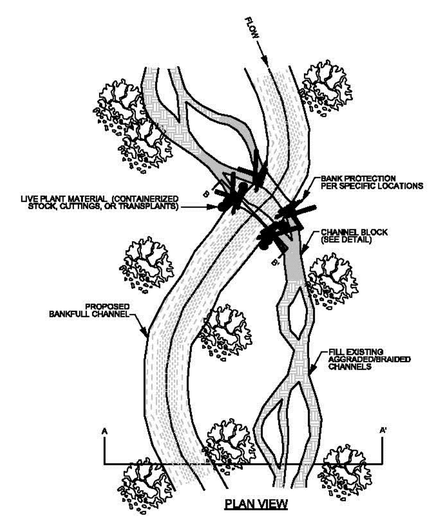
NOTE: TYPICAL RESTORATION APPROACHES APPLY TO WORK AT RIFFLE SECTIONS ONLY.



OVERWIDENED REACH

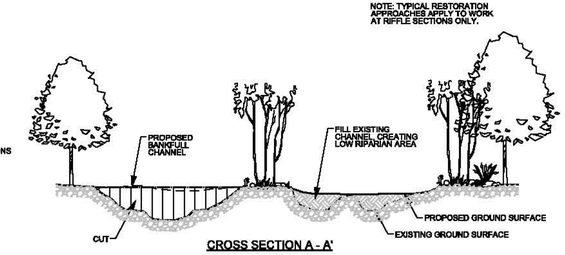
AGGRADED REACH RESTORATION APPROACH

NTS

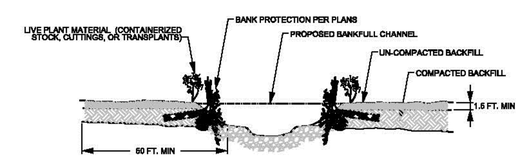


PLAN VIEW

NOTE: TYPICAL RESTORATION APPROACHES APPLY TO WORK AT RIFFLE SECTIONS ONLY.



CROSS SECTION A - A'



CROSS SECTION B - B' - CHANNEL BLOCK DETAIL

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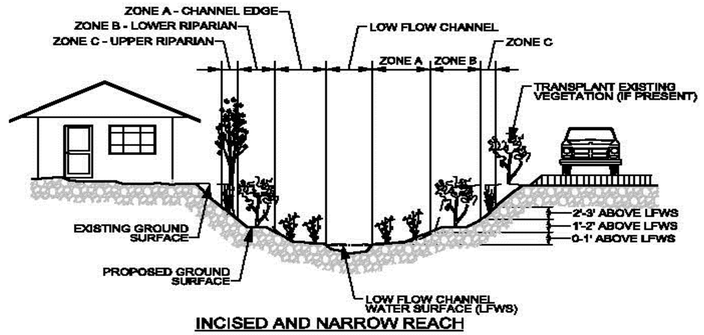
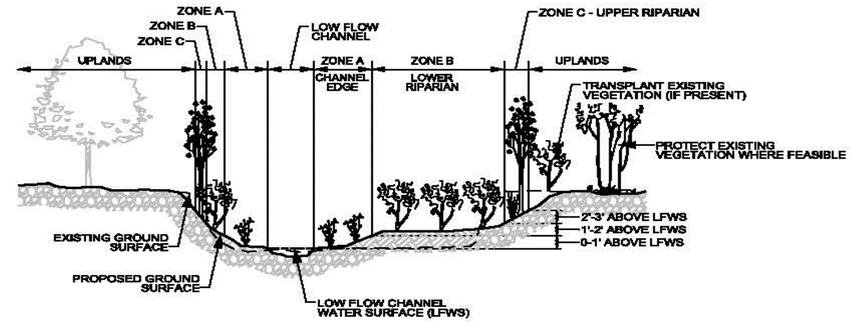
Treatment 1: Restoration Approach for Incised Reaches

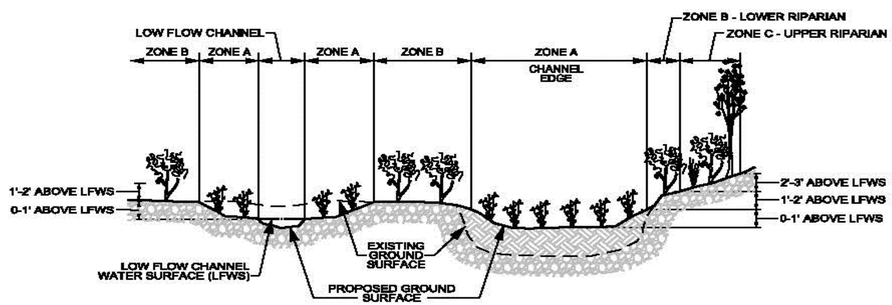
NTS



INCISED AND NARROW REACH



INCISED AND OVER-WIDENED REACH



INCISED REACH - CHANNEL RELOCATION : SEE TABLE 1 FOR PLANT LIST

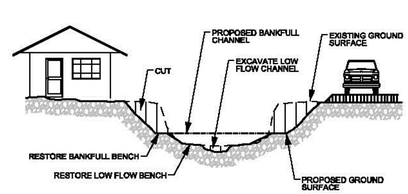
NOTES:
IN REACHES WHERE ROCK GREATER THAN 2 INCH IN DIAMETER COMPRISES OVER 50 PERCENT OF THE CHANNEL BANK MATERIAL, LIVE PLANT MATERIAL (TRANSPLANTS, CONTAINERIZED STOCK, AND CUTTINGS) WILL BE INSTALLED BY USING EQUIPMENT TO EXCAVATE A TRENCH AT THE EDGE OF THE APPROXIMATE BANKFULL CHANNEL. THE BOTTOM OF THE TRENCH WILL CORRESPOND TO THE APPROXIMATE ELEVATION OF THE LOW FLOW CHANNEL WATER SURFACE. THE PLANT MATERIAL WILL BE PLACED INTO THE TRENCH, BACKFILLED, AND LIGHTLY COMPACTED. WILLOW AND COTTONWOOD CUTTINGS MAY BE COMPLETELY BURIED (HORIZONTALLY OR VERTICALLY), BUT ALL OTHER LIVE PLANT MATERIALS WILL BE PLACED UPRIGHT SO THAT AT LEAST ONE-THIRD OF THE PLANT IS ABOVE GROUND (SEE TABLE 5 FOR PLANT LIST).

NOTES:
IF CHANNEL DEGRADATION HAS LEFT EXISTING RIPARIAN VEGETATION ABOVE ITS SUITABLE HEIGHT, THE EXISTING VEGETATION WILL BE TRANSPLANTED TO THE APPROPRIATE ELEVATION ABOVE THE LOW FLOW CHANNEL WATER SURFACE: 0-1' FOR HERBACEOUS WETLAND VEGETATION AND 1'-3' FOR WETLAND/RIPARIAN WOODY VEGETATION.

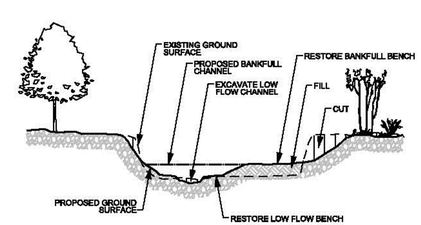
NOTE:
WHERE INCISED REACHES ARE TOO CONSTRAINED TO ALLOW RE-GRADING OF BANK SLOPES, CONSTRUCT SOIL WRAPPED LIFT AT SLOPE EQUAL TO EXISTING GROUND AND REVEGETATE USING TREATMENT 3 (SEE TABLE 3 FOR PLANT LIST).

INCISED REACH RESTORATION APPROACH

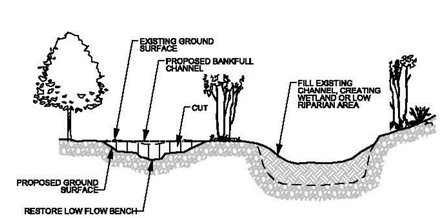
NTS



INCISED AND NARROW REACH



INCISED AND OVER-WIDENED REACH



INCISED REACH CHANNEL RELOCATION

NOTE:
TYPICAL RESTORATION APPROACHES APPLY TO WORK AT RIFFLE SECTIONS ONLY.

NOTE:
WHERE INCISED REACHES ARE TOO CONSTRAINED TO ALLOW RE-GRADING OF BANK SLOPES, CONSTRUCT SOIL WRAPPED LIFT AT SLOPE EQUAL TO EXISTING GROUND AND REVEGETATE USING TREATMENT 3 (SEE TABLE 3 FOR PLANT LIST).

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BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	3

Michael Baker INTERNATIONAL
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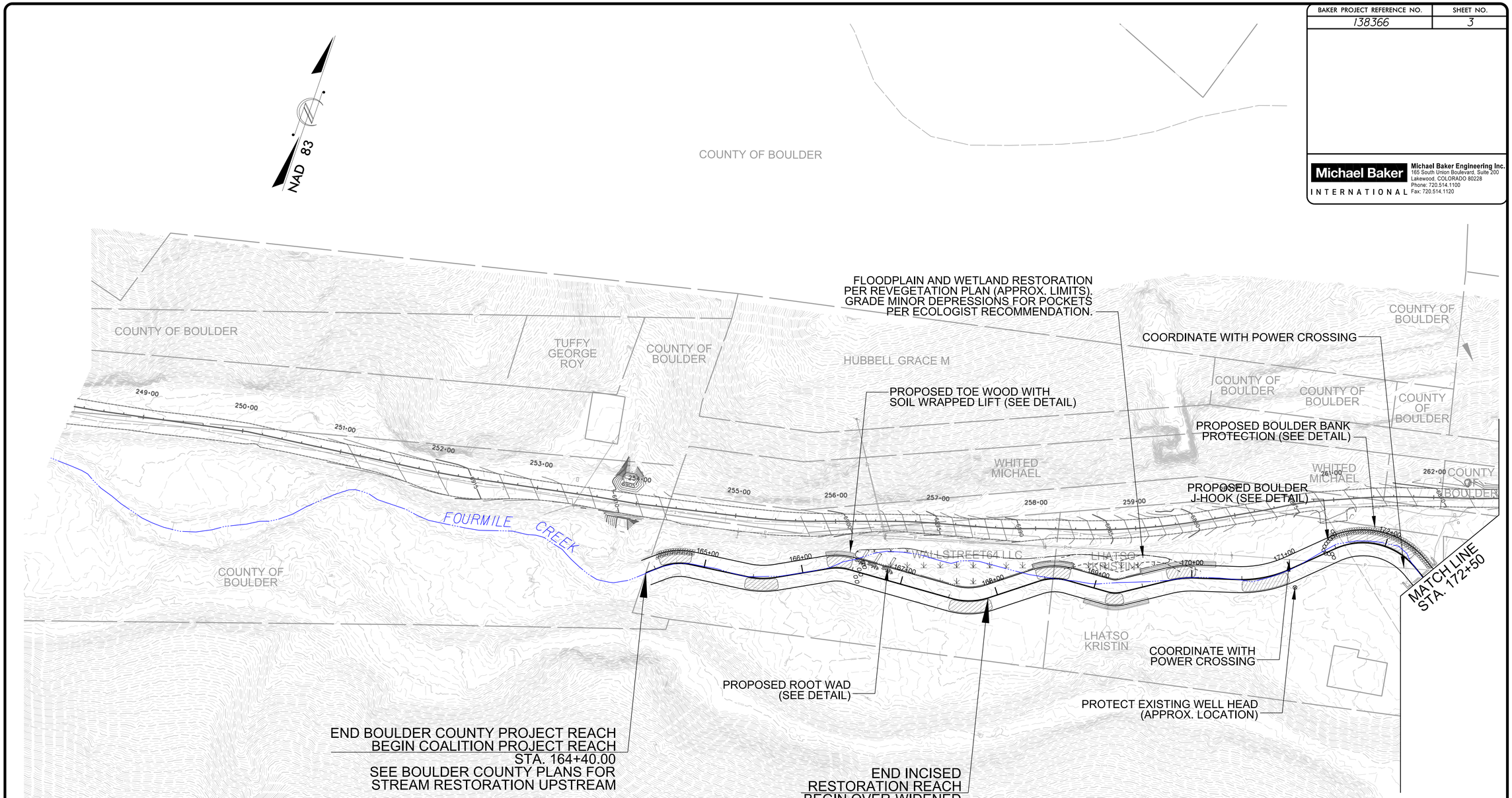

Description	Station	Elevation	Northing	Easting
PC	158+28.09	6913.88	257218.7271	29623.3459
PT	158+51.86	6913.02	257213.1337	29646.3593
PC	158+85.46	6911.80	257200.5375	29677.5108
PT	159+06.24	6911.03	257198.0529	29697.8980
PC	159+73.28	6908.55	257207.5215	29764.2700
PT	160+04.67	6907.39	257221.1204	29791.9922
PC	160+51.13	6905.67	257253.4757	29825.3329
PT	161+18.61	6903.18	257282.0656	29885.1535
PC	161+41.54	6902.33	257284.8396	29907.9152
PT	161+74.90	6901.10	257285.3419	29941.2023
PC	161+97.23	6900.27	257283.3105	29963.4421
PT	162+13.13	6899.65	257283.6196	29979.3036
PC	162+51.39	6898.15	257288.5827	30017.2489
PT	162+68.40	6897.49	257292.5721	30033.7433
PC	162+93.88	6896.49	257301.1808	30057.7324
PT	163+37.17	6894.80	257301.2142	30100.1670
PC	163+76.37	6893.39	257288.0316	30137.0838
PT	164+28.23	6891.53	257296.6877	30185.8968

Description	Station	Elevation	Northing	Easting
PC	164+56.88	6890.50	257315.0083	30207.9151
PT	164+85.69	6889.46	257326.2303	30234.0232
PC	165+43.15	6887.40	257332.9900	30291.0846
PT	165+73.73	6886.30	257342.1501	30320.0733
PC	166+25.89	6884.82	257366.8898	30365.9891
PT	166+47.79	6884.20	257372.7682	30386.9041
PC	167+52.79	6881.22	257378.4122	30491.7459
PT	167+91.39	6880.12	257391.5002	30527.4597
PC	168+43.29	6878.65	257422.8582	30568.8156
PT	168+73.13	6877.80	257432.9523	30596.4318
PC	169+14.22	6876.58	257435.0920	30637.4617
PT	169+28.41	6876.16	257439.3726	30650.8271
PC	169+76.48	6874.74	257465.2250	30691.3563
PT	170+03.54	6873.94	257476.4784	30715.8662
PC	170+45.27	6872.70	257488.5334	30755.8181
PT	171+00.26	6871.07	257515.8327	30802.9914
PC	171+48.79	6869.64	257549.1272	30838.2913
PT	172+37.17	6867.02	257557.4912	30920.0791

NOTES:
1. RIFFLES TO BE CONSTRUCTED BETWEEN PT AND PC. SEE TYPICAL RIFFLE CROSS SECTION DETAIL AND CONSTRUCTED RIFFLE DETAIL.
2. RUN-POOL-GLIDE SEQUENCE TO BE CONSTRUCTED BETWEEN PC AND PT. SEE TYPICAL POOL CROSS SECTION DETAIL, TYPICAL PROFILE DETAIL, AND CONSTRUCTED POOL AND POINT BAR DETAIL.
3. REFER TO RESTORATION APPROACH DETAILS FOR APPROACHES TO RESTORING PARTIALLY HEALED, INCISED, AGGRADED, AND OVER WIDENED REACHES.
4. POOL LENGTH, WIDTH, AND DEPTH VARY PER TYPICAL DETAILS. POOL LENGTH, WIDTH, AND DEPTH MUST VARY BETWEEN POOLS.

UPPER FOURMILE CREEK STREAM RESTORATION PLAN VIEW

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BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	4

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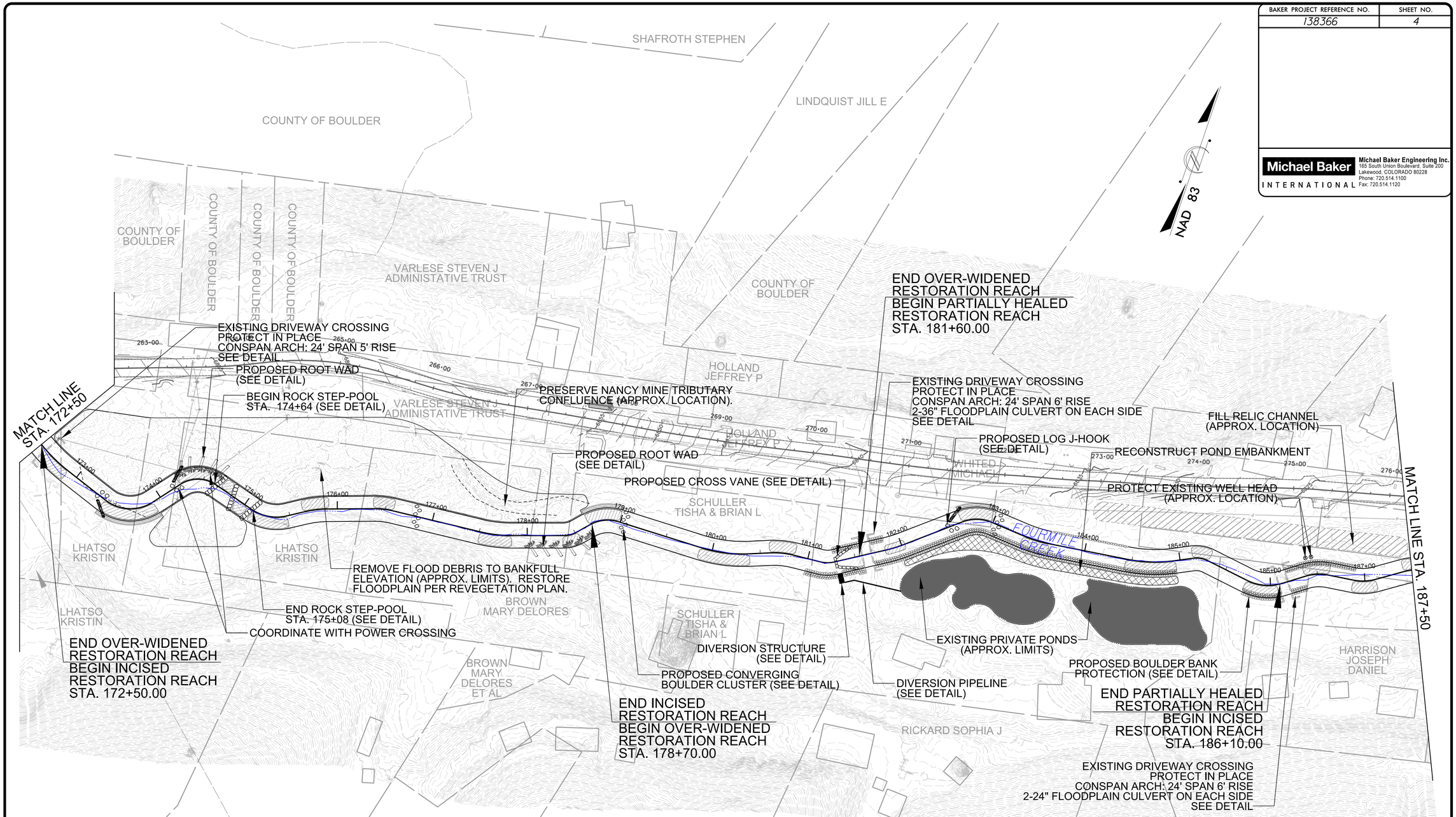

Description	Station	Elevation	Northing	Easting
PC	172+52.30	6866.57	257549.5535	30932.9578
PT	172+89.17	6865.48	257533.7365	30966.1779
PC	173+37.91	6864.04	257517.6485	31012.1868
PT	173+90.67	6862.48	257531.4697	31059.6631
PC	174+24.49	6861.48	257558.0290	31080.6117
PT	174+64.25	6860.30	257569.5989	31116.2775
PC	175+08.44	6857.30	257557.5741	31158.8015
PT	175+47.09	6856.07	257562.9237	31195.9438
PC	175+64.36	6855.52	257572.1230	31210.5626
PT	175+91.31	6854.66	257583.7885	31234.7918
PC	176+37.63	6853.18	257599.0511	31278.5296
PT	176+58.38	6852.52	257603.4558	31298.7512
PC	177+50.85	6849.57	257612.0615	31390.8188
PT	177+83.79	6848.52	257618.9435	31422.9608

Description	Station	Elevation	Northing	Easting
PC	178+37.06	6846.82	257636.1373	31473.3794
PT	178+52.67	6846.32	257644.6572	31486.2489
PC	178+67.24	6845.85	257655.5159	31495.9645
PT	178+98.82	6844.85	257668.3913	31523.8409
PC	179+87.11	6842.03	257670.5507	31612.1067
PT	180+38.83	6840.38	257680.7528	31662.5399
PC	180+59.79	6839.71	257688.4275	31682.0529
PT	180+86.10	6838.87	257694.3656	31707.5851
PC	181+13.36	6838.00	257696.6061	31734.7500
PT	181+28.07	6837.53	257701.1780	31748.5867
PC	181+82.33	6835.80	257729.8124	31794.6726
PT	182+03.62	6834.50	257742.3084	31811.8968
PC	182+66.95	6830.61	257783.0720	31860.3610
PT	182+99.29	6829.32	257792.8154	31890.3649

Description	Station	Elevation	Northing	Easting
PC	183+34.59	6827.90	257790.3004	31925.5683
PT	183+62.60	6826.77	257791.1451	31953.5203
PC	184+43.70	6823.51	257801.7989	32033.9181
PT	184+95.19	6822.38	257816.8240	32082.9192
PC	185+13.26	6821.99	257824.8985	32099.0818
PT	185+30.03	6821.62	257827.5874	32115.3876
PC	185+74.62	6820.64	257821.5237	32159.5565
PT	186+12.88	6819.80	257830.6170	32195.7671
PC	186+37.08	6819.33	257844.8479	32215.3467
PT	186+62.03	6818.85	257853.9860	32238.2866
PC	186+87.93	6818.34	257857.3348	32263.9673
PT	187+11.26	6817.89	257865.5431	32285.5834
PC	187+41.68	6817.30	257882.6187	32310.7496
PT	187+58.13	6816.69	257889.4727	32325.6295

NOTES:
1. RIFFLES TO BE CONSTRUCTED BETWEEN PT AND PC. SEE TYPICAL RIFFLE CROSS SECTION DETAIL AND CONSTRUCTED RIFFLE DETAIL.
2. RUN-POOL-GLIDE SEQUENCE TO BE CONSTRUCTED BETWEEN PC AND PT. SEE TYPICAL POOL CROSS SECTION DETAIL, TYPICAL PROFILE DETAIL, AND CONSTRUCTED POOL AND POINT BAR DETAIL.
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UPPER FOURMILE CREEK STREAM RESTORATION PLAN VIEW

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BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	5

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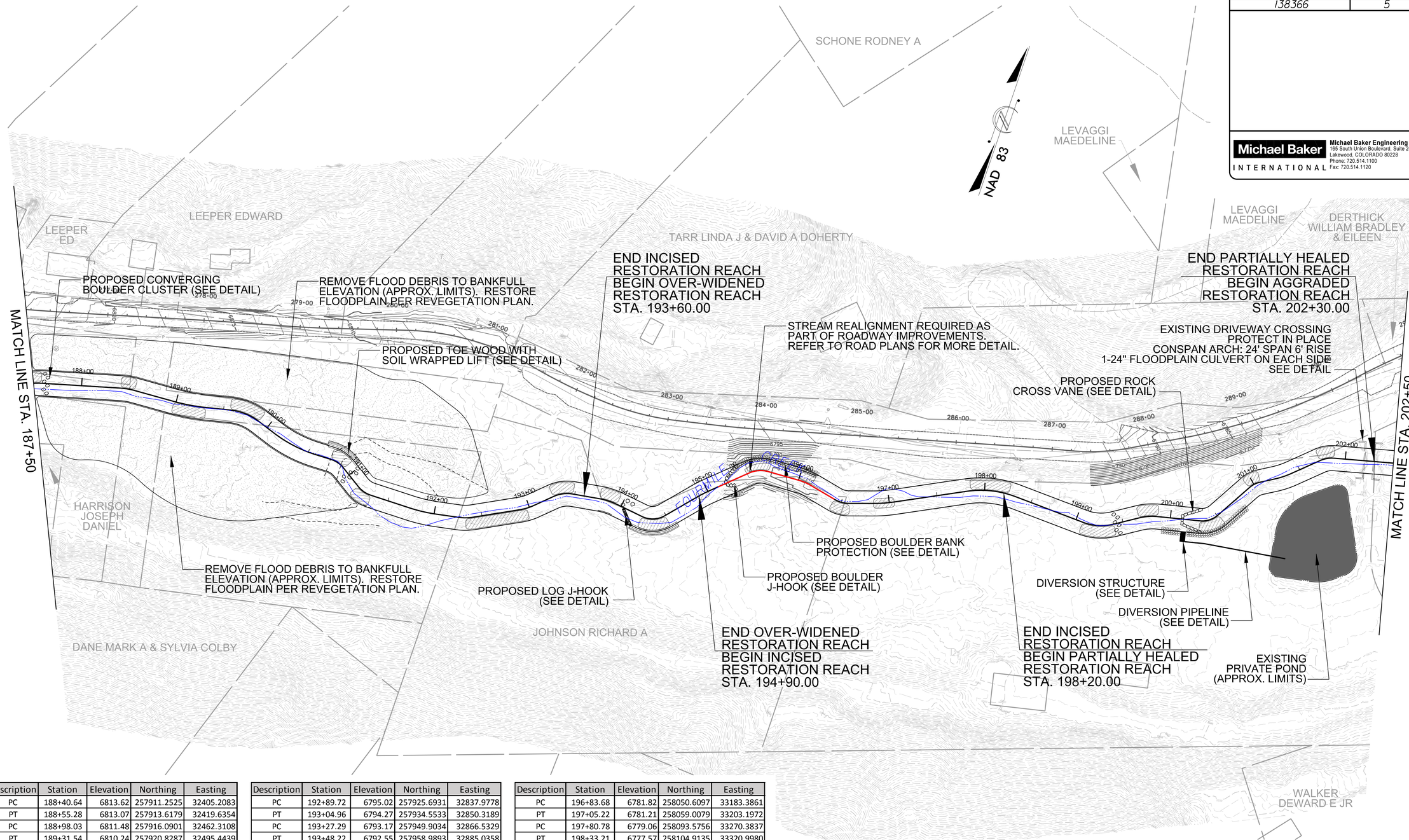

Description	Station	Elevation	Northing	Easting
PC	188+40.64	6813.62	257911.2525	32405.2083
PT	188+55.28	6813.07	257913.6179	32419.6354
PC	188+98.03	6811.48	257916.0901	32462.3108
PT	189+31.54	6810.24	257920.8287	32495.4439
PC	189+57.04	6809.29	257926.5476	32520.2892
PT	189+89.25	6808.09	257924.9544	32552.0539
PC	190+08.77	6807.37	257918.6932	32570.5464
PT	190+57.80	6805.54	257911.3778	32618.7650
PC	190+74.68	6804.91	257911.8057	32635.6458
PT	190+90.91	6804.31	257907.5077	32651.0498
PC	191+15.14	6803.41	257894.4429	32671.4537
PT	191+31.52	6802.80	257890.0089	32686.9801
PC	191+73.66	6800.73	257890.5646	32729.1170
PT	192+02.70	6799.30	257893.4715	32757.9692
PC	192+25.61	6798.17	257897.7455	32780.4786
PT	192+40.60	6797.44	257902.6896	32794.5687

Description	Station	Elevation	Northing	Easting
PC	192+89.72	6795.02	257925.6931	32837.9778
PT	193+04.96	6794.27	257934.5533	32850.3189
PC	193+27.29	6793.17	257949.9034	32866.5329
PT	193+48.22	6792.55	257958.9893	32885.0358
PC	193+76.35	6791.71	257963.3293	32912.8309
PT	193+95.08	6791.15	257963.6335	32931.4993
PC	194+24.14	6790.28	257960.0884	32960.3396
PT	194+48.88	6789.54	257968.5829	32982.5391
PC	194+88.15	6788.37	257998.1726	33008.3647
PT	195+00.56	6788.00	258007.0861	33016.9896
PC	195+46.71	6785.80	258038.5563	33050.7385
PT	195+67.77	6784.80	258046.6171	33069.7376
PC	196+00.53	6784.09	258048.3215	33102.4567
PT	196+14.16	6783.80	258047.2833	33116.0086
PC	196+42.31	6783.00	258041.5540	33143.5705
PT	196+58.50	6782.54	258042.5270	33159.5335

Description	Station	Elevation	Northing	Easting
PC	196+83.68	6781.82	258050.6097	33183.3861
PT	197+05.22	6781.21	258059.0079	33203.1972
PC	197+80.78	6779.06	258093.5756	33270.3837
PT	198+33.21	6777.57	258104.9135	33320.9980
PC	199+07.52	6775.46	258102.3539	33395.2670
PT	199+40.22	6774.53	258110.8747	33426.3217
PC	199+67.14	6773.77	258125.4026	33448.9857
PT	199+86.87	6773.21	258133.0411	33467.0718
PC	200+30.72	6771.96	258143.0031	33509.7729
PT	200+51.20	6771.38	258154.8736	33525.7611
PC	200+94.35	6770.15	258192.2669	33547.3043
PT	201+06.92	6769.80	258201.1602	33555.9960
PC	201+22.55	6769.40	258209.2683	33569.3515
PT	201+40.49	6768.95	258220.0878	33583.6296
PC	201+73.21	6768.12	258242.4173	33607.5368
PT	201+88.37	6767.74	258249.5919	33620.7109

NOTES:
1. RIFFLES TO BE CONSTRUCTED BETWEEN PT AND PC. SEE TYPICAL RIFFLE CROSS SECTION DETAIL AND CONSTRUCTED RIFFLE DETAIL.
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UPPER FOURMILE CREEK STREAM RESTORATION PLAN VIEW

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Description	Station	Elevation	Northing	Easting
PC	202+64.96	6765.80	258268.2506	33694.9960
PT	203+09.47	6764.53	258271.7027	33739.1635
PC	203+89.71	6762.25	258264.4845	33819.0727
PT	204+09.58	6761.59	258269.1426	33838.0223
PC	204+63.93	6759.80	258298.5688	33883.7130
PT	204+94.91	6759.19	258321.3908	33904.1110
PC	205+22.46	6758.64	258346.0747	33916.3441
PT	205+50.07	6758.10	258369.4175	33931.0083
PC	205+95.31	6757.21	258405.1044	33958.8022
PT	206+30.56	6756.51	258424.0705	33987.7647
PC	206+70.94	6755.72	258434.0796	34026.8893
PT	207+15.94	6754.83	258430.3386	34070.8851
PC	207+87.09	6753.42	258401.3180	34135.8519
PT	208+18.72	6752.80	258392.4714	34166.1176
PC	208+65.90	6750.78	258385.4843	34212.7769
PT	208+83.18	6750.05	258385.3392	34229.9982
PC	209+10.02	6748.90	258388.8664	34256.6057
PT	209+25.00	6748.26	258386.4015	34271.1594

Description	Station	Elevation	Northing	Easting
PC	209+72.32	6746.24	258365.0823	34313.4064
PT	210+06.11	6744.80	258365.4805	34345.9088
PC	210+20.38	6744.19	258372.2182	34358.4846
PT	210+35.75	6743.53	258383.0679	34369.0376
PC	210+73.86	6741.90	258417.1412	34386.0942
PT	210+87.96	6741.30	258427.3617	34395.5410
PC	211+49.66	6739.45	258459.2303	34448.3773
PT	211+65.70	6738.97	258463.8385	34463.5596
PC	211+91.86	6738.19	258465.0586	34489.6981
PT	212+07.06	6737.73	258468.6999	34504.3488
PC	212+42.59	6736.67	258483.8547	34536.4930
PT	212+64.67	6736.01	258498.1650	34552.9333
PC	212+81.57	6735.50	258512.3110	34562.1786
PT	213+01.61	6735.11	258527.2156	34575.4628
PC	213+26.85	6734.63	258543.3554	34594.8709
PT	213+39.41	6734.39	258550.3137	34605.3014
PC	213+52.85	6734.13	258556.5539	34617.2035
PT	213+66.92	6733.86	258565.6394	34627.7864

Description	Station	Elevation	Northing	Easting
PC	213+85.96	6733.49	258580.9724	34639.0807
PT	214+04.27	6733.14	258593.3911	34652.3881
PC	214+28.59	6732.67	258606.4308	34672.9204
PT	214+48.40	6732.29	258619.1561	34688.0190
PC	214+62.92	6732.01	258629.9162	34697.7654
PT	214+82.22	6731.63	258642.7838	34712.1072
PC	215+09.41	6731.11	258658.7530	34734.1134
PT	215+25.61	6730.80	258670.0816	34745.6161
PC	215+50.09	6730.33	258689.6699	34760.2920
PT	215+66.53	6730.01	258701.2013	34771.9223
PC	215+81.74	6729.72	258710.2210	34784.1778
PT	215+95.65	6729.45	258717.2283	34796.1574
PC	216+13.50	6729.10	258724.5739	34812.4274
PT	216+29.33	6728.80	258735.0766	34823.9169
PC	216+63.89	6727.54	258765.1797	34840.9047
PT	216+85.27	6726.76	258785.8328	34842.6942
PC	217+47.42	6724.50	258844.4029	34821.9154
PT	217+80.94	6723.50	258877.4357	34819.7900

BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	6

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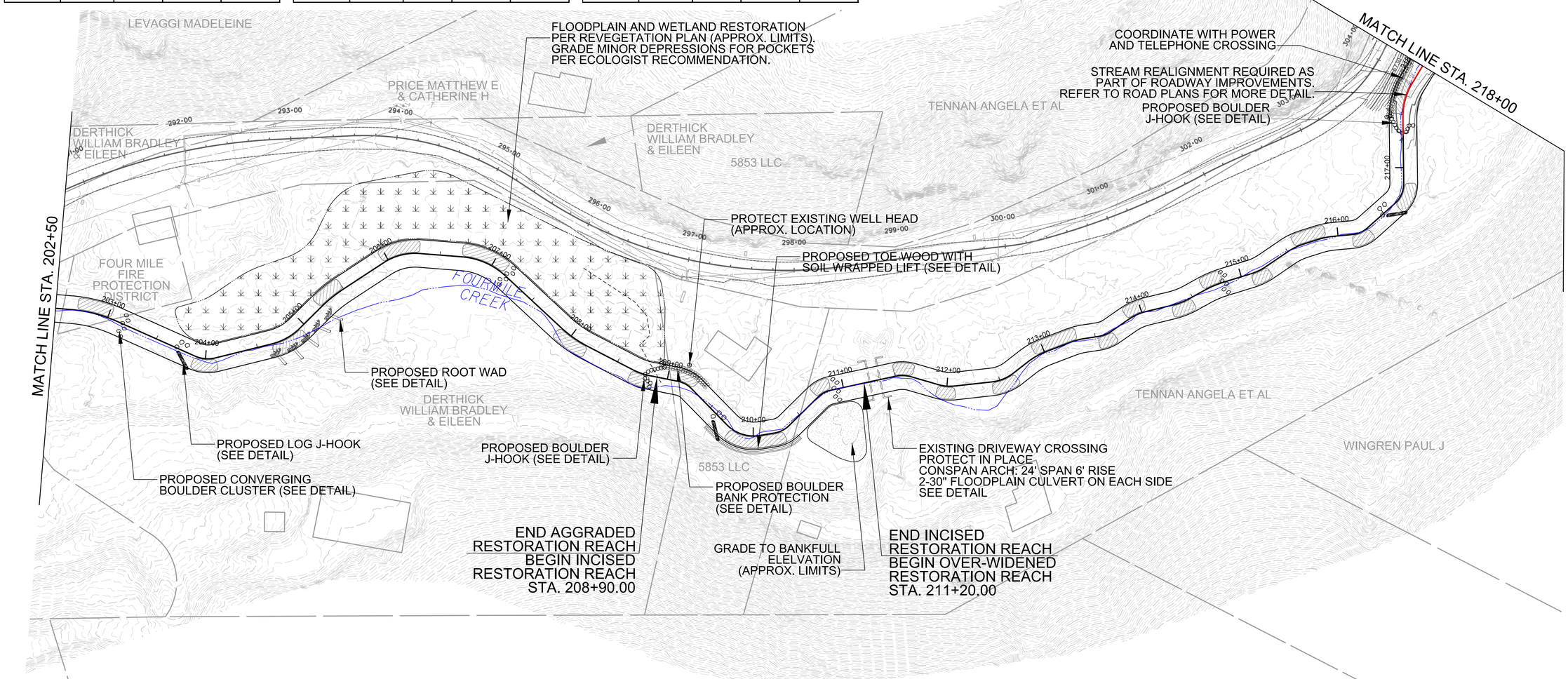

NOTES:
1. RIFFLES TO BE CONSTRUCTED BETWEEN PT AND PC. SEE TYPICAL RIFFLE CROSS SECTION DETAIL AND CONSTRUCTED RIFFLE DETAIL.
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UPPER FOURMILE CREEK STREAM RESTORATION PLAN VIEW

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NOTES:
1. RIFFLES TO BE CONSTRUCTED BETWEEN PT AND PC. SEE TYPICAL RIFFLE CROSS SECTION DETAIL AND CONSTRUCTED RIFFLE DETAIL.
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BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	7

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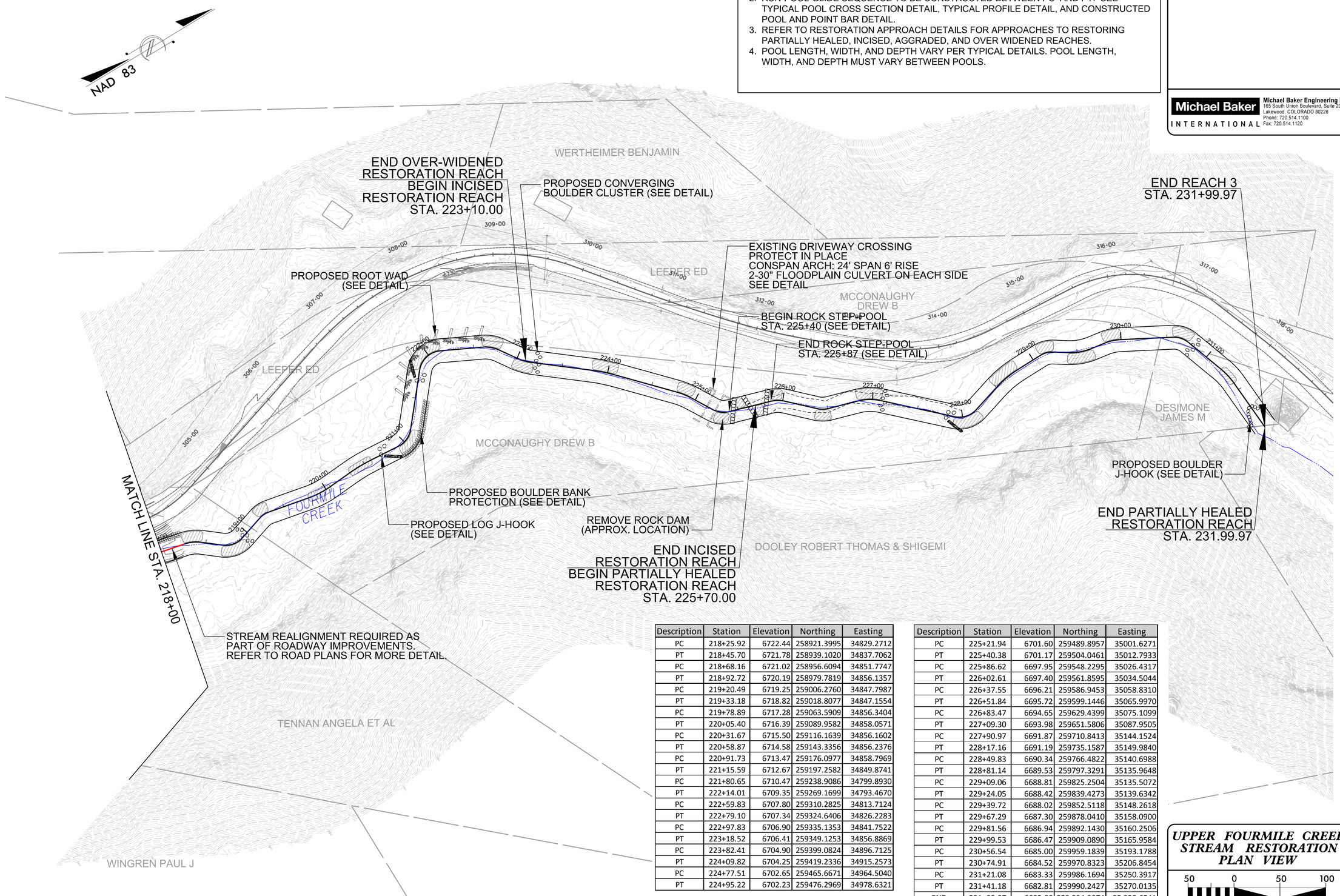

Description	Station	Elevation	Northing	Easting
PC	218+25.92	6722.44	258921.3995	34829.2712
PT	218+45.70	6721.78	258939.1020	34837.7062
PC	218+68.16	6721.02	258956.6094	34851.7747
PT	218+92.72	6720.19	258979.7819	34856.1357
PC	219+20.49	6719.25	259006.2760	34847.7987
PT	219+33.18	6718.82	259018.8077	34847.1554
PC	219+78.89	6717.28	259063.5909	34856.3404
PT	220+05.40	6716.39	259089.9582	34858.0571
PC	220+31.67	6715.50	259116.1639	34856.1602
PT	220+58.87	6714.58	259143.3356	34856.2376
PC	220+91.73	6713.47	259176.0977	34858.7969
PT	221+15.59	6712.67	259197.2582	34849.8741
PC	221+80.65	6710.47	259238.9086	34799.8930
PT	222+14.01	6709.35	259269.1699	34793.4670
PC	222+59.83	6707.80	259310.2825	34813.7124
PT	222+79.10	6707.34	259324.6406	34826.2283
PC	222+97.83	6706.90	259335.1353	34841.7522
PT	223+18.52	6706.41	259349.1253	34856.8869
PC	223+82.41	6704.90	259399.0824	34896.7125
PT	224+09.82	6704.25	259419.2336	34915.2573
PC	224+77.51	6702.65	259465.6671	34964.5040
PT	224+95.22	6702.23	259476.2969	34978.6321

Description	Station	Elevation	Northing	Easting
PC	225+21.94	6701.60	259489.8957	35001.6271
PT	225+40.38	6701.17	259504.0461	35012.7933
PC	225+86.62	6697.95	259548.2295	35026.4317
PT	226+02.61	6697.40	259561.8595	35034.5044
PC	226+37.55	6696.21	259586.9453	35058.8310
PT	226+51.84	6695.72	259599.1446	35065.9970
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UPPER FOURMILE CREEK STREAM RESTORATION PLAN VIEW

50 0 50 100
SCALE (FT)

9/21/2016
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BAKER PROJ. REFERENCE NO.	SHEET NO.
138366	P-1

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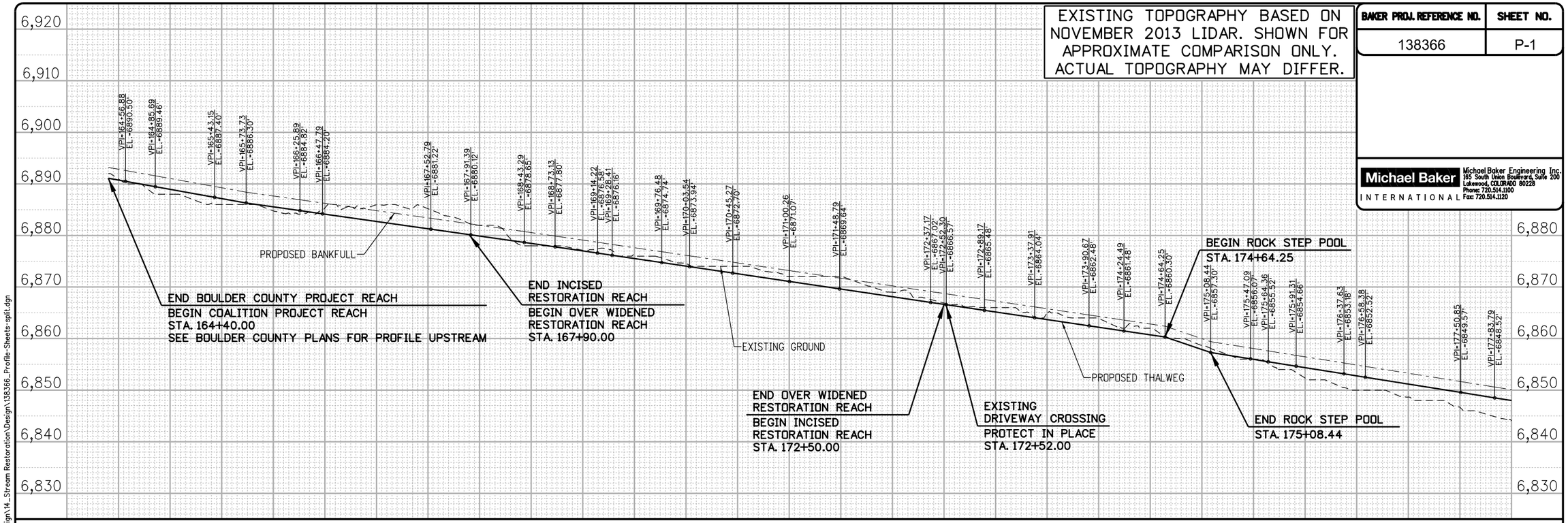

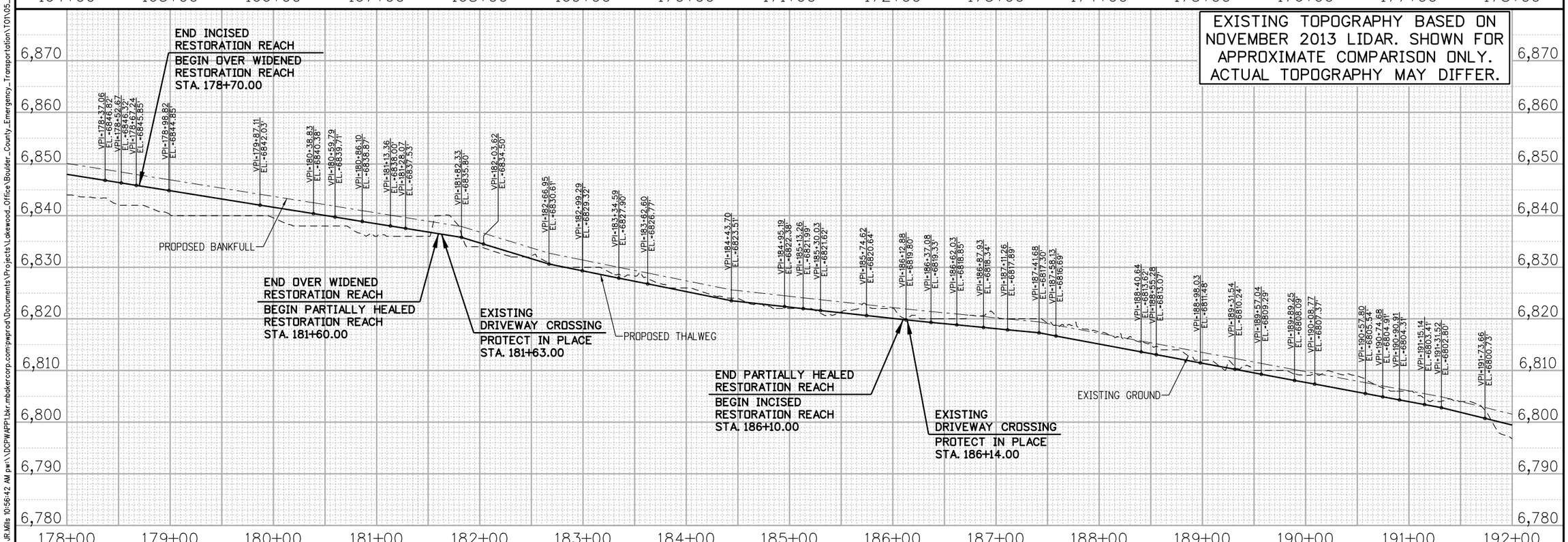

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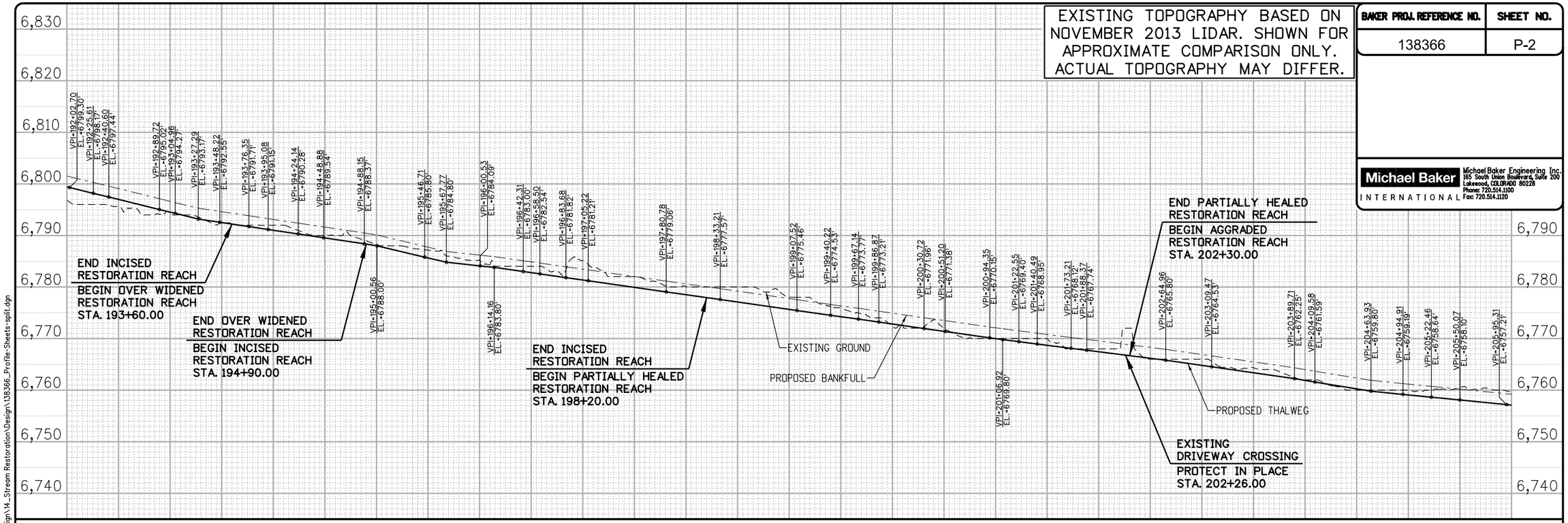

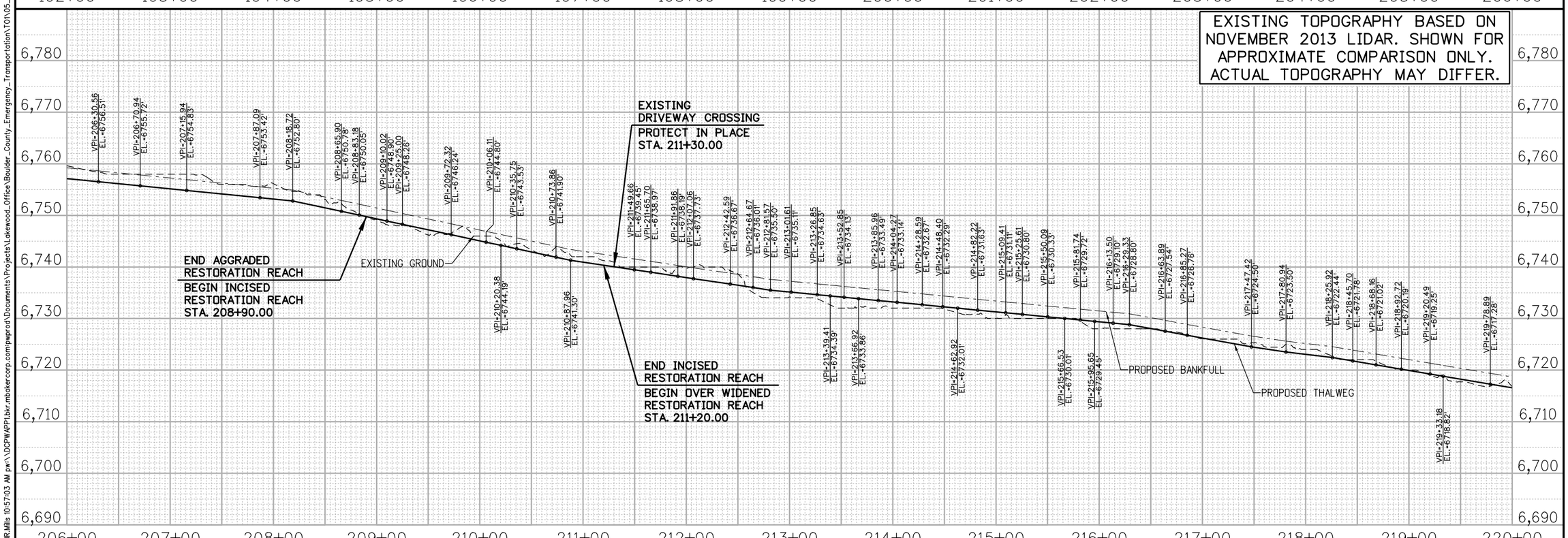

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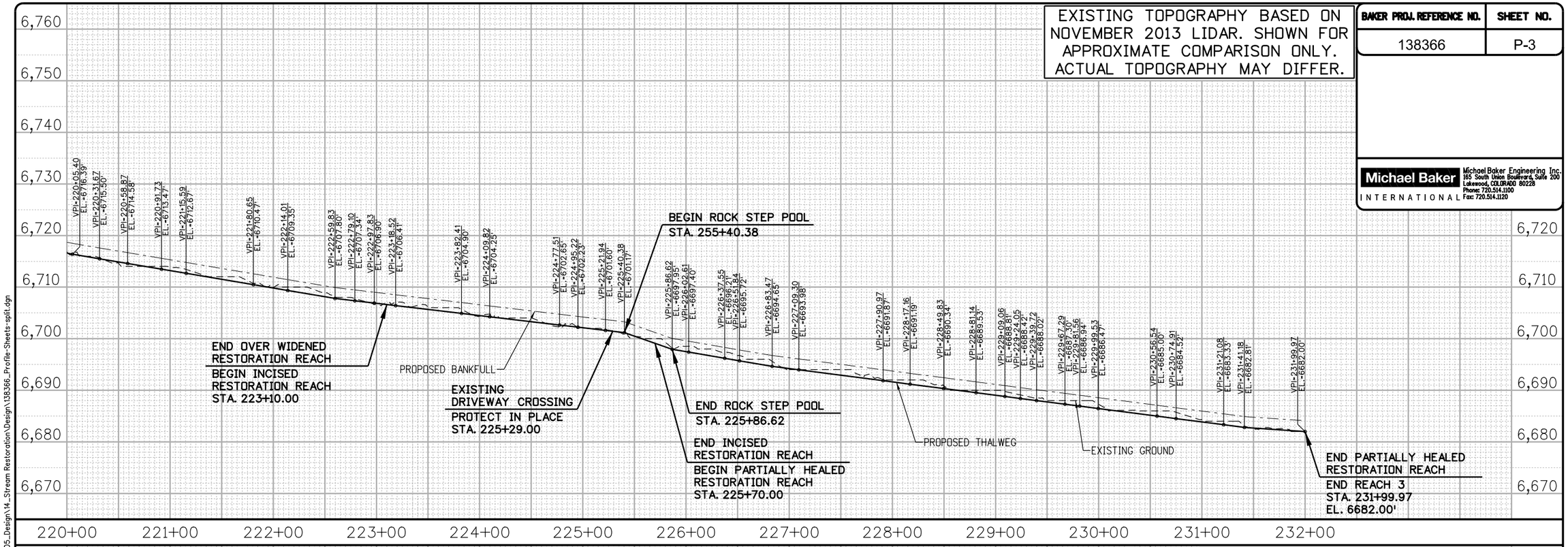

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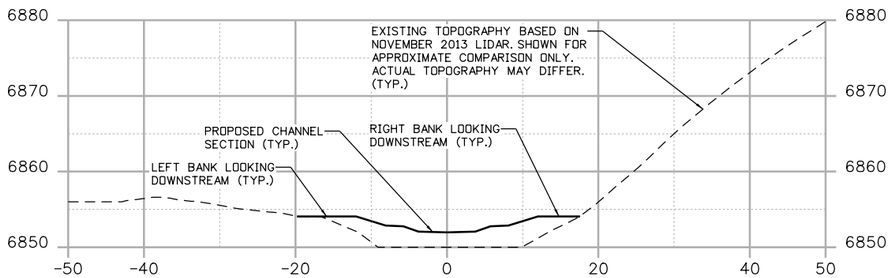
NOTE: CROSS SECTION VIEWS SHOW APPROXIMATE GRADING REQUIRED TO TIE-IN TO EXISTING GROUND ELEVATIONS. REFER TO TYPICAL RIFFLE, POOL AND BANKFULL BENCH CROSS SECTIONS DETAIL FOR DETAILED CHANNEL DIMENSIONS.



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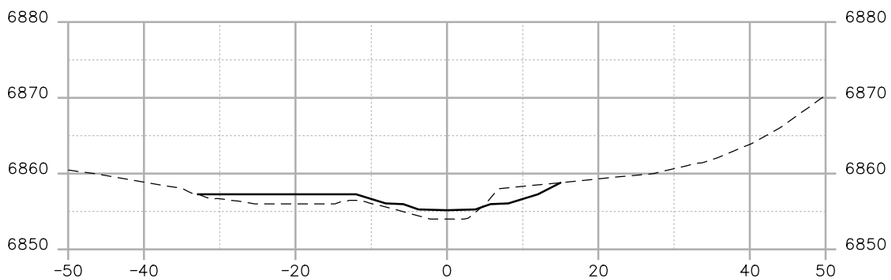

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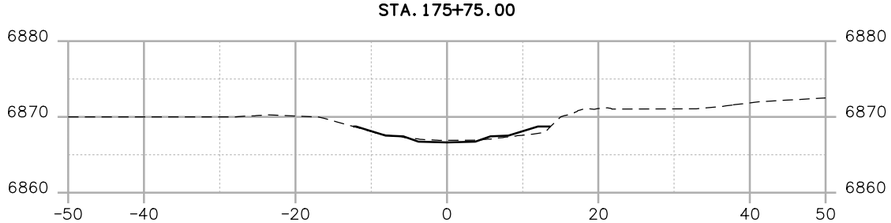

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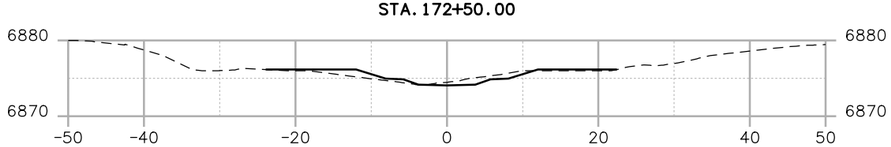

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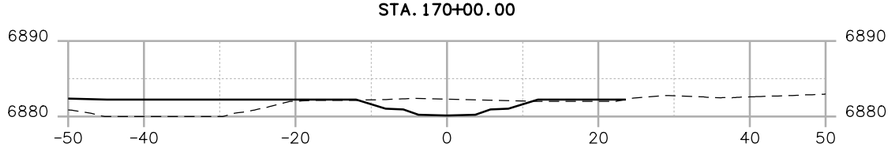

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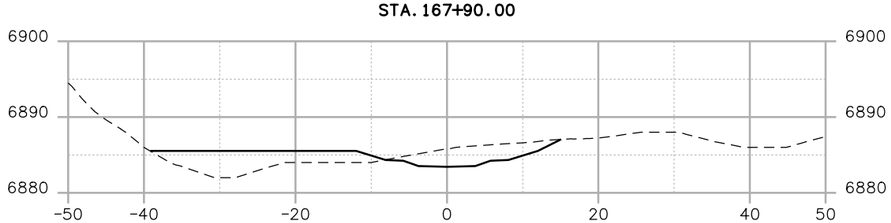

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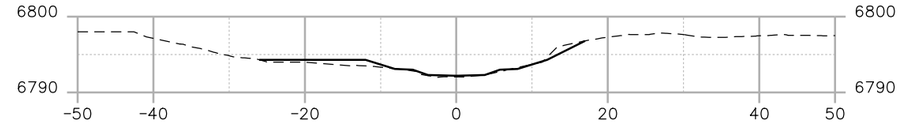

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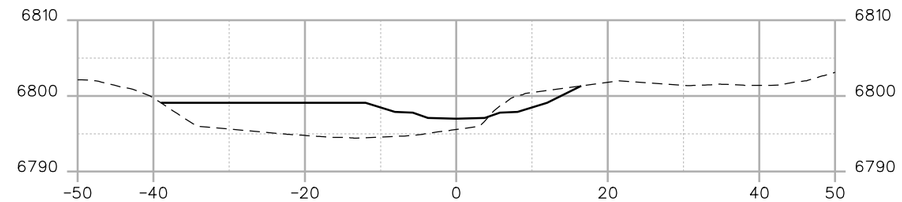

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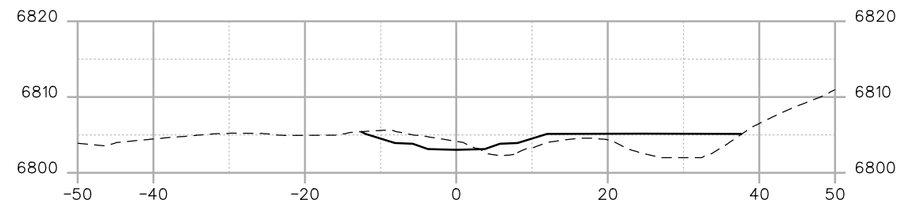

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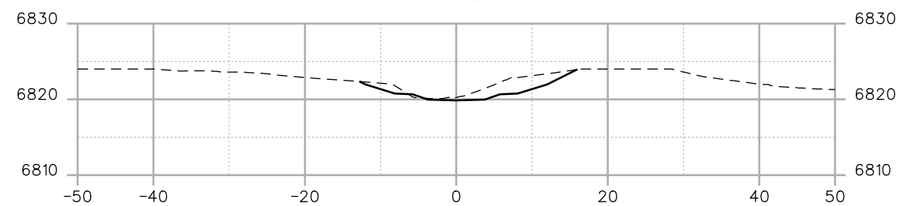

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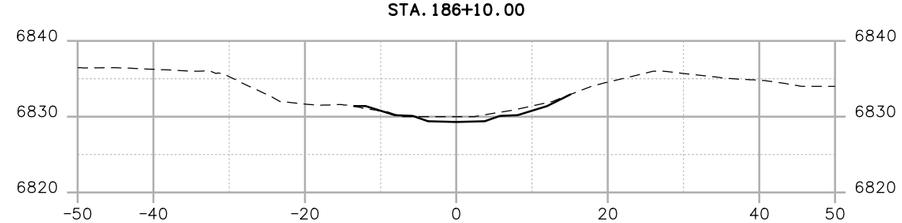

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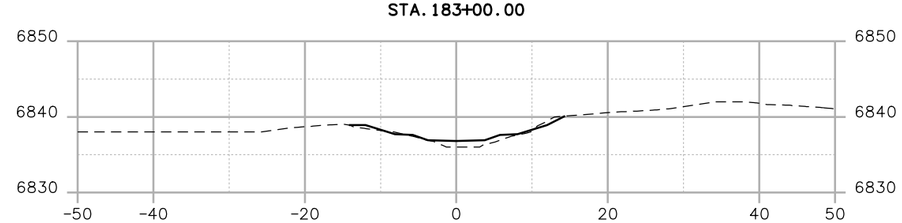

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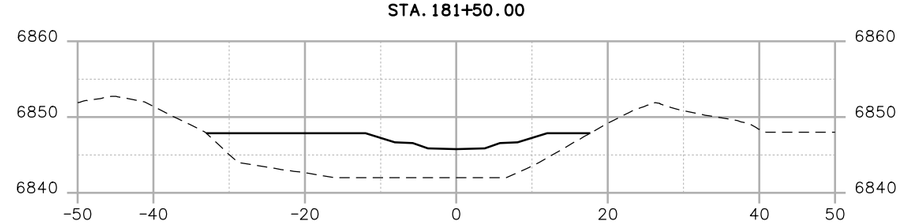

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NOTE: CROSS SECTION VIEWS SHOW APPROXIMATE GRADING REQUIRED TO TIE-IN TO EXISTING GROUND ELEVATIONS. REFER TO TYPICAL RIFFLE, POOL AND BANKFULL BENCH CROSS SECTIONS DETAIL FOR DETAILED CHANNEL DIMENSIONS.

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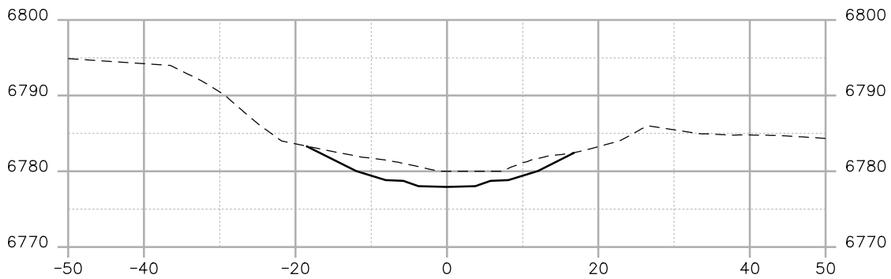

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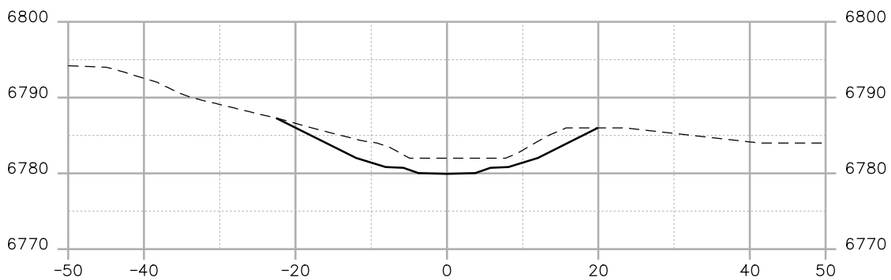

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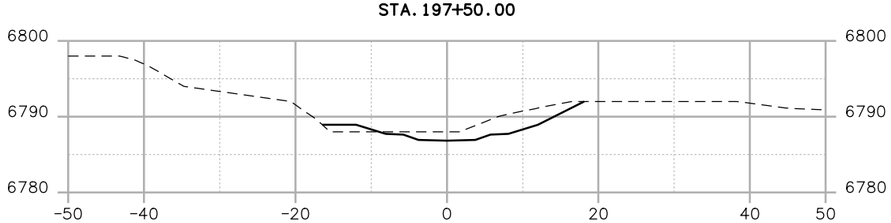

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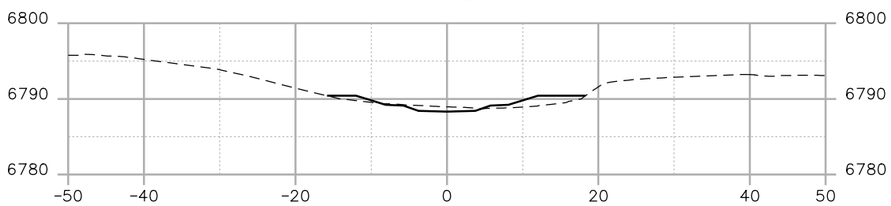

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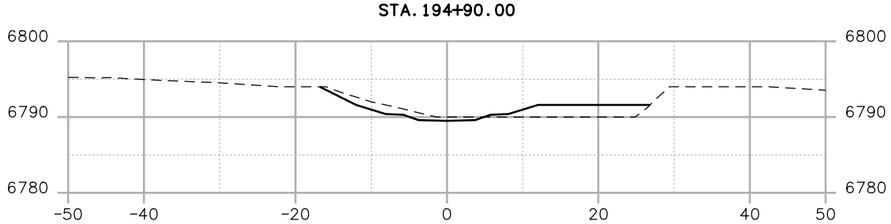

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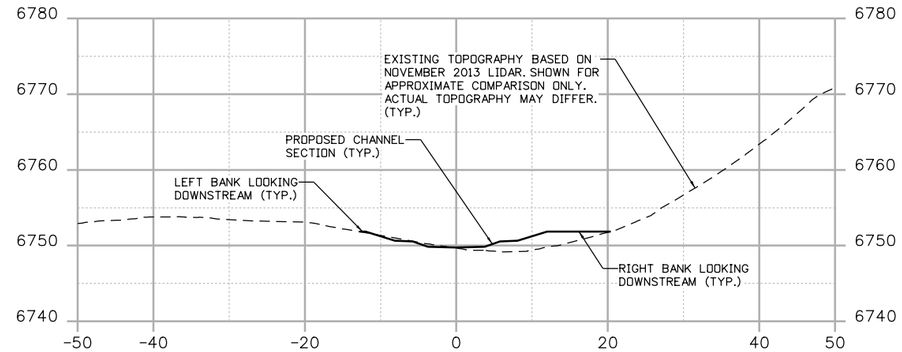

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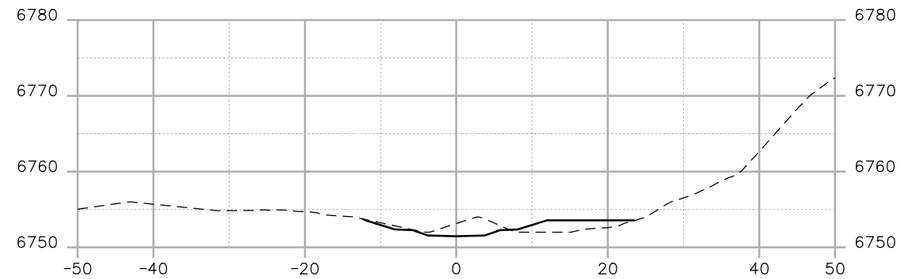

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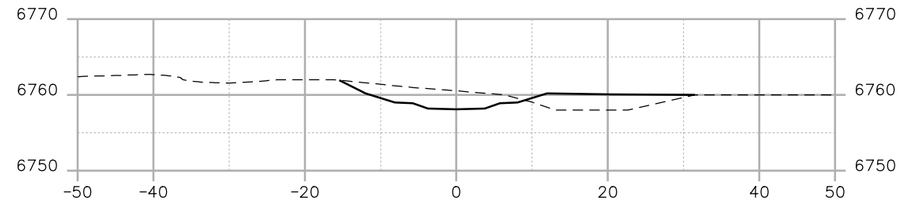

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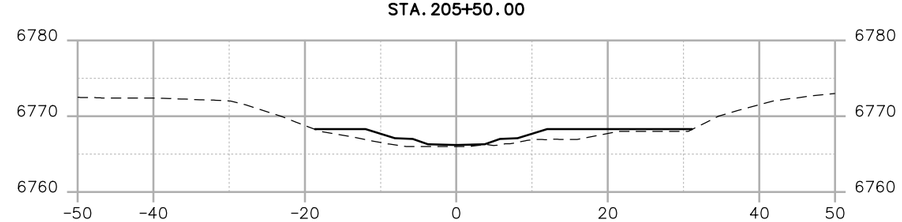

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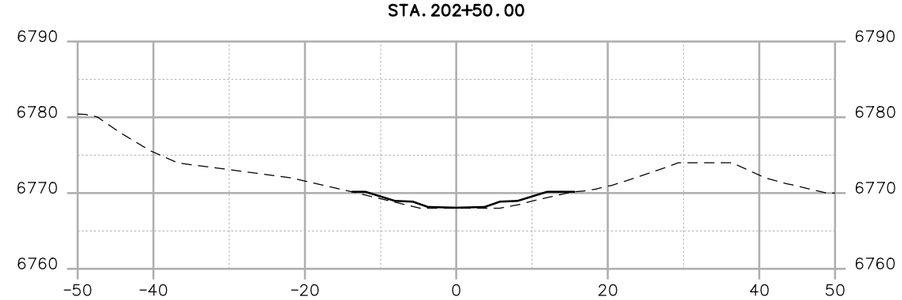

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138366	X-3

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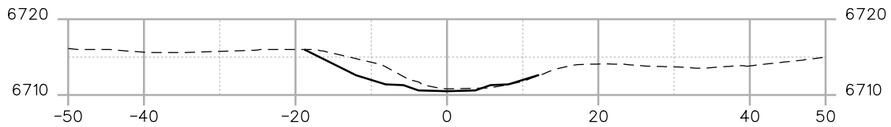
NOTE: CROSS SECTION VIEWS SHOW APPROXIMATE GRADING REQUIRED TO TIE-IN TO EXISTING GROUND ELEVATIONS. REFER TO TYPICAL RIFFLE, POOL AND BANKFULL BENCH CROSS SECTIONS DETAIL FOR DETAILED CHANNEL DIMENSIONS.



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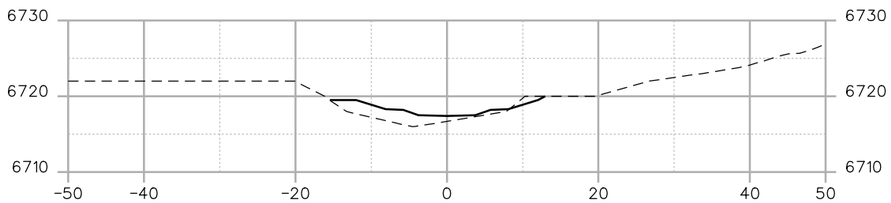

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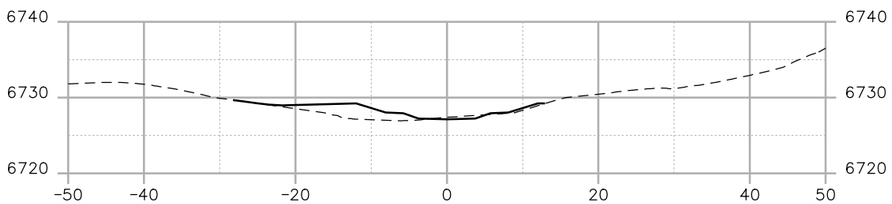

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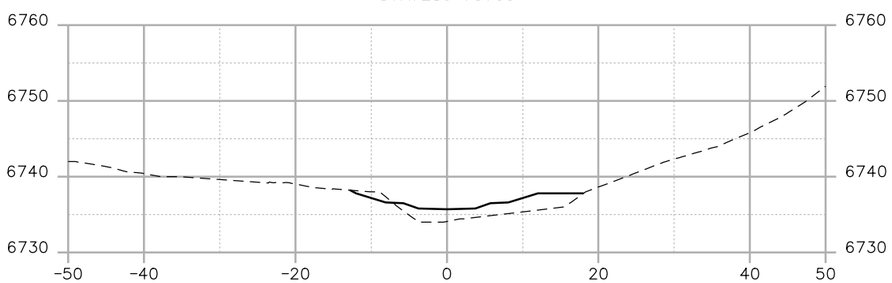

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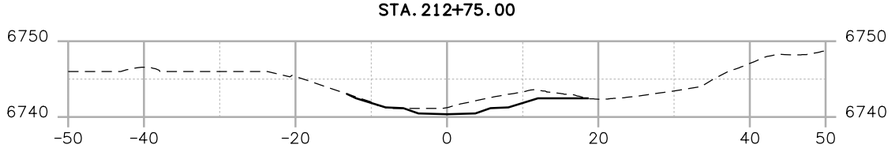

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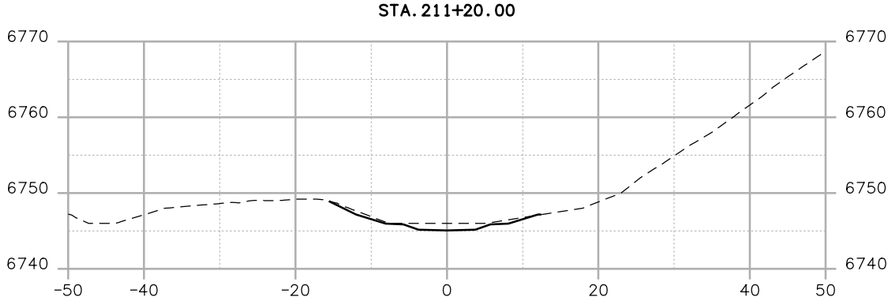

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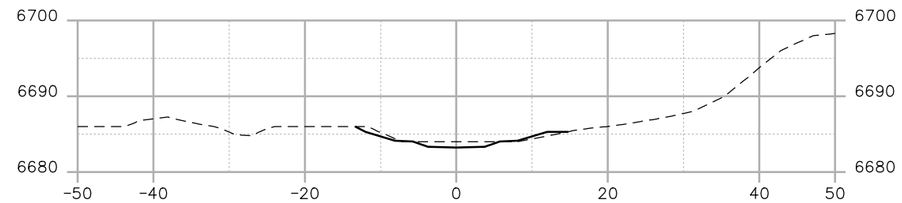

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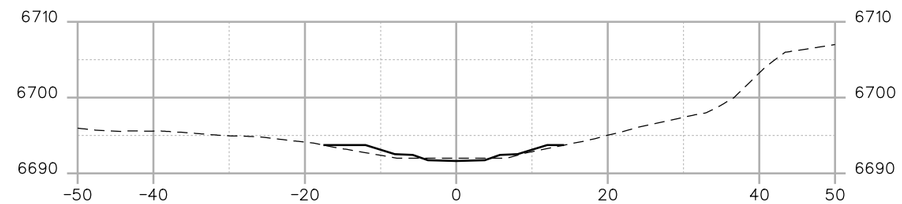

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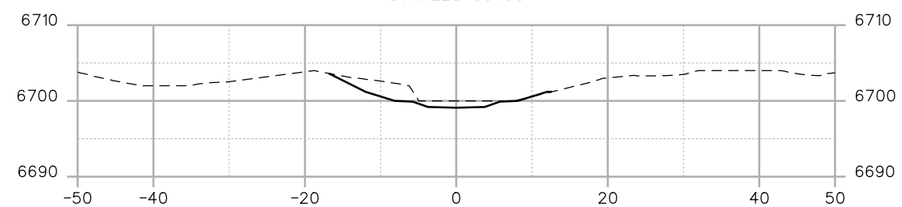

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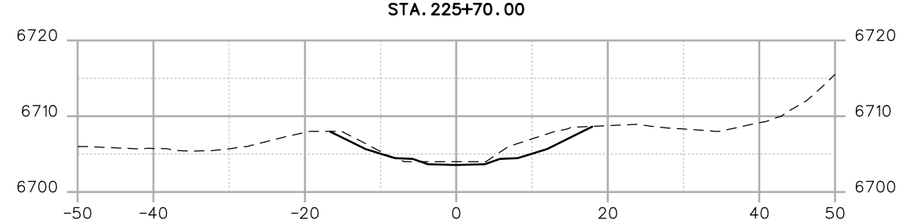

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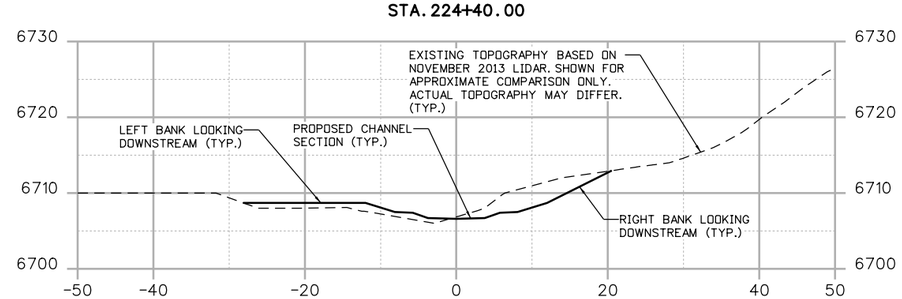

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BAKER PROJECT REFERENCE NO.	SHEET NO.
138366	11

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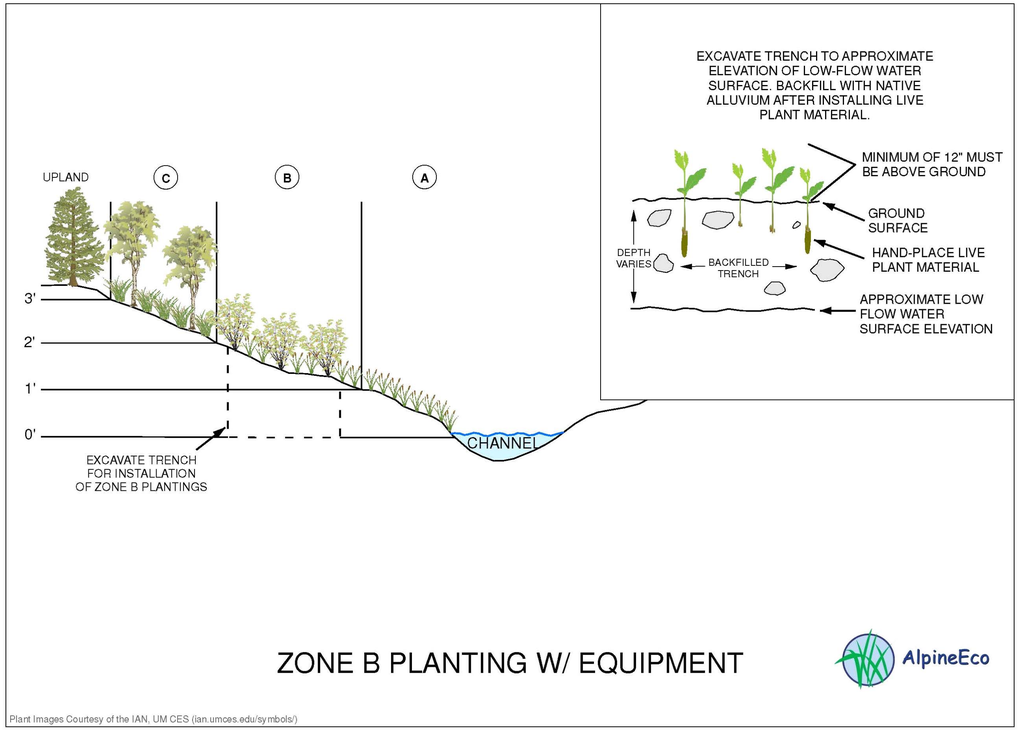

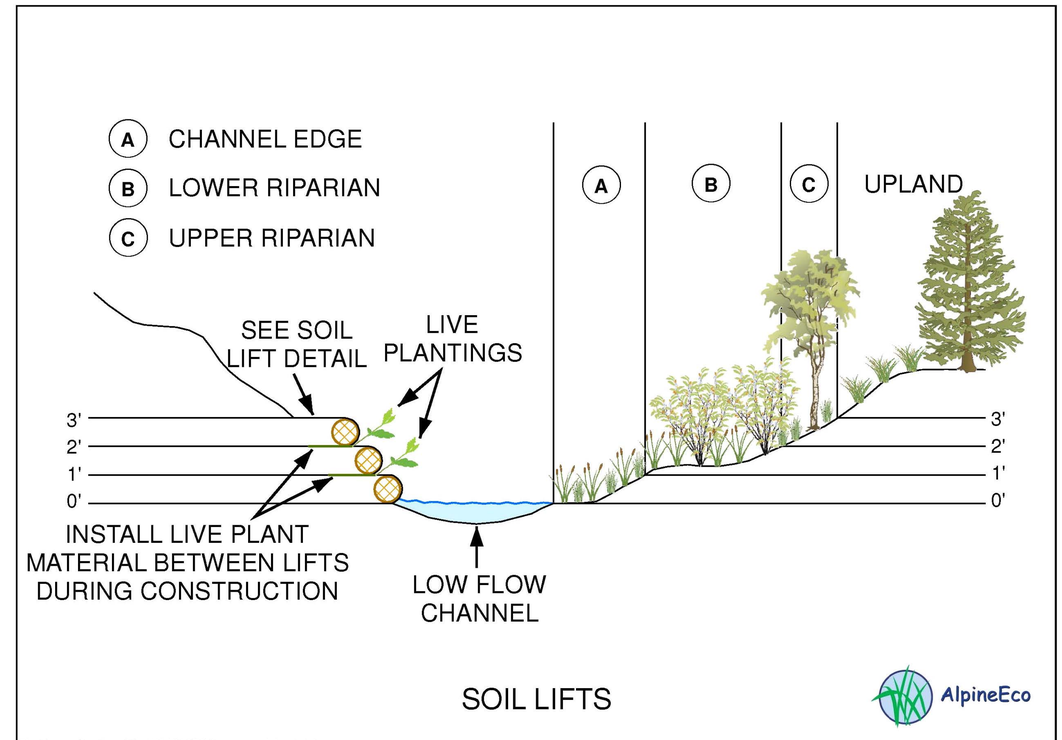

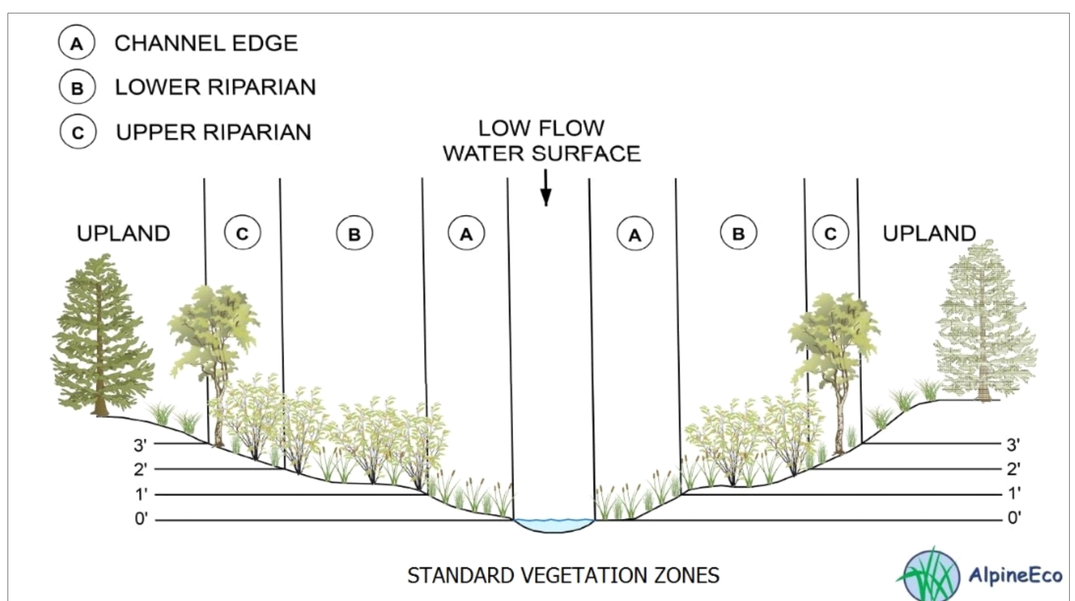

UPPER FOURMILE CREEK STREAM RESTORATION REVEGETATION PLAN

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Table 1: Plants Needed for Standard Restoration[1]

Common Name	Scientific Name	Plant Size (cubic inch)	Plants per Acre
Zone A: Channel Edge[2]			
Bluejoint	*Calamagrostis canadensis*	10	750
Nebraska sedge	*Carex nebrascensis*	10	1,500
Woolly sedge	*Carex pellita*	10	1,000
Creeping spikerush	*Eleocharis palustris*	10	1,000
Baltic rush	*Juncus balticus*	10	1,000
Red-tinge bulrush	*Scirpus microcarpus*	10	750
		Total	**6,000**
Zone B: Lower Riparian[2]			
Thinleaf alder	*Alnus incana*	40	1,000
Water birch	*Betula occidentalis*	40	750
Redosier dogwood	*Cornus alba*	40	750
Mixed cottonwood/willow alder	*Populus/Salix/Alnus spp.*	Transplant	As available
Narrowleaf cottonwood	*Populus angustifolia*	40	1,250
Narrowleaf cottonwood	*Populus angustifolia*	5' cutting	2,000
Mixed willow	*Salix spp.*	5' cutting	2,000
Narrowleaf willow	*Salix exigua*	40	1,250
Dewystem willow	*Salix irrorata*	40	1,000
		Total	**10,000**
Zone C: Upper Riparian[3]			
Narrowleaf cottonwood	*Populus angustifolia*	40	350
Chokecherry	*Prunus virginiana*	40	250
Common snowberry	*Symphoricarpos alba*	40	250
White-stem gooseberry	*Ribes inerme*	40	200
Woods' rose	*Rosa woodsii*	40	350
		Total	**1,400**

[1]Zone A is 0-1', Zone B is 1-2', and Zone C is 2-3' above the water surface of the low-flow channel; exact planting locations will be based on final grading and directed by a qualified ecologist; plant nomenclature from Corps 2016
[2]Quantity of containerized stock based on approximately 3-foot centers. Wherever possible, Zone B plants will be installed in a trench (excavated using earthmoving equipment) parallel to the channel located at approximately the edge of the bankfull channel; the bottom of the trench will be approximately the elevation of the low-flow water surface; mixed willow will be harvested from Boulder County (or adjacent counties) within 1,000 vertical feet (see notes); all plants randomly mixed; plant nomenclature from Corps 2016
[3]Based on approximately 6-foot centers

Table 2: Plants Needed for Rootwads/Channel Blocks[1]

Common Name	Scientific Name	Plant Size (cubic inch)	Plants per Rootwad
Zone A: Channel Edge			
Nebraska sedge	*Carex nebrascensis*	10	75
Creeping spikerush	*Eleocharis palustris*	10	75
Red-tinge bulrush	*Scirpus microcarpus*	10	75
		Total	**225**
Zone B: Lower Riparian			
Thinleaf alder	*Alnus incana*	40	5
Water birch	*Betula occidentalis*	40	5
Narrowleaf cottonwood	*Populus angustifolia*	40	5
Narrowleaf cottonwood	*Populus angustifolia*	5' cutting	50
Mixed willow	*Salix spp.*	5' cutting	50
Mixed riparian shrub	--	transplant	as available
Narrowleaf willow	*Salix exigua*	40	5
Dewystem willow	*Salix irrorata*	40	5
		Total	**125**

[1]Zone A is 0-1' and Zone B is 1-2' above the water surface of the low-flow channel; exact planting locations will be based on final grading and directed by a qualified ecologist; mixed willow will be harvested from Boulder County (or adjacent counties) within 1,000 vertical feet (see notes); plant nomenclature from Corps 2016

Table 3: Plants Needed for Soil Lifts[1]

Common Name	Scientific Name	Plant Size (cubic inch)	Plants per Linear Foot
Zone A: Channel Edge[2]			
Nebraska sedge	*Carex nebrascensis*	10	3
Woolly sedge	*Carex pellita*	10	3
		Total	**6**
Zone B: Lower Riparian[3]			
Mixed willow	*Salix spp.*	5' cutting	6
		Total	**6**

[1]Plant nomenclature from Corps 2016
[2]Zone A plants only placed between lifts that are within 1 foot (vertical) of the low-flow water surface elevation; species not mixed, a minimum of 16 linear feet of each species
[3]Zone B plants only placed between lifts that are 1 to 2 feet (vertical) above the low-flow water surface elevation; mixed willow will be harvested from Boulder County (or adjacent counties) within 1,000 vertical feet (see notes).

Table 4: Riparian Seed Mix[1]

Type	Common Name	Scientific Name	Variety[2]	Seeds per Pound[2]	Seeds per Square Foot	Pounds of Pure Live Seed/Acre
Graminoids	Sideoats grama	*Bouteloua curtipendula*	Butte or Pierre	191,000	5.3	1.2
	Blue grama[3]	*Bouteloua gracilis*[3]	Birds Eye, Alma, or Lovington	825,000	11.4	0.6
	Slender wheatgrass	*Elymus trachycaulus*	White River or San Luis	159,000	4.4	1.2
	Idaho fescue[3]	*Festuca idahoensis*[3]	Winchester	450,000	8.3	0.8
	Fowl mannagrass	*Glyceria striata*	-	180,000	8.3	2.0
	Needle and thread	*Hesperostipa comata*	-	115,000	5.3	2.0
	Prairie junegrass[3]	*Koeleria macrantha*[3]	-	2.3 million	5.3	0.1
	Baltic rush[3]	*Juncus balticus*[3]	-	10.9 million	25.0	0.1
	Torrey's rush[3]	*Juncus torreyi*[3]	-	12.3 million	28.2	0.1
	Green needlegrass	*Nassella viridula*	Cucharas or Lodorm	181,000	4.2	1.0
	Western wheatgrass	*Pascopyrum smithii*	Arriba	110,000	10.1	4.0
	Fowl bluegrass[3]	*Poa palustris*[3]	-	3.2 million	7.3	0.1
	Sandberg bluegrass[3]	*Poa secunda*[3]	Sims Mesa or High Plains	1 million	6.9	0.3
	Bluebunch wheatgrass	*Pseudoroegneria spicata*	P7	140,000	6.4	2.0
	Little bluestem	*Schizachyrium scoparium*	Pastura, Cimarron, or Camper	260,000	6.0	1.0
Forbs	Common yarrow[3]	*Achillea millefolium*[3]	-	2.7 million	6.2	0.1
	Rocky Mountain bee plant	*Cleome serrulata*	-	66,000	3.0	2.0
	Golden tickseed[3]	*Coreopsis tinctoria*[3]	-	1.4 million	3.2	0.1
	Blanketflower	*Gaillardia aristata*	Meriweather	132,000	1.5	0.5
	Showy goldeneye[3]	*Heliomeris multiflora*[3]	-	1 million	2.3	0.1
	Rocky Mountain penstemon	*Penstemon strictus*	Bandera	490,000	2.2	0.2
	American vetch	*Vicia americana*	-	33,000	0.8	1.0
Bulk	Rice hulls	-	-	-	-	4.5
				Total	**16.6**	**25.0**

[1]Nomenclature follows PLANTS Database (NRCS 2016); seeding rate based on hand-broadcasting; any substitutions must be native to Colorado and from a US or Canada seed source.
[2]Sources: NRCS 2016, Granite Seed 2016, Western Native Seed 2016, NSN 2016
[3]Bag separately if drill-seeding

- Standard Revegetation (see Tables 1 and 4)
  - Standard treatment areas include the entire natural floodplain, unless otherwise noted. The standard revegetation plan includes three planting zones (A, B, and C), and seeding in all zones.
  - Planting Zone A (Channel Edge) encompasses those areas between 0 and 1 foot (vertical) above the low flow channel water surface elevation and generally in areas protected from scour/direct flow. Zone B (Lower Riparian) includes those areas between 1 and 2 feet above the low flow channel, and Zone C (Upper Riparian) includes those areas between 2 and 3 feet above. See typical cross-section.
  - All portions of the project corridor (including areas where no earthwork occurs) will be hand-seeded with the Riparian Seed Mix (Table 4) at approximately 25.0 pounds of pure live seed per acre, including rice hulls for bulk.
  - All portions of Zones B and C where earthwork occurs will be hand-mulched with excelsior (spun aspen wood) at a rate of approximately 1,800 pounds per acre (approximately 30 bales at 60 pounds each).

- Rootwads/Channel Blocks (see Table 2)
  - The treatment for Root Wads/Channel Blocks conforms with the typical detail and includes the installation of live plant material (transplants, containerized stock, and cuttings). These materials will be installed during and after the construction of the rootwads/channel blocks and placed primarily in the area downstream of the rootwad (where a back eddy may form), but will also be installed in other areas of suitable hydrology (according to the elevation above the low-flow channel water surface—see Treatment 1 typical cross-section for planting zones).
  - Willow cuttings (3-foot long) will be placed during installation of the rootwads in areas where a portion of the cutting is the elevation is between 1 and 2 feet above the low-flow water surface.
  - Containerized herbaceous plants (10 ci) will be placed after the rootwads are installed in areas protected from direct flow/scour (mainly on the downstream side of the rootwad) where the elevation is 1 foot or less above the low-flow water surface.

- Soil Lifts (see Table 3)
  - This treatment involves the installation of live plant material during the construction of the soil lifts. Containerized herbaceous plants (10 ci) will be placed in between lifts (during construction of the lifts) where the elevation is 1 foot or less above the water surface of the low-flow channel. Willow cuttings (5-foot long) will be installed between the lifts (during construction) where the elevation is between 1 and 2 feet above the low-flow water surface.
  - The lifts will be constructed with native soil mixed with compost (300 cubic yards/acre) and then hand-seeded with the Riparian Mix at approximately 25.0 pounds of pure live seed per acre (including rice hulls for bulk) before wrapping with fabric. Seed should be placed on the soil surface, just beneath the fabric.

Literature Cited

Granite Seed and Erosion Control (Granite Seed). 2016. Website: http://www.graniteseed.com/

Native Seed Network (NSN). 2016. Website: http://www.nativeseednetwork.org

Natural Resources Conservation Service (NRCS). 2016. The PLANTS Database (http://plants.usda.gov). National Plant Data Team, Greensboro, NC 27401-4901 USA.

US Army Corps of Engineers (Corps). 2016. *National Wetland Plant List*, version 3.2. Website: http://wetland_plants.usace.army.mil/. Accessed in September.

Western Native Seed. 2016. Website: http://www.westernnativeseed.com/

General Notes:

- If existing riparian shrubs or small trees (<4" diameter at breast height) are present but too high above the low-flow channel to be wetted through capillary action (because of channel degradation associated with the flood), then the banks will be laid back and the existing vegetation will be moved (transplanted) to the appropriate elevation above the water surface of the low-flow channel; 0 to 1 foot above for herbaceous wetland vegetation and 1 to 3 feet for wetland/riparian woody vegetation.
- All natural floodplain areas (including those not disturbed by restoration activities) will be hand-seeded with the Riparian Seed Mix (Table 4) at approximately 25.0 pounds of pure live seed per acre, including rice hulls for bulk. Seeding will only be performed between September 1 and when the ground freezes, and when the ground thaws and June 1, unless approved by a qualified ecologist.
- After seeding, all portions of Zone B and C disturbed by restoration activities will be hand-mulched using excelsior (spun aspen wood) mulch applied at approximately 1,800 pounds per acre (approximately 30 bales at 60 pounds each). Although floodplain areas not disturbed by restoration activities will be seeded, only those disturbed will be mulched.
- The exact locations of live plant material will be based on the final grading, as determined by a qualified ecologist.
- All areas disturbed by restoration activities, including the soil lifts, will be amended with 300 cubic yards per acre of compost. The compost will be mixed with native soil/alluvium to a depth of 12 inches. The compost will have the following characteristics:
  - pH: 5.5-8.0
  - Moisture content: 35-55 percent
  - Particle size: pass through 1-inch screen or smaller
  - Stability: stable to highly stable, providing nutrients for plant growth
  - Maturity/growth screening: demonstrate ability to enhance plant growth
  - Soluble salt concentration: 2.5 dS (mmhos/cm) or less preferred
  - Organic matter content: 30-70 percent
  - Suggested compost source: A-1 Organic, Eaton, Colorado 970-454-3492 or an approved equal.
- All willow and cottonwood cuttings will be collected on-site or from elsewhere in Boulder County (or immediately adjacent counties) within 1,000 vertical feet of near the site, as directed by a qualified ecologist. Acceptable willow species for "mixed willow" include (nomenclature from Corps 2016): *Salix exigua*, *S. interior*, *S. irrorata*, *S. bebbiana*, *S. monticola*, *S. drummondiana*, *S. ligulifolia*, *S. lasiandra*, and *S. lutea*. No one species can account for more than 70 percent of the mix.
- All willow and cottonwood cuttings will be harvested when dormant (before leaves emerge or after they are dropped) from live plants 0.5 to 1.0 inch in diameter. The stem will be stripped of all branches before cutting and then trimmed to the desired length. The lower (rooting) end of the stem will be cut at a 45 degree angle and the upper end will be cut at 90 degree angle. The cuttings will be placed into water within two minutes of cutting and soaked—completely submerged—for at least 72 hours, but not more than 14 days, prior to planting. The cuttings will be kept wet until placed into the ground and will not be allowed out of water for more than 10 minutes during planting. All cuttings will be trimmed after installation to ensure that no more than one-third of their length is left above ground.
- Whenever possible, Zone B live plant material (containerized stock and cuttings) will be installed by using equipment to excavate a trench parallel to the channel, with the bottom of the trench corresponding to the approximate elevation of the low-flow channel water surface. The plant material will be placed into the trench, backfilled, and lightly tamped. Willow and cottonwood cuttings may be completely buried (horizontally or vertically), but containerized stock and transplants will be placed upright and so that at least 1/3 of the above-ground plant mass is above the new ground surface.
- All containerized plants will be inspected by a qualified ecologist prior to planting. Any dead, dying, stressed, or badly "rootbound" plants will be rejected.
- A qualified ecologist will direct and supervise all plantings
- In an attempt to avoid the continued spreading of noxious weeds, all discrete populations of Colorado List A or B noxious weeds found in or within 100 feet of the restoration area will be sprayed with the appropriate herbicide(s) prior to construction in coordination with the Boulder County weed coordinator.
- All finish grades will be left rough and natural with no smooth surfaces, straight edges, or right angles
- All work areas (other than the immediate channel banks) will be loosened to a depth of 12 inches before planting and seeding
- No equipment will be allowed in the restoration area after seeding or planting
- Any trees to be removed for the project will be removed during the non-nesting season for migratory birds (between September 1 and March 31). If this is not possible, active nest surveys for migratory birds may be required.
- All finish grades will be left rough and natural with no smooth surfaces, straight edges, or right angles
- All work areas (other than the immediate channel banks) will be loosened to a depth of 12 inches before planting and seeding
- No equipment will be allowed in the restoration area after seeding or planting
- Any trees to be removed for the project will be removed during the non-nesting season for migratory birds (between September 1 and March 31). If this is not possible, active nest surveys for migratory birds may be required.
- All best management practices (BMPs) used shall be selected, installed, implemented, and maintained according to appropriate engineering, hydrologic and pollution control practices.

- The use of chemicals such as soil stabilizers, dust palliatives, herbicides, growth inhibitors, fertilizers, deicing salts, etc., shall be in accordance with the manufacturer's recommended application rates, frequency, and instructions. These chemicals shall not be used, stored, or stockpiled within 50 horizontal feet of the creek or other aquatic habitats.
- Construction equipment, fuels, lubricants, and other petroleum distillates shall not be stored or stockpiled within 50 horizontal feet of the creek or other aquatic habitats. Equipment fueling and servicing shall occur only within approved designated areas.

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UPPER FOURMILE CREEK STREAM RESTORATION REVEGETATION PLAN

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