Zink Environmental, PLLC
129 Norwood Ave, Asheville, NC 28804
828-273-8322 | jmzink@gmail.com

CONCEPTUAL DESIGN
LITTLE RIVER ABOVE BRIDAL VEIL FALLS (S02)

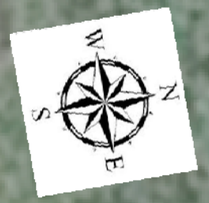
Designed By: JMZ

Date: October 23, 2015

Scale: 1" = 100'

Little River Restoration Master Plan
DuPont State Recreational Forest
Transylvania and Henderson Counties, North Carolina

Sheet G1



Legend

- Thalweg (existing/design)
- Trail (existing)
- Trail (proposed)
- Boulder Structure

Relocate Shoal Creek Trail and Flatwoods Trail outside of riparian buffer

Existing head cut

Start project (STA 0+00)

End project (STA 21+35)

Existing road bed

Reach 1

Raise streambed profile with in-stream structures and backfill to eliminate head cut
Restore appropriate cross-section dimension to areas with eroding banks
Plant vegetation on streambanks and within riparian buffer,
including bare areas on road bed and abandoned trails.

Reach 2

No change to bed profile or plan view
As needed, restore appropriate cross-section dimension to areas with eroding banks
As needed, install structures to promote bedform diversity and improve habitat
Enhance vegetation on streambanks and within riparian buffer

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CONCEPTUAL DESIGN
SHOAL CREEK (515)

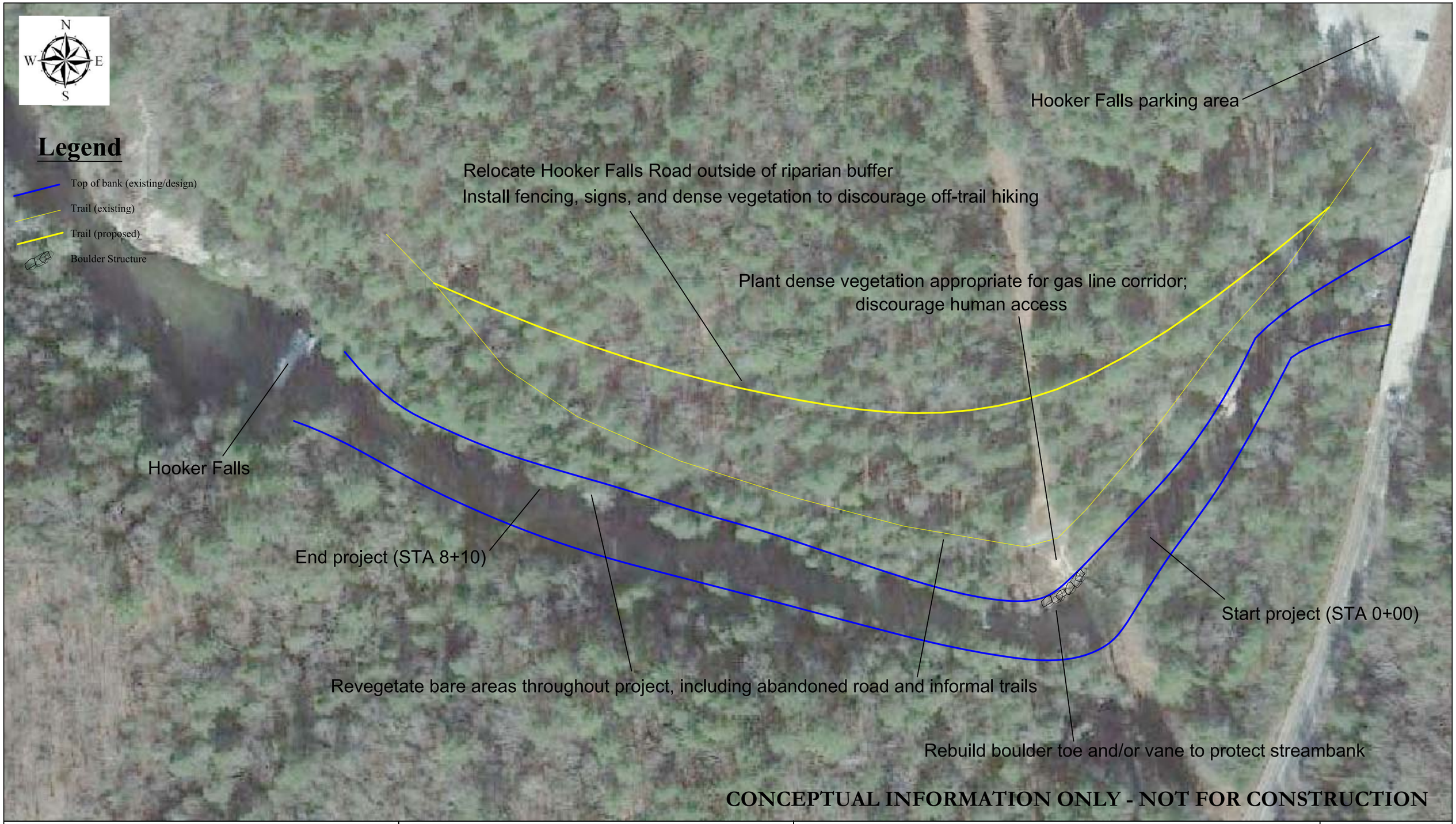
Designed By: JMZ

Date: October 23, 2015

Scale: 1" = 200'

Little River Restoration Master Plan
DuPont State Recreational Forest
Transylvania and Henderson Counties, North Carolina

Sheet G2



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129 Norwood Ave, Asheville, NC 28804
828-273-8322 | jmzink@gmail.com

CONCEPTUAL DESIGN
LITTLE RIVER AT HOOKER FALLS ROAD (S17)

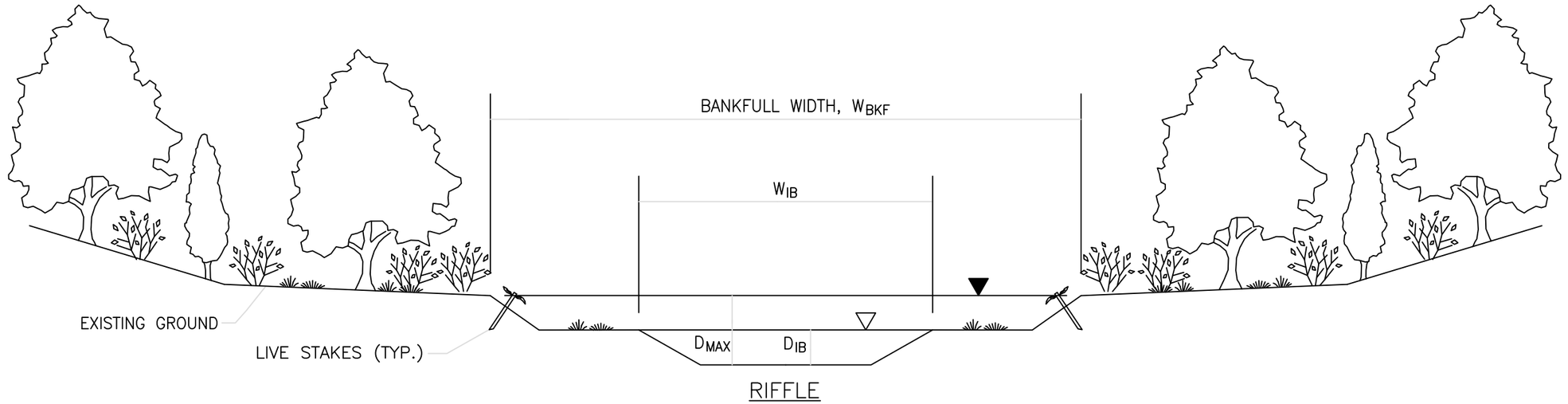
Designed By: JMZ

Date: October 23, 2015

Scale: 1" = 100'

Little River Restoration Master Plan
DuPont State Recreational Forest
Transylvania and Henderson Counties, North Carolina

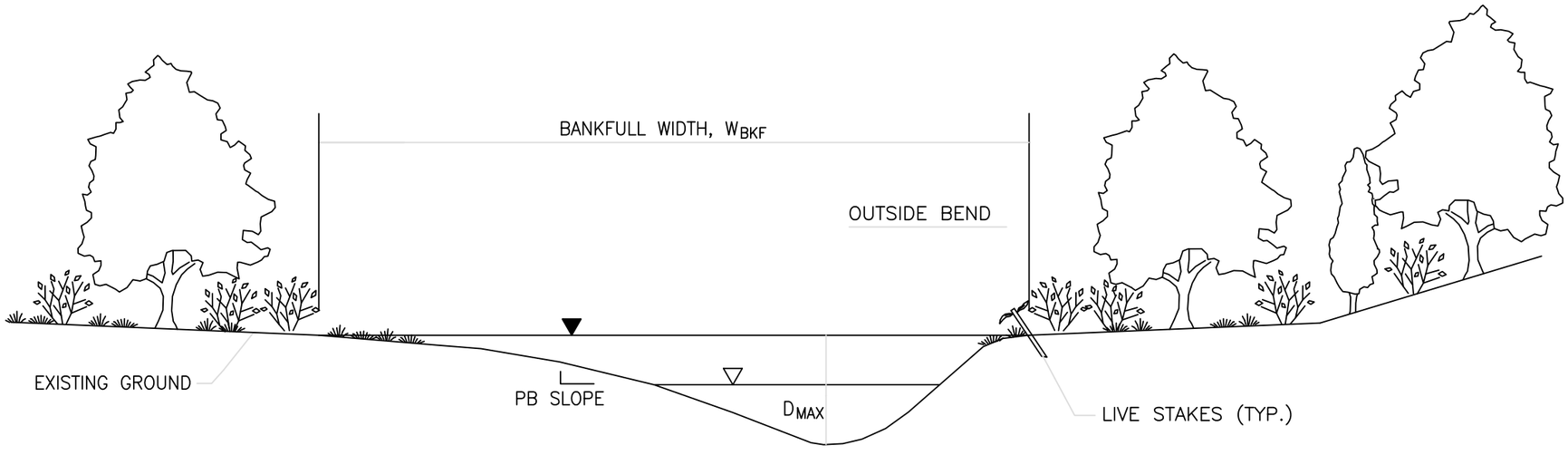
Sheet G3



RIFFLE

▼ BANKFULL WATER SURFACE

▽ APPROXIMATE LOW FLOW WATER SURFACE



POOL

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CONCEPTUAL DESIGN
CROSS-SECTION

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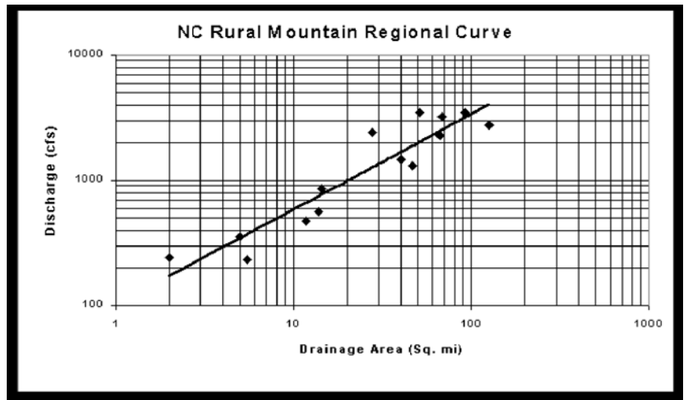
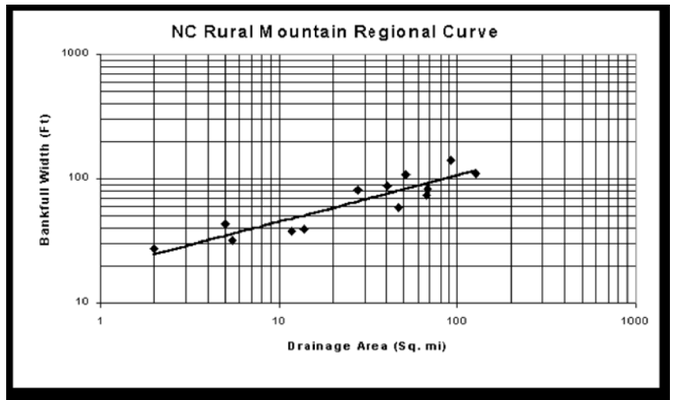
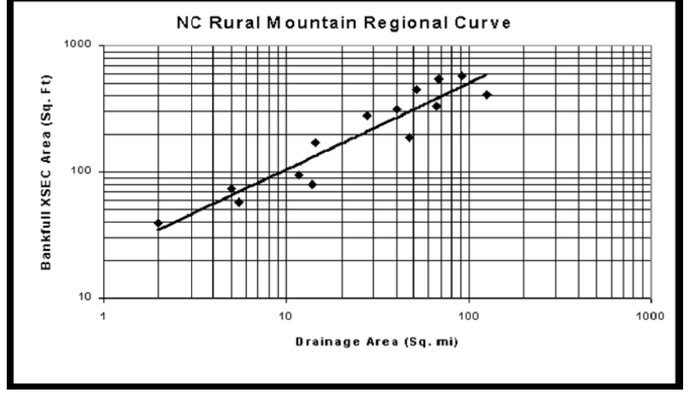
Scale: NOT TO SCALE

Little River Restoration Master Plan
DuPont State Recreational Forest
Transylvania and Henderson Counties, North Carolina

Sheet G4







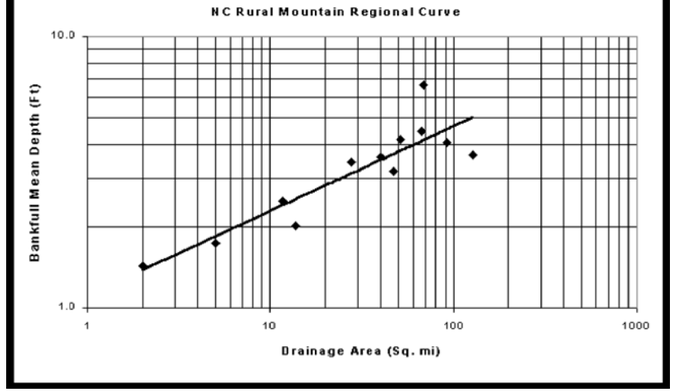


Table of Regional Curve data for the Mountain region:

Stream Name	Gage Station ID	Stream Type (Rosgen)	Drainage Area (mi2)	Bankfull Discharge (cfs)	Bankfull Xsec Area (ft2)	Bankfull Width (ft)	Bankfull Mean Depth (ft)	Water Surface Slope (ft/ft)	Return Interval (Years)	Exceedence Probability (%)	Mean Annual Rainfall (Inches)
French Broad at Rosman	3439000	E4	67.9	3226	544.9	82.4	6.6	0.0009	1.3	0.77	98
Mills River	3446000	C4	66.7	2263	333	74.3	4.5	0.0035	1.9	0.53	90
Davidson River	3441000	B4c	40.4	1457	316	87.6	3.6	0.004	1.1	0.91	94
Catheys Creek near Brevard	344000	B4c	11.7	470	94.2	38	2.5	0.013	1.67	0.60	94
West Fork of the Pigeon	3455500	B3c	27.6	2433	277.9	80.6	3.4	0.0077	1.10	0.91	70
East Fork Pigeon River	3456500	B	51.5	3450	446.3	107	4.2	incomplete	1.59	0.63	70
Watauga River	3479000	B4c	92.1	3492	572	140.3	4.1	0.0033	1.25	0.80	56
Big Laurel	3454000	B4	126	2763	406	110.8	3.7	0.0045	1.59	0.63	42
East Fork Hickey Fork Creek	n/a	B3a	2.0	242	39.3	27.4	1.4	0.045	n/a	n/a	48
Cold Spring Creek	n/a	B4	5.0	352	74.4	42.9	1.7	0.025	n/a	n/a	50
Caldwell Fork	n/a	B	13.8	560	79.3	39.4	2.0	0.02	n/a	n/a	74
Cataloochee	3460000	B4c	46.9	1320	186.9	58.7	3.2	0.008	1.60	0.63	74
Bee Tree	3450000	B3	5.46	231.5	56	32.1	1.7	incomplete	1.85	0.54	
North Fork Swannanoa	344894205	C3	14.5	855.7	170.6	69.3	2.5	incomplete			

Equations for the Regional Curve Relationships:

Bankfull Cross-Sectional Area vs. Drainage Area: $y = 21.61x^{0.68}$
Bankfull Discharge vs. Drainage Area: $y = 100.64x^{0.76}$
Bankfull Width vs. Drainage Area: $y = 19.05x^{0.37}$
Bankfull Mean Depth vs. Drainage Area: $y = 1.11x^{0.31}$

* where x = drainage area

From: Harman, W.A., D.E. Wise, M.A. Walker, R. Morris, M.A. Cantrell, M. Clemmons, G.D. Jennings, D. Clinton, J. Patterson, 2000. Bankfull regional curves for North Carolina mountain streams. In *Proceedings of the American Water Resources Association conference: Water Resources in Extreme Environments*, Anchorage, Alaska, pp. 185-190.

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Zink Environmental, PLLC
129 Norwood Ave, Asheville, NC 28804
828-273-8322 | jmzink@gmail.com

REFERENCE DATA
CROSS-SECTION

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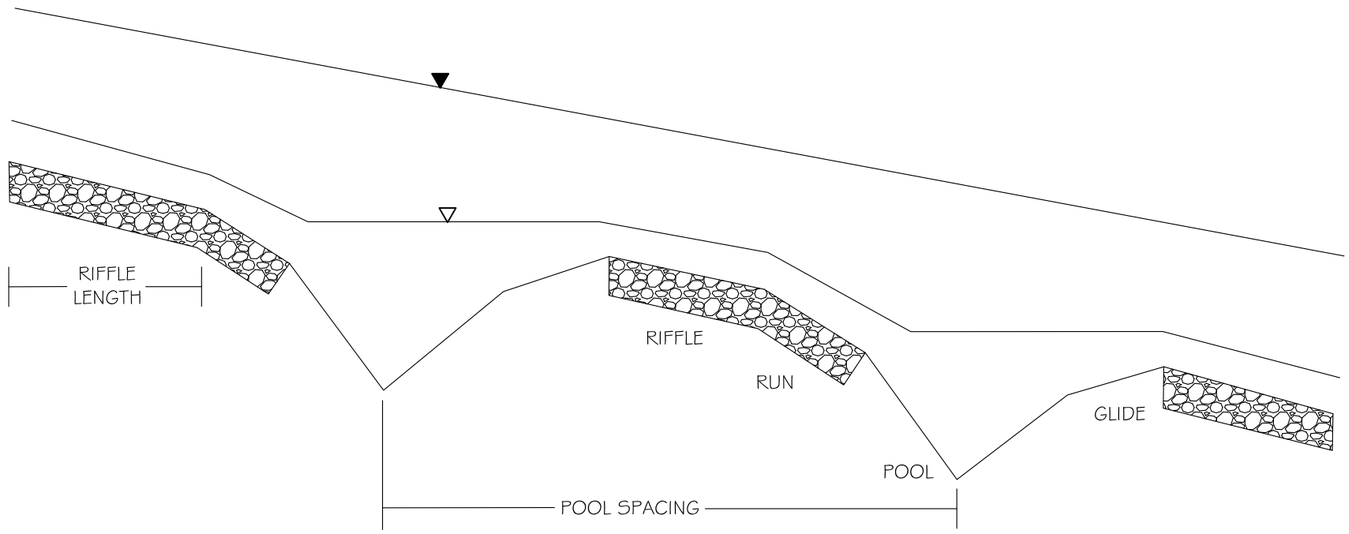
Little River Restoration Master Plan
DuPont State Recreational Forest
Transylvania and Henderson Counties, North Carolina

Sheet G5

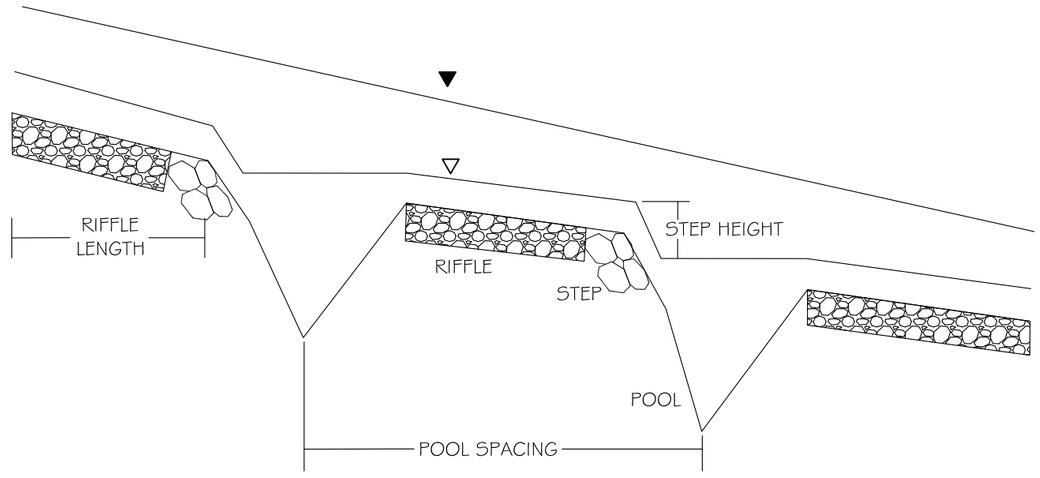
LONGITUDINAL PROFILE: RIFFLE/POOL (MEANDERING) STREAM



▼ BANKFULL WATER SURFACE

▽ LOW-FLOW WATER SURFACE

LONGITUDINAL PROFILE: RIFFLE/STEP/POOL STREAM



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828-273-8322 | jmzink@gmail.com

CONCEPTUAL DESIGN
LONGITUDINAL PROFILE

Designed By: JMZ

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Little River Restoration Master Plan
DuPont State Recreational Forest
Transylvania and Henderson Counties, North Carolina

Sheet
G6

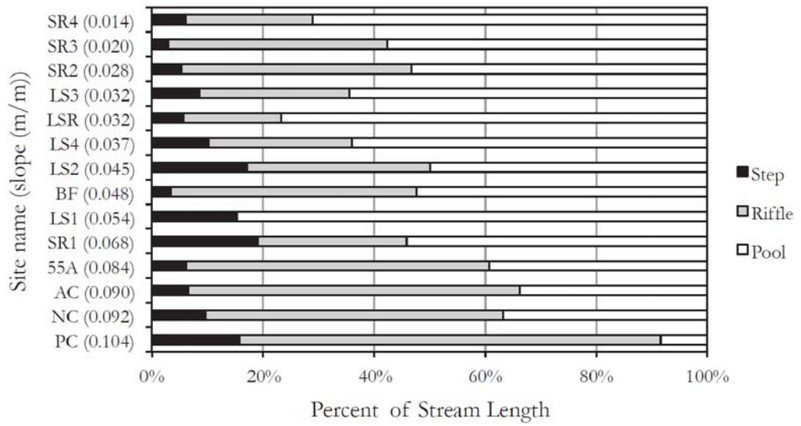

FIGURE 4. Percent of Length Occupied by Steps, Riffles, and Pools. Sites listed in order of increasing slope.

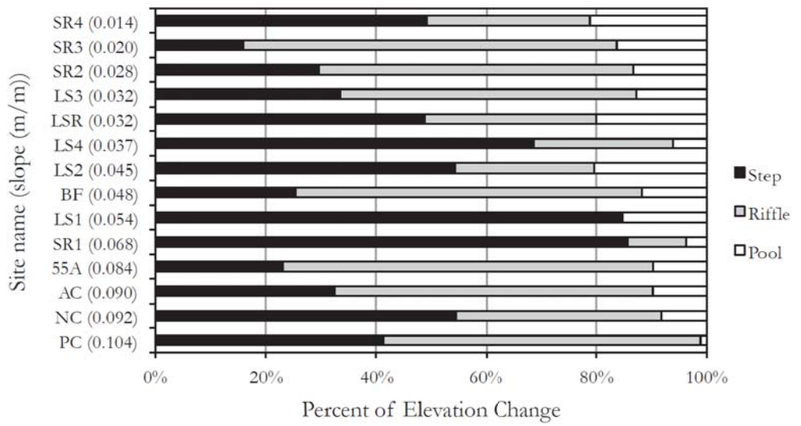

FIGURE 5. Percent of Elevation Drop Over Steps, Riffles, and Pools. Sites listed in order of increasing slope.

TABLE 3. Selected Dimensionless Ratios.

Site Name	Step Height Ratio	Riffle Slope Ratio	Riffle Length Ratio	Pool Length Ratio	Pool Spacing Ratio
SR4	0.01 (0.00-0.01)	1.3 (1.1-1.6)	0.6 (0.3-1.2)	0.5 (0.0-1.3)	0.6 (0.1-0.7)
SR3	0.01 (0.01-0.03)	1.8 (1.0-2.2)	0.9 (0.2-2.4)	1.0 (0.4-2.1)	1.8 (0.7-3.0)
SR2	0.04 (0.01-0.08)	1.5 (1.0-2.0)	0.9 (0.4-2.0)	0.9 (0.5-1.7)	1.8 (0.9-3.1)
LS3	0.02 (0.02-0.02)	1.9 (1.7-2.1)	0.5 (0.3-0.8)	0.6 (0.3-1.3)	1.1 (0.6-2.0)
LSR	0.02 (0.01-0.03)	1.6 (1.4-2.0)	0.4 (0.1-0.8)	0.6 (0.2-1.0)	0.8 (0.3-1.7)
LS4	0.02 (0.00-0.03)	1.0 (0.6-1.6)	0.6 (0.2-1.0)	0.4 (0.0-1.7)	0.6 (0.1-2.8)
LS2	0.04 (0.02-0.05)	0.8 (0.7-1.0)	1.3 (0.8-1.7)	1.0 (0.4-1.3)	2.1 (0.6-4.3)
BF	0.04 (0.03-0.06)	1.6 (0.8-2.5)	0.7 (0.4-1.3)	0.9 (0.4-1.2)	1.6 (0.9-2.2)
LS1	0.04 (0.02-0.07)	No riffles	No riffles	0.8 (0.5-1.2)	1.0 (0.7-1.4)
SR1	0.07 (0.01-0.20)	0.4 (0.2-0.5)	1.0 (0.5-1.7)	0.7 (0.3-1.4)	1.3 (0.5-2.5)
55A	0.08 (0.07-0.09)	1.2 (1.0-1.3)	3.3 (1.6-5.0)	1.0 (0.3-2.1)	2.8 (0.6-7.1)
AC	0.08 (0.06-0.09)	1.1 (0.8-1.5)	0.8 (0.2-1.7)	0.7 (0.5-0.8)	2.0 (1.2-3.1)
NC	0.09 (0.05-0.13)	0.7 (0.6-0.9)	1.5 (0.6-2.9)	0.7 (0.2-1.1)	1.9 (0.4-5.4)
PC	0.10 (0.05-0.17)	0.8 (0.5-1.2)	1.5 (0.5-3.4)	0.2 (0.1-0.4)	1.3 (1.2-1.4)

Notes: Means reported, with range in parentheses. Sites listed in order of increasing slope. See Table 1 for full site names.

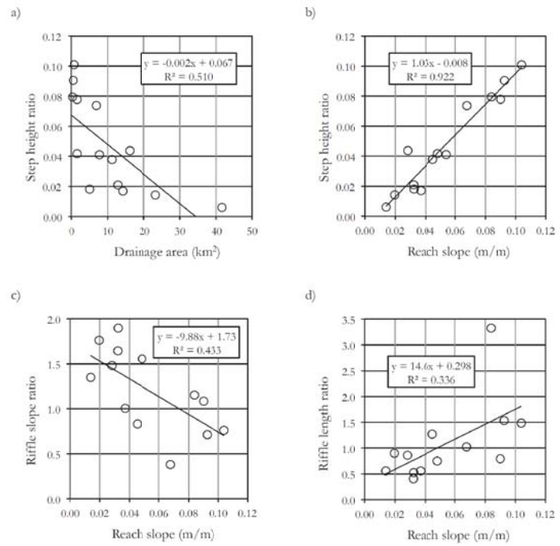

FIGURE 6. Correlations Between Selected Morphological Variables; All Significant at $p < 0.05$: Step Height Ratio and Drainage Area (a); Step Height Ratio and Reach Slope (b); Riffle Slope Ratio and Reach Slope (c); and Riffle Length Ratio and Reach Slope (d).

From: Zink, Jason M., Gregory D. Jennings, and G.Alexander Price, 2012. Morphology Characteristics of Southern Appalachian Wilderness Streams. Journal of the American Water Resources Association (JAWRA) 1-11. DOI: 10.1111/j.1752-1688.2012.00647.x.

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828-273-8322 | jmzink@gmail.com

REFERENCE DATA
LONGITUDINAL PROFILE

Designed By: JMZ

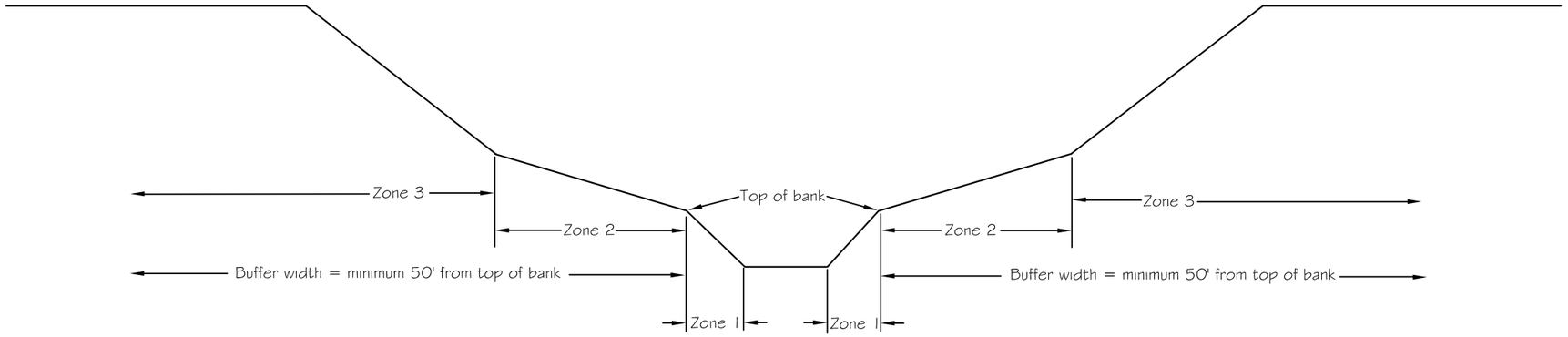
Date: October 23, 2015

Scale: NOT TO SCALE

Little River Restoration Master Plan
DuPont State Recreational Forest
Transylvania and Henderson Counties, North Carolina

Sheet G7

Typical Valley Cross-section and Planting Zones



Zone 1:
- -apply riparian seed mix (Ernst Seed Mix 178 or similar)
- -install live stakes on 3-foot centers (see typical live stake planting list)

Zone 2:
- -install sod mats (if available)
- -apply riparian seed mix (Ernst Seed Mix 178 or similar)
- -install live stakes on 3-foot centers (see typical live stake planting list)

Zone 3:
- -apply upland seed mix (Ernst Seed Mix 210 or similar)
- -install bare root trees on 10-foot centers (see typical bare root planting list)

Typical Live Stake Planting List:
- -Black willow (Salix nigra), OBL
- -Silky willow (Salix sericea), OBL
- -Elderberry (Sambucus canadensis), FACW
- -Silky dogwood (Cornus amomum), FACW

Typical Bare Root Planting List:
- -Overcup oak (Quercus lyrata), OBL
- -Green ash (Fraxinus pennsylvanica), FACW
- -Silver maple (Acer saccarinum), FACW
- -Sycamore (Platanus occidentalis), FACW
- -Swamp chestnut oak (Quercus michauxii), FACW
- -Red maple (Acer rubrum), FAC
- -American beech (Fagus grandiflora), FACU
- -Black cherry (Prunus serotina), FACU
- -Sugar maple (Acer saccharum), FACU
- -White oak (Quercus alba), FACU

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CONCEPTUAL DESIGN
PLANTING ZONES

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Sheet G8