APPENDIX J

LEVEL II ROSGEN WORKSHEETS

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Buffalo Ri	ver-1-1.19		Station Number:	N/A	
LOCATION:	Buffalo Ri	ver-1-1.19				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	636224	acres	994.1	mi ² Drainage Area Mn ELEV:	848.05	ft
Reference REACH SLO			ft/ft	Valley Type:	X	
Stream Type:	E6					
		'BANKFU	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	73.1	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTI	H (d _{bkf})	6.3	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	462.7	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	76.6	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	((u)	0.9	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	420.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	420.0	cfs
Recurrence Interval (Log	ȝ-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.04	yrs
From the	Annual Pea	<mark>k Flow Freq</mark>	uency Anal	lysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharg	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEA	NDER O	GEOMETRY		
Meander Length (L _m	,)	681	ft	Radius of Curvature (R _C)	94.0	ft
Belt Width (W _{blt})		953	ft	Meander Width Ratio (W _{blt} /W _{bkf})	13.0	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean I	Depth (d) & Me	ean Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	. ,		ft	Manning's "n" at Bankfull Stage	0.035	Coeff.
	F	_	<u> </u>			
	" n " = 1	.4865 [(Area	ι) (Hydraul	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI		/ DISCHAI	RGE E	stir	nates		
Site	Buffalo Rive	er-1-1.	19		Location	Buffa	lo R	ver-1-1.1	9	
Date	9/27/2011	Stre	am Type	E6	Valley T	уре		X		
Observers	KD, JB				HUC			·		·
	INPUT VA	RIAB	LES			OU	TPU	T VARIA	BLES	
Bankfull	Cross-section	al	462.7	A _{bkf} (ft ²)	Bankfu	ull Mea	n DI	EPTH	6.3	D _{bkf} (ft)
Bank	full WIDTH		73.1	W _{bkf}		ed PER * d _{bkf} + '		TER	85.7	W _p (ft)
D ₈	4 @ Riffle		0.022	Dia. (mm)	D ₈₄	mm / 3	04.8	3 =	0.0001	D ₈₄ (ft)
Bank	Bankfull SLOPE 0.00004 Sokf (ft/ft)					aulic R A _{bkf} / W _r		US	5.4	R (ft)
Gravitatio	Gravitational Acceleration 32.2 g (ft / sec ²)						ughr ₄ (ft)	ness	74759	
Draii	nage AREA	994.1	DA (mi²)		near Ve u* =√gl		ty	0.08	u* (ft / sec)	
	ESTIMA	METHO	os		Bankf	ull V	ELOCITY	Bankfull DISCHARGE		
1. Friction Factor	Relative u = Roughness	[2.83	8 + 5.66Log	{	}]u*	2.	4	ft / sec	1126	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.) Manni 4865*R	ng's 'n' from fr 2 ^{/3*} S ^{1/2} /n		r / relative =	0.	8	ft / sec	367	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	JSGS):		1.4865* R ^{2/:} ¹⁶ n	^{3*} S ^{1/2} /n	4.	5	ft / sec	2087	cfs
	tion is for applications ble- and boulder-do C2 and E3.							ĮI		
2. Roughness c) Manning	s Coefficient: s 'n' from Strea	т Туре		= 1.4865* R 0.035	^{2/3} *S ^{1/2} /n	0.	8	ft / sec	367	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	, Chezy C, etc	.)		0.	9	ft / sec	420	cfs
3. Other Metho	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)				ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfu		gional Curves arge	s u = (Q = 1.46				ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q / A			ft / sec		cfs
Option 1. For Sub	s for using the D sand-bed chan ostitute an avera	nels: M ge sand	easure the "p dune protrus	rotrusion height (height" (h _{sd}) o (h _{sd} in ft) for th	of sand o ne D ₈₄ te	dunes rm in	above chan est. method	inel bed eleva 1.	tions.
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion hei	" protrusion ght (h _{bo} in ft) f	heights or the D	" (h _{bo} ₈₄ teri) of boulders m in est. met	above chanr thod 1.	nel bed
' uplif	bedrock-dominated surfaces abo term in estimation	ve char	nnel bed eleva	sure severa ations. Sub	l "protrusion stitute an ave	heights rage be	s" (h _b drock	_r) of rock sep protrusion h	parations/step neight (h _{br} in fo	s/joints/ eet) for the

Stream:	Buffalo River-1-1.19		
Basin:	Red River Basin Drainage Area: 636224 acres	994.1	mi ²
Location:	Buffalo River-1-1.19		
Twp.&Rge:	: - Sec.&Qtr.: -		
Cross-Sect	tion Monuments (Lat./Long.): -	Date:	9/27/201 ⁻
Observers:	: KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	73.1	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	6.3	ft
	Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	462.7	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	11.5	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.	9.0	ft
	WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d _{mbld}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	196.0	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{tpa} / W_{bkf}) (riffle section).	2.7	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations	0.0015	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000037	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.2	
	Stream E6 See Classificati Type (Figure 2-2		

	eam: Buffalo River-1-1.1	9				Lo	cation:	Buffal	o Rive	r-1-1.19				
Ob	servers: KD, JB			Date:	9/27/2	2011		Valle	у Туре:	Х	Stream	m Type:	E6	
				Rive	er Rea	ach Sum	mary I	Data						
\square	Mean Riffle Depth (d _{bkf})	6.3	ft	Riffle V	Vidth (N _{bkf})	73	5.1	ft	Riffle Area (A _t	_{okf})	462	2.7	ft ²
_	Mean Pool Depth (d _{bkfp})		ft	Pool W	idth (V	V _{bkfp})	:		ft	Pool Area (A _{bkfp})				ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	idth/Ri	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / Ri			A _{bkfp} /A	
Dim	Max Riffle Depth (d _{maxrif})	9.01	ft	Max Po	ol Dep	th (d _{maxp})			ft	Max Riffle Dep	oth/Mean Rif	iffle Depth		1.4
lanc	Max Pool Depth/Mean Riffle De	epth		Point B	ar Slop	De	ft/ft Inner Berm Width (W _{ib})						ft	
Channel	Inner Berm Depth (d _{ib})		ft	Inner B	erm W	idth/Dept	h Ratio			W _{ib} /d _{ib} Inne	r Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean V	/elocity	at Bank	full Stag	ge (u _{bkf}))	0	.9	ft/s	Estimation Me	Н	EC-RA	S	
	Streamflow: Estimated Dischar	rge at E	Bankfull	Stage (C	Q _{bkf})		420 cfs Drainage Area					994	l.1	mi²
	Geometry	Mean	Min	Max			Dime	ensionl	ess Ge	ometry Ratio	5	Mean	Min	Max
	Meander Wavelength (L _m)	681			ft	Meander	Length	Ratio ((L _m /W _{bkf}	j)		9.3		
Pattern	Radius of Curvature (R _c)	94			ft	Radius o	of Curva	ture/Rif	fle Wid	th (R _c /W _{bkf})		1.3		
	Belt Width (W _{blt})	953			ft	Meander	Width	Ratio (\	N _{blt} /W _{bk}	,f)		13.0		
Channel	Individual Pool Length		<u> </u>	ft Pool Length/Riffle Width										
ပို	Pool to Pool Spacing		-		ft	Pool to F	Pool Spacing/Riffle Width							
\bigcup	Riffle Length		<u> </u>		ft	Riffle Le	ngth/Rif	fle Wid	th					
$\overline{\bigcap}$	Valley Slope (VS)		ft/ft	Average	e Wate	er Surface	Slope (S)		ft/ft	Sinuosity (VS/S)		
	Stream Length (SL) 17491 ft			Valley Length (VL)					81	14 ft	Sinuosity (SL/VL)		2.2
	Low Bank Height start (LBH) end	 	ft ft	Γ	Max Ri Deptl					Bank-Hei (LBH/Ma		start end	j	
	Facet Slopes	Mean	Min	Max			Dimer	sionle	ss Slop	pe Ratios		Mean	Min	Max
Profile	Riffle Slope (S _{rif})	0.0			ft/ft	Riffle Slo	ppe/Ave	rage W	ater Su	rface Slope (S _r	_{if} / S)	1.0		
	Run Slope (S _{run})				ft/ft	Run Slo	be/Avera	age Wa	ter Surf	ace Slope (S _{rur}	, / S)			
Channel	Pool Slope (S _p)				ft/ft			-		face Slope (S _p				
Cha	Glide Slope (S _g)				ft/ft	Glide Slo	ppe/Ave	rage W	ater Su	rface Slope (S _g	/ S)			
	Feature Midpoint ^a	Mean	Min	Max		I N			-	th Ratios	<u>,</u>	Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	9.0	<u> </u>	i i 1 1	ft					Depth (d _{maxrif} / d _t		1.4		!
	Max Run Depth (d _{maxrun})	<u> </u>	<u> </u>	<u>.</u>	ft					epth (d _{maxrun} / d _t				<u> </u>
	Max Pool Depth (d _{maxp})	 	<u> </u>		ft					epth (d _{maxp} / d _{bk}				<u> </u>
	Max Glide Depth (d _{maxg})		<u> </u>		ft	Max Glic	le Deptr	Niviean	Riffie D	epth (d _{maxg} / d _b	kf)			
		ach ^b	Rif	fle ^c		Bar			ich ^b	Riffle ^c	Bar	Protru	sion H	eight ^d
<u>s</u>	% Silt/Clay 9	8					D ₁₆		001					mm
Materials		2					D ₃₅		001					mm
Mai		0					D ₅₀		015					mm
Channel		0					D ₈₄	0.0)22					mm
וסד	% Boulder	0	1				D ₉₅	0.0)63					mm
୫		0	1		D ₁₀₀ 4.7									1

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool. ^b Composite sample of riffles and pools within the designated reach. ^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Wolverton	Creek - 1 -	0.64	Station Number:	N/A	
LOCATION:		Creek - 1 -			•	
Period of RECORD:	N	I/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	65920	acres	103	mi ² Drainage Area Mn ELEV:	885.63	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	B6c]				
		<mark>BANKFU</mark>	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME		NT	Determined from GAGE DA	ATA Analys	is
Bankfull WIDTH (W _{bk}	_{:f})	25.4	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPT	H (d _{bkf})	2.1	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	53.7	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	26.9	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	۲ (u)	2.5	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	130.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	130.0	cfs
Recurrence Interval (Log	j-Pearson)a	associated wit	h "field-det	termined" Bankfull Discharge	1.1	yrs
From the	Annual Pea	a <mark>k Flow Freq</mark>	uency Anal	lysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER C	GEOMETRY		
Meander Length (Lm	<u>ן (</u>	314	ft	Radius of Curvature (R _C)	57.0	ft
Belt Width (W _{blt})		656	ft	Meander Width Ratio (W _{blt} /W _{bkf})	25.8	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean I	Depth (d) & Me	ean Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a giv Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)	·····	L'opu: (= ,			
Slope Exponent:	(b)					
Hydraulic Radius: R	$= A / W_p$		ft	Manning's "n" at Bankfull Stage	0.045	Coeff.
	" n " = 1	.4865 [(A rea	a)(Hydraul	ic R adius ^{2/3}) (S lope ^{1/2})] / Q _{bkf}		

		Bar	kfull VE			RGE Esti	mates			
Site	Wolverton C	Creek ·	- 1 - 0.64		Location	Wolverto	on Creek -	1 - 0.64		
Date	9/28/2011	Stre	am Type	B6c	Valley Ty	/pe	Х			
Observers	KP, AL			•	HUC		- <mark></mark>			
	INPUT VA		LES			OUTPL	JT VARIA	ABLES		
Bankfull	Cross-section	nal	53.7	A _{bkf} (ft ²)	Bankfu	III Mean D	EPTH	2.1	D _{bkf} (ft)	
Banl	vfull WIDTH		25.4	W _{bkf} (ft)		d PERIME * d _{bkf} + W _{bkf}	TER	29.6	W _p (ft)	
D ₈	₄ @ Riffle		0.01	Dia. (mm)	D ₈₄ I	mm / 304.8	8 =	0.00	D ₈₄ (ft)	
Bank	full SLOPE		0.0012	S _{bkf} (ft / ft)		aulic RAD A _{bkf} / W _p	IUS	1.8	R (ft)	
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)		55337		
Drai	nage AREA		103.0	DA (mi²)		ear Veloci ı* =√gRS	ity	0.3	u* (ft / sec)	
	ESTIMA		METHO	DS		Bankfull \	/ELOCITY	Bankfull DISCHARGE		
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{	•]u*	8.0	ft / sec	429	cfs	
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	a) Manni .4865*R	ng's 'n' from fr 2 ^{/3*} S ^{1/2} /n		r / relative =	1.7	ft / sec	93	cfs	
	Coefficient: 'n' from Jarrett (lation is for application		n = 0.39S ^{.38} R ⁻		=	2.8	ft / sec	150	cfs	
	ble- and boulder-do									
2. Roughness c) Manning	s Coefficient: 's 'n' from Strea	ım Type		= 1.4865* R 3 0.045	^{2/3*} S ^{1/2} /n	1.7	ft / sec	93	cfs	
3. Other Metho HEC-RAS	ods (Hey, Darcy-W	/eisbach	<mark>, Chezy C, etc</mark>	:.)		2.5	ft / sec	130	cfs	
3. Other Metho	ods (Hey, Darcy-W	/eisbach	, Chezy C, etc	:.)			ft / sec		cfs	
4. Continuity Return	Equations: Period for Bankf		gional Curve large	s u = 0 Q = 1.46	1		ft / sec		cfs	
4. Continuity	Equations:	b) US	GS Gage Dat	:a u = (Q / A		ft / sec		cfs	
Option 1. For	<mark>s for using the I</mark> • sand-bed chan bstitute an averag	nels: M	easure the "p	protrusion h	neight" (h _{sd}) c	of sand dune	s above char	nnel bed eleva		
Option 2. For	boulder-domina ations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) fe	heights" (h _b or the D ₈₄ te	_o) of boulders rm in est. me	s above chan thod 1.	nel bed	
Option 3. For uplif	bedrock-domin ted surfaces abo term in estimatio	ated ch ove cha	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	_{br}) of rock se	parations/step	os/joints/ eet) for the	

Stream:	Wolverton Creek - 1 - 0.64		
Basin:	Red River Basin Drainage Area: 65920 acres	103	mi ²
Location:	Wolverton Creek - 1 - 0.64		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	9/28/201 1
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	25.4	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	2.1	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	53.7	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	12.2	ft/ft
	Maximum DEPTH (d _{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.	3.3	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkl}) =$ the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	47.5	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	1.9	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D ₅₀ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	<0.001	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.0012	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.7	
	Stream B6c See Classification (Figure 2-2		

Stre	eam: Wolverton Creek -	1 - 0.6	4			Lo	cation:	Wolve	rton C	reek - 1 - 0.6	4			
Obs	servers: KP, AL			Date:	9/28/2	2011		Valle	у Туре:	Х	Stream	n Type:	B6c	
				Riv	er Rea	ach Sum	mary [Data						
\bigcap	Mean Riffle Depth (d _{bkf})	2.09	ft	Riffle V	Vidth (\	N _{bkf})	25	.4	ft	Riffle Area (A _t	_{skf})	53	.7	ft ²
_	Mean Pool Depth (d _{bkfp})		ft	Pool W	idth (V	V _{bkfp})			ft	Pool Area (A _b	_{fp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / Ri	ffle Area			A _{bkfp} /A _{bkf}
Din	Max Riffle Depth (d _{maxrif})	3.3	ft	Max Po	ool Dep	th (d _{maxp})			ft	Max Riffle Dep	oth/Mean Rif	Riffle Depth		1.6
Jue	Max Pool Depth/Mean Riffle De	epth		Point E	Bar Slop	be	e ft/			Inner Berm W	idth (W _{ib})			ft
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Depth	n Ratio			W _{ib} /d _{ib} Inne	r Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity	at Bank	full Sta	ge (u _{bkf}))	2.5 ft/s			t/s Estimation Method			EC-R/	IS
	Streamflow: Estimated Dischar	ge at B	ankfull	Stage (0	Q _{bkf})		13	0	cfs	Drainage Area	10)3	mi²	
	Geometry	Mean	Min	Max			Dime	ensionl	ess Ge	ometry Ratio	\$	Mean	Min	Max
$\begin{bmatrix} 1 \end{bmatrix}$	Meander Wavelength (L _m)	314			ft	Meander	Length	Ratio (L _m /W _{bkf})		12.4		
Pattern	Radius of Curvature (R _c)	57			ft					th (R _c /W _{bkf})		2.2		
	Belt Width (W _{blt})	656			ft	Meander	Width	Ratio (V	V _{blt} /W _{bk}	f)		25.8		
Channel	Individual Pool Length			<u> </u>	ft	Pool Len	gth/Riff	le Widt	h					
မြို	Pool to Pool Spacing			1	ft	Pool to P	to Pool Spacing/Riffle Width							
\cup	Riffle Length ft Riffle Length/Riffle Width													
\square	Valley Slope (VS)	ft/ft Average Water Surface Slope (S) ft/ft Sinuosity (/S/S)				
	Stream Length (SL) 84	58	ft	Valley	Length	(VL) 48				83 ft	Sinuosity (S	SL/VL)		1.7
	Low Bank Height start (LBH) end		ft ft		Max Rif Depth		start end		ft ft		ght Ratio (B⊢ x Riffle Dept		start end	
	Facet Slopes	Mean	Min	Max			i	sionle		e Ratios	•	Mean	Min	Max
Profile	Riffle Slope (S _{rif})	0.0			ft/ft	Riffle Slo	pe/Ave	rage W	ater Su	rface Slope (S _r	_f / S)	1.0		
	Run Slope (S _{run})				ft/ft	Run Slop								
Channel	Pool Slope (S _p)		1	i	tt/ft Pool Slope/Average Water Surface Slope (S _p / S)									
Ř			1	<u>i</u>	ft/ft	Pool Slop		-	ter Surf					
	Glide Slope (Sg)				ft/ft ft/ft		be/Avera	age Wa			/ S)			
	Feature Midpoint ^a	Mean	Min	Мах	ft/ft	Glide Slo	pe/Avera pe/Aver Dimen	age Wa age Wa sionle	ater Sui ss Dep	face Slope (S _p fface Slope (S _g th Ratios	/ S) / S)	Mean	Min	Max
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif})	Mean 3.3	Min	Max	ft/ft ft	Glide Slo	pe/Avera ppe/Avera Dimen e Depth	age Wa rage Wa sionle	ater Sui ss Dep r Riffle D	face Slope (S _p fface Slope (S _c th Ratios Pepth (d _{maxrif} / d _t	/ S) / S) " _{kf})	Mean 1.6	Min	Max
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})		Min	Max	ft/ft ft ft	Glide Slo Max Riffl Max Run	pe/Avera pe/Aver Dimen e Depth Depth/	age Wa rage Wa sionle /Mean Mean F	ater Sui ss Dep Riffle D Riffle De	face Slope (S _p rface Slope (S _p th Ratios lepth (d _{maxrif} / d _t epth (d _{maxrun} / d _t	/ S) / S) _{ktl})	1	Min	Max
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp})		Min	Max	ft/ft ft ft ft	Glide Slo Max Riffl Max Run Max Poo	pe/Avera ppe/Avera Dimen e Depth Depth/ I Depth/	age Wa rage Wi sionles /Mean F Mean F	ater Sui ss Dep Riffle D Riffle De Riffle De	face Slope (S _p fface Slope (S _p th Ratios hepth (d _{maxrif} / d _t epth (d _{maxrun} / d _b	/ S) / S) ,kt) ,kt)	1	Min	Max
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})		Min	Max	ft/ft ft ft	Glide Slo Max Riffl Max Run Max Poo	pe/Avera ppe/Avera Dimen e Depth Depth/ I Depth/	age Wa rage Wi sionles /Mean F Mean F	ater Sui ss Dep Riffle D Riffle De Riffle De	face Slope (S _p rface Slope (S _p th Ratios lepth (d _{maxrif} / d _t epth (d _{maxrun} / d _t	/ S) / S) ,kt) ,kt)	1	Min	Max
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxg}) Max Glide Depth (d _{maxg})	3.3		Max	ft/ft ft ft ft	Glide Slo Max Riffl Max Run Max Poo	pe/Avera ppe/Avera Dimen e Depth/ Depth/ I Depth/ e Depth	age Wa rage Wa sionles /Mean F Mean F /Mean F /Mean	ater Sun ss Dep Riffle De Riffle De Riffle De Riffle D	face Slope (S _p fface Slope (S _p th Ratios hepth (d _{maxrif} / d _t epth (d _{maxrun} / d _b	/ S) / S) ,kt) ,kt)	1		
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay 9	3.3		Max	ft/ft ft ft ft	Glide Slo Max Riffl Max Run Max Poo Max Glid	pe/Avera ppe/Avera Dimen e Depth Depth/ I Depth/	age Wa rage Wa sionle /Mean F Mean F /Mean F /Mean	ater Sur ss Dep Riffle De Riffle De Riffle De Riffle D ch ^b 001	face Slope (S _p face Slope (S _p th Ratios lepth (d _{maxrif} / d _t epth (d _{maxron} / d _b epth (d _{maxp} / d _b	/ S) / S) .kt) .kt) .kt) .kt) .kt)	1.6		
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay 9 % Sand 4	3.3 		Max	ft/ft ft ft ft	Glide Slo Max Riffl Max Run Max Poo Max Glid	De/Avera pe/Avera Dimen e Depth Depth/ I Depth/ e Depth D ₁₆ D ₁₅	age Wa age Wa sionles //Mean Mean F /Mean /Mean Rea <.(<.(ater Sur ss Dep Riffle De Riffle De Riffle De Riffle De Riffle De Riffle De Riffle De Riffle De Riffle De	face Slope (S _p face Slope (S _p th Ratios lepth (d _{maxrif} / d _t epth (d _{maxron} / d _b epth (d _{maxp} / d _b	/ S) / S) .kt) .kt) .kt) .kt) .kt)	1.6		eight ^d
Materials	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel	3.3 		Max	ft/ft ft ft ft	Glide Slo Max Riffl Max Run Max Poo Max Glid	De/Avera pe/Avera Dimen e Depth/ Depth/ I Depth/ I Depth/ e Depth D ₁₆ D ₃₅ D ₅₀	age Wa age Wa sionles /Mean F Mean F Mean F /Mean Rea <.(<.(<0.	ater Sul ss Dep Riffle De Riffle De Riffle De Riffle D Ch ^b 001 001	face Slope (S _p face Slope (S _p th Ratios lepth (d _{maxrif} / d _t epth (d _{maxron} / d _b epth (d _{maxp} / d _b	/ S) / S) .kt) .kt) .kt) .kt) .kt)	1.6		eight ^d
Materials	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel % Cobble	3.3 		Max	ft/ft ft ft ft	Glide Slo Max Riffl Max Run Max Poo Max Glid	De/Avera pe/Avera Dimen e Depth/ Depth/ I Depth/ e Depth D ₁₆ D ₃₅ D ₅₀ D ₈₄	age Wa age Wa sionles //Mean F /Mean F /Mean F /Mean A .(C <.(C <0.	ater Sur ss Dep Riffle D Riffle De Riffle De Riffle D Riffle D Rif	face Slope (S _p face Slope (S _p th Ratios lepth (d _{maxrif} / d _t epth (d _{maxron} / d _b epth (d _{maxp} / d _b	/ S) / S) .kt) .kt) .kt) .kt) .kt)	1.6		eight ^d mm
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Rea % Sitt/Clay % Sand % Gravel % Cobble % Boulder	3.3 		Max	ft/ft ft ft ft	Glide Slo Max Riffl Max Run Max Poo Max Glid	De/Avera pe/Avera Dimen e Depth/ Depth/ I Depth/ I Depth/ e Depth D ₁₆ D ₃₅ D ₅₀	age Wa age Wa sionles /Mean F Mean F Mean F /Mean A (.(<.(<.(<.(<.(<.(.) .) .) .)	ater Sul ss Dep Riffle De Riffle De Riffle De Riffle D Ch ^b 001 001	face Slope (S _p face Slope (S _p th Ratios lepth (d _{maxrif} / d _t epth (d _{maxron} / d _b epth (d _{maxp} / d _b	/ S) / S) .kt) .kt) .kt) .kt) .kt)	1.6		eight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Wild Rice	River-6-42.	36	Station Number:	N/A	
LOCATION:	Wild Rice	River-6-42.3	36			
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	1182080	acres	1847	mi ² Drainage Area Mn ELEV:	904.68	ft
Reference REACH SLO			ft/ft	Valley Type:	X	
Stream Type:	E6			HUC:		
				ARACTERISTICS		
Determined from	FIELD ME		NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	76.2	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPT	H (d _{bkf})	6.1	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	462.2	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	80.1	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.1	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	517.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE asso	ociated with	"field-det	ermined" Bankfull STAGE	517.0	cfs
Recurrence Interval (Log	₃-Pearson)a	ssociated wit	h "field-de	termined" Bankfull Discharge	1.3	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Ana	lysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	20 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER (GEOMETRY		
Meander Length (Lm	,)	1353	ft	Radius of Curvature (R _C)	328.0	ft
Belt Width (W _{blt})		2214	ft	Meander Width Ratio (W _{blt} /W _{bkf})	29.1	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean [Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
			ft	Manning's "n" at Papiriul Stage	0.042	Cooff
Hydraulic Radius: R	= A / VV _p		ft	Manning's "n" at Bankfull Stage	0.043	Coeff.
	" n " = 1	.4865 [(A rea) (Hydraul	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	nkfull VEI		/ DISCHAF	RGE Esti	mates				
Site	Wild Rice Ri	ver-6	-42.36		Location	Wild Rice	e River-6-	42.36			
Date	10/1/2011	Stre	am Type	E6	Valley Ty	/pe	X				
Observers	KD, JB				HUC						
	INPUT VA	RIAB	LES		OUTPUT VARIABLES						
Bankfull	Cross-section	al	462.2	A _{bkf} (ft ²)	Bankfu	III Mean D	EPTH	6.1	D _{bkf} (ft)		
Bank	full WIDTH		76.2	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	TER	88.3	W _p (ft)		
D ₈ ,	D ₈₄ @ Riffle 0.073 Dia. (mm)					mm / 304.8	3 =	0.00	D₈₄ (ft)		
Bank	full SLOPE	0.0001	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	5.2	R (ft)			
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)		21845			
Drair	nage AREA		1847.0	DA (mi²)		ear Veloci ı* =√gRS	ty	0.1	u* (ft / sec)		
	ESTIMA	TION	METHO	DS		Bankfull V	ELOCITY	Bankfull DISCHARGE			
1. Friction Factor	Relative u = Roughness	[2.83	3 + 5.66Log	{	•]u*	3.3	ft / sec	1545	cfs		
	Coefficient: a s. 2-18, 19) u = 1.				r / relative =	1.0	ft / sec	453	cfs		
2. Roughness b) Manning's	Coefficient: n' from Jarrett (L	JSGS):		1.4865* R ^{2/3} .16 n	^{3*} S ^{1/2} /n	4.9	ft / sec	2258	cfs		
	tion is for applications ble- and boulder-do 22 and E3.										
2. Roughness c) Manning	Coefficient: s 'n' from Strea	m Type		= 1.4865* R).043	^{2/3} *S ^{1/2} /n	1.0	ft / sec	453	cfs		
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	n, Chezy C, etc	:.)		1.1	ft / sec	517	cfs		
3. Other Metho	ds (Hey, Darcy-W	eisbach	<mark>n, Chezy C, etc</mark>	:.)			ft / sec		cfs		
4. Continuity Return	Equations: Period for Bankfu		gional Curve harge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1 1		ft / sec		cfs		
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A		ft / sec		cfs		
Option 1, For	for using the D sand-bed chan ostitute an averag	nels: M	easure the "p	protrusion h	neight " (h _{sd}) o	f sand dunes	s above char	nnel bed eleva	d 1. tions.		
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion I ght (h _{bo} in ft) fo	heights" (h _b or the D ₈₄ ter	 o) of boulders m in est. me 	s above chanr thod 1.	nel bed		
Option 3. For uplif	bedrock-dominated surfaces abo term in estimation	ated ch ve char	annels: Meas	sure severa	protrusion	heights" (h	_{br}) of rock se	parations/step	s/joints/ eet) for the		

Stream:	Wild Rice River-6-42.36		
Basin:	Red River Basin Drainage Area: 1E+06 acres	1847	mi ²
Location:	Wild Rice River-6-42.36		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/1/201
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	76.2	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	6.1	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	462.2	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	12.6	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	157.7	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	2.1	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.0027	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000088	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.7	
	Stream E6 See Classification (Figure 2-2		

	eam: Wild Rice River-6	-42.36				Lo	ocation:	Wild F	Rice Ri	ver-6-42.	.36				
Ob	servers: KD, JB			Date:	10/1/2	2011		Valle	у Туре:	Х		Strean	n Type:	E6	
_				Riv	er Rea	ach Sum	mary I	Data							
	Mean Riffle Depth (d _{bkf})	6.1	ft	Riffle \	Vidth (\	W _{bkf})	76	5.2	ft	Riffle Area (A _{bkf})			46	2.2	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (V	V _{bkfp})			ft	Pool Area (A _{bkfp})					ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth	•	d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width	Width $W_{bkfp}^{bkfp'}$ Pool Area / Riffle Area							A _{bkfp} /A _{bkf}	
Di	Max Riffle Depth (d _{maxrif})	8.4	ft	Max P	ool Dep	oth (d _{maxp})			ft Max Riffle Depth/Mean R			th/Mean Rif	iffle Depth		1.4
lanc	Max Pool Depth/Mean Riffle	Depth		Point E	Bar Slop	De	ft/ft			Inner Berm Width (W _{ib})					ft
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	/idth/Deptl	h Ratio			W_{ib}/d_{ib}	Inner	Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean	Velocity	at Banl	dfull Sta	ge (u _{bkf}))	1	.1	ft/s	Estimatio	n Met	thod	Н	EC-R	AS
	Streamflow: Estimated Disch	arge at E	Bankfull	Stage (Q _{bkf})		5′	17	cfs	Drainage	Area		18	47	mi²
	Geometry	Mean	Min	Мах			Dime	ensionl	ess Ge	eometry R	atios	i	Mean	Min	Max
	Meander Wavelength (L _m)	1353			ft	Meander	r Length	n Ratio ((L _m /W _{bk}	(_t			17.8		
Pattern	Radius of Curvature (R _c)	328		ft Radius of Curvature/Riffle Width (R _c /W _{bkf})							4.3				
	Belt Width (W _{blt})	2214			ft Meander Width Ratio (W _{blt} /W _{bkl})							29.1			
Channel	Individual Pool Length				ft Pool Length/Riffle Width										
Cha Cha	Pool to Pool Spacing				ft	Pool to F	Pool Spacing/Riffle Width								
\cup	Riffle Length				ft Riffle Length/Riffle Width										
\square	Valley Slope (VS)		ft/ft	Avera	e Wate	er Surface	Slope (S)		ft	/ft	Sinuosity (/S/S)	_	
		4371	ft	1	Length							Sinuosity (2.7
	Low Bank Height sta	rt	ft		Max Rif	. ,	start		ft	T		ht Ratio (BF		star	-
	(LBH) er	d	ft		Depth	n	end		ft			Riffle Dept		enc	1
a l	Facet Slopes	Mean	Min	Max	e. 10.	Diffle Sk				pe Ratios		(5)	Mean	Min	Max
Profile	Riffle Slope (S _{rif}) Run Slope (S _{run})	0.0	<u>i</u> 1	<u>i</u> 1	ft/ft			-		rface Slop			1.0		1
I = I	Pool Slope (S _p)			<u> </u>	ft/ft ft/ft	-		-		face Slope					
Channel	Glide Slope (S _q)	<u> </u>	<u> </u> 	<u> </u> 	ft/ft	-		-		rface Slope					
၃		Maar	Min	Max	IVIL	Glide Sid					-	/ 3)	Meen	Min	Max
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif})	Mean 8.4	Min	Max	ft	Max Riff				th Ratios Depth (d _{max}		_d)	Mean 1.4	Min	Max
	Max Run Depth (d _{maxrun})			1	ft					epth (d _{maxre}					
	Max Pool Depth (d _{maxp})				ft					epth (d _{maxp}					
	Max Glide Depth (d _{maxg})		ft Max Glide Depth/Mean Riffle Depth (d _{maxg} / d _{bkf})								_f)				
		each ^b		ffle ^c					h		c	-	_		d
\square	R % Silt/Clay		Bar	D ₁₆		nch ^b 101	Riffle)	Bar	Protru	ision H	leight ^d mm			
1 1		84	<u> </u>				D ₁₆		001						mm
ials	% Sand	16					- 35			i					1
laterials	% Sand	16 0		_			D50	0.0	027						mm
el Materials	% Sand % Gravel % Cobble	16 0 0					D ₅₀		027)73						mm mm
	% Gravel % Cobble	0					D ₈₄	0.0	073						mm
Channel Materials	% Gravel	0						0.0 1							:

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Wild Rice	River-5-38.4	49	Station Number:	N/A	
LOCATION:		River-5-38.4				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	1191680	acres	1862	mi ² Drainage Area Mn ELEV:	901.37	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	E6			HUC:		
	"	' <mark>BANKFU</mark>	LL" CHA	RACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	74.1	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPT	H (d _{bkf})	7.0	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	516.1	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	79.0	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	((u)	1.0	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	517.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE asso	ociated with	"field-det	ermined" Bankfull STAGE	517.0	cfs
Recurrence Interval (Log	ȝ-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.3	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER C	EOMETRY		
Meander Length (Lm	,)	1709	ft	Radius of Curvature (R _C)	352.0	ft
Belt Width (W_{blt})		2019	ft	Meander Width Ratio (W_{blt}/W_{bkf})	27.2	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean [Depth (d) & Me	an Velocity (egression analyses of measured discharge (a), determine the <i>intercept coefficient</i> (a) and elected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope ex	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R			ft	Manning's "n" at Bankfull Stage	0.043	Coeff.
	- 77 VVp			manning 5 in at Danktun Stage	0.043	
	" n " = 1	.4865 [(A rea) (Hydrauli	c Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI		/ DISCHA	RGE Esti	mates		
Site	Wild Rice Ri	iver-5-	·38.49		Location	Wild Ric	e River-5-	38.49	
Date	10/2/2011	Stre	am Type	E6	Valley Ty	уре	X		
Observers	KD, JB				HUC				·
	INPUT VA		LES			OUTPU	JT VARIA	ABLES	
Bankfull	Cross-section	al	516.1	A _{bkf} (ft ²)	Bankfu	ull Mean D	EPTH	7.0	D _{bkf} (ft)
Bank	full WIDTH		74.1	W _{bkf} (ft)		ed PERIME * d _{bkf} + W _{bkf}	TER	88.1	W _p (ft)
D ₈	4 @ Riffle		0.013	Dia. (mm)	D ₈₄	mm / 304.8	0.00	D ₈₄ (ft)	
Bank	full SLOPE	0.0001	S _{bkf} (ft / ft)		aulic RAD A_{bkf} / W_p	IUS	5.9	R (ft)	
Gravitatio	onal Accelerat	32.2	g (ft / sec ²)		tive Rough R (ft) / D ₈₄ (ft)		142927		
Drai	nage AREA	1862.0	DA (mi²)	Sh	near Veloci u* =√gRS	ty	0.1	u* (ft / sec)	
	ESTIMA	TION	METHO	DS		Bankfull \	/ELOCITY	Bankfull DISCHARGE	
1. Friction Factor	Relative u = Roughness	= [2.83	6 + 5.66Log	{	•]u*	3.9	ft / sec	2037	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	i) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	1.0	ft / sec	520	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	5.3	ft / sec	2738	cfs
	tion is for application ble- and boulder-do C2 and E3.					·			I
2. Roughness c) Manning	s Coefficient: s 'n' from Strea	m Type		= 1.4865* R 3 0.043	^{2/3} *S ^{1/2} /n	1.0	ft / sec	520	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	, Chezy C, etc	.)		1.0	ft / sec	517	cfs
3. Other Metho	ds (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfo		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=0	Q / A		ft / sec		cfs
Option 1. For Sub	s for using the E sand-bed chan ostitute an avera	nels: M ge sand	easure the "p dune protrus	sion height (height" (h _{sd}) o h _{sd} in ft) for th	of sand dune ne D ₈₄ term ir	s above char n est. method	nnel bed eleva 1.	tions.
Option 2. For elev	boulder-domina ations. Substitut	a ted ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _b or the D ₈₄ te	 o) of boulders rm in est. me 	s above chanr thod 1.	nel bed
' uplif	bedrock-dominated surfaces about term in estimation	ve char	nnel bed eleva	sure severa ations. Sub	l "protrusion stitute an ave	h eights" (h rage bedrocl	_{br}) of rock se _l k protrusion h	parations/step neight (h _{br} in fo	s/joints/ eet) for the

Stream:	Wild Rice River-5-38.49		
Basin:	Red River Basin Drainage Area: 1E+06 acres	1862	mi ²
Location:	Wild Rice River-5-38.49		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/2/201
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	74.1	ft
	Bankfull DEPTH (d _{bkf})		
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ($d_{bkf} = A / W_{bkf}$).	7.0	ft
	Bankfull X-Section AREA (A _{bkf})		
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	516.1	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf})		
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	10.6	ft/ft
	Maximum DEPTH (d _{mbkf})		
	Maximum depth of the bankfull channel cross-section, or distance between the bankful		
	stage and Thalweg elevations, in a riffle section.	9.6	ft
	WIDTH of Flood-Prone Area (W _{fpa})		
	Twice maximum DEPTH, or $(2 \times d_{mbkl})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	000.0	<i>t</i> .
		236.0	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	3.2	ft/ft
		0.2	
	Channel Materials (Particle Size Index) D ₅₀		
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.		
		0.0025	mm
	Water Surface SLOPE (S)		
	Channel slope = "rise over run" for a reach approximately 20-30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000094	£1 /£1
		0.000081	n/n
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by		
	channel slope (VS / S).	1.9	
	E6 See Classification (Figure 2-2		
	Type (Figure 2-2	••/	J

	eam: Wild Rice River-5-3	88.49				Lo	ocation:	Wild I	Rice Ri	ver-5-38.4	49			
Ob	servers: KD, JB			Date:	10/2/2	011		Valle	ey Type:	X	Stream	n Type:	E6	
				Riv	er Rea	ch Sum	mary [Data						
	Mean Riffle Depth (d _{bkf})	7.0	ft	Riffle \	Vidth (V	N _{bkf})	74	.1	ft	Riffle Area		51	6.1	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft	Pool Area	i (A _{bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	ffle Width			W _{bkfp} / W _{bkf}	Pool Area	/ Riffle Area			A _{bkfp} /A _{bkf}
	Max Riffle Depth (d _{maxrif})	9.6	ft	Max P	ool Dep	th (d _{maxp})			ft	Max Riffle	e Depth/Mean Rif	fle Dept	th	1.4
Channel	Max Pool Depth/Mean Riffle De	epth		Point E	Bar Slop	e			ft/ft	Inner Berr	m Width (W _{ib})			ft
Cha	Inner Berm Depth (d _{ib})		ft	Inner E	Inner Berm Width/Depth Ratio W _{ib} /d _{ib} Inner Berm Area							(A _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity	at Bank	full Sta	ull Stage (u _{bkf}) 1.0 ft/s Estimation Method						n Method	Н	EC-RA	AS
	Streamflow: Estimated Dischar	rge at E	Bankfull	ull Stage (Q _{bkl}) 517 cfs Drainage Area							18	62	mi ²	
	Geometry	Mean	Min	Max			Dime	ension	less Ge	eometry Ra	atios	Mean	Min	Max
	Meander Wavelength (L _m)	1709			ft	Meander	Length	Ratio	(L _m /W _{bk}	f)		23.1		
Pattern	Radius of Curvature (R _c)	352			ft	Radius c	of Curva	ture/Ri	ffle Wid	th (R _c /W _{bkf}	f)	4.8		
	Belt Width (W _{blt})	2019	<u> </u>		ft	Meander	Width	Ratio (W _{blt} /W _{bk}	(h		27.2		
Channel	Individual Pool Length				ft	Pool Len	gth/Riff	le Widt	h					
Cha	Pool to Pool Spacing				ft	Pool to F	Pool Spa	acing/R	iffle Wio	dth				
	Riffle Length	<u> </u>			ft	Riffle Le	ngth/Rif	fle Wic	lth					
\square	Valley Slope (VS)		ft/ft	Avera	je Wate	r Surface	Slope (S)		ft/	ft Sinuosity (/S/S)		
		195	ft		Length			,	21	767 ft	Sinuosity (S			1.9
	Low Bank Height start		ft		Max Rif		start		ft		Height Ratio (BH	IR)	start	
	(LBH) end		ft		Depth	1	end		ft	<u> </u>	I/Max Riffle Dept		end	·
e	Facet Slopes Riffle Slope (S _{rif})	Mean 0.0	Min	Max	ft/ft	Riffle Slo				pe Ratios rface Slope	e (S _{rif} / S)	Mean 1.0	Min	Max
Profile	Run Slope (S _{run})		<u> </u>	<u> </u>	ft/ft			•		face Slope	, ,			<u> </u>
	Pool Slope (S _p)	<u> </u>	<u> </u> 	<u> </u>	ft/ft			-		face Slope				<u> </u>
Channel	Glide Slope (S _q)	<u> </u>	<u> </u>	1	ft/ft	· · · · · ·		-		rface Slope	· F ,			
U	Feature Midpoint ^a	Mean	Min	Max				-		th Ratios	(g /	Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	9.6			ft	Max Riff			-	Depth (d _{maxr}	_{rif} / d _{bkf})	1.4		
	Max Run Depth (d _{maxrun})				ft	Max Rur	Depth/	Mean I	Riffle De	epth (d _{maxru}	n / d _{bkf})			
	Max Pool Depth (d _{maxp})				ft	Max Poc	l Depth	/Mean	Riffle De	epth (d _{maxp}	/ d _{bkf})			
	Max Glide Depth (d _{maxg})				ft	Max Glic	le Depth	/Mean	Riffle D	Depth (d _{maxç}	g / d _{bkf})			
	2	ich ^b		ffle ^c		Bar				Riffle	^c Bar	Brotr	ion l	leight ^d
\square		<u>ich"</u> 4	Rif	ne		Jai	D ₁₆		ach ^b 001	Riffle	Bai	Protru	ISION F	mm
rials	% Sand	6					D ₃₅		001					mm
Materials	% Gravel	0					D ₅₀	0.0	025					mm
	% Cobble	0					D ₈₄	0.0	125					mm
Channel	% Boulder	0					D ₉₅	0.	.13					mm
Ū	% Bedrock	0					D ₁₀₀	4.	.75					mm
	max, mean depths are ave. mid-po	aint valu			4-1	t de encet r					d of a riffle.			

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Wild Rice	River-4-22.9	94	Station Number:	N/A	
LOCATION:		River-4-22.9				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	1219200	acres	1905	mi ² Drainage Area Mn ELEV:	892.85	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	B6c			HUC:		
		' <mark>BANKFU</mark>	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	75.5	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPT	H (d _{bkf})	5.6	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	424.6	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	78.8	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	je Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	((u)	1.2	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGI	E (Q _{bkf})	517.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE asso	ociated with	"field-det	ermined" Bankfull STAGE	517.0	cfs
Recurrence Interval (Log	J-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.3	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Anal	lysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER C	GEOMETRY		
Meander Length (Lm	,)	1514	ft	Radius of Curvature (R _C)	613.0	ft
Belt Width (W _{blt})		2633	ft	Meander Width Ratio (W _{blt} /W _{bkf})	34.9	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean [Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R			ft	Manning's "n" at Bankfull Stage	0.043	Coeff.
	- ~ / vv _p				0.043	
	" n " = 1	.4865 [(A rea) (Hydraul	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	kfull VE		/ DISCHAF	RGE Estir	nates		
Site	Wild Rice Ri	ver-4	22.94		Location	Wild Rice	River-4-2	22.94	
Date	10/3/2011	Stre	am Type	B6c	Valley Ty	/pe	X		
Observers	KD, JB				HUC				
	INPUT VA	RIAB	LES			OUTPU	T VARIA	BLES	
Bankfull	Cross-section	al	424.6	A _{bkf} (ft ²)	Bankfu	III Mean DE	EPTH	5.6	D _{bkf} (ft)
Bank	full WIDTH		75.5	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	86.7	W _p (ft)	
D ₈	4 @ Riffle		0.012	Dia. (mm)	D ₈₄	mm / 304.8	0.00	D₈₄ (ft)	
Bank	full SLOPE	0.0001	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	4.9	R (ft)	
Gravitatio	onal Acceleration	32.2	g (ft / sec ²)		ive Roughr R (ft) / D ₈₄ (ft)	ness	124350		
Draiı	nage AREA		1905.0	DA (mi²)		ear Velocit ı* =√gRS	ty	0.1	U* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	[2.83	+ 5.66Log	{	•]u*	4.6	ft / sec	1963	cfs
2. Roughness roughness (Fig	Coefficient: a) s. 2-18, 19) u = 1.4) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		/ relative =	1.2	ft / sec	492	cfs
2. Roughness b) Manning's	Coefficient: n' from Jarrett (U	SGS):		1.4865* R ^{2/:} ¹⁶ n	^{3*} S ^{1/2} /n	4.9	ft / sec	2065	cfs
Note: This equa roughness, cob A3, B1, B2, B3, (tion is for applications ble- and boulder-dor 22 and E3.	involving minated	steep, step-poo stream systems	ol, high bound ; i.e., for strean	lary n types A1, A2,	·			
2. Roughness c) Manning	Coefficient: s 'n' from Strear	m Type		= 1.4865* R 0.043	^{2/3} *S ^{1/2} /n	1.2	ft / sec	492	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-We	eisbach	<mark>, Chezy C, etc</mark>	.)		1.2	ft / sec	517	cfs
3. Other Metho	ds (Hey, Darcy-We	eisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfu		gional Curve arge	s u = 0 Q = 1.46	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A		ft / sec		cfs
Option 1, For	for using the D sand-bed chanr ostitute an averag	nels: M	easure the "p	rotrusion h	neight " (h _{sd}) c	of sand dunes	above char	nnel bed eleva	d 1. tions.
Option 2. For elev	boulder-domina ations. Substitute	i ted ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _{bo} or the D ₈₄ ter) of boulders m in est. me	above chanr thod 1.	nel bed
. uplif	bedrock-domina ted surfaces abov term in estimation	ve char	nnel bed eleva	sure severa ations. Sub	l "protrusion stitute an ave	heights" (h _b rage bedrock	_r) of rock sep protrusion h	parations/step neight (h _{br} in fo	s/joints/ eet) for the

Stream:	Wild Rice River-4-22.94		
Basin:	Red River Basin Drainage Area: 1E+06 acres	1905	mi ²
Location:	Wild Rice River-4-22.94		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/3/201 ⁻
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	75.5	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	5.6	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	424.6	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	13.4	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.	8.2	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkl})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	144.3	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	1.9	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.0032	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00014	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.8	
	Stream B6c See Classification (Figure 2-2		

20	eam: Wild Rice River-4-2	22.94				Lo	cation:	Wild F	Rice Ri	ver-4-22	2.94						
Ob	servers: KD, JB			Date:	10/3/2	2011		Valle	у Туре:	<u>X</u>		Stream	n Type:	B6c			
_				Riv	er Rea	ich Sum	mary [Data									
\square	Mean Riffle Depth (d _{bkf})	5.6	ft	Riffle \	Nidth (V	N _{bkf})	75	5.5	ft	Riffle Ar	ea (A _b	_{kf})	42	4.6	ft ²		
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft	Pool Are	ea (A _{bk}	_{fp})			ft ²		
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / Riffle Area					A _{bkfp} /A _{bkf}		
Di	Max Riffle Depth (d _{maxrif})	8.2	ft	Max Po	ool Dept	th (d _{maxp})			ft	Max Riff	fle Dep	oth/Mean Rif	an Riffle Depth		1.5		
lane	Max Pool Depth/Mean Riffle D	epth		Point E	3ar Slop	e			ft/ft	Inner Berm Width (W _{ib})					ft		
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Deptl			W _{ib} /d _{ib} Inner Berm Area			(A _{ib})		ft ²			
	Streamflow: Estimated Mean V	/elocity	at Bank	dull Sta	ge (u _{bkf})		1.	.2	ft/s	Estimati	on Me	thod	Н	EC-R	AS		
\bigcup	Streamflow: Estimated Dischar	red Discharge at Bankfull Stage (Q _{bkf}) 517 cfs Drainage Area								l	19	05	mi²				
	Geometry	Mean	Min	Max			Dime	ension	ess Ge	ometry	Ratios	5	Mean	Min	Max		
	Meander Wavelength (L _m)	1514		•	ft	Meander							20.1				
Pattern	Radius of Curvature (R _c)	613			ft	Radius o	of Curva	ture/Ri	ffle Wid	th (R _c /W	_{bkf})		8.1				
	Belt Width (W _{blt})	2633			ft	Meander	Width	Ratio (N _{blt} /W _{bk}	_d)			34.9				
Channel	Individual Pool Length				ft	Pool Len	gth/Riff	le Widt	h								
Cha	Pool to Pool Spacing				ft	Pool to F	ool Spa	acing/R	iffle Wio	dth							
\bigcup	Riffle Length				ft	Riffle Le	ngth/Rif	fle Wic	lth								
\square	Valley Slope (VS)		ft/ft	Averac	e Wate	r Surface	Slope (S)		1	ft/ft	Sinuosity (\	/S/S)				
		892	ft		-			- /	36						1.8		
	Low Bank Height start	!	ft	-	-					1	Valley Length (VL) 36411 ft Sinuosity (S						
			; I L		Max Riffle start ft Bank-Height Ratio (BH							IR)	star	t			
	(LBH) end		ft		Max Rif Depth		start end		ft ft			ght Ratio (B⊦ x Riffle Dept		star enc			
	Facet Slopes	Mean	ft	Max	Depth	<u>ו</u>	end Dimer		ft ss Sloj	(LE pe Ratios	BH/Ma s	x Riffle Dept	h) Mean				
ofile	Facet Slopes Riffle Slope (S _{rif})		ft		Depth ft/ft	Riffle Slo	end Dimer ope/Ave	rage W	ft ss Sloj ater Su	(LE pe Ratios rface Slo	BH/Ma s pe (S _{ri}	x Riffle Dept _f / S)	h)	enc	1		
el Profile	Facet Slopes Riffle Slope (Srif) Run Slope (Srun)	Mean	ft		Depth ft/ft ft/ft	Riffle Slo	end Dimer ope/Ave oe/Avera	rage W age Wa	ft ss Slop ater Su tter Surf	(LE be Ratios rface Slo face Slop	BH/Ma s pe (S _{ri}	x Riffle Dept _f / S) / S)	h) Mean	enc	1		
	Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p)	Mean	ft		Depth ft/ft ft/ft ft/ft	Riffle Slo Run Slop Pool Slop	end Dimer ope/Ave oe/Avera	rage W age Wa age Wa	ft ss Slop ater Su ter Surf ater Surf	(LE De Ratios rface Slo face Slop face Slop	BH/Ma s pe (S _{ri} pe (S _{ru} pe (S _p /	x Riffle Dept _f / S) / S) / S)	h) Mean	enc	1		
Channel Profile	Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg)	Mean 0.0	ft Min	Max	Depth ft/ft ft/ft	Riffle Slo Run Slop Pool Slop	end Dimer ope/Ave oe/Avera ope/Avera	rage Wa age Wa age Wa rage W	ft ss Slop ater Su tter Surf ater Sur ater Su	(LE oe Ratios rface Slop face Slop face Slop rface Slop	BH/Ma: s pe (S _{ri} pe (S _p / pe (S _g	x Riffle Dept _f / S) / S) / S)	h) Mean 1.0	enc Min	Max		
	Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a	Mean 0.0	ft Min		Depth ft/ft ft/ft ft/ft ft/ft	Riffle Slo Run Slop Pool Slop Glide Slo	end Dimer ppe/Ave pe/Aver ppe/Aver ppe/Ave	rage W age Wa age Wa rage W rage W	ft ss Slop ater Su ter Surl ater Sur ater Su ss Dep	(LE oe Ratios rface Slop face Slop face Slop rface Slop th Ratios	BH/Ma s pe (S _{ri} pe (S _p / pe (S _g s	x Riffle Dept , / S) / S) / S) / S)	h) Mean 1.0 Mean	enc	1		
	Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif)	Mean 0.0	ft Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft	Riffle Slo Run Slop Pool Slop Glide Slo	end Dimer ope/Ave ope/Aver ope/Aver ope/Aver Dimer te Depth	rage W age Wa age Wa rage W nsionle	ft ss Slop ater Su ter Sur ater Sur ater Su ater Su ss Dep Riffle D	(LE De Ration rface Slop face Slop rface Slop rface Slop rface Slo Depth (d _m	BH/Ma s pe (S _{ri} pe (S _p pe (S _g s axrif / d _b	x Riffle Dept f / S) / S) / S) / S) kd)	h) Mean 1.0	enc Min	Max		
	Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun)	Mean 0.0	ft Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft	Riffle Slo Run Slop Pool Slop Glide Slop Max Riffl Max Run	end Dimer ppe/Ave pe/Aver ppe/Ave Dimer le Depth	rage Wa age Wa age Wa rage W nsionle n/Mean F	ft ss Slop ater Su tter Surt ater Su ater Su ss Dep Riffle De	(LE pe Ratios rface Slop face Slop face Slop rface Slop rface Slop th Ratios Depth (d _{max}	BH/Ma s pe (S _{ru} pe (S _p / pe (S _g s axrif / d _b	x Riffle Dept f / S) / S) / S) / S) / S) kt)	h) Mean 1.0 Mean	enc Min	Max		
	Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxp})	Mean 0.0	ft Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft ft/ft ft ft	Riffle Slo Run Slop Pool Slop Glide Slo Max Riff Max Run Max Poo	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer le Depth/ I Depth/	rage W age Wa age Wa rage W nsionle n/Mean f /Mean f	ft ss Slop ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De	(LE be Ratios rface Slop face Slop face Slop rface Slop th Ratios Depth (d _{max} epth (d _{max}	BH/Ma s pe (S _{ri} pe (S _p / pe (S _g s axrif / d _b xp / d _b d	x Riffle Dept f / S) / S) / S) / S) kd))	h) Mean 1.0 Mean	enc Min	Max		
	Facet Slopes Riffle Slope (Srun) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Glide Depth (dmaxg)	Mean 0.0 Mean 8.2	ft Min Min Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft ft	Riffle Slo Run Slop Pool Slop Glide Slop Max Riffl Max Run	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer le Depth/ I Depth/	rage W age Wa age Wa rage W sionle n/Mean Mean I /Mean	ft ss Slop ater Sur ater Sur ater Sur ater Su ss Dep Riffle De Riffle De Riffle De	(LE pe Ratios rface Slop face Slop rface Slop rface Slop rface Slop th Ratios Depth (d _{max} pepth (d _{max} pepth (d _{max})	BH/Ma s pe (S _{run} pe (S _p / pe (S _g axrif / d _b crun / d _b axg / d _b	x Riffle Dept f / S) / S) / S) / S) kd))	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max		
	Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Glide Depth (dmaxg) Read	Mean 0.0 Mean 8.2	ft Min Min Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft ft ft ft ft	Riffle Slo Run Slop Pool Slop Glide Slo Max Riff Max Run Max Poo	end Dimer ope/Aver ope/Aver ope/Aver Dimer le Depth I Depth I Depth	rage Wa age Wa rage Wa sionle Masionle Mean f Mean f Mean Mean	ft ss Slop ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De Riffle De Riffle De	(LE be Ratios rface Slop face Slop face Slop rface Slop th Ratios Depth (d _{max} epth (d _{max}	BH/Ma s pe (S _{run} pe (S _p / pe (S _g axrif / d _b crun / d _b axg / d _b	x Riffle Dept f / S) / S) / S) / S) kd))	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max		
Channel	Facet Slopes Riffle Slope (Srift) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrift) Max Run Depth (dmaxrift) Max Glide Depth (dmaxrift) Max Glide Depth (dmaxrift) Read % Silt/Clay S	Mean 0.0 Mean 8.2 Ach ^b 19	ft Min Min Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft ft ft ft ft	Riffle Slo Run Slop Pool Slo Glide Slo Max Riffl Max Run Max Poo Max Glid	end Dimer ope/Aver ope/Aver ope/Aver Dimer de Depth d Depth/ d Depth/ d Depth/ d Depth/	rage W age Wa age Wa rage W sionle n/Mean I /Mean I /Mean I n/Mean I Mean I	ft ss Slop ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do	(LE pe Ratios rface Slop face Slop rface Slop rface Slop rface Slop th Ratios Depth (d _{max} pepth (d _{max} pepth (d _{max})	BH/Ma s pe (S _{run} pe (S _p / pe (S _g axrif / d _b crun / d _b axg / d _b	x Riffle Dept f / S) / S) / S) / S) kt) kt) kt) kd)	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max Max		
Channel	Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrift) Max Run Depth (dmaxrift) Max Glide Depth (dmaxg) Read % Silt/Clay S % Sand S	Mean 0.0 Mean 8.2 Ach ^b 99	ft Min Min Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft ft ft ft ft	Riffle Slo Run Slop Pool Slo Glide Slo Max Riffl Max Run Max Poo Max Glid	end Dimer ope/Aver ope/Aver ope/Aver Dimer le Depth I Depth/ I Depth/ le Depth D ₁₆ D ₃₅	rage Wa age Wa rage Wa rage W msionle m/Mean f m/Mean f m/Maa f m/Ma	ft ss Slop ater Sur ater Sur ater Sur ater Sur ater Sur ss Dep Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	(LE pe Ratios rface Slop face Slop rface Slop rface Slop rface Slop th Ratios Depth (d _{max} pepth (d _{max} pepth (d _{max})	BH/Ma s pe (S _{run} pe (S _p / pe (S _g axrif / d _b crun / d _b axg / d _b	x Riffle Dept f / S) / S) / S) / S) kt) kt) kt) kd)	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max Max		
Materials Channel	Facet Slopes Riffle Slope (Srun) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth	Mean 0.0 Mean 8.2 Ach ^b 99 1	ft Min Min Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft ft ft ft ft	Riffle Slo Run Slop Pool Slo Glide Slo Max Riffl Max Run Max Poo Max Glid	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer de Depth/ d Depth/ d Depth/ d Depth/ d Depth/ d Depth/ d Depth/ d Depth/ d Depth/	rage W age Wa age Wa rage W sionle n/Mean f /Mean f /Mean f /Mean f /Mean f (Mean f /Mean f (Mean f (Mean f (Mean f (Mean f (Mean f (Mean f (Mean f))))))))))))))))))))))))))))))))))))	ft ss Slop ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	(LE pe Ratios rface Slop face Slop rface Slop rface Slop rface Slop th Ratios Depth (d _{max} pepth (d _{max} pepth (d _{max})	BH/Ma s pe (S _{run} pe (S _p / pe (S _g axrif / d _b crun / d _b axg / d _b	x Riffle Dept f / S) / S) / S) / S) kt) kt) kt) kd)	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max Max		
Materials Channel	Facet Slopes Riffle Slope (Srift) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrift) Max Run Depth (dmaxrift) Max Glide Depth (dmaxrift) <t< td=""><td>Mean 0.0 Mean 8.2 Ach^b 99 1 0</td><td>ft Min Min Min</td><td>Max Max Max</td><td>Depth ft/ft ft/ft ft/ft ft/ft ft ft ft ft</td><td>Riffle Slo Run Slop Pool Slo Glide Slo Max Riffl Max Run Max Poo Max Glid</td><td>end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer de Depth d Depth/ d Depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ dept</td><td>rage Wa age Wa rage Wa rage Wa sionle n/Mean f /Mean f</td><td>ft ss Slop ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do 01 001 001</td><td>(LE pe Ratios rface Slop face Slop rface Slop rface Slop rface Slop th Ratios Depth (d_{max} pepth (d_{max} pepth (d_{max})</td><td>BH/Ma s pe (S_{run} pe (S_p / pe (S_g axrif / d_b crun / d_b axg / d_b</td><td>x Riffle Dept f / S) / S) / S) / S) kt) kt) kt) kd)</td><td>h) Mean 1.0 Mean 1.5</td><td>enc Min Min</td><td>Max Max Max Max Max Max Max</td></t<>	Mean 0.0 Mean 8.2 Ach ^b 99 1 0	ft Min Min Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft ft ft ft ft	Riffle Slo Run Slop Pool Slo Glide Slo Max Riffl Max Run Max Poo Max Glid	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer de Depth d Depth/ d Depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ dept	rage Wa age Wa rage Wa rage Wa sionle n/Mean f /Mean f	ft ss Slop ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do 01 001 001	(LE pe Ratios rface Slop face Slop rface Slop rface Slop rface Slop th Ratios Depth (d _{max} pepth (d _{max} pepth (d _{max})	BH/Ma s pe (S _{run} pe (S _p / pe (S _g axrif / d _b crun / d _b axg / d _b	x Riffle Dept f / S) / S) / S) / S) kt) kt) kt) kd)	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max Max Max Max Max		
Channel	Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Glide Depth (dmaxrg) Read % Silt/Clay % Sand % Cobble % Boulder	Mean 0.0 Mean 8.2 Ach ^b 99 1	ft Min Min Min	Max Max Max	Depth ft/ft ft/ft ft/ft ft/ft ft ft ft ft	Riffle Slo Run Slop Pool Slo Glide Slo Max Riffl Max Run Max Poo Max Glid	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer de Depth/ d Depth/ d Depth/ d Depth/ d Depth/ d Depth/ d Depth/ d Depth/ d Depth/	rage W age Wa age Wa rage W sionle /Mean I /Mean I /Mean I /Mean I /Mean I 0.00000.00000000000000000000000000000	ft ss Slop ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	(LE pe Ratios rface Slop face Slop rface Slop rface Slop rface Slop th Ratios Depth (d _{max} pepth (d _{max} pepth (d _{max})	BH/Ma s pe (S _{run} pe (S _p / pe (S _g axrif / d _b crun / d _b axg / d _b	x Riffle Dept f / S) / S) / S) / S) kt) kt) kt) kd)	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max Max		

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Wild Rice	River-3-17.	52	Station Number:	N/A	
		River-3-17.				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	1260800	acres	1970	mi ² Drainage Area Mn ELEV:	888.52	ft
Reference REACH SLOP	PE:		ft/ft	Valley Type:	X]
Stream Type:	E6			HUC:		
		BANKFU	LL" CH/	ARACTERISTICS		
Determined from	FIELD ME	<mark>ASUREME</mark> I		Determined from GAGE DA	ATA Analys	is
Bankfull WIDTH (W _{bkt}	_f)	73.8	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	6.1	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA ((A _{bkf})	450.7	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	77.1	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.2	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	517.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE asso	ciated with	"field-det	ermined" Bankfull STAGE	517.0	cfs
Recurrence Interval (Log	l-Pearson)a	ssociated with	h "field-det	termined" Bankfull Discharge	1.3	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> ı	uency Anal	lysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	э =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER G	GEOMETRY		
Meander Length (L _m)	1346	ft	Radius of Curvature (R _C)	283.0	ft
Belt Width (W _{blt})		1344	ft	Meander Width Ratio (W_{blt}/W_{bkf})	18.2	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Are	ea (A), Mean [Depth (d) & Me	an Velocity (regression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope ex	ponent (b)
Intercept Coefficient:	(a)	Vildar (tr)				
Slope Exponent:	(b)					
Hydraulic Radius: R	= A / W ₂		ft	Manning's "n" at Bankfull Stage	0.03	Coeff.
	·	.4865 [(A rea		ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI		/ DISCHAF	RGE Esti	mates		
Site	Wild Rice R	iver-3	17.52		Location	Wild Rice	e River-3-	17.52	
Date	10/4/2011	Stre	am Type	E6	Valley Ty	rpe	X		
Observers	KD, JB				HUC				
	INPUT VA	RIAB	LES			OUTPL	IT VARIA	ABLES	
Bankfull	Cross-section	al	450.7	A _{bkf} (ft ²)	Bankfu	III Mean DI	ЕРТН	6.1	D _{bkf} (ft)
Bank	full WIDTH		73.8	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	86.0	W _p (ft)	
D ₈	4 @ Riffle	0.0046	Dia. (mm)	D ₈₄ I	mm / 304.8	0.00	D ₈₄ (ft)		
Bank	full SLOPE	0.0001	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	5.2	R (ft)	
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)	ness	347177	
Draiı	nage AREA		1970.0	DA (mi²)		ear Veloci ı* =√gRS	ty	0.1	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull VELOCITY			full ARGE
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{]u*	3.8	ft / sec	1709	cfs
	Coefficient: a s. 2-18, 19) u = 1.				r / relative =	1.3	ft / sec	575	cfs
2. Roughness b) Manning's	Coefficient: n' from Jarrett (L	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	4.8	ft / sec	2153	cfs
	tion is for application: ble-and boulder-do 22 and E3.						_		
2. Roughness c) Manning	Coefficient: s 'n' from Strea	m Type		= 1.4865* R 0.03	^{2/3} *S ^{1/2} /n	1.3	ft / sec	575	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)		1.2	ft / sec	517	cfs
3. Other Metho	ds (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfo		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A		ft / sec		cfs
Option 1, For	for using the E sand-bed chan ostitute an avera	nels: M	easure the "p	rotrusion h	neight " (h _{sd}) o	f sand dunes	s above char	nnel bed eleva	d 1. tions.
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion I ght (h _{bo} in ft) fo	heights" (h _{bo} or the D ₈₄ ter) of boulders m in est. me	s above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-domina ted surfaces abo term in estimatio	ated ch	annels: Meas	sure severa	protrusion	heights" (h	or) of rock se	parations/step	s/joints/ eet) for the

Stream:	Wild Rice River-3-17.52		
Basin:	Red River Basin Drainage Area: 1E+06 acres	1970	mi ²
Location:	Wild Rice River-3-17.52		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/4/201
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	73.8	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).		ft
	Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	450.7	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	12.1	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	150.7	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	2.0	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.001	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000073	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.5	
	Stream E6 See Classification (Figure 2-2		

	eam: Wild Rice River-3-1	7.52				Lo	cation:	Wild F	Rice Ri	ver-3-17.52				
Ob	servers: KD, JB			Date:	10/4/2	011		Valle	у Туре:	<u>X</u>	Stream	n Type:	E6	
_				Riv	er Rea	ch Sum	mary [Data						
	Mean Riffle Depth (d _{bkf})	6.1	ft	Riffle \	Nidth (N	V _{bkf})	73	.8	ft	Riffle Area (A _{bkf})	45	0.7	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft	Pool Area (A	_{'bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	fle Width			W _{bkfp} / W _{bkf}	Pool Area / F	Riffle Area			A _{bkfp} /A _{bkf}
Di	Max Riffle Depth (d _{maxrif})	8.7	ft	Max Po	ool Dept	h (d _{maxp})			ft	Max Riffle D	epth/Mean Rif	fle Dept	th	1.4
lane	Max Pool Depth/Mean Riffle De	epth		Point E	Bar Slope	е			ft/ft	Inner Berm	Width (W _{ib})			ft
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Inner Berm Width/Depth Ratio W _{ib} /d _{ib} Inner Berm Area							(A _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity	at Bank	full Sta	ull Stage (u _{bkf}) 1.2 ft/s Estimation Method							Н	EC-R/	S
\bigcup	Streamflow: Estimated Dischar	ge at E	Bankfull	full Stage (Q _{bkf}) 517 cfs Drainage Area							19	70	mi²	
	Geometry	Mean	Min	Max			Dime	ension	ess Ge	ometry Rati	os	Mean	Min	Max
\square	Meander Wavelength (L _m)	1346			ft	Meander						18.2		
Pattern	Radius of Curvature (R _c)	283		Ì	ft	Radius o	of Curva	ture/Ri	fle Wid	th (R _c /W _{bkf})		3.8		
	Belt Width (W _{blt})	1344			ft	Meander	Width	Ratio (\	N _{blt} /W _{bk}	f)		18.2		
Channel	Individual Pool Length				ft	Pool Len	gth/Riff	le Widt	h					
Cha	Pool to Pool Spacing				ft	Pool to P	ool Spa	ool Spacing/Riffle Width						
\bigcup	Riffle Length				ft	Riffle Le	ngth/Rif	fle Wid	th					
\square	Valley Slope (VS)		ft/ft	Averac	e Water	r Surface	Slope (S)		ft/ft	Sinuosity (/S/S)		
		534	ft	-	Length (0.000 (21	177 ft	Sinuosity (S			1.5
	Low Bank Height start		ft		Max Riff	. ,	start		ft	I	eight Ratio (BF		start	
	(LBH) end		ft		Depth		end		ft		lax Riffle Dept		end	
	Facet Slopes	Mean	Min	Max			Dimen	sionle		e Ratios				Max
Profile	Riffle Slope (S _{rif})	0.0		1	ft/ft								Min	1
	Run Slope (S _{run})		1	<u>i </u>								Mean 1.0	Min	
6					: :	Run Slop	be/Avera	age Wa	ter Surf	rface Slope (S ace Slope (S	_{run} / S)		Min	
annel	Pool Slope (S _p)				ft/ft	Run Slop Pool Slop	pe/Avera	age Wa age Wa	ter Surf ater Surf	rface Slope (S face Slope (S face Slope (S	_{run} / S) _p / S)		Min	
Channel	Pool Slope (S _p) Glide Slope (S _g)	Mee			ft/ft	Run Slop Pool Slop	pe/Avera	age Wa age Wa rage W	ter Surf ater Surf ater Sur	rface Slope (S face Slope (S face Slope (S rface Slope (S	_{run} / S) _p / S)	1.0		
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a	Mean 8.7	Min	Max	ft/ft ft/ft	Run Slop Pool Slop Glide Slo	pe/Avera pe/Avera ppe/Avera Dimen	age Wa age Wa rage W sionle	ter Surf ater Surf ater Sur ss Dep	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios	_{run} / S) _p / S) S _g / S)	1.0	Min	Max
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})	Mean 8.7	Min		ft/ft ft/ft ft	Run Slop Pool Slop Glide Slo Max Riffl	pe/Avera pe/Avera ppe/Avera Dimen le Depth	age Wa age Wa rage W sionle Mean	ter Surf ater Surf ater Sur ss Dep Riffle D	rface Slope (S face Slope (S face Slope (S rface Slope (S	r _{un} / S) _p / S) S _g / S) d _{bkt})	1.0		
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a		Min		ft/ft ft/ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run	pe/Avera pe/Avera ppe/Avera Dimen le Depth	age Wa age Wa rage W sionle n/Mean Mean F	ter Surf ater Surf ater Sur ss Dep Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} /	$r_{run} / S)$ p / S) $S_g / S)$ d_{bkl} d_{bkl}	1.0		
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})		Min		ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Poo	pe/Avera pe/Avera ppe/Avera Dimen le Depth Depth/ I Depth/	age Wa age Wa rage W sionle Mean F Mean F	ter Surf ater Sur ater Su ss Dep Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / Pepth (d _{maxrun} /	run / S) p / S) Sg / S) d _{bkf}) d _{bkf})	1.0		
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxru}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg})	8.7			ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Poo Max Glid	pe/Avera pe/Avera ppe/Avera Dimen le Depth Depth/ I Depth/	age Wa age Wa rage W sionle Mean F Mean I /Mean I	ter Surf ater Sur ater Su ss Dep Riffle De Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S th Ratios bepth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxp} / d hepth (d _{maxg} /	r _{un} / S) _p / S) S _g / S) d _{bkl}) d _{bkl}) b _{bl})	1.0 Mean 1.4	Min	Max
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea	8.7			ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Poo	pe/Avera pe/Avera ppe/Avera Dimen le Depth/ l Depth/ l Depth/ le Depth	age Wa age Wa rage W sionle Mean F Mean I Mean I Mean I	ter Surf ater Surf ater Sur ss Dep Riffle De Riffle De Riffle De Riffle D	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxp} / d	run / S) p / S) Sg / S) d _{bkf}) d _{bkf})	1.0	Min	Max Max
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxrif) Max Glide Depth (dmaxrif) Rea % Silt/Clay 9	8.7			ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Poo Max Glid	De/Avera De/Avera De/Avera Dimen le Depth/ I Depth/ I Depth/ le Depth	age Wa age Wa rage W sionle //Mean I /Mean I /Mean I /Mean I /Mean A	ter Surf ater Surf ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do	rface Slope (S face Slope (S face Slope (S th Ratios bepth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxp} / d hepth (d _{maxg} /	r _{un} / S) _p / S) S _g / S) d _{bkl}) d _{bkl}) b _{bl})	1.0 Mean 1.4	Min	Max Max eight ^d
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay 9 % Sand 4	8.7			ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Poo Max Glid	De/Avera pe/Avera ppe/Avera Dimen le Depth l Depth/ l Depth/ le Depth d Depth/ le Depth	age Wa age Wa rage Wa sionle Mean F Mean f Mean I Mean A Mean A M	ter Surf ater Surf ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do	rface Slope (S face Slope (S face Slope (S th Ratios bepth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxp} / d hepth (d _{maxg} /	r _{un} / S) _p / S) S _g / S) d _{bkl}) d _{bkl}) b _{bl})	1.0 Mean 1.4	Min	Max Max eight ^d mm
Materials	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxrif) Max Glide Depth (dmaxrif) M	8.7			ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Poo Max Glid	De/Avera De/Avera De/Avera Dimen le Depth/ l Dep	age Wa age Wa rage Wa sionle Mean F Mean F Mean I Mean A Mean A M	ter Surf ater Surf ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope (S face Slope (S face Slope (S th Ratios bepth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxp} / d hepth (d _{maxg} /	r _{un} / S) _p / S) S _g / S) d _{bkl}) d _{bkl}) b _{bl})	1.0 Mean 1.4	Min	Max Max eight ^d mm mm
Materials	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxrif) Max Glide Depth (dmaxrif) Max Glide Depth (dmaxrif) Rea % Silt/Clay % Sand % Gravel % Cobble	8.7 			ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Poo Max Glid	pe/Avera pe/Avera ppe/Avera ppe/Avera Dimen le Depth/ l D	age Wa age Wa rage Wa sionle Mean P Mean P Mean P Mean P Mean O Mean O M	ter Surf ater Surf ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do	rface Slope (S face Slope (S face Slope (S th Ratios bepth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxp} / d hepth (d _{maxg} /	r _{un} / S) _p / S) S _g / S) d _{bkl}) d _{bkl}) b _{bl})	1.0 Mean 1.4	Min	Max Max eight ^d mm mm mm
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxnif) Max Run Depth (dmaxnif) Max Pool Depth (dmaxn) Max Glide Depth (dmaxn) Max Glide Depth (dmaxn) Ø Sand % Gravel % Cobble % Boulder	8.7			ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Poo Max Glid	De/Avera De/Avera De/Avera Dimen le Depth/ l Dep	age Wa age Wa rage Wa sionle Mean I Mean I Mean I Mean I (Mean A C.(0.(0.0 0.0	ter Surf ater Surf ater Sur ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope (S face Slope (S face Slope (S th Ratios bepth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxp} / d hepth (d _{maxg} /	r _{un} / S) _p / S) S _g / S) d _{bkl}) d _{bkl}) b _{bl})	1.0 Mean 1.4	Min	Max Max eight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Wild Rice	River-2-4.23	3	Station Number:	N/A	
LOCATION:		River-2-4.23				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	1287040	acres	2011	mi ² Drainage Area Mn ELEV:	880.59	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	E6	1		HUC:		
		BANKFU	LL" CH/	ARACTERISTICS		
Determined from	FIELD ME	ASUREME!	NT	Determined from GAGE DA	TA Analys	sis
Bankfull WIDTH (W _{bk}	_{cf})	84.3	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	6.2	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	525.3	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	87.5	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	r (u)	1.1	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	600.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	HARGE asso	ociated with	"field-det	ermined" Bankfull STAGE	600.0	cfs
Recurrence Interval (Log	յ-Pearson)a	ssociated wit	h "field-dei	termined" Bankfull Discharge	1.3	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Ana	lysis data for the Gage Station, detern	nine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	je=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	je=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER C	GEOMETRY		
Meander Length (Lm	,)	745	ft	Radius of Curvature (R _C)	153.0	ft
Belt Width (W _{blt})		1608	ft	Meander Width Ratio (W_{blt}/W_{bkf})	19.1	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean [Depth (d) & Me	an Velocity (regression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	$a = A / W_p$		ft	Manning's "n" at Bankfull Stage	0.045	Coeff.
		.4865 [(A rea	ı) (Hydraul	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		J

		Bar	kfull VEI		/ DISCHAP	RGE Esti	mates		
Site	Wild Rice Ri	iver-2-	4.23		Location	Wild Rice	e River-2-	4.23	
Date	10/4/2011	Stre	am Type	E6	Valley Ty	/pe	X		
Observers	KP, AL				HUC		- 		- <mark></mark>
	INPUT VA	RIAB	LES			OUTPL	JT VARIA	BLES	
Bankfull	Cross-section	al	525.3	A _{bkf} (ft ²)	Bankfu	ull Mean D	EPTH	6.2	D _{bkf} (ft)
Bank	full WIDTH		84.3	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	96.8	W _p (ft)
D ₈	4 @ Riffle		0.05	Dia. (mm)	D ₈₄	mm / 304.8	3 =	0.00	D ₈₄ (ft)
Bank	full SLOPE		0.0001	S _{bkf} (ft / ft)		aulic RADI A_{bkf} / W p	US	5.4	R (ft)
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)		33090	
Drai	nage AREA		2011.0	DA (mi²)		near Veloci u* =√gRS	ty	0.1	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	[2.83	+ 5.66Log	{]u*	3.5	ft / sec	1853	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	1.0	ft / sec	503	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	5.0	ft / sec	2644	cfs
	tion is for application: ble-and boulder-do C2 and E3.					·	_		1
2. Roughness c) Manning	s Coefficient: s 'n' from Strea	m Type		= 1.4865* R 3 0.045	^{2/3} *S ^{1/2} /n	1.0	ft / sec	503	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)		1.1	ft / sec	600	cfs
3. Other Metho	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfo		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1 1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=0	Q/A		ft / sec		cfs
Option 1. For Sub	s for using the E sand-bed chan ostitute an avera	nels: M ge sand	easure the "p dune protrus	rotrusion h sion height (height" (h _{sd}) o h _{sd} in ft) for th	of sand dunes ie D ₈₄ term in	s above char est. method	nnel bed eleva 1.	tions.
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _b or the D ₈₄ ter	 of boulders m in est. me 	above chanr thod 1.	nel bed
. uplif	bedrock-dominated surfaces about term in estimation	ve char	nnel bed eleva	sure severa ations. Sub	l "protrusion stitute an ave	heights" (h _i rage bedrock	_{br}) of rock se _l k protrusion h	parations/step neight (h _{br} in f	s/joints/ eet) for the

Stream:	Wild Rice River-2-4.23		
Basin:	Red River Basin Drainage Area: 1E+06 acres	2011	mi ²
Location:	Wild Rice River-2-4.23		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/4/2011
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	84.3	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	6.2	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	525.3	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	13.5	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.	_	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	283.7	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	3.4	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.0029	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000088	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.3	
	Stream E6 See Classification (Figure 2-2		

	eam: Wild Rice River-2-4	.23				Lo	ocation:	Wild F	Rice Ri	ver-2-4.23				
Ob	servers: KP, AL			Date:	10/4/2	2011		Valle	у Туре:	X	Stream	n Type:	E6	
_				Riv	er Rea	ach Sum	mary [Data						
\square	Mean Riffle Depth (d _{bkf})	6.2	ft	Riffle \	Nidth (\	N _{bkf})	84	.3	ft	Riffle Area (At	_{okf})	52	5.3	ft ²
c	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (V	V _{bkfp})			ft	Pool Area (A _{bk}	(qt			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / Ri	ffle Area			A _{bkfp} /A _{bkf}
Di	Max Riffle Depth (d _{maxrif})	8.5	ft	Max P	ool Dep	th (d _{maxp})			ft	Max Riffle Dep	oth/Mean Rif	fle Dept	h	1.4
lanc	Max Pool Depth/Mean Riffle De	epth		Point E	Bar Slop	De			ft/ft	Inner Berm W	idth (W _{ib})			ft
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Dept	n Ratio			W _{ib} /d _{ib} Inne	r Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity/	at Bank	full Sta	ge (u _{bkf}))	1.	1	ft/s	Estimation Me	ethod	Н	EC-R/	IS
	Streamflow: Estimated Dischar	rge at E	Bankfull	Stage (Q _{bkf})		60	00	cfs	Drainage Area	1	20	11	mi²
	Geometry	Mean	Min	Max			Dime	ension	less Ge	ometry Ratios	S	Mean	Min	Max
	Meander Wavelength (L _m)	745			ft	Meander	Length	Ratio	(L _m /W _{bk}	f)		8.8		
Pattern	Radius of Curvature (R _c)	153			ft	Radius c	of Curva	ture/Ri	ffle Wid	th (R _c /W _{bkf})		1.8		
	Belt Width (W _{blt})	1608			ft	Meander	Width	Ratio (N _{blt} /W _{bk}	(_t		19.1		
Channel	Individual Pool Length				ft	Pool Len	gth/Riff	le Widt	h					
Cha	Pool to Pool Spacing				ft	Pool to F	Pool Spa	icing/R	iffle Wio	dth				
	Riffle Length			1	ft	Riffle Le	ngth/Rif	fle Wic	lth					
\square	Valley Slope (VS)		ft/ft	Avera	ge Wate	er Surface	Slope (S)		ft/ft	Sinuosity (\	/S/S)		
	Stream Length (SL) 55	572	ft	Valley	Length	(VL)			24	623 ft	Sinuosity (S	SL/VL)		2.3
	Low Bank Height start	 	ft		Max Rif		start		ft		ght Ratio (B⊢		start	
	(LBH) end	Mean	ft Min	Max	Depth	1	end	cionlo	ft	e Ratios	x Riffle Dept		end Min	Max
ile	Riffle Slope (S _{rif})	0.0		IVIAX	ft/ft	Riffle Slo				rface Slope (Sr	_{if} / S)	Mean 1.0		IVIAX
Profile	Run Slope (S _{run})				ft/ft	Run Slop	oe/Avera	age Wa	ater Surf	ace Slope (S _{rur}	, / S)			
le	Pool Slope (S _p)			1	ft/ft	Pool Slo	pe/Avera	age Wa	ater Sur	face Slope (S _p	/ S)			
Channel	Glide Slope (Sg)				ft/ft	Glide Slo	pe/Ave	rage W	ater Su	rface Slope (S _g	/ S)			
	Feature Midpoint ^a	Mean	Min	Max			Dimen	sionle	ss Dep	th Ratios		Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	8.5			ft	Max Riff	le Depth	/Mean	Riffle D	Depth (d _{maxrif} / d _t	_{okf})	1.4		
	Max Run Depth (d _{maxrun})				ft					epth (d _{maxrun} / d _t				
	Max Pool Depth (d _{maxp})				ft					epth (d _{maxp} / d _{bk}				
	Max Glide Depth (d _{maxg})				ft	Max Glic	e Depth	/Mean	Riffle D	Depth (d _{maxg} / d _b	_{kf})			
	Roa	ich ^b	Rif	ffle ^c		Bar		Res	ach ^b	Riffle ^c	Bar	Protru	sion H	eiaht ^d
		9 9					D ₁₆		001					mm
srials	% Sand 1	1					D ₃₅	<.	001					mm
Materials	% Gravel	0					D ₅₀	0.0	029					mm
	% Cobble	0					D ₈₄	0.	05					mm
Channel	% Boulder	0					D ₉₅	0	.3					mm
ပ	% Bedrock	0					D ₁₀₀	4.	75					mm
	max, mean depths are ave. mid-po									^c Active bed of a				

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Wild Rice	River-1-3.0 ²	1	Station Number:	N/A	
LOCATION:	Wild Rice	River-1-3.0 ²	1	I		
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	1287680	acres	2012	mi ² Drainage Area Mn ELEV:	875.87	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	E6					
	"	'BANKFU	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME	ASUREME	Т	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	79.2	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	7.0	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	556.2	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	83.8	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.1	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	600.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE asso	ociated with	"field-det	ermined" Bankfull STAGE	600.0	cfs
Recurrence Interval (Log	₃-Pearson)a	ssociated wit	h "field-det	termined" Bankfull Discharge	1.3	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Anal	lysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER (GEOMETRY		
Meander Length (Lm	,)	910	ft	Radius of Curvature (R _C)	137.0	ft
Belt Width (W _{blt})		1940	ft	Meander Width Ratio (W _{blt} /W _{bkf})	24.5	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean [Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R			ft	Manning's "n" at Bankfull Stage	0.045	Coeff.
	- 77 VVp				0.045	
	" n " = 1	.4865 [(A rea) (Hydraul	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bank	full VEL		/ DISCHAP	RGE Esti	mates		
Site	Wild Rice Rive	r-1-3.	.01		Location	Wild Ric	e River-1-:	3.01	
Date	10/4/2011	Strear	m Type	E6	Valley Ty	/pe	X		
Observers	KP, AL				HUC				
	INPUT VAR	ABL	ES			OUTPL	JT VARIA	BLES	
Bankfull	Cross-sectional		556.2	A _{bkf} (ft ²)	Bankfu	ull Mean D	EPTH	7.0	D _{bkf} (ft)
Bank	full WIDTH		79.2	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	93.2	W _p (ft)
D ₈	4 @ Riffle		0.022	Dia. (mm)	D ₈₄	mm / 304.8	8 =	0.00	D₈₄ (ft)
Bank	full SLOPE		0.0001	S _{bkf} (ft / ft)		aulic RADI А _{ькf} / W _p	IUS	6.0	R (ft)
Gravitatio	onal Acceleration		32.2	g (ft / sec ²)	Relat	ive Rough R (ft) / D ₈₄ (ft)	ness	82706	
Draiı	nage AREA		2012.0	DA (mi²)		near Veloci u* =√gRS	ty	0.1	u* (ft / sec)
	ESTIMATI	л ис	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = [Roughness	2.83 +	5.66Log	{]u*	4.3	ft / sec	2400	cfs
2. Roughness roughness (Fig	Coefficient: a) M s. 2-18, 19) u = 1.480	anning 55*R ^{2/3}	's 'n' from fr *S ^{1/2} /n		r / relative =	1.1	ft / sec	614	cfs
2. Roughness b) Manning's	Coefficient:	S): n:		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	5.5	ft / sec	3085	cfs
	tion is for applications inv ble- and boulder-domin 22 and E3.					·	_		
2. Roughness c) Manning	Coefficient: s 'n' from Stream	Гуре	u = n = 0	= 1.4865* R .045	^{2/3} *S ^{1/2} /n	1.1	ft / sec	614	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-Weis	bach, C	Chezy C. etc	.)		1.1	ft / sec	600	cfs
3. Other Metho	ds (Hey, Darcy-Weis	bach, C	Chezy C, etc	.)			ft / sec		cfs
4. Continuity Return	Equations: a) Period for Bankfull I		onal Curves	s u = 0 Q = 1.46	1 1		ft / sec		cfs
4. Continuity	Equations: b)	USGS	6 Gage Dat	a u=(Q/A		ft / sec		cfs
Option 1, For	for using the D₈₄ sand-bed channels ostitute an average	: Mea	sure the "p	rotrusion h	neight " (h _{sd}) c	of sand dunes	s above char	nnel bed eleva	od 1. itions.
Option 2. For elev	boulder-dominate ations. Substitute a	i chan n ave.	nels: Meas boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _b or the D ₈₄ ter	o) of boulders m in est. me	above chani thod 1.	nel bed
. uplif	bedrock-dominate ted surfaces above term in estimation n	channe	el bed eleva	sure severa ations. Sub	l "protrusion stitute an ave	heights" (h rage bedrock	_{br}) of rock se _l < protrusion h	parations/step neight (h _{br} in f	es/joints/ eet) for the

Stream:	Wild Rice River-1-3.01		
Basin:	Red River Basin Drainage Area: 1E+06 acres	2012	mi ²
Location:	Wild Rice River-1-3.01		
Twp.&Rge:	: - Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/4/201
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	79.2	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	7.0	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	556.2	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	11.3	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		ft
	WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d _{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	333.0	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	4.2	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations	0.0031	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00010	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	3.9	
	Stream E6 See Classification (Figure 2-2		

Stre	eam: Wild Rice River-1-3	3.01				Lo	cation:	Wild R	lice Ri	ver-1-3.01				
Ob	servers: KP, AL			Date:	10/4/2	2011		Valle	у Туре:	<u>X</u>	Stream	n Type:	E6	
_				Riv	er Rea	ich Sum	mary [Data						
$\left[\right]$	Mean Riffle Depth (d _{bkf})	7.0	ft	Riffle V	Vidth (\	N _{bkf})	79	.2	ft	Riffle Area (A _b	_{kf})	556	6.2	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (V	/ _{bkfp})			ft	Pool Area (A _{bk}	_{ip})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / Rif	fle Area			A _{bkfp} /A _{bkf}
Dim	Max Riffle Depth (d _{maxrif})	10.2	ft	Max Po	ool Dep	th (d _{maxp})			ft	Max Riffle Dep	th/Mean Rif	fle Dept	h	1.5
lei	Max Pool Depth/Mean Riffle De	epth		Point E	Bar Slop)e			ft/ft	Inner Berm W	dth (W _{ib})			ft
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Depth	n Ratio			W _{ib} /d _{ib} Inner	^r Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity/	at Bank	full Sta	ge (u _{bkf}))	1.	1	ft/s	Estimation Me	thod	Н	EC-RA	S
\bigcup	Streamflow: Estimated Dischar	rge at E	Bankfull	Stage (၃ _{bkf})		60	0	cfs	Drainage Area		20	12	mi²
	Geometry	Mean	Min	Max			Dime	ension	ess Ge	ometry Ratios	5	Mean	Min	Max
\bigcap	Meander Wavelength (L _m)	910		1	ft	Meander						11.5		
Pattern	Radius of Curvature (R _c)	137			ft	Radius o	f Curva	ture/Rif	fle Wid	th (R _c /W _{bkf})		1.7		
	Belt Width (W _{blt})	1940			ft	Meander	Width	Ratio (V	V _{blt} /W _{bk}	(_t		24.5		
Channel	Individual Pool Length				ft	Pool Len	gth/Riff	le Widtl	า					
Cha	Pool to Pool Spacing				ft	Pool to P	ool Spa	cing/Ri	ffle Wic	lth				
	Riffle Length				ft	Riffle Le	ngth/Rif	fle Wid	th					
\square	Valley Slope (VS)		ft/ft	Averao	o Wate	er Surface	Slope (9)		ft/ft	Sinuosity (\	/\$/\$)		
		405	ft		Length		Clope (0)	54	83 ft	Sinuosity (S			3.9
	Low Bank Height start		ft	1 ·	Max Rif	. ,	start		ft	ı I	ht Ratio (BH		start	0.0
	(LBH) end		ft		Depth		end		ft		k Riffle Deptl		end	
	Facet Slopes	Mean	Min	Max		1				be Ratios		Mean	Min	Max
Profile	Riffle Slope (S _{rif})	0.0	<u> </u>	<u> </u>	ft/ft		·	<u> </u>		rface Slope (S _{ri}		1.0		
	Run Slope (S _{run})	<u> </u>	<u> </u>	<u> </u>	ft/ft					ace Slope (S _{run}				
Channel	Pool Slope (S _p)	!	<u> </u>	<u> </u>	ft/ft	Pool Slop	oe/Avera	age Wa	ter Surl	Face Slope (S		i		
เรื่	Glide Slope (Sg)				4.14					face Slope (S _p /				
	-	<u> </u>	<u> </u>		ft/ft	Glide Slo	pe/Ave	-		rface Slope (S _g				
	Feature Midpoint ^a	Mean	Min	Max	1		pe/Ave	sionles	ss Dep	rface Slope (S _g th Ratios	/ S)	Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	Mean 10.2	Min		ft	Max Riffl	Dimen Dimen e Depth	sionle: /Mean	ss Dep Riffle D	rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b	/ S) _{kf})	Mean 1.5	Min	Max
	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	1	Min		ft	Max Riffl Max Run	Dimen Dimen e Depth	sionles /Mean Mean F	ss Dep Riffle D Riffle De	rface Slope (S _g th Ratios Pepth (d _{maxrif} / d _b epth (d _{maxrun} / d _b	/ S) _{k1}) k1)		Min	Max
	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp})	1	Min		ft ft	Max Riffl Max Run Max Poo	Dimen Dimen e Depth Depth/ I Depth/	sionles /Mean Mean R Mean R	s s Dep Riffle D Riffle De Riffle De	rface Slope (S _g th Ratios Pepth (d _{maxrif} / d _b Pepth (d _{maxrun} / d _b	/ S) _{kl}) kl)		Min	Max
	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxru}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg})	10.2	Min		ft	Max Riffl Max Run Max Poo	Dimen Dimen e Depth Depth/ I Depth/	sionles /Mean Mean R Mean R	s s Dep Riffle D Riffle De Riffle De	rface Slope (S _g th Ratios Pepth (d _{maxrif} / d _b epth (d _{maxrun} / d _b	/ S) _{kl}) kl)	1.5		
	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea	10.2			ft ft ft	Max Riffl Max Run Max Poo	Dimen Dimen e Depth Depth/ I Depth/ e Depth	sionles //Mean Mean F Mean F /Mean Rea	ss Dep Riffle D Riffle De Riffle De Riffle D Riffle D	rface Slope (S _g th Ratios Pepth (d _{maxrif} / d _b Pepth (d _{maxrun} / d _b	/ S) _{kl}) kl)			eight ^d
	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay 9	10.2			ft ft ft	Max Riffl Max Run Max Poo Max Glid	Dimen e Depth Depth/ I Depth/ e Depth D ₁₆	sionles /Mean Mean F Mean F /Mean Rea <.0	ss Dep Riffle D Riffle De Riffle De Riffle De Riffle D Riffle D Riffle D	rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxrun} / d _b epth (d _{maxp} / d _{bl} lepth (d _{maxg} / d _{bl}	/ S) kl) kl) d)	1.5		eight ^d
Iterials	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand	10.2			ft ft ft	Max Riffl Max Run Max Poo Max Glid	Dimen e Depth Depth/ I Depth/ e Depth D ₁₆ D ₁₅	sionles //Mean Mean F /Mean /Mean Rea <.0	ss Dep Riffle D Riffle De Riffle De Riffle D Riffle D Ch ^b 001	rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxrun} / d _b epth (d _{maxp} / d _{bl} lepth (d _{maxg} / d _{bl}	/ S) kl) kl) d)	1.5		eight ^d mm
I Materials	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxru}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel	10.2 10.2 10 10 10 10 10 10 10 10 10 10 10 10 10			ft ft ft	Max Riffl Max Run Max Poo Max Glid	Dimen e Depth Depth/ I Depth/ e Depth/ e Depth D ₁₆ D ₃₅ D ₅₀	sionles //Mean F Mean F /Mean F /Mean Rea <.0 <.0	ss Dep Riffle De Riffle DE	rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxrun} / d _b epth (d _{maxp} / d _{bl} lepth (d _{maxg} / d _{bl}	/ S) kl) kl) d)	1.5		eight ^d mm mm
	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel % Cobble	10.2			ft ft ft	Max Riffl Max Run Max Poo Max Glid	Dimen e Depth Depth/ I Depth/ e Depth D ₁₆ D ₃₅ D ₅₀ D ₈₄	sionles /Mean F Mean F /Mean F /Mean Rea <.0 <.0 0.00	ss Dep Riffle De Riffle De Riffle De Riffle De Ch ^b 01 01 01 031	rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxrun} / d _b epth (d _{maxp} / d _{bl} lepth (d _{maxg} / d _{bl}	/ S) kl) kl) d)	1.5		eight ^d mm
Channel Materials	Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel % Cobble % Boulder	10.2 10.2 10 10 10 10 10 10 10 10 10 10 10 10 10			ft ft ft	Max Riffl Max Run Max Poo Max Glid	Dimen e Depth Depth/ I Depth/ e Depth/ e Depth D ₁₆ D ₃₅ D ₅₀	sionles //Mean F Mean F /Mean F /Mean Rea <.0 <.0	ss Dep Riffle De Riffle De Riffle De Riffle De Ch ^b 001 001 001 001 001	rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxrun} / d _b epth (d _{maxp} / d _{bl} lepth (d _{maxg} / d _{bl}	/ S) kl) kl) d)	1.5		eight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Sheyenne	River-8-55.	75	Station Number:	N/A	
LOCATION:	_	River-8-55.				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	2179840	acres	3406	mi ² Drainage Area Mn ELEV:	911.79	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X	
Stream Type:	E5			HUC:		
		BANKFU	LL" CHA	RACTERISTICS		
Determined from	FIELD ME	ASUREMEN	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	74.7	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	8.3	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	616.4	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	80.5	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.6	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	1000.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE asso	ciated with	"field-det	ermined" Bankfull STAGE	1000.0	cfs
Recurrence Interval (Log	₁-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.5	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> ı	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	ə =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER G	BEOMETRY		
Meander Length (L _m)	1265	ft	Radius of Curvature (R _C)	210.0	ft
Belt Width (W _{blt})		2807	ft	Meander Width Ratio (W _{blt} /W _{bkf})	37.6	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean [Depth (d) & Me	an Velocity (egression analyses of measured discharge (a), determine the <i>intercept coefficient</i> (a) and elected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)	· · · · · · · · · · · · · · · · · · ·	Sopur (U)			
Slope Exponent:	(b)					
Hydraulic Radius: R	= A / W _p		ft	Manning's "n" at Bankfull Stage	0.052	Coeff.
	·	.4865 [(A rea) (Hydrauli	c Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		р

		Bar	kfull VEI		/ DISCHAF	RGE Esti	mates		
Site	Sheyenne R	iver-8	-55.75		Location	Sheyenn	e River-8-	55.75	
Date	10/2/2011	Stre	am Type	E5	Valley Ty	/pe	X		
Observers	KP, AL				HUC				
	INPUT VA		LES			OUTPL	JT VARIA	ABLES	
Bankfull	Cross-section	al	616.4	A _{bkf} (ft ²)	Bankfu	III Mean D	EPTH	8.3	D _{bkf} (ft)
Bank	full WIDTH		74.7	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	TER	91.2	W _p (ft)
D ₈	4 @ Riffle		0.24	Dia. (mm)	D ₈₄ I	mm / 304.8	3 =	0.00	D ₈₄ (ft)
Bank	full SLOPE		0.0001	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	6.8	R (ft)
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)		8765	
Draiı	nage AREA		3406.0	DA (mi²)		ear V <u>elo</u> ci ı* =√gRS	ty	0.2	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{]u*	3.8	ft / sec	2334	cfs
	Coefficient: a s. 2-18, 19) u = 1.				r / relative =	1.0	ft / sec	643	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	6.2	ft / sec	3794	cfs
	tion is for application: ble-and boulder-do C2 and E3.						_		
2. Roughness c) Manning	Coefficient: s 'n' from Strea	ım Type		= 1.4865* R 0.052	^{2/3} *S ^{1/2} /n	1.0	ft / sec	643	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	.)		1.6	ft / sec	1000	cfs
3. Other Metho	ds (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfi		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A		ft / sec		cfs
Option 1, For	for using the E sand-bed chan ostitute an avera	nels: M	easure the "p	rotrusion h	neight" (h _{sd}) a	f sand dunes	s above char	nnel bed eleva	od 1. itions.
Option 2. For elev	boulder-domina rations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) fe	heights" (h _b or the D ₈₄ ter	 o) of boulders m in est. me 	s above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-dominated surfaces about term in estimation	ated ch we cha	annels: Meas	sure severa	protrusion	heights" (h	_{br}) of rock se	parations/step	eet) for the

Stream:	Sheyenne River-8-55.75		
Basin:	Red River Basin Drainage Area: 2E+06 acres	3406	mi ²
Location:	Sheyenne River-8-55.75		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	40818
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	74.7	ft
	Bankfull DEPTH (d _{bkf})		-
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ($d_{bkf} = A / W_{bkf}$).	8.3	ft
	Bankfull X-Section AREA (A _{bkf})		
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	616.4	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf})		
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	9.0	ft/ft
	Maximum DEPTH (d _{mbkf})		
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull		
	stage and Thalweg elevations, in a riffle section.	13.1	ft
	WIDTH of Flood-Prone Area (W _{fpa})		
	Twice maximum DEPTH, or $(2 \times d_{mbkr})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.		<i>.</i> .
	WIDTH is determined in a finite section.	898.5	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	12.0	f+/f+
		12.0	ft/ft
	Channel Materials (Particle Size Index) D ₅₀		
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.		
		0.18	mm
	Water Surface SLOPE (S)		1
	Channel slope = "rise over run" for a reach approximately 20-30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00040	61 / C ·
		0.00010	ft/ft
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by		
	channel slope (VS / S).	4.0	
			1
	Stream E5 See Classificatio		
	Type (Figure 2-2	1)	

Str	eam: Sheyenne River-8	-55.75				Lo	ocation:	Sheye	enne Ri	iver-8-55	5.75				
Ob	servers: KP, AL			Date:	40818	3		Valle	y Type:	X	_	Stream	n Type:	E5	
\frown				Riv	er Rea	ach Sum	mary I	Data	-				1		
	Mean Riffle Depth (d _{bkf})	8.26	ft		Vidth (\	4,	74	1.7	ft	Riffle Are			616	5.40	ft ²
Ę	Mean Pool Depth (d _{bkfp})	<u> </u>	ft	Pool W	/idth (V	V _{bkfp})			ft	Pool Are	a (A _{bk}	_{fp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width			W _{bkfp} / W _{bkf}	Pool Are	a / Rif	ffle Area			A _{bkfp} /A
Ē	Max Riffle Depth (d _{maxrif})	13.1	ft	Max Po	ool Dep	oth (d _{maxp})			ft	Max Riffle Depth/Mean Ri			ffle Depth		<mark>1.584</mark>
Channel	Max Pool Depth/Mean Riffle I	Depth		Point E	Bar Slop	be	ft/ft Inner B		Inner Be	nner Berm Width (W _{ib})				ft	
Cha	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	/idth/Dept	Depth Ratio W _{ib} /d _{ib}		Inne	r Berm Area	ı (A _{ib})		ft ²		
	Streamflow: Estimated Mean	Velocity	at Bank					625	ft/s	Estimatio	on Me	thod	Н	EC-R/	AS
\bigcup	Streamflow: Estimated Discha	arge at E	Bankfull	Stage (Q _{bkf})		10	00	cfs	Drainage	e Area	l	34	06	mi²
_	Geometry	Mean	Min	Max			Dim	ension	less Ge	eometry F	Ratios	3	Mean	Min	Max
	Meander Wavelength (L _m)	1265			ft	Meande	r Length	n Ratio	(L _m /W _{bk}	f)			####		
Pattern	Radius of Curvature (R _c)	210			ft	Radius o	of Curva	ture/Ri	ffle Wid	th (R₀/W♭	_{okf})		2.811		
	Belt Width (W _{blt})	2807			ft	Meande	r Width	Ratio (N _{blt} /W _{bk}	ď)			####		
Channel	Individual Pool Length				ft	Pool Ler	ngth/Riff	fle Widt	h						
Cha	Pool to Pool Spacing	<u> </u>			ft	Pool to F	Pool Spa	acing/R	iffle Wio	dth					
	Riffle Length				ft	Riffle Le	ngth/Ri	ffle Wic	lth						
$\overline{\bigcirc}$	Valley Slope (VS)		ft/ft	Averac	e Wate	er Surface	Slope ((S)		f	t/ft	Sinuosity (VS/S)		
		3167	ft	1	Length		•	() 	23	447 f	t	Sinuosity (4.0
	Low Bank Height star	t	ft	1	Max Rif	ffle	start		ft	Banl	k-Heig	ht Ratio (Bl	HR)	star	t
	(LBH) en	d I	ft		Depth	<u>1</u>	end		ft	(LB	H/Ma	x Riffle Dept	th)	enc	1
0	Facet Slopes	Mean 0.000	1	Max	ft/ft	Riffle Sk				oe Ratios rface Slop		(5)	Mean 1.000	Min	Max
Profile	Run Slope (S _{run})	0.000	' <u>i</u> I	<u> </u>	ft/ft			-		face Slop			1.000		<u> </u>
	Pool Slope (S _p)	1	<u>i</u> i	<u> </u> 	ft/ft			•		face Slop			<u> </u> 		<u>i</u>
Channel	Glide Slope (S_q)	<u> </u>	<u> </u>	<u> </u> 	ft/ft			-		rface Slop	1				<u> </u>
0	Feature Midpoint ^a	Mean	Min	Max		ende en				th Ratios		,	Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	####			ft	Max Riff			-	Depth (d _{ma}		_{okf})	1.584		
	Max Run Depth (d _{maxrun})				ft	Max Rur	n Depth	/Mean I	Riffle De	epth (d _{max}	_{run} / d _b	_{okf})			
	Max Pool Depth (d _{maxp})				ft	Max Poo	Depth	/Mean	Riffle De	epth (d _{max}	p / d _{bkt}	F)			
	Max Glide Depth (d _{maxg})				ft	Max Glic	le Depti	n/Mean	Riffle D	Depth (d _{ma}	_{ixg} / d _{bl}	kf)			
		ach ^b		fle ^c		Bar		Dee	ach ^b	Riffl		Bar	Protru	ision L	leight ^d
	Re Re			ne			D ₁₆		125	Riffi	e		lingung		mm
	% Silt/Clay	·											_	1	
rials		6 94	<u> </u>				D ₃₅	0.	16						mm
Materials							D ₃₅ D ₅₀	i	16 18						mm
nel Materials	% Sand	94						0.							1
	% Sand % Gravel	94 0					D ₅₀	0. 0.:	18						mm
Channel Materials	% Sand % Gravel % Cobble	94 0 0					D ₅₀ D ₈₄	0. 0.2 0.2	18 235						mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Sheyenne	River-7-43.	27	Station Number:	N/A	
LOCATION:		River-7-43.				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	2190720	acres	3423	mi ² Drainage Area Mn ELEV:	895.49	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	E6			HUC:		
		BANKFU	LL" CHA	RACTERISTICS		
Determined from	FIELD ME	ASUREMEN	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	80.8	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	10.1	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	819.7	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	89.0	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	je Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.5	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	1200.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE asso	ociated with	"field-det	ermined" Bankfull STAGE	1200.0	cfs
Recurrence Interval (Log	J-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.7	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> ı	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	ə =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER G	EOMETRY		
Meander Length (Lm	,)	1028	ft	Radius of Curvature (R _C)	217.0	ft
Belt Width (W _{blt})		1646	ft	Meander Width Ratio (W _{blt} /W _{bkf})	20.4	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean [Depth (d) & Me	an Velocity (egression analyses of measured discharge (a), determine the <i>intercept coefficient</i> (a) and elected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	= A / W _p		ft	Manning's "n" at Bankfull Stage	0.052	Coeff.
		.4865 [(A rea) (Hydrauli	c Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		р

		Bar	kfull VEI		/ DISCHAF	RGE Esti	mates			
Site	Sheyenne R	iver-7	-43.27		Location	Sheyenn	e River-7-	43.27		
Date	10/5/2011	Stre	am Type	E6	Valley Ty	/pe	X			
Observers	KD, JB				HUC					
	INPUT VA		LES			OUTPL	JT VARIA	ABLES		
Bankfull	Cross-section	al	819.7	A _{bkf} (ft ²)	Bankfu	Bankfull Mean DEPTH			D _{bkf} (ft)	
Bank	full WIDTH		80.8	W _{bkf}	Wetted PERIMETER ~ 2 * d _{bkf} + W _{bkf}			101.1	W _p (ft)	
D ₈	D ₈₄ @ Riffle 0.12 Dia. (mm)					mm / 304.8	3 =	0.00	D ₈₄ (ft)	
Bankfull SLOPE 0.0000 Sbkf (ft / ft)						aulic RADI A _{bkf} / W _p	US	8.1	R (ft)	
Gravitatio	Gravitational Acceleration 32.2 g (ft / sec ²)					ive Rough R (ft) / D ₈₄ (ft)		20600		
Draiı	nage AREA		3423.0	DA (mi²)	Sh	ear_ ∤⁄elo ci	ty	0.0	u* (ft / sec)	
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bank DISCH		
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log [.]	{	•]u*	0.5	ft / sec	380	cfs	
	Coefficient: a s. 2-18, 19) u = 1.				r / relative =	0.1	ft / sec	100	cfs	
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (l	JSGS):		1.4865* R ^{2/:} ¹⁶ n	^{3*} S ^{1/2} /n	4.1	ft / sec	3400	cfs	
	tion is for application ble- and boulder-do C2 and E3.									
2. Roughness c) Manning	Coefficient: s 'n' from Strea	ım Type		= 1.4865* R 0.052	^{2/3*} S ^{1/2} /n	0.1	ft / sec	100	cfs	
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	leisbach	, Chezy C, etc	.)		1.5	ft / sec	1200	cfs	
3. Other Metho	ds (Hey, Darcy-W	leisbach	, Chezy C, etc	.)			ft / sec		cfs	
4. Continuity Return	Equations: Period for Bankf		gional Curve	s u = 0 Q = 1.46	1		ft / sec		cfs	
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q / A		ft / sec		cfs	
Option 1. For Sub	for using the I sand-bed chan ostitute an averag	nels: M ge sanc	easure the "p dune protrus	sion height (height" (h _{sd}) c h _{sd} in ft) for th	of sand dunes le D ₈₄ term in	s above char est. method	nnel bed eleva 1.	tions.	
Option 2. For elev	boulder-dominations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _b or the D ₈₄ ter	 o) of boulders m in est. me 	s above chanr thod 1.	nel bed	
uplif	bedrock-domin ted surfaces abo term in estimatio	ve cha	nnel bed eleva	sure severa ations. Sub	l "protrusion stitute an ave	heights" (h rage bedrock	_{br}) of rock se _l k protrusion h	parations/step neight (h _{br} in f	s/joints/ eet) for the	

Stream:	Sheyenne River-7-43.27		
Basin:	Red River BasinDrainage Area:2E+06acres	3423	mi ²
Location:	Sheyenne River-7-43.27		
Twp.&Rge:	: - Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/5/201
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	80.8	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	10.1	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	819.7	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	8.0	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		ft
	WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d _{mbk}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	903.7	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	11.2	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations	0.0495	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00000	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.8	
	Stream E6 See Classification (Figure 2-2		

	eam: Sheyenne River-7-4	43.27				Lo	cation:	Sheye	nne Ri	iver-7-4	3.27				
Obs	servers: KD, JB			Date:	10/5/20	11		Valle	у Туре:	<u>x</u>		Stream	n Type:	E6	
				Riv	er Reac	h Sumi	mary [Data							
	Mean Riffle Depth (d _{bkf})	10.1	ft	Riffle \	Nidth (W _t	_{bkf})	80	.8	ft	Riffle A	rea (A _{bl}	(_b	81	9.7	ft ²
c.	Mean Pool Depth (d _{bkfp})		ft	Pool W	Vidth (W _{bk}	_{kfp})			ft	Pool Are	ea (A _{bkf}	p)			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Riffl	e Width			W _{bkfp} / W _{bkf}	Pool Are	ea / Rif	fle Area			A _{bkfp} /A _{bkf}
	Max Riffle Depth (d _{maxrif})	14.8	ft	Max Po	ool Depth	(d _{maxp})			ft	Max Rif	fle Dep	th/Mean Rif	fle Dep	th	1.5
Channel	Max Pool Depth/Mean Riffle De	epth		Point E	Bar Slope				ft/ft	Inner Be	ərm Wi	dth (W _{ib})			ft
Cha	Inner Berm Depth (d _{ib})		ft	Inner E	Berm Wid	th/Depth	n Ratio			W _{ib} /d _{ib}	Inner	Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean V	/elocity	at Bank	full Sta	ge (u _{bkf})		1.	.5	ft/s	Estimation Method			HEC-RA		AS
\Box	Streamflow: Estimated Dischar	rge at B	ankfull	Stage (Q _{bkf})		12	00	cfs	Drainag	e Area		34	23	mi²
	Geometry	Mean	Min	Max	•					ometry	Ratios		Mean	Min	Max
	Meander Wavelength (L _m)	1028		<u> </u>	ft N	Meander	Length	Ratio	L _m /W _{bkt}	;)			12.7		
Pattern	Radius of Curvature (R _c)	217		<u> </u>						th (R _c /W	_{bkf})		2.7		<u> </u>
	Belt Width (W _{blt})	1646		<u> </u>		Meander				,f)			20.4		<u> </u>
Channel	Individual Pool Length	<u> </u>	<u> </u>	<u> </u>		Pool Len	•								<u> </u>
Ü	Pool to Pool Spacing	1	<u> </u>	<u> </u>		Pool to P		-		lth					<u> </u>
	Riffle Length			<u> </u>	ft F	Riffle Ler	ngth/Rif	fle Wid	th]			
\square	Valley Slope (VS)		ft/ft	Averag	ge Water S	Surface	Slope (S)			ft/ft	Sinuosity (\	/S/S)		
	Stream Length (SL) 43	888	ft	Valley	Length (V	/L)			24	110	ft	Sinuosity (S	SL/VL)		1.8
	Low Bank Height start (LBH) end		ft ft		Max Riffle	e	start		ft	Ban	k-Hoia			star	
					Depth		end		ft			ht Ratio (BH Riffle Deptl			•
<u>o</u>	Facet Slopes	Mean	Min	Max	Depth		end Dimer	sionle			3H/Max			enc	•
١Ę	Riffle Slope (S _{rif})	Mean 0.0	Min	Max	•	Riffle Slo	Dimer		ss Slop	(LE	BH/Max	Riffle Dept	h)	enc	
Profile			Min	Max	ft/ft F		Dimer pe/Ave	rage W	ss Slop ater Su	(LE De Ratio	BH/Max s ope (S _{rif}	<pre>/ Riffle Deptl / S)</pre>	h) Mean	enc	
I = I	Riffle Slope (S _{rif})		Min	Max	ft/ft F ft/ft F ft/ft F	Run Slop Pool Slop	Dimer ppe/Ave pe/Avera	rage W age Wa age Wa	ss Slop ater Su ter Surf ter Surf	(LE De Ratio rface Slop face Slop	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p /	<pre>/ S) / S) S)</pre>	h) Mean	enc	
Channel Profil	Riffle Slope (S _{rif}) Run Slope (S _{run})		Min	Max	ft/ft F ft/ft F ft/ft F	Run Slop Pool Slop	Dimer ppe/Ave pe/Avera	rage W age Wa age Wa	ss Slop ater Su ter Surf ter Surf	(LE be Ratio rface Slo face Slop	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p /	<pre>/ S) / S) S)</pre>	h) Mean	enc	
1 – 1	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a	0.0	Min Min	Max Max Max	ft/ft F ft/ft F ft/ft F ft/ft C	Run Slop Pool Slop Glide Slo	Dimer pe/Ave pe/Avera pe/Avera pe/Ave	rage W age Wa age Wa rage W rage W	ss Slop ater Su ter Surf ater Surf ater Sur	(LE ce Ratio rface Slop face Slop face Slop rface Slop rface Slop	BH/Max s ppe (S _{rif} pe (S _p / pe (S _g s	<pre>/ S) / S) / S) / S) / S)</pre>	h) Mean 1.0 Mean	enc	
I = I	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})	0.0			ft/ft F ft/ft F ft/ft F ft/ft C ft/ft C	Run Slop Pool Slop Glide Slo Max Riffl	Dimer pe/Ave pe/Avera pe/Avera pe/Avera pe/Avera Dimen e Depth	rage W age Wa age Wa rage W sionle n/Mean	ss Slop ater Su ter Surf ter Surf ater Sur ater Su ss Dep Riffle D	(LE be Ratio rface Slop face Slop face Slop rface Slop th Ratio bepth (d _m	BH/Max s ppe (S _{rif} pe (S _p / pe (S _p ppe (S _g s axrif / d _{bl}	<pre>(Riffle Deptl / S) / S) / S) / S) / S)</pre>	h) Mean 1.0	enc Min	Max
1 – 1	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrun})	0.0		Max	ft/ft F ft/ft F ft/ft F ft/ft C ft/ft C ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run	Dimer pe/Aver pe/Aver pe/Aver pe/Aver Dimen e Depth	rage W age Wa age Wa rage W sionle n/Mean Mean F	ss Slop ater Su ter Surf ater Surf ater Su ss Dep Riffle De	(LE be Ratio rface Slop face Slop face Slop rface Slop th Ratio bepth (d _m	BH/Max ppe (S _{rif} pe (S _{run} pe (S _g ppe (S _g s s axrif / d _{bl}	<pre>< Riffle Deptl / S) / S) / S) / S) / S) / d) </pre>	h) Mean 1.0 Mean	enc Min	Max
1 – 1	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp})	0.0		Max	ft/ft F ft/ft F ft/ft F ft/ft C ft N ft N ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Pool	Dimer ppe/Aver pe/Aver pe/Aver pe/Aver Dimer e Depth/ Depth/	rage W age Wa age Wa rage W sionle n/Mean F Mean F	ter Surf ter Surf ater Surf ater Surf ater Sur ss Dep Riffle De Riffle De	(LE pe Ratio rface Slop face Slop face Slop rface Slop rface Slo th Ratio bepth (d _{ma} epth (d _{ma}	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p / pe (S _g s s axrif / d _b xrun / d _b	<pre>(Riffle Deptl / S) / S) / S) / S) / S) / d) d)</pre>	h) Mean 1.0 Mean	enc Min	Max
I = I	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrun})	0.0		Max	ft/ft F ft/ft F ft/ft F ft/ft C ft N ft N ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Pool	Dimer ppe/Aver pe/Aver pe/Aver pe/Aver Dimer e Depth/ Depth/	rage W age Wa age Wa rage W sionle n/Mean F Mean F	ter Surf ter Surf ater Surf ater Surf ater Sur ss Dep Riffle De Riffle De	(LE be Ratio rface Slop face Slop face Slop rface Slop th Ratio bepth (d _m	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p / pe (S _g s s axrif / d _b xrun / d _b	<pre>(Riffle Deptl / S) / S) / S) / S) / S) / d) d)</pre>	h) Mean 1.0 Mean	enc Min	Max
I = I	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Ol Depth (d _{maxg}) Max Glide Depth (d _{maxg})	0.0 Mean 14.8	Min	Max	ft/ft F ft/ft F ft/ft F ft/ft C ft N ft N ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Pool Max Glid	Dimer pe/Avera pe/Avera pe/Avera pe/Avera Dimen e Depth/ Depth/ I Depth/ e Depth	rage W age Wa age Wa rage W sionle Mean F Mean F Mean I Mean Mean	ss Slop ater Surf ter Surf ater Surf ater Sur ss Dep Riffle De Riffle De Riffle De	(LE pe Ratio rface Slop face Slop face Slop rface Slop rface Slo th Ratio bepth (d _{ma} epth (d _{ma}	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p / pe (S _g s axrif / d _b xrun / d _b axg / d _b	<pre>(Riffle Deptl / S) / S) / S) / S) / S) / d) d)</pre>	h) Mean 1.0 Mean 1.5	enc Min Min	Max
Channel	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxg}) Max Glide Depth (d _{maxg})	0.0 Mean 14.8 ach ^b 66	Min	Max	ft/ft F ft/ft F ft/ft F ft/ft C ft/ft N ft N ft N ft N ft N ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Pool Max Glid	Dimer ppe/Aver pe/Aver pe/Aver pe/Aver Dimer e Depth/ Depth/	rage W age Wa age Wa rage W sionle n/Mean F /Mean I n/Mean I n/Mean I Mean A (Mean I	ss Slop ater Surf ter Surf ater Surf ater Surf ater Surf ss Dep Riffle De Riffle De Riffle De Riffle De Riffle De	(LE pe Ratio rface Slop face Slop face Slop rface Slop rface Slop th Ratio Depth (dma epth (dma epth (dma epth (dma	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p / pe (S _g s axrif / d _b xrun / d _b axg / d _b	<pre>(Riffle Deptl / S) / S) S) / S) d) d) d) f)</pre>	h) Mean 1.0 Mean 1.5	enc Min Min	Max
Channel	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand	0.0 Mean 14.8 ach ^b 66	Min	Max	ft/ft F ft/ft F ft/ft F ft/ft C ft/ft N ft N ft N ft N ft N ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Pool Max Glid	Dimer pe/Avera pe/Avera pe/Avera pe/Avera Dimen e Depth/ Depth/ I Depth/ e Depth Dapth/ e Depth	rage W age Wa age Wa rage W sionle Mean F Mean I Mean I Mean A Mean A Me	ss Slop ater Surf ter Surf ater Surf ater Surf ater Surf ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do	(LE pe Ratio rface Slop face Slop face Slop rface Slop rface Slop th Ratio Depth (dma epth (dma epth (dma epth (dma	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p / pe (S _g s axrif / d _b xrun / d _b axg / d _b	<pre>(Riffle Deptl / S) / S) S) / S) d) d) d) f)</pre>	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max
Materials Channel	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Glide Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Gravel	0.0 Mean 14.8 14.8 ach ^b 56	Min	Max	ft/ft F ft/ft F ft/ft F ft/ft C ft/ft N ft N ft N ft N ft N ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Pool Max Glid	Dimer pe/Avera pe/Avera pe/Avera Dimen e Depth/ Depth/ I Depth/ I Depth/ I Depth/ I Depth/ I Depth/ Dast Das Das	rage W age Wa age Wa rage W sionle Mean P Mean P Mean I Mean I Mean O C.C 0.C	ss Slop ater Surf ter Surf ater Surf ater Surf ater Surf ss Dep Riffle De Riffle De	(LE pe Ratio rface Slop face Slop face Slop rface Slop rface Slop th Ratio Depth (dma epth (dma epth (dma epth (dma	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p / pe (S _g s axrif / d _b xrun / d _b axg / d _b	<pre>(Riffle Deptl / S) / S) S) / S) d) d) d) f)</pre>	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max I I I I I I I I I I I I I I I I I I I
Materials Channel	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Glide Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Gravel % Cobble	0.0 Mean 14.8 14.8	Min	Max	ft/ft F ft/ft F ft/ft F ft/ft C ft/ft N ft N ft N ft N ft N ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Pool Max Glid	Dimer pe/Avera pe/Avera pe/Avera pe/Avera Dimen e Depth/ Depth/ I Depth/ I Depth/ e Depth Daga Daga Daga Daga	rage W age Wa age Wa rage W sionle m/Mean f /Mean f /Mean f /Mean f (Mean f 0.0 0.0	ss Slop ater Surf ter Surf ater Surf ater Surf ater Surf ss Dep Riffle De Riffle DE Ri	(LE pe Ratio rface Slop face Slop face Slop rface Slop rface Slop th Ratio Depth (dma epth (dma epth (dma epth (dma	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p / pe (S _g s axrif / d _b xrun / d _b axg / d _b	<pre>(Riffle Deptl / S) / S) S) / S) d) d) d) f)</pre>	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max Max
Channel	Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Ool Depth (d _{maxrun}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Gravel % Cobble % Boulder	0.0 Mean 14.8 14.8 ach ^b 56	Min	Max	ft/ft F ft/ft F ft/ft F ft/ft C ft/ft N ft N ft N ft N ft N ft N ft N	Run Slop Pool Slop Glide Slo Max Riffl Max Run Max Pool Max Glid	Dimer pe/Avera pe/Avera pe/Avera Dimen e Depth/ Depth/ I Depth/ I Depth/ I Depth/ I Depth/ I Depth/ Dast Das Das	rage W age Wa age Wa rage W sionle /Mean F /Mean I /Mean I /Mean 0. 0.0 0.0	ss Slop ater Surf ter Surf ater Surf ater Surf ater Surf ss Dep Riffle De Riffle De	(LE pe Ratio rface Slop face Slop face Slop rface Slop rface Slop th Ratio Depth (dma epth (dma epth (dma epth (dma	BH/Max ppe (S _{rif} pe (S _{run} pe (S _p / pe (S _g s axrif / d _b xrun / d _b axg / d _b	<pre>(Riffle Deptl / S) / S) S) / S) d) d) d) f)</pre>	h) Mean 1.0 Mean 1.5	enc Min Min	Max Max Max

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Sheyenne	River - 6 - 3	35.82	Station Number:	N/A	
		River - 6 - 3				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	2197120	acres	3433	mi ² Drainage Area Mn ELEV:	891.87	ft
Reference REACH SLO			ft/ft	Valley Type:	<u> </u>	
Stream Type:	E6	'BANKFU	LL" CH/			
Determined from				Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_{.f})	72.0	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	7.9	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	568.9	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	78.0	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	((u)	1.5	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	860.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	termined" Bankfull STAGE	860.0	cfs
Recurrence Interval (Log	₃-Pearson)a	ssociated wit	h "field-det	termined" Bankfull Discharge	1.4	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Ana	lysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER (GEOMETRY		
Meander Length (Lm	,)	936	ft	Radius of Curvature (R _C)	224.0	ft
Belt Width (W _{blt})		1744	ft	Meander Width Ratio (W _{blt} /W _{bkf})	24.2	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean [Depth (d) & Me	an Velocity (regression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)	······································	D op at (D)			
Slope Exponent:	(b)					
Hydraulic Radius: R	$= A / W_p$		ft	Manning's "n" at Bankfull Stage	0.046	Coeff.
	" n " = 1	.4865 [(A rea	۱) (Hydraul	lic R adius ^{2/3}) (S lope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI			RGE Estir	nates		
Site	Sheyenne R	iver -	6 - 35.82		Location	Sheyenn	e River - 6	6 - 35.82	
Date	11/21/2010	Stre	am Type	E6	Valley Ty	rpe	X		
Observers	KP, AL				HUC				
	INPUT VA	RIAB	LES			OUTPU	T VARIA	ABLES	
Bankfull	Cross-section	al	568.9	A _{bkf} (ft ²)	Bankfu	Bankfull Mean DEPTH			D _{bkf} (ft)
Bank	cfull WIDTH		72.0	W _{bkf}	Wetted PERIMETER ~ 2 * d _{bkf} + W _{bkf}			87.8	W _p (ft)
D ₈	D ₈₄ @ Riffle 0.12 Dia. (mm)					mm / 304.8	3 =	0.00	D ₈₄ (ft)
Bankfull SLOPE 0.0002 Sbkf (ft / ft)						aulic RADI A _{bkf} / W _p	US	6.5	R (ft)
Gravitatio	Gravitational Acceleration 32.2 g (ft / sec ²)					ive Roughı १ (ft) / D ₈₄ (ft)	ness	16455	
Drai	nage AREA		3433.0	DA (mi²)		ear Veloci ı* =√gRS	ty	0.2	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull VELOCITY			tfull ARGE
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log [.]	{	•]u*	4.8	ft / sec	2709	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	i) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	1.4	ft / sec	789	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (U	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	6.2	ft / sec	3540	cfs
roughness, cob	tion is for applications								
A3, B1, B2, B3, C 2. Roughness c) Manning		m Type		= 1.4865* R 3 0.046	^{2/3*} S ^{1/2} /n	1.4	ft / sec	789	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	, Chezy C, etc	.)		1.5	ft / sec	860	cfs
3. Other Metho	ods (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfu		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1 1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=0	Q / A		ft / sec		cfs
Option 1. For	s for using the E sand-bed chan ostitute an averag	nels: M	easure the "p	rotrusion h	neight" (h _{sd}) o	f sand dunes	above char	nnel bed eleva	
Option 2. For	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion I ght (h _{bo} in ft) fo	heights" (h _{bo} or the D ₈₄ ter) of boulders m in est. me	s above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-domination ted surfaces abo term in estimation	ated ch ive chai	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	or) of rock se	parations/step	s/joints/ eet) for the

Stream:	Sheyenne River - 6 - 35.82		
Basin:	Red River Basin Drainage Area: 2E+06 acres	3433	mi ²
Location:	Sheyenne River - 6 - 35.82		
Twp.&Rge:	: - Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date	11/21/2010
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	72.0	ft
	Bankfull DEPTH (d _{bkf})		1
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	7.9	ft
	Bankfull X-Section AREA (A _{bkf})		1
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	568.9	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf})]
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	9.1	ft/ft
	Maximum DEPTH (d _{mbkf})]
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	11.6	ft
	WIDTH of Flood-Prone Area (W _{fpa})		1
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area		
	WIDTH is determined in a riffle section.	810.8	ft
	Entrenchment Ratio (ER)]
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	11.3	ft/ft
	Channel Materials (Particle Size Index) D ₅₀]
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.		
		0.0175	mm
	Water Surface SLOPE (S)		-
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.		
		0.00015	ft/ft
	Channel SINUOSITY (k)]
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by		
	channel slope (VS / S).	1.8	
	Stream F6 See Classification	on Key]
	Stream E6 See Classification (Figure 2-2)		

SIL	eam: Sheyenne River - 6	5 - 35.8	2			Location:	Sheye	nne Ri	iver - 6 - 35.82			
Obs	servers: KP, AL			Date:	11/21/2010		Valley	/ Туре:	X Strea	am Type:	E6	
_				Riv	er Reach Su	ımmary I	Data					
\bigcap	Mean Riffle Depth (d _{bkf})	7.9	ft	Riffle V	Vidth (W _{bkf})	72	2.0	ft	Riffle Area (A _{bkf})	56	8.9	ft ²
_	Mean Pool Depth (d _{bkfp})	<u> </u>	ft	Pool W	/idth (W _{bkfp})			ft	Pool Area (A _{bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Riffle Wid	dth		W _{bkfp} / W _{bkf}	Pool Area / Riffle Area			A _{bkfp} /A _{bkf}
Dim	Max Riffle Depth (d _{maxrif})	11.6	ft	Max Po	ool Depth (d _{max}	_{xp})		ft	Max Riffle Depth/Mean F	Riffle Dept	th	1.5
Channel	Max Pool Depth/Mean Riffle D	epth		Point E	Bar Slope			ft/ft	Inner Berm Width (W_{ib})			ft
Cha	Inner Berm Depth (d _{ib})	<u> </u>	ft	Inner E	Berm Width/De	Depth Ratio W _{ib} /d _{ib} Inner Berm		W _{ib} /d _{ib} Inner Berm Are	Area (A _{ib})		ft ²	
	Streamflow: Estimated Mean	/elocity	at Bank	full Sta	ge (u _{bkf})	1	.5	ft/s	Estimation Method	Н	HEC-RA	
	Streamflow: Estimated Discha	rge at B	ankfull	Stage (Q _{bkf})	8	60	cfs	Drainage Area	34	33	mi²
	Geometry	Mean	Min	Max		Dime	ensionl	ess Ge	eometry Ratios	Mean	Min	Max
[_]	Meander Wavelength (L _m)	936			ft Mean	der Length	n Ratio (L _m /W _{bkf}	.)	13.0		
Pattern	Radius of Curvature (R _c)	224							th (R _c /W _{bkf})	3.1		
	Belt Width (W _{blt})	1744			ft Mean	der Width	Ratio (V	V _{blt} /W _{bk}	f)	24.2		
Channel	Individual Pool Length	<u> </u>	<u> </u>	<u> </u>	ft Pool L	_ength/Riff	le Width	1				
یّ اگ	Pool to Pool Spacing	<u> </u>	<u> </u>	<u> </u>		o Pool Spa	-		lth			
\Box	Riffle Length	<u> </u>			ft Riffle	Length/Rif	fle Widt	h				
\square	Valley Slope (VS)		ft/ft	Averag	e Water Surfa	ace Slope (S)		ft/ft Sinuosity	(VS/S)		
	Stream Length (SL) 61	075	ft	Valley	Length (VL)			34	279 ft Sinuosity	(SL/VL)		1.8
	Low Bank Height start (LBH) end		ft ft		Max Riffle Depth	start end		ft ft	Bank-Height Ratio (B (LBH/Max Riffle De		start end	•
	Facet Slopes	Mean	Min	Max		Dimer	i i	ss Slor				Max
Profile	Riffle Slope (S _{rif})	0.0		1		Bunor	nsionles		pe Ratios	Mean	Min	mux
I = I	Run Slope (S _{run})			<u>i</u>	ft/ft Riffle				pe Ratios rface Slope (S _{rif} / S)	Mean 1.0	Min	
101						Slope/Ave	rage Wa	ater Su			Min	
Ê	Pool Slope (S _p)				ft/ft Run S ft/ft Pool S	Slope/Ave Slope/Aver Slope/Aver	rage Wa age Wa age Wa	ater Surf ter Surf ter Surf	rface Slope (S _{rif} / S) ace Slope (S _{run} / S) face Slope (S _p / S)		Min	
Channel	Glide Slope (Sg)				ft/ft Run S ft/ft Pool S	Slope/Ave Slope/Aver Slope/Aver Slope/Ave	rage Wa age Wa age Wa rage Wa	ater Surf ter Surf ter Surf ater Sur	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S)		Min	
Chann	Glide Slope (S _g) Feature Midpoint ^a	Mean	Min	Max	ft/ft Run S ft/ft Pool S ft/ft Glide	Slope/Aver Slope/Aver Slope/Aver Slope/Ave Dimer	rage Wa age Wa age Wa rage Wa nsionles	ater Surf ter Surf ater Surf ater Surf	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios	1.0	Min Min	Max
Chann	Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})	Mean 11.6	Min		ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F	Slope/Aver Slope/Aver Slope/Aver Slope/Ave Dimer Riffle Depth	rage Wa age Wa age Wa rage Wa nage Wa	ater Surf ter Surf ter Surf ater Surf ss Dep Riffle D	fface Slope (S_{rif} / S) face Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios Depth (d_{maxrif} / d_{bkf})	1.0		
Chann	Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})		Min		ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F	Slope/Ave Slope/Aver Slope/Aver Slope/Ave Dimer Riffle Depth Run Depth/	rage Wa age Wa age Wa rage Wa nsionles n/Mean Mean R	ater Surf ter Surf ater Surf ater Surf ss Dep Riffle De	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) rface Slope (S_d / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxrun} / d_{bkf})	1.0		
Chann	Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxru}) Max Pool Depth (d _{maxp})		Min		ft/ft Run S ft/ft Pool S ft/ft Glide ft Max R ft Max R ft Max R	Slope/Ave Slope/Aver Slope/Aver Slope/Ave Dimer Riffle Depth Run Depth/	rage Wa age Wa age Wa rage Wa nsionles n/Mean R /Mean R	ater Surf ter Surf ater Surf Riffle De Riffle De	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf})	1.0		
Chann	Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})		Min		ft/ft Run S ft/ft Pool S ft/ft Glide ft Max R ft Max R ft Max R	Slope/Ave Slope/Aver Slope/Aver Slope/Ave Dimer Riffle Depth Run Depth/	rage Wa age Wa age Wa rage Wa nsionles n/Mean R /Mean R	ater Surf ter Surf ater Surf Riffle De Riffle De	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) rface Slope (S_d / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxrun} / d_{bkf})	1.0		
Chann	Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea	11.6			ft/ft Run S ft/ft Pool S ft/ft Glide ft Max R ft Max R ft Max R	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth/ Pool Depth Glide Depth	rage Wa age Wa rage Wa rage Wa nasionles n/Mean Mean R n/Mean n/Mean Rea	ater Surf ter Surf ater Surf ater Surf Bater	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf})	1.0 Mean 1.5	Min	
	Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Re: % Silt/Clay	ach ^b			ft/ft Run S ft/ft Pool S ft/ft Glide ft Max R ft Max R ft Max R ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth/ Slide Depth Slide Depth	rage Wa age Wa rage State rage rage rage rage rage rage rage rage	ater Surf ter Surf ater Surf ater Surf Riffle De Riffle De Riffle De Riffle De Riffle D	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) rface Slope (S_g / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf}) epth (d_{maxg} / d_{bkf})	1.0 Mean 1.5	Min	Max
	Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Re: % Silt/Clay % Sand	11.6 ach ^b 73 27			ft/ft Run S ft/ft Pool S ft/ft Glide ft Max R ft Max R ft Max R ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth Pool Depth Blide Depth Blide Depth	rage Wa age Wa age Wa rage Wa rage Wa n/Mean Mean R Mean R n/Mean R n/Mean Rea <.0	ater Surf ter Surf ter Surf ater Surf ater Surf SS Dep Riffle De Riffle De Riffle De Riffle De Ch ^b 01 035	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) rface Slope (S_g / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf}) epth (d_{maxg} / d_{bkf})	1.0 Mean 1.5	Min	Max Max
Materials	Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel	11.6 ach ^b 73 27 0			ft/ft Run S ft/ft Pool S ft/ft Glide ft Max R ft Max R ft Max R ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth, Slide Depth Glide Depth D ₁₆ D ₃₅ D ₅₀	rage Wa age Wa age Wa rage Wa rage Wa rage Wa rage Wa n/Mean /Mean R /Mean R /Mean A /Mean A /Mean A 0.00 0.00	ater Surf ter Surf ter Surf ater Surf ater Surf ater Surf ss Dep Riffle De Riffle De Riffle De Riffle D Ch ^b 01 035	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) rface Slope (S_g / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf}) epth (d_{maxg} / d_{bkf})	1.0 Mean 1.5	Min	Max Max eight ^d
Materials	Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxrun}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel % Cobble	11.6 ach ^b 73 27 0			ft/ft Run S ft/ft Pool S ft/ft Glide ft Max R ft Max R ft Max R ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth/ Pool Depth Slide Depth D ₁₆ D ₃₅ D ₅₀ D ₈₄	rage Wa age Wa age Wa rage Wa rage Wa rage Wa sionles n/Mean R n/Mean R n/Mean R Rea 0.00 0.0	ater Surf ter Surf ter Surf ater Surf ater Surf ss Dep Riffle De ch ^b 01 035 175	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) rface Slope (S_g / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf}) epth (d_{maxg} / d_{bkf})	1.0 Mean 1.5	Min	Max Max eight ^d mm
	Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxrun}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand 2 % Gravel 9 % Boulder 9	11.6 ach ^b 73 27 0			ft/ft Run S ft/ft Pool S ft/ft Glide ft Max R ft Max R ft Max R ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth, Slide Depth Glide Depth D ₁₆ D ₃₅ D ₅₀	rage Wa age Wa age Wa rage Wa rage Wa rage Wa rage Wa n/Mean /Mean R /Mean R /Mean A /Mean A /Mean A 0.00 0.00	ater Surf ter Surf ter Surf ater Surf ater Surf ss Dep Riffle De ch ^b 01 035 175 12	rface Slope (S_{rif} / S) race Slope (S_{run} / S) face Slope (S_p / S) rface Slope (S_g / S) rface Slope (S_g / S) th Ratios Depth (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf}) epth (d_{maxg} / d_{bkf})	1.0 Mean 1.5	Min	Max Max eight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Sheyenne	River-5-26.	.47	Station Number:	N/A	
		River-5-26.			·	
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	2224640	acres	3476	mi ² Drainage Area Mn ELEV:	881.57	ft
Reference REACH SLO			ft/ft	Valley Type:	X]
Stream Type:	E5					
	"	'BANKFU	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME			Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_{(f})	62.7	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	6.1	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	379.3	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	67.5	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	r (u)	1.5	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	580.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	HARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	580.0	cfs
Recurrence Interval (Log	յ-Pearson)a	ssociated wit	h "field-det	termined" Bankfull Discharge	1.2	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Anal	lysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER G	GEOMETRY		
Meander Length (Lm	n)	850	ft	Radius of Curvature (R _C)	196.0	ft
Belt Width (W _{blt})		2230	ft	Meander Width Ratio (W_{blt}/W_{bkf})	35.5	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Are	rea (A), Mean I	Depth (d) & Me	an Velocity (regression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	d the slope exp	ponent (b)
Intercept Coefficient:	(a)	,				
Slope Exponent:	(b)					
Hydraulic Radius: R	$z = A / W_p$		ft	Manning's "n" at Bankfull Stage	0.046	Coeff.
	" n " = 1	.4865 [(A rea	ı) (Hydrauli	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	nkfull VE		/ DISCHAF	RGE Estii	nates		
Site	Sheyenne R	iver-5	-26.47		Location	Sheyenn	e River-5-	26.47	
Date	10/5/2011	Stre	am Type	E5	Valley Ty	rpe	X		
Observers	KP, AL				HUC				
	INPUT VA	RIAB	LES			OUTPU	IT VARIA	ABLES	
Bankfull	Cross-section	al	379.3	A _{bkf} (ft ²)	Bankfu	Bankfull Mean DEPTH			D _{bkf} (ft)
Bank	full WIDTH		62.7	W _{bkf}	Wetted PERIMETER ~ 2 * d _{bkf} + W _{bkf}			74.9	W _p (ft)
D ₈	D ₈₄ @ Riffle 0.24 Dia. (mm)					mm / 304.8	3 =	0.00	D ₈₄ (ft)
Bankfull SLOPE 0.0002 S bkf (ft / ft)						aulic RADI A _{bkf} / W _p	US	5.1	R (ft)
Gravitatio	Gravitational Acceleration 32.2 g (tt / sec ²)					ive Roughı R (ft) / D ₈₄ (ft)	ness	6435	
Draiı	nage AREA		3476.0	DA (mi²)		ear Veloci ı* =√gRS	ty	0.2	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{]u*	4.0	ft / sec	1525	cfs
	Coefficient: a s. 2-18, 19) u = 1.				r / relative =	1.2	ft / sec	467	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	JSGS):		1.4865* R ^{2/:} ¹⁶ n	^{3*} S ^{1/2} /n	5.1	ft / sec	1946	cfs
	tion is for application: ble-and boulder-do C2 and E3.								
2. Roughness c) Manning	s Coefficient: s 'n' from Strea	m Type		= 1.4865* R 0.046	^{2/3} *S ^{1/2} /n	1.2	ft / sec	467	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)		1.5	ft / sec	580	cfs
3. Other Metho	ds (Hey, Darcy-W	leisbach	n, Chezy C, etc	.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfu		gional Curve aarge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A		ft / sec		cfs
Option 1, For	for using the E sand-bed chan ostitute an averag	nels: M	easure the "p	rotrusion h	neight " (h _{sd}) o	f sand dunes	above char	nnel bed eleva	d 1. tions.
Option 2. For elev	boulder-domina vations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion I ght (h _{bo} in ft) fo	h eights" (h _{bo} or the D ₈₄ ter) of boulders m in est. me	s above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-dominated surfaces about term in estimation	ated ch	annels: Meas	sure severa	protrusion	heights" (h	or) of rock se	parations/step	s/joints/ eet) for the

Stream:	Sheyenne River-5-26.47		
Basin:	Red River Basin Drainage Area: 2E+06 acres	3476	mi ²
Location:	Sheyenne River-5-26.47		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/5/201 ⁻
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	62.7	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	6.1	ft
	Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	379.3	ft ²
	Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	10.4	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.	9.9	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkl}) =$ the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	376.7	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	6.0	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D ₅₀ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.12	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00017	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.7	
	Stream E5 See Classification (Figure 2-2		

	eam: Sheyenne River-5-2	26.47				Lo	cation:	Sheye	enne Ri	iver-5-2	6.47				
Ob	servers: KP, AL			Date:	10/5/2	011		Valle	у Туре:	Х		Stream	n Type:	E5	
_				Riv	er Rea	ch Sum	mary I	Data							
	Mean Riffle Depth (d _{bkf})	6.1	ft	Riffle \	Width (V	V _{bkf})	62	2.7	ft	Riffle Ar	ea (A _{bk}	(_t	379	9.3	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft	Pool Are	ea (A _{bkfi}	p)			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	fle Width			W _{bkfp} / W _{bkf}	Pool Are	ea / Riff	fle Area			A _{bkfp} /A _{bkf}
ا قا	Max Riffle Depth (d _{maxrif})	9.89	ft	Max Po	ool Dept	th (d _{maxp})			ft	Max Riff	fle Dep	th/Mean Rif	fle Dept	h	1.6
lan	Max Pool Depth/Mean Riffle De	epth		Point E	3ar Slop	е			ft/ft	Inner Be	erm Wi	dth (W _{ib})			ft
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Depth	n Ratio			W_{ib}/d_{ib}	Inner	Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean V	/elocity	at Bank	full Sta	ge (u _{bkf})		1	.5	ft/s	Estimati	on Met	hod	Н	EC-R/	AS
	Streamflow: Estimated Dischar	rge at E	Bankfull	Stage (Q _{bkf})		58	30	cfs	Drainag	e Area		34	76	mi ²
	Geometry	Mean	Min	Max			Dime	ension	less Ge	ometry	Ratios		Mean	Min	Max
	Meander Wavelength (L _m)	850			ft	Meander	Length	Ratio	(L _m /W _{bk}	f)			13.5		
Pattern	Radius of Curvature (R _c)	196			ft	Radius o	f Curva	ture/Ri	ffle Wid	th (R _c /W	_{bkf})		3.1		
	Belt Width (W _{blt})	2230			ft	Meander	Width	Ratio (N _{blt} /W _{bk}	(t			35.5		
Channel	Individual Pool Length				ft	Pool Len	gth/Riff	le Widt	h						
မြို	Pool to Pool Spacing		-	-	ft	Pool to P	ool Spa	acing/R	iffle Wio	dth					
\bigcup	Riffle Length			<u> </u>	ft	Riffle Le	ngth/Rif	fle Wic	lth						
\square	Valley Slope (VS)		ft/ft	Averag	je Wate	r Surface	Slope (S)		1	ft/ft	Sinuosity (\	/S/S)		
	Stream Length (SL) 32	606	ft	Valley	Length	(VL)			19	226	ft	Sinuosity (S	SL/VL)		1.7
	Low Bank Height start		ft		Max Rif		start		ft			ht Ratio (BH		star	•
	(LBH) end Facet Slopes	Mean	ft Min	Max	Depth	1	end	nionlo	ft	(LE De Ratio		Riffle Dept	n) Mean	end Min	Max
ie	Riffle Slope (S _{rif})	0.0		IVIAX	ft/ft	Riffle Slo						/ S)	1.0		IVIAX
Profile	Run Slope (S _{run})			<u> </u>	ft/ft	Run Slop	be/Avera	age Wa	ater Surf	face Slop	e (S _{run}	/ S)			
<u>e</u>	Pool Slope (S _p)		<u> </u>	<u>.</u>	ft/ft	Pool Slop	oe/Aver	age Wa	ater Sur	face Slop	be (S _p /	S)			
Channel	Glide Slope (Sg)				ft/ft	Glide Slo	pe/Ave	rage W	ater Su	rface Slo	pe (S _g	/ S)			
	Feature Midpoint ^a	Mean	Min	Max					-	th Ratio			Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	9.9			ft	Max Riff							1.6		
	Max Run Depth (d _{maxrun})				ft	Max Run									
	Max Pool Depth (d _{maxp})				ft	Max Poo					<u> </u>				
\cup	Max Glide Depth (d _{maxg})				ft	Max Glid	e Depth	n/Mean	Riffle D	epth (d _m	_{axg} / d _{bk}	f)			
	Rea	ach ^b	Rif	fle ^c	E	Bar		Rea	ach ^b	Riff	le ^c	Bar	Protru	sion F	leight ^d
6		67 67					D ₁₆		001						mm
erial	% Sand 6	63					D ₃₅	0.	071						mm
Materials	% Gravel	0					D ₅₀	0.	12						mm
	% Cobble	0					D ₈₄	0.	24						mm
Channel	% Boulder	0					D ₉₅	0.	49						mm
Ľ	% Bedrock	0					D ₁₀₀		5						mm
L A Con	max, mean depths are ave. mid-p									^c Active b					

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

			TATION Data/Records for CLASSIFICATION		
Station NAME: Sheyen	ne River-4-22	.27	Station Number:	N/A	
	ne River-4-22			•	
Period of RECORD:	N/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA: 222912	0 acres	3483	mi ² Drainage Area Mn ELEV:	871.97	ft
Reference REACH SLOPE:		ft/ft	Valley Type:	X]
Stream Type: E6			HUC:		
	"BANKFU	ILL" CHA	RACTERISTICS		
Determined from FIELD		NT	Determined from GAGE DA	ATA Analys	is
Bankfull WIDTH (W _{bkf})	71.5	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH (d _{bkf})	8.6	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA (A _{bkf})	571.8	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER (W _p)	73.8	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gage Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY (u)	1.8	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE (Q _{bkf})	1030.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCHARGE a	ssociated with	ו "field-det	ermined" Bankfull STAGE	1030.0	cfs
Recurrence Interval (Log-Pearson) associated wit	th "field-det	ermined" Bankfull Discharge	1.5	yrs
From the Annual	^v eak Flow Freq	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
	MEA	NDER C	GEOMETRY		
Meander Length (L _m)	923	ft	Radius of Curvature (R _C)	178.0	ft
Belt Width (W _{blt})	1243	ft	$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	17.4	ft/ft
	HYDR	AULIC	GEOMETRY		
parameters of Width (W), Area (A), Me	an Depth (d) & Me	ean Velocity (ι	egression analyses of measured discharge (a), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient: (a					
Slope Exponent: (b)					
Hydraulic Radius: $R = A / W_p$		ft	Manning's "n" at Bankfull Stage	0.054	Coeff.
	= 1.4865 [(A rea		ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	nkfull VE		/ DISCHAF	RGE Estir	nates		
Site	Sheyenne R	iver-4	-22.27		Location	Sheyenn	e River-4-	22.27	
Date	10/1/2011	Stre	am Type	E6	Valley Ty	rpe	X		
Observers	KP, AL				HUC				
	INPUT VA	RIAB	LES			OUTPU	IT VARIA	ABLES	
Bankfull	Cross-section	al	571.8	A _{bkf} (ft ²)	Bankfu	III Mean DI	EPTH	8.6	D _{bkf} (ft)
Bank	full WIDTH		71.5	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	TER	88.6	W _p (ft)
D ₈	4 @ Riffle	0.13	Dia. (mm)	D ₈₄ I	mm / 304.8	3 =	0.00	D ₈₄ (ft)	
Bank	full SLOPE	0.0003	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	6.5	R (ft)	
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Roughr R (ft) / D ₈₄ (ft)	ness	14902	
Draiı	nage AREA		3483.0	DA (mi²)		ear Velocit ı* =√gRS	ty	0.3	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	: [2.83	8 + 5.66Log	{]u*	7.0	ft / sec	3980	cfs
	Coefficient: a s. 2-18, 19) u = 1.				r / relative =	1.7	ft / sec	996	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	6.8	ft / sec	3895	cfs
	tion is for application: ble-and boulder-do C2 and E3.						<u> </u>	L	
2. Roughness c) Manning	Coefficient: s 'n' from Strea	m Type		= 1.4865* R 0.054	^{2/3} *S ^{1/2} /n	1.7	ft / sec	996	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)		1.8	ft / sec	1030	cfs
3. Other Metho	ds (Hey, Darcy-W	eisbach	n, Chezy C, etc	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfi		gional Curve harge	s u = 0 Q = 1.46	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A		ft / sec		cfs
Option 1, For	for using the E sand-bed chan ostitute an avera	nels: M	easure the "p	rotrusion h	neight" (h _{sd}) a	f sand dunes	above char	nnel bed eleva	d 1. tions.
Option 2. For elev	boulder-domina rations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	h eights" (h _{bc} or the D ₈₄ ter) of boulders m in est. me	s above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-dominated surfaces about term in estimation	ated ch	annels: Meas	sure severa	protrusion	heights" (h	or) of rock se	parations/step	s/joints/ eet) for the

Stream:	Sheyenne River-4-22.27		
Basin:	Red River Basin Drainage Area: 2E+06 acres	3483	mi ²
Location:	Sheyenne River-4-22.27		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/1/201
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	71.5	ft
	Bankfull DEPTH (d _{bkf})		
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ($d_{bkf} = A / W_{bkf}$).	8.6	ft
	Bankfull X-Section AREA (A _{bkf})		
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		2
	section.	571.8	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf})		
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	8.4	ft/ft
	Maximum DEPTH (d _{mbkf})		
	Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		<i>c.</i>
		12.8	ft
	WIDTH of Flood-Prone Area (W _{fpa})		
	Twice maximum DEPTH, or $(2 \times d_{mbkr})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	535.7	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W _{fpa} / W _{bkf})		
	(riffle section).	7.5	ft/ft
	Channel Materials (Particle Size Index) D ₅₀		
	The D_{50} particle size index represents the mean diameter of channel materials, as		
	sampled from the channel surface, between the bankfull stage and Thalweg elevations.		
		0.073	mm
	Water Surface SLOPE (S)		
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient		
	at bankfull stage.	0.00033	ft/ft
	Channel SINUOSITY (k)		-
	Sinuosity is an index of channel pattern, determined from a ratio of stream length		
	divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).		
		1.8	ļ
	Stream E6 See Classification	on Key	
	Type (Figure 2-2		

0.16	eam: Sheyenne River-4-	22.27				Lc	cation:	Sheye	enne Ri	iver-4-22.27				
Obs	servers: KP, AL			Date:	10/1/2	011		Valle	у Туре:	<u>x</u>	Stream	n Type:	E6	
				Riv	er Rea	ch Sum	mary I	Data						
	Mean Riffle Depth (d _{bkf})	8.6	ft	Riffle V	Vidth (V	V _{bkf})	71	.5	ft	Riffle Area (A		57	1.8	ft ²
_	Mean Pool Depth (d _{bkfp})	<u> </u>	ft	Pool W	/idth (W	_{bkfp})			ft	Pool Area (A	_{bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	fle Width			W _{bkfp} / W _{bkf}	Pool Area / F	Riffle Area			A _{bkfp} /A
	Max Riffle Depth (d _{maxrif})	12.8	ft	Max Po	ool Dept	h (d _{maxp})			ft	Max Riffle De	epth/Mean Rif	fle Dep	th	1.5
Channel	Max Pool Depth/Mean Riffle D	epth		Point B	Bar Slope	e			ft/ft	Inner Berm V	Vidth (W _{ib})			ft
Cha	Inner Berm Depth (d _{ib})		ft	Inner B	Berm Wi	idth/Deptl	n Ratio			W _{ib} /d _{ib} Inn	er Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean \	/elocity	at Bank	full Sta	ge (u _{bkf})		1.	.8	ft/s	Estimation N	lethod	Н	EC-RA	AS
\Box	Streamflow: Estimated Discha	eamflow: Estimated Discharge at Bankfull Stage (Q _{bkf}) 1030 cfs Drainage Area								a	34	83	mi²	
	Geometry	Mean	Min	Max						eometry Ratio	os	Mean	Min	Max
[_]	Meander Wavelength (L _m)	923			ft	Meander	Length	Ratio	(L _m /W _{bkt}	f)		12.9		
Pattern	Radius of Curvature (R _c)	178	<u> </u>	<u> </u>						th (R _c /W _{bkf})		2.5		
	Belt Width (W _{blt})	1243	<u> </u>	<u> </u>		Meander				(_h		17.4		
Channel	Individual Pool Length	<u> </u>	<u> </u>	<u> </u>		Pool Len	-							
เรื่	Pool to Pool Spacing	<u> </u>	<u> </u>	i	i	Pool to F		<u> </u>)th				
\bigcup	Riffle Length	<u> </u>		<u> </u>	ft	Riffle Le	ngth/Rif	fle Wic	lth					
\square	Valley Slope (VS)		ft/ft	Averag	e Water	r Surface	Slope (S)		ft/ft	Sinuosity (VS/S)		
	Stream Length (SL) 23	284	ft	Valley I	Length ((VL)			13	295 ft	Sinuosity (SL/VL)		1.8
	Low Bank Height start (LBH) end		ft ft		Max Riff Depth		start end		ft ft		ight Ratio (BH ax Riffle Dept		start end	
	Facet Slopes	Mean		Max	Bopti		criu			(==: ::::			Chiu	
lie	Riffle Slope (S _{rif})	0.0	1	:			Dimer	nsionle	ss Slor	be Ratios			Min	Max
Profile				<u> </u>	ft/ft	Riffle Slo				be Ratios rface Slope (S		Mean 1.0	Min	Max
	Run Slope (S _{run})						ppe/Ave	rage W	ater Su		S _{rif} / S)	Mean	Min	Max
Juel	Run Slope (S _{run}) Pool Slope (S _p)					Run Slop	ope/Ave oe/Avera	rage W age Wa	ater Su iter Surf	rface Slope (S	S _{rif} / S) _{un} / S)	Mean	Min	Max
Channel					ft/ft ft/ft	Run Slop Pool Slop	ope/Ave oe/Avera oe/Avera	rage W age Wa age Wa	ater Su ter Surf ater Surf	rface Slope (S face Slope (S	S _{rif} / S) _{un} / S) _o / S)	Mean	Min	Max
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a	Mean	Min	Max	ft/ft ft/ft ft/ft	Run Slop Pool Slop Glide Slo	ppe/Ave pe/Aver pe/Aver ppe/Ave Dimer	rage W age Wa age Wa rage W rage W	ater Surf ater Surf ater Surf ater Sur ss Dep	rface Slope (S face Slope (S, face Slope (S rface Slope (S th Ratios	S _{rif} / S) un / S) o / S) S _g / S)	Mean 1.0 	Min	Max Max
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})	Mean 12.8	Min	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slop Glide Slo Max Riff	ppe/Ave pe/Aver pe/Aver ppe/Ave Dimer le Depth	rage W age Wa age Wa rage W nsionle	ater Surf ater Surf ater Surf ater Sur ss Dep Riffle D	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios	S _{rif} / S) _{un} / S) _b / S) S _g / S) d _{bkt})	Mean 1.0		
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	1	Min	Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riffl Max Run	ppe/Ave pe/Aver pe/Aver ppe/Ave Dimer le Depth	rage Wa age Wa age Wa rage W nsionle n/Mean F	ater Sur ter Surf ater Sur ater Sur ss Dep Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrun} / d	S _{rif} / S) _{un} / S) _b / S) _b / S) _b / S) _b / S) _b / S) _b / S)	Mean 1.0 		
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp})	1	Min	Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riffl Max Run Max Poo	ppe/Ave pe/Avera ppe/Ave Dimer le Depth l Depth/ l Depth/	rage W age Wa age Wa rage W nsionle n/Mean f /Mean f	ater Surf ater Surf ater Surf ater Sur ss Dep Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxp} / d	S _{rif} / S) _{un} / S) _b / S) S _g / S) S _g / S) S _{b(t}) d _{b(t}) d _{b(t})	Mean 1.0 		
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	1	Min	Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riffl Max Run Max Poo	ppe/Ave pe/Avera ppe/Ave Dimer le Depth l Depth/ l Depth/	rage W age Wa age Wa rage W nsionle n/Mean f /Mean f	ater Surf ater Surf ater Surf ater Sur ss Dep Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrun} / d	S _{rif} / S) _{un} / S) _b / S) S _g / S) S _g / S) S _{b(t}) d _{b(t}) d _{b(t})	Mean 1.0 		
Channel	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxru}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg})	1		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riffl Max Run Max Poo	ppe/Ave pe/Avera ppe/Ave Dimer le Depth l Depth/ l Depth/	rage W age Wa age Wa rage W sionle n/Mean Mean I /Mean	ater Surf ater Surf ater Surf ater Sur ss Dep Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxp} / d	S _{rif} / S) _{un} / S) _b / S) S _g / S) S _g / S) S _{b(t}) d _{b(t}) d _{b(t})	Mean 1.0 Mean 1.5	Min	
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay	12.8		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Ave Dimer le Depth l Depth/ l Depth/	rage W age Wa age Wa rage W sionle n/Mean I /Mean I /Mean I n/Mean I Mean I 0.0	ater Su tter Surf ater Surf ater Surf ater Surf Riffle De Riffle De Riffle De Riffle De Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrun} / d epth (d _{maxp} / d Depth (d _{maxg} / d	S _{rif} / S) _{un} / S) _b / S) _b / S) _b / S) d _{bkt}) d _{bkt}) d _{bkt})	Mean 1.0 Mean 1.5	Min	Max
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay % Sand 4	12.8 ach ^b 54		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo Max Glid	ope/Ave ope/Aver ope/Aver ope/Aver Dimer le Depth I Depth/ I Depth/	rage W age Wa age Wa rage W sionle n/Mean I /Mean I /Mean I n/Mean I Mean I 0.0	ater Su tter Surf ater Surf ater Surf ater Surf Riffle De Riffle De Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrun} / d epth (d _{maxp} / d Depth (d _{maxg} / d	S _{rif} / S) _{un} / S) _b / S) _b / S) _b / S) d _{bkt}) d _{bkt}) d _{bkt})	Mean 1.0 Mean 1.5	Min	Max
Materials	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay % Sand 4	12.8		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Ave Dimer le Depth I Depth/ I Depth/ I Depth/ I Depth/ Das Das Das	rage W age Wa age Wa rage W sionle Mean M Mean M Mean M Mean M Mean M Mean M Mean M M M M M M M M M M M M M M M M M M M	ater Su tter Surf ater Surf ater Surf ater Surf Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrun} / d epth (d _{maxp} / d Depth (d _{maxg} / d	S _{rif} / S) _{un} / S) _b / S) _b / S) _b / S) d _{bkt}) d _{bkt}) d _{bkt})	Mean 1.0 Mean 1.5	Min	Max Max leight ^d
Materials	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxrif) Max Glide Depth (dmaxrif) Max Glide Depth (dmaxrif) Rea % Silt/Clay % Sand % Gravel % Cobble	12.8 ach ^b 54 16 0		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Ave Dimer le Depth l Depth/ l Depth/ le Depth l Depth/ l Dept	rage Wa age Wa rage Wa rage Wa sionle n/Mean f /Mean f /Mean f /Mean f 0.0	ater Su ter Surf ater Surf ater Surf ater Surf ss Dep Riffle De Riffle De Riffle De Riffle De Riffle D 29 045 073 132	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrun} / d epth (d _{maxp} / d Depth (d _{maxg} / d	S _{rif} / S) _{un} / S) _b / S) _b / S) _b / S) d _{bkt}) d _{bkt}) d _{bkt})	Mean 1.0 Mean 1.5	Min	Max Max leight ^d mm
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxrif) Max Glide Depth (dmaxrif) Max Glide Depth (dmaxrif) Rea % Silt/Clay % Sand % Gravel % Cobble	12.8 ach ^b 54		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Ave Dimer le Depth I Depth/ I Depth/ I Depth/ I Depth/ Das Das Das	rage Wa age Wa rage Wa rage Wa sionle n/Mean f /Mean f /Mean f /Mean f 0.0	ater Su tter Surf ater Surf ater Surf ater Surf Riffle De Riffle De	rface Slope (S face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrun} / d epth (d _{maxp} / d Depth (d _{maxg} / d	S _{rif} / S) _{un} / S) _b / S) _b / S) _b / S) d _{bkt}) d _{bkt}) d _{bkt})	Mean 1.0 Mean 1.5	Min	Max Max leight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Sheyenne	River-3-18.	.15	Station Number:	N/A	
		River-3-18.				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	3179520	acres	4968	mi ² Drainage Area Mn ELEV:	867.44	ft
Reference REACH SLOP	PE:		ft/ft	Valley Type:	X]
Stream Type:	E6	1		HUC:		
		BANKFU	LL" CHA	RACTERISTICS		
Determined from	FIELD ME		νт	Determined from GAGE DA	TA Analys	; <mark>is</mark>
Bankfull WIDTH (W _{bkf}	_f)	93.8	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	9.4	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA ((A _{bkf})	881.1	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	100.3	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	je Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.9	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	1680.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	1680.0	cfs
Recurrence Interval (Log	J-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.4	yrs
From the	<mark>Annual Pea</mark>	<mark>k Flow Freq</mark> i	uency Anal	ysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharge	э =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER G	BEOMETRY		
Meander Length (L _m)	1538	ft	Radius of Curvature (R _C)	246.0	ft
Belt Width (W _{blt})		1749	ft	$\begin{tabular}{lllllllllllllllllllllllllllllllllll$	18.6	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Are	ea (A), Mean D	Depth (d) & Me	an Velocity (ι	egression analyses of measured discharge (a), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	d the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	= A / W _p		ft	Manning's "n" at Bankfull Stage	0.048	Coeff.
	" n " = 1	.4865 [(A rea) (Hydrauli	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	nkfull VEI		/ DISCHAP	RGE Estii	mates		
Site	Sheyenne R	iver-3	-18.15		Location	Sheyenn	e River-3-	18.15	
Date	9/30/2011	Stre	am Type	E6	Valley Ty	/pe	Х		
Observers	KD, JB				HUC				
	INPUT VA	RIAB	LES			OUTPU	IT VARIA	BLES	
Bankfull	Cross-section	al	881.1	A _{bkf} (ft ²)	Bankfull Mean DEPTH			9.4	D _{bkf} (ft)
Bank	full WIDTH		93.8	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	112.6	W _p (ft)
D ₈ .	4 @ Riffle	0.1	Dia. (mm)	D ₈₄	mm / 304.8	3 =	0.00	D ₈₄ (ft)	
Bank	full SLOPE	0.0002	S _{bkf} (ft / ft)		aulic RADI А _{ькf} / W _p	US	7.8	R (ft)	
Gravitatio	onal Accelerat	32.2	g (ft / sec ²)		ive Roughi R (ft) / D ₈₄ (ft)	ness	18340		
Draiı	nage AREA		4968.0	DA (mi²)	Sh	lear_ ∤/elo ci	ty	0.2	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull VELOCITY			dull ARGE
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log [.]	{	•]u*	6.4	ft / sec	5644	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	i) Manni 4865*R	ng's 'n' from fi . ^{2/3*} S ^{1/2} /n		r / relative =	1.8	ft / sec	1610	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (l	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	7.6	ft / sec	6709	cfs
	tion is for application ble- and boulder-do C2 and E3.								
2. Roughness c) Manning	s Coefficient: s 'n' from Strea	m Type		= 1.4865* R 0.048	^{2/3} *S ^{1/2} /n	1.8	ft / sec	1610	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)		1.9	ft / sec	1680	cfs
3. Other Metho	ods (Hey, Darcy-W	leisbach	<mark>i, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankf		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q / A		ft / sec		cfs
Option 1. For Sub	s for using the [sand-bed chan ostitute an avera	nels: M ge sand	easure the " p I dune protrus	sion height (height" (h _{sd}) o h _{sd} in ft) for th	of sand dunes ie D ₈₄ term in	s above char est. method	nnel bed eleva 1.	tions.
Option 2. For elev	boulder-dominations. Substitut	a ted ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	"protrusion ght (h _{bo} in ft) f	heights" (h _{bc} or the D ₈₄ ter) of boulders m in est. me	above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-domin ted surfaces abo term in estimatio	ated ch	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	or) of rock se	parations/step	eet) for the

Stream:	Sheyenne River-3-18.15		
Basin:	Red River Basin Drainage Area: 3E+06 acres	4968	mi ²
Location:	Sheyenne River-3-18.15		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	9/30/201
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	93.8	ft
	Bankfull DEPTH (d _{bkf})		, 1
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ($d_{bkf} = A / W_{bkf}$).	9.4	ft
	Bankfull X-Section AREA (A _{bkf})		1
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	881.1	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf})		1
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	10.0	ft/ft
	Maximum DEPTH (d _{mbkf})		1
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull		
	stage and Thalweg elevations, in a riffle section.	12.9	ft
	WIDTH of Flood-Prone Area (W _{fpa})		1
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area	_	
	WIDTH is determined in a riffle section.	534.7	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	F 7	£1./£1
		5.7	ft/ft
	Channel Materials (Particle Size Index) D ₅₀		
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.		
		0.73	mm
	Water Surface SLOPE (S)		I
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.		
		0.00022	ft/ft
	Channel SINUOSITY (k)]
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by		
	channel slope (VS / S).	1.9	
			1
	Stream E6 See Classificatio		
	Type (Figure 2-2	1)	

	eam: Sheyenne River-3-	18.15				Lo	cation:	Sheye	enne R	iver-3-1	8.15				
Ob	servers: KD, JB			Date:	9/30/2	011		Valle	у Туре:	Х		Stream	n Type:	E6	
				Riv	er Rea	ch Sum	mary I	Data							
\bigcap	Mean Riffle Depth (d _{bkf})	9.4	ft	Riffle \	Nidth (V	V _{bkf})	93	.8	ft	Riffle Ar	ea (A _{bk}	f)	88 [,]	1.1	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft	Pool Are	ea (A _{bkfi}	»)			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	fle Width			W _{bkfp} / W _{bkf}	Pool Are	ea / Riff	le Area			A _{bkfp} /A _{bkf}
Ē	Max Riffle Depth (d _{maxrif})	12.9	ft	Max P	ool Dept	h (d _{maxp})			ft	Max Riff	le Dep	th/Mean Rif	fle Dept	th	1.4
Channel	Max Pool Depth/Mean Riffle D	epth		Point E	3ar Slop	е			ft/ft	Inner Be	erm Wi	dth (W _{ib})			ft
Chai	Inner Berm Depth (d _{ib})		ft						Berm Area	(A _{ib})	ft ²				
	Streamflow: Estimated Mean \	/elocity							hod	Н	EC-R/	AS			
	Streamflow: Estimated Dischar	rge at E	Bankfull	Stage (Q _{bkf})		16	80	cfs	Drainag	e Area		49	68	mi²
	Geometry	Mean	Min	Max			Dime	ension	less Ge	eometry	Ratios		Mean	Min	Max
[_]	Meander Wavelength (L _m)	1538	<u> </u>	<u> </u>	ft	Meander	Length	Ratio	(L _m /W _{bk}	f)			16.4		
Pattern	Radius of Curvature (R _c)	246			ft	Radius o	of Curva	ture/Ri	ffle Wid	th (R _c /W	_{bkf})		2.6		
	Belt Width (W _{blt})	1749			ft	Meander	Width	Ratio (W _{blt} /W _{bl}	_{tf})			18.6		
Channel	Individual Pool Length		<u> </u>	<u> </u>	ft	Pool Len	gth/Riff	le Widt	h						
	Pool to Pool Spacing		<u> </u>	<u> </u>	ft	Pool to F	· ·			dth					
\bigcup	Riffle Length			<u> </u>	ft	Riffle Le	ngth/Rif	fle Wic	lth						
\square	Valley Slope (VS)		ft/ft	Averag	ge Wate	r Surface	Slope (S)		1	ft/ft	Sinuosity (\	/S/S)		
	Stream Length (SL) 34	110	ft	Valley	Length	(VL)			18	101	ft	Sinuosity (S	SL/VL)		1.9
	Low Bank Height start (LBH) end		ft ft		Max Rif		start end		ft ft			ht Ratio (BH Riffle Dept		star	
	Facet Slopes	Mean		Max				sionle		be Ratio			Mean	Min	Max
file	Riffle Slope (S _{rif})	0.0			ft/ft	Riffle Slo						/ S)	1.0		
Profile	Run Slope (S _{run})				ft/ft	Run Slop	be/Avera	age Wa	ater Sur	face Slop	e (S _{run}	/ S)			
land	Pool Slope (S _p)				ft/ft	Pool Slo	pe/Aver	age Wa	ater Sur	face Slop	e (S _p /	S)			
Channel	Glide Slope (Sg)				ft/ft	Glide Slo	pe/Ave	rage W	ater Su	rface Slo	pe (S _g	/ S)			
	Feature Midpoint ^a	Mean	Min	Max		 -:				th Ratio			Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	12.9	1	<u> </u>	ft	Max Riff							1.4		
	Max Run Depth (d _{maxrun})				ft	Max Rur									
	Max Pool Depth (d _{maxp})			1	ft	Max Poo					·				
	Max Glide Depth (d _{maxg})				ft	Max Glid	e Depth	/Mean	Riffle D	epth (d _m	axg / d _{bki}	f)			
_	Rea	ach ^b	Rif	fle ^c	E	Bar		Rea	ach ^b	Riff	e ^c	Bar	Protru	ision H	leight ^d
<u>s</u>		6					D ₁₆		001						mm
Materials		4					D ₃₅	0.	035						mm
	% Gravel	0					D ₅₀	0.	.73						mm
land		0					D ₈₄	0.	.13						mm
Channel	% Boulder	0					D ₉₅	0.1	155						mm
Ŭ	% Bedrock	0					D ₁₀₀	0	.3						mm
N.4:	max, mean depths are ave. mid-p									^c Active b					

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Sheyenne	River-2-11.	.56	Station Number:	N/A	
		River-2-11.			•	
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	3255040	acres	5086	mi ² Drainage Area Mn ELEV:	862.08	ft
Reference REACH SLOP			ft/ft	Valley Type:	X]
Stream Type:	E5			HUC:		
		BANKFU	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME		NT	Determined from GAGE DA	ATA Analys	is
Bankfull WIDTH (W _{bkf}	_f)	111.5	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	8.8	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA ((A _{bkf})	988.1	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	116.6	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	je Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.8	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	1750.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE asso	ociated with	"field-det	ermined" Bankfull STAGE	1750.0	cfs
Recurrence Interval (Log	J-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.5	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	ə =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER G	GEOMETRY		
Meander Length (L_m)	1474	ft	Radius of Curvature (R _C)	291.0	ft
Belt Width (W _{blt})		1861	ft	Meander Width Ratio (W_{blt}/W_{bkf})	16.7	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Are	ea (A), Mean [Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	= A / W _p		ft	Manning's "n" at Bankfull Stage	0.048	Coeff.
		.4865 [(A rea) (Hydrauli	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	nkfull VEI		/ DISCHAF	RGE Estii	mates		
Site	Sheyenne R	iver-2	-11.56		Location	Sheyenn	e River-2-	·11.56	
Date	10/3/2011	Stre	am Type	E5	Valley Ty	/pe	Х		
Observers	KP, AL			•	HUC		- 		
	INPUT V		LES			OUTPU	IT VARIA	ABLES	
Bankfull	Cross-sectior	al	988.1	A _{bkf} (ft ²)	Bankfu	III Mean DI	EPTH	8.8	D _{bkf} (ft)
Bank	vfull WIDTH		111.5	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	129.2	W _p (ft)	
D ₈	₄ @ Riffle	1.8	Dia. (mm)	D ₈₄ I	mm / 304.8	3 =	0.01	D ₈₄ (ft)	
Bank	full SLOPE	0.0002	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	7.7	R (ft)	
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Roughı R (ft) / D ₈₄ (ft)	ness	1318	
Drai	nage AREA		5086.0	DA (mi²)		ear Veloci ı* =√gRS	ty	0.2	u* (ft / sec)
	ESTIMA	TION	METHO	DS		Bankfull VELOCITY			dull ARGE
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{]u*	4.1	ft / sec	4032	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	a) Manni 4865*R	ng's 'n' from fr . ^{2/3*} S ^{1/2} /n		r / relative =	1.5	ft / sec	1508	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (I	JSGS):		1.4865* R ^{2/3} ^{.16} n	^{3*} S ^{1/2} /n	7.2	ft / sec	7100	cfs
	ation is for application ble- and boulder-do C2 and E3.					L	<u> </u>]	ļ	
2. Roughness c) Manning	s Coefficient: 's 'n' from Strea	ım Type		= 1.4865* R 0.048	^{2/3} *S ^{1/2} /n	1.5	ft / sec	1508	cfs
3. Other Metho HEC-RAS	ods (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)		1.8	ft / sec	1750	cfs
3. Other Metho	ods (Hey, Darcy-W	leisbach	n, Chezy C, etc	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankf		gional Curve harge	s u = 0 Q = 1.46	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	:a u = (Q/A		ft / sec		cfs
Option 1. For	s for using the I sand-bed chan ostitute an avera	nels: M	easure the "p	protrusion h	neight" (h _{sd}) c	f sand dunes	above char	nnel bed eleva	
Option 2. For elev	boulder-dominations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heig	"protrusion ght (h _{bo} in ft) fe	heights" (h _{bo} or the D ₈₄ ter) of boulders m in est. me	s above chani thod 1.	nel bed
Option 3. For uplif	bedrock-domin ited surfaces abo term in estimatio	ated ch we cha	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	or) of rock se	parations/step	eet) for the

Stream:	Sheyenne River-2-11.56									
Basin:	Red River Basin Drainage Area: 3E+06 acres	5086	mi ²							
Location:	Sheyenne River-2-11.56									
Twp.&Rge:	- Sec.&Qtr.: -									
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/3/201 ⁻							
Observers:	KP, AL	Valley Type:	Х							
	Bankfull WIDTH (W _{bkf})									
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	111.5	ft							
	Bankfull DEPTH (d _{bkf})									
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a									
	riffle section ($d_{bkf} = A / W_{bkf}$).	8.8	ft							
	Bankfull X-Section AREA (A _{bkf})									
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle									
	section.	988.1	ft ²							
	Width/Depth Ratio (W _{bkf} / d _{bkf})									
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	12.6	ft/ft							
	Maximum DEPTH (d _{mbkf})									
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull									
	stage and Thalweg elevations, in a riffle section.	13.0	ft							
	WIDTH of Flood-Prone Area (W _{fpa})									
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.									
	WIDTH is determined in a finite section.	787.7	ft							
	Entrenchment Ratio (ER)									
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	7.1	ft/ft							
		7.1	1011							
	Channel Materials (Particle Size Index) D ₅₀									
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.									
		0.51	mm							
	Water Surface SLOPE (S)		l							
	Channel slope = "rise over run" for a reach approximately 20-30 bankfull channel									
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00040	£ . /£ .							
		0.00016	ft/ft							
	Channel SINUOSITY (k)									
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by									
	channel slope (VS / S).	1.5								
			1							
	Type (Figure 2-2	•)]							

Stre	eam: Sheyenne River-2-7	11.56				Location:	Sheye	nne Ri	ver-2-11.56				
Obs	servers: KP, AL			Date:	10/3/2011		Valley	/ Туре:	X	Stream	Гуре:	E5	
				Riv	er Reach Su	ummary I	Data						
	Mean Riffle Depth (d _{bkf})	8.8	ft		Vidth (W _{bkf})	11	1.5	ft	Riffle Area (A _{bkf})		988		ft ²
c	Mean Pool Depth (d _{bkfp})	<u> </u>	ft	Pool W	/idth (W _{bkfp})			ft	Pool Area (A _{bkfp})				ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Riffle Wi	dth		W _{bkfp} / W _{bkf}	Pool Area / Riffle /	Area			A _{bkfp} /A _{bkf}
	Max Riffle Depth (d _{maxrif})	13	ft	Max Po	ool Depth (d _{max}	_{xp})		ft	Max Riffle Depth/	Mean Riffle	e Dept	h	1.5
Channel	Max Pool Depth/Mean Riffle De	epth		Point E	Bar Slope			ft/ft	Inner Berm Width	(W _{ib})			ft
Cha	Inner Berm Depth (d _{ib})		ft		Berm Width/De	epth Ratio			W _{ib} /d _{ib} Inner Be	erm Area (A	۹ _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity/	at Bank					ft/s	Estimation Method	d	HEC-RAS		
\bigcup	Streamflow: Estimated Dischar	rge at E	Bankfull	Stage (Q _{bkf})	17	'50	cfs	Drainage Area		50	86	mi²
	Geometry	Mean	Min	Max	Iax Dimensionless Geometry Ratios					N	lean	Min	Max
	Meander Wavelength (L _m)	1474	<u> </u>	<u> </u>	ft Mean	der Length	n Ratio (I	L _m /W _{bkf})	1	3.2		
Pattern	Radius of Curvature (R _c)	291		<u> </u>					th (R _c /W _{bkf})		2.6		
	Belt Width (W _{blt})	1861	<u> </u>	<u> </u>	•	der Width			f)	1	6.7		
Channel	Individual Pool Length	!	<u> </u>	1		_ength/Riff							
- Š	Pool to Pool Spacing		<u> </u>	i		o Pool Spa			lth				
\bigcup	Riffle Length				ft Riffle	Length/Ri	ffle Widt	h					
\square	Valley Slope (VS)		ft/ft	Average Water Surface Slope (S)					ft/ft Sir	nuosity (VS	5/S)		
	Stream Length (SL) 89	66	ft	Valley	Length (VL)		ĺ	61	<mark>95</mark> ft Sir	nuosity (SL	/VL)		1.4
	Low Bank Height start (LBH) end		ft ft		Max Riffle Depth	start end		ft ft	Bank-Height F (LBH/Max Ri		.)	start	
	Facet Slopes	Mean	Min	Max	·					ffle Depth)		end	
Profile	Riffle Slope (S _{rif})			IVIAN		Dimer	ii	ss Slop	e Ratios	ffle Depth)	lean	end Min	Мах
121		0.0		WIAX	ft/ft Riffle		nsionles		· · · · · · · · · · · · · · · · · · ·	N	lean 1.0		Max
	Run Slope (S _{run})	0.0				Slope/Ave	n sionles rage Wa	ater Su	e Ratios	S)	1		Max
		0.0			ft/ft Run S	Slope/Ave Slope/Aver	nsionles rage Wa age Wat	ater Sur	pe Ratios rface Slope (S _{rif} / S	S)	1		Max
Channel P	Run Slope (S _{run})	0.0			ft/ft Run S ft/ft Pool S	Slope/Ave Slope/Aver Slope/Aver	n sionles rage Wa age Wat age Wat	ater Surf er Surf ter Surf	n <mark>e Ratios</mark> rface Slope (S _{rif} / S race Slope (S _{run} / S)	1		Max
	Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a	Mean	Min	Max	ft/ft Run S ft/ft Pool S ft/ft Glide	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer	nsionles age Wat age Wat age Wat rage Wat	ater Surf ter Surf ater Surf ater Surf	pe Ratios rface Slope (S _{rif} / S ace Slope (S _{run} / S face Slope (S _p / S) rface Slope (S _g / S) th Ratios	N 3) 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	1.0 		Max Max Max
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})		Min	Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Deptl	nsionles rage Wat age Wat age Wat rage Wat rage Wat nsionles	ater Surf ter Surf ater Surf ater Surf s Dep Riffle D	pe Ratios rface Slope (S _{rin} / S ace Slope (S _{run} / S face Slope (S _p / S) rface Slope (S _g / S) th Ratios lepth (d _{maxrif} / d _{bkl})	N 3) 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	1.0	Min	
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean	Min	Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Deptl Run Depth	nsionles rage Wat age Wat age Wat rage Wa nsionles n/Mean R	ater Surf ter Surf ater Surf SS Dep Riffle De	pe Ratios rface Slope (S _{rif} / S ace Slope (S _{run} / S face Slope (S _p / S) rface Slope (S _g / S) th Ratios hepth (d _{maxrif} / d _{bkl}) pth (d _{maxrun} / d _{bkl})	N 3) 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	1.0 	Min	
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp})	Mean	Min	Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F ft Max F	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth	nsionles rage Wat age Wat rage Wat rage Wat rage Wa nsionles n/Mean R /Mean R	ater Surf ter Surf ater Surf ater Surf ss Dep Riffle De tiffle De	pe Ratios rface Slope (S_{run} / S ace Slope (S_{run} / S face Slope (S_p / S) rface Slope (S_g / S) th Ratios repth (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf})	N 3) 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	1.0 	Min	
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean	Min	Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F ft Max F	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth	nsionles rage Wat age Wat rage Wat rage Wat rage Wa nsionles n/Mean R /Mean R	ater Surf ter Surf ater Surf ater Surf ss Dep Riffle De tiffle De	pe Ratios rface Slope (S _{rif} / S ace Slope (S _{run} / S face Slope (S _p / S) rface Slope (S _g / S) th Ratios hepth (d _{maxrif} / d _{bkl}) pth (d _{maxrun} / d _{bkl})	N 3) 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	1.0 	Min	
	Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Pool Depth (dmaxrun) Max Glide Depth (dmaxrg)	Mean		Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F ft Max F	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth Slide Depth	nsionles rage Wat age Wat rage Wat rage Wat rage Wat nsionles n/Mean R n/Mean R n/Mean R	ater Sur er Surf ater Surf ater Sur ss Dep Riffle De tiffle De Riffle De Riffle D	pe Ratios rface Slope (S_{run} / S ace Slope (S_{run} / S face Slope (S_p / S) rface Slope (S_g / S) th Ratios th Ratios th (d_{maxrif} / d_{bkf}) epth (d_{maxp} / d_{bkf})	N 3) 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1.0 Iean 1.5	Min	Max
Channel	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay 2	Mean 13.0		Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Deptl Run Depth Pool Depth Slide Depth	nsionles rage Wat age Wat rage Wat rage Wat rage Wat rage Wat nsionles h/Mean R /Mean R /Mean R /Mean R /Mean A /Mean A	ater Surf er Surf ater Surf ater Surf ater Surf ss Dep Riffle De tiffle De Riffle De Riffle De Riffle D	pe Ratios rface Slope (S_{run} / S ace Slope (S_p / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios hepth (d_{maxrif} / d_{bkf}) epth (d_{maxg} / d_{bkf}) lepth (d_{maxg} / d_{bkf})	N 3) 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1.0 Iean 1.5	Min	Max
Channel	Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Glide Depth (dmaxg) Max Glide Depth (dmaxg) Rea % Silt/Clay 2 % Sand 7	Mean 13.0		Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth Slide Depth	nsionles rage Wat age Wat rage Wat rage Wat rage Wa nsionles n/Mean R /Mean R /Mean R Mean I Rea 0.0	ater Surf ter Surf ater Surf ater Surf Biffle De ch ^b 16	pe Ratios rface Slope (S_{run} / S ace Slope (S_p / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios hepth (d_{maxrif} / d_{bkf}) epth (d_{maxg} / d_{bkf}) lepth (d_{maxg} / d_{bkf})	N 3) 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1.0 Iean 1.5	Min	Max Max
Materials Channel	Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay 2 % Sand 7 % Gravel 2	Mean 13.0		Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Deptl Run Depth Pool Depth Slide Depth	nsionles rage Wat age Wat rage Mat rage O Mean R row 0.00000000000000000000000000000000000	ater Surf er Surf ater Surf ater Surf ater Surf ss Dep Riffle De iffle De Riffle De Riffle De Riffle De Riffle De 16	pe Ratios rface Slope (S_{run} / S ace Slope (S_p / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios hepth (d_{maxrif} / d_{bkf}) epth (d_{maxg} / d_{bkf}) lepth (d_{maxg} / d_{bkf})	N 3) 2 2) 2 2) 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1.0 Iean 1.5	Min	Max Max eight ^d
Materials Channel	Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxrif) Max Glide Depth (dmaxg) Rea % Silt/Clay % Sand 7 % Gravel 6 % Cobble 0	Mean 13.0 15.0 10.0 10.0 10.0 10.0 10.0 10.0 10		Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Depth Run Depth Ool Depth Slide Depth Slide Depth D16 D35 D50 D84	nsionles rage Wat age Wat age Wat rage Wat rage Wa nsionles n/Mean R /Mean R /Mean R 0.0 0.1 0.1	ater Sur er Surf ater Surf ater Surf ater Surf Biffle De Biffle De Ch ^b 16 16	pe Ratios rface Slope (S_{run} / S ace Slope (S_p / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios hepth (d_{maxrif} / d_{bkf}) epth (d_{maxg} / d_{bkf}) lepth (d_{maxg} / d_{bkf})	N 3) 2 2) 2 2) 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1.0 Iean 1.5	Min	Max Max eight ^d mm
Channel	Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Glide Depth (dmaxrun) <	Mean 13.0		Max	ft/ft Run S ft/ft Pool S ft/ft Glide ft Max F ft Max F ft Max C	Slope/Aver Slope/Aver Slope/Aver Slope/Aver Dimer Riffle Deptl Run Depth Pool Depth Blide Depth Blide Depth D ₁₆ D ₃₅	nsionles rage Wat age Wat rage Mat rage O Mean R row 0.00000000000000000000000000000000000	ater Sur er Surf ater Surf ater Surf ater Surf iffle De iffle De iffle De ch ^b 16 16 16 51 77 4	pe Ratios rface Slope (S_{run} / S ace Slope (S_p / S) face Slope (S_p / S) rface Slope (S_g / S) th Ratios hepth (d_{maxrif} / d_{bkf}) epth (d_{maxg} / d_{bkf}) lepth (d_{maxg} / d_{bkf})	N 3) 2 2) 2 2) 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1.0 Iean 1.5	Min	Max Max eight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Sheyenne	River-1-4.2	0	Station Number:	N/A	
LOCATION:	Sheyenne	River-1-4.2	0			
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	3359360	acres	5249	mi ² Drainage Area Mn ELEV:	851.8	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X	
Stream Type:	E6			HUC:		
	'	'BANKFU	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	86.9	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPT	H (d _{bkf})	9.4	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	820.3	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	93.2	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	(u)	2.3	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	1900.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	ARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	1900.0	cfs
Recurrence Interval (Log	g-Pearson)a	ssociated wit	h " field-de t	ermined" Bankfull Discharge	1.5	yrs
From the	Annual Pea	k Flow Freq	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER C	SEOMETRY		
Meander Length (Lm	,)	1238	ft	Radius of Curvature (R _C)	283.0	ft
Belt Width (W _{blt})		2100	ft	Meander Width Ratio (W _{blt} /W _{bkf})	24.2	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean I	Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
· · ·			<i>f</i> +	Manning's "n" at Dankfull Stars	0.020	Cooff
Hydraulic Radius: R	$= A / VV_p$		ft	Manning's "n" at Bankfull Stage	0.036	Coeff.
	" n " = 1	.4865 [(A rea) (Hydraul	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	nkfull VEI			RGE Esti	mates		
Site	Sheyenne R	iver-1	-4.20		Location	Sheyenn	e River-1-	4.20	
Date	10/6/2011	Stre	am Type	E6	Valley Ty	/pe	X		
Observers	KP, AL				HUC		- <mark></mark>		·
	INPUT VA		LES			OUTPL	JT VARIA	BLES	
Bankfull	Cross-section	nal	820.3	A _{bkf} (ft ²)	Bankfu	III Mean D	EPTH	9.4	D _{bkf} (ft)
Bank	full WIDTH		86.9	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	TER	105.8	W _p (ft)
D ₈	4 @ Riffle		0.15	Dia. (mm)	D ₈₄ I	mm / 304.8	3 =	0.00	D ₈₄ (ft)
Bank	full SLOPE		0.0002	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	7.8	R (ft)
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)		15763	
Drai	nage AREA		5249.0	DA (mi²)		ear Veloci ı* =√gRS	ty	0.2	u* (ft / sec)
	ESTIMA	TION	METHO	DS		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	= [2.83	3 + 5.66Log [.]	{]u*	5.5	ft / sec	4476	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	a) Manni .4865*R	ng's 'n' from fi 2 ^{/3*} S ^{1/2} /n		/ relative =	2.1	ft / sec	1724	cfs
	Coefficient: 'n' from Jarrett (lation is for application		n = 0.39S ^{.38} R		=	7.3	ft / sec	5995	cfs
	ble-and boulder-do								
2. Roughness c) Manning	s Coefficient: 's 'n' from Strea	ım Type		= 1.4865* R 2 0.036	^{2/3} *S ^{1/2} /n	2.1	ft / sec	1724	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	/eisbach	<mark>i, Chezy C, etc</mark>	.)		2.3	ft / sec	1900	cfs
3. Other Metho	ods (Hey, Darcy-W	/eisbach	n, Chezy C, etc	.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankf		gional Curve harge	s u = 0 Q = 1.46			ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u = 0	A / A		ft / sec		cfs
Option 1. For	s for using the I sand-bed chan ostitute an averag	nels: M	easure the "p	rotrusion h	eight" (h _{sd}) c	f sand dunes	s above char	nnel bed eleva	
Option 2. For	boulder-domina ations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heic	" protrusion pht (h _{bo} in ft) fo	heights" (h _b or the D ₈₄ ter	 o) of boulders m in est. me 	above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-domin ted surfaces abo term in estimatio	ated ch ove char	annels: Meas nnel bed eleva	sure several	"protrusion	heights" (h	_{br}) of rock se	parations/step	es/joints/ eet) for the

Stream:	Sheyenne River-1-4.20		
Basin:	Red River Basin Drainage Area: 3E+06 acres	5249	mi ²
Location:	Sheyenne River-1-4.20		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/6/2011
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	86.9	ft
	Bankfull DEPTH (d _{bkf})		1
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ($d_{bkf} = A / W_{bkf}$).	9.4	ft
	Bankfull X-Section AREA (A _{bkf})		1
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	820.3	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf})]
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	9.2	ft/ft
	Maximum DEPTH (d _{mbkf})		
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull	I	
	stage and Thalweg elevations, in a riffle section.	14.7	ft
	WIDTH of Flood-Prone Area (W _{fpa})		
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area		
	WIDTH is determined in a riffle section.	437.3	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	5.0	f+/f+
		5.0	ft/ft
	Channel Materials (Particle Size Index) D ₅₀		
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.		
		0.175	mm
	Water Surface SLOPE (S)		-
	Channel slope = "rise over run" for a reach approximately 20-30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.		
		0.00017	ft/ft
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by		
	2.8		
		i]	
	Stream E6 See Classificatio		
	Type (Figure 2-2	(1)	

ft ft d _{bkfp} /	Date: 10/6/2011 River Reach Su Riffle Width (W _{bkf}) Pool Width (W _{bkfp})		ey Type:	Riffle Area (A _{bkf})	m Type: E6 820.3	ft ²
ft d _{bkfp} /	Riffle Width (W _{bkf})	i	<u>.</u>		820.3	ft ²
ft d _{bkfp} /		86.9	<u>.</u>		820.3	ft ²
d _{bkfp} /	Pool Width (W _{bkfp})		4			
			ft	Pool Area (A _{bkfp})		ft ²
d _{bkf}	Pool Width/Riffle Wi	dth	W _{bkfp} / W _{bkf}	Pool Area / Riffle Area		A _{bkfp} /A _{bkf}
7 ft	Max Pool Depth (d _{ma}	_φ)	ft	Max Riffle Depth/Mean Ri	ffle Depth	1.6
	Point Bar Slope		ft/ft	Inner Berm Width (W _{ib})		ft
ft	Inner Berm Width/De	epth Ratio		W _{ib} /d _{ib} Inner Berm Area	ı (A _{ib})	ft ²
y at Banl	kfull Stage (u _{bkf})	2.3	ft/s	Estimation Method	HEC-R	AS
Bankfull	Stage (Q _{bkf})	1900	cfs	Drainage Area	5249	mi ²
n Min	Max	Dimensior	nless Ge	eometry Ratios	Mean Min	Max
8	ft Mean	der Length Ratio	(L _m /W _{bk}	(_t	14.3	
<u> </u>	ft Radiu	s of Curvature/R	iffle Wic	th (R _c /W _{bkf})	3.3	
0	ft Mean	der Width Ratio	(W _{blt} /W _b	(_t	<mark>24.2</mark>	
	ft Pool I	ength/Riffle Wid	lth			
		o Pool Spacing/F	Riffle Wi	dth		
	ft Riffle	Length/Riffle Wi	dth			
ft/ft	Average Water Surfa	ice Slope (S)		ft/ft Sinuosity (VS/S)	
ft	Valley Length (VL)		21	222 ft Sinuosity (SL/VL)	2.8
ft	Max Riffle Depth	start	ft ft		,	
	· ·			·		Max
1					1.0	
	ft/ft Run S	Slope/Average W	ater Sur	face Slope (S _{run} / S)		
	ft/ft Pool	Slope/Average W	ater Sur	face Slope (S _p / S)		
	ft/ft Glide	Slope/Average V	Vater Su	rface Slope (S _g / S)		
	Max		-		Mean Min	Max
7					1.6	
				•		
	ft Max 0	Jilde Depth/Mear	n Ritfle [Depth (d _{maxg} / d _{bkf})		
Ri	ffle ^c Bar	Re	ach ^b	Riffle ^c Bar	Protrusion	Height ^d
						mm
		D ₃₅ 0.	0033			mm
		D ₅₀ 0 .	.175			mm
			.175).15			mm mm
		D ₈₄ 0				
	ity at Bankfull an Min 38 3 3 3 3 3 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5	ft Inner Berm Width/De ity at Bankfull Stage (U _{bkf}) t Bankfull Stage (Q _{bkf}) an Min Max 38 ft 30 ft 31 ft 32 ft 4 ft 4 ft 58 ft 6 ft 7 Mean 6 ft 7 ft 7 ft 7 ft 6 ft 7 ft <	Image: The series of the se	ft Inner Berm Width/Depth Ratio ity at Bankfull Stage (ubst) 2.3 ft/s t Bankfull Stage (Qbst) 1900 cfs an Min Max Dimensionless Gas 3 ft Meander Length Ratio (Lm/Wbst) 3 ft Radius of Curvature/Riffle Width 3 ft Pool Length/Riffle Width 6 ft Pool to Pool Spacing/Riffle Width 6 ft Nax Riffle Length/Riffle Width 7 ft/ft Riffle Slope/Average Water Surface Slope 8 ft/ft Max Riffle Slope/Average Water Surface Slope 9 ft/ft Riffle Slope/Average Water Surface Slope 10 ft/ft Riffle Slope/Average Water Surface Slope 11 Max Riffle Slope/Average Water Surface Slope Surface Slope 11 ft/ft Riffle Slope/Average Water Surface Slope <td>Inner Berm Width/Depth Ratio Witb/dib Inner Berm Area ity at Bankfull Stage (ubde) 2.3 ft/s Estimation Method t Bankfull Stage (Qbde) 1900 cfs Drainage Area an Min Max Dimensionless Geometry Ratios 38 ft Meander Length Ratio (Lm/Wbde) 0 3 ft Radius of Curvature/Riffle Width (Re/Wbde) 0 3 ft Meander Width Ratio (Wbde/Wbde) 0 10 ft Meander Width Ratio (Wbde/Wbde) 0 11 Pool Length/Riffle Width 1 1 11 Pool to Pool Spacing/Riffle Width 1 1 11 ft Riffle Length/Riffle Width 1 1 11 Average Water Surface Slope (S) ft/ft Sinuosity (' 11 Max Riffle start ft Bank-Height Ratio (Be) 11 Max Riffle start ft Bank-Height Ratio (Be) 12 ft/ft Nin Max Dimensionless Slope Ratios 0 11 ft/ft Riffle Slope/Average Water Surface Slope (Sn' / S) 1</td> <td>It Inner Berm Width/Depth Ratio W_{lb}/d_b Inner Berm Area (A_{lb}) ity at Bankfull Stage (u_{bd}) 2.3 ft/s Estimation Method HEC-R t Bankfull Stage (Q_{bd}) 1900 cfs Drainage Area 5249 an Min Max Dimensionless Geometry Ratios Mean Min 38 ft Meander Length Ratio (L_m/W_{bd}) 14.3 3 30 ft Radius of Curvature/Riffle Width (R_c/W_{bd}) 3.3 3 90 ft Meander Width Ratio (W_{bb}/W_{bd}) 24.2 4.2 if t Pool Length/Riffle Width 24.2 24.2 4.2 if t Pool to Pool Spacing/Riffle Width 24.2 5 ift/ft Average Water Surface Slope (S) ft/ft Sinuosity (VS/S) 5 itt Valley Length (VL) 21222 ft Sinuosity (SL/VL) 5 ift Max Riffle start ft Bank-Height Ratio (BHR) star itt Valley Length (VL) 21222 ft Sinuosity (SL/VL) 5 ift Max Riffle start <td< td=""></td<></td>	Inner Berm Width/Depth Ratio Witb/dib Inner Berm Area ity at Bankfull Stage (ubde) 2.3 ft/s Estimation Method t Bankfull Stage (Qbde) 1900 cfs Drainage Area an Min Max Dimensionless Geometry Ratios 38 ft Meander Length Ratio (Lm/Wbde) 0 3 ft Radius of Curvature/Riffle Width (Re/Wbde) 0 3 ft Meander Width Ratio (Wbde/Wbde) 0 10 ft Meander Width Ratio (Wbde/Wbde) 0 11 Pool Length/Riffle Width 1 1 11 Pool to Pool Spacing/Riffle Width 1 1 11 ft Riffle Length/Riffle Width 1 1 11 Average Water Surface Slope (S) ft/ft Sinuosity (' 11 Max Riffle start ft Bank-Height Ratio (Be) 11 Max Riffle start ft Bank-Height Ratio (Be) 12 ft/ft Nin Max Dimensionless Slope Ratios 0 11 ft/ft Riffle Slope/Average Water Surface Slope (Sn' / S) 1	It Inner Berm Width/Depth Ratio W _{lb} /d _b Inner Berm Area (A _{lb}) ity at Bankfull Stage (u _{bd}) 2.3 ft/s Estimation Method HEC-R t Bankfull Stage (Q _{bd}) 1900 cfs Drainage Area 5249 an Min Max Dimensionless Geometry Ratios Mean Min 38 ft Meander Length Ratio (L _m /W _{bd}) 14.3 3 30 ft Radius of Curvature/Riffle Width (R _c /W _{bd}) 3.3 3 90 ft Meander Width Ratio (W _{bb} /W _{bd}) 24.2 4.2 if t Pool Length/Riffle Width 24.2 24.2 4.2 if t Pool to Pool Spacing/Riffle Width 24.2 5 ift/ft Average Water Surface Slope (S) ft/ft Sinuosity (VS/S) 5 itt Valley Length (VL) 21222 ft Sinuosity (SL/VL) 5 ift Max Riffle start ft Bank-Height Ratio (BHR) star itt Valley Length (VL) 21222 ft Sinuosity (SL/VL) 5 ift Max Riffle start <td< td=""></td<>

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Rush Rive	r-2-6.15		Station Number:	N/A	
LOCATION:	Rush Rive	r-2-6.15				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	89152	acres	139.3	mi ² Drainage Area Mn ELEV:	884.59	ft
Reference REACH SLO			ft/ft	Valley Type:	X]
Stream Type:	E6			HUC:		
		BANKFU	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_{.f})	27.0	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTI	H (d _{bkf})	3.1	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	84.4	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	29.7	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	۲ (u)	1.9	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	150.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	150.0	cfs
Recurrence Interval (Log	ȝ-Pearson)a	ssociated wit	h "field-det	termined" Bankfull Discharge	1.2	yrs
From the	Annual Pea	k Flow Frequ	uency Anal	lysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharg	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER C	GEOMETRY		
Meander Length (L _m	,)	2344	ft	Radius of Curvature (R _C)	234.0	ft
Belt Width (W _{blt})		1408	ft	Meander Width Ratio (W _{blt} /W _{bkf})	52.2	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean I	Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	. ,		ft	Manning's "n" at Bankfull Stage	0.04	Coeff.
	F	.4865 [(A rea		ic Radius ^{2/3}) (S lope ^{1/2})] / Q _{bkf}		J I

		Bar	kfull VE			RGE Estir	nates		
Site	Rush River-	2-6.15			Location	Rush Riv	er-2-6.15		
Date	9/27/2011	Stre	am Type	E6	Valley Ty	/pe	X		
Observers	KP, AL				HUC		· ·		·
	INPUT VA		LES			OUTPU	IT VARIA	BLES	
Bankfull	Cross-section	al	84.4	A _{bkf} (ft ²)	Bankfu	III Mean DE	EPTH	3.1	D _{bkf} (ft)
Banł	full WIDTH		27.0	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	TER	33.2	W _p (ft)
D ₈	4 @ Riffle		0.0017	Dia. (mm)	D ₈₄	mm / 304.8	3 =	0.00	D ₈₄ (ft)
Bank	full SLOPE		0.0007	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	2.5	R (ft)
Gravitatio	onal Accelerati	ion	32.2	g (ft / sec ²)		ive Roughr R (ft) / D ₈₄ (ft)	ness	456233	
Drai	nage AREA		139.3	DA (mi²)	Sh ı	ear Velocit ı* =√gRS	ty	0.2	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	[2.83	6 + 5.66Log	{	•]u*	8.1	ft / sec	688	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	1.8	ft / sec	151	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (U	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	3.4	ft / sec	290	cfs
	tion is for applications ble-and boulder-do C2 and E3.								
2. Roughness		т Туре		= 1.4865* R 0.04	^{2/3*} S ^{1/2} /n	1.8	ft / sec	151	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)		1.9	ft / sec	150	cfs
3. Other Metho	ds (Hey, Darcy-W	eisbach	, Chezy C, etc	.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfu		gional Curve	s u = 0 Q = 1.46	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(A / C		ft / sec		cfs
Option 1. For Sul	s for using the D sand-bed chan ostitute an averaç	nels: M ge sand	easure the "p dune protrus	rotrusion height (height" (h _{sd}) c h _{sd} in ft) for th	of sand dunes le D ₈₄ term in	above char est. method	nel bed eleva 1.	tions.
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _{bc} or the D ₈₄ ter) of boulders m in est. me	above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-domina ted surfaces abo term in estimation	ated ch	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	,) of rock se	parations/step	s/joints/ eet) for the

Stream:	Rush River-2-6.15		
Basin:	Red River Basin Drainage Area: 89152 acres	139.3	mi ²
Location:	Rush River-2-6.15		
Twp.&Rge:	: - Sec.&Qtr.: -		
Cross-Sect	tion Monuments (Lat./Long.): -	Date:	9/27/2011
Observers:	: KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	27.0	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	3.1	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	84.4	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	8.7	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.	5.0	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbk})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	79.3	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	2.9	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations	<0.001	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00067	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.43	
	Stream E6 See Classification (Figure 2-2		

	ream: Rush River-2-6.15					Lo	ocation:	Rush	River-2	2-6.15				
Ob	servers: KP, AL			Date:	9/27/2	2011		Valle	еу Туре:	Х	Stream	n Type:	E6	
				Riv	er Rea	ich Sum	mary [Data						
\bigcap	Mean Riffle Depth (d _{bkf})	3.1	ft	Riffle \	Vidth (\	N _{bkf})	27	.0	ft	Riffle Area (At	_{okf})	84	.4	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft	Pool Area (A _{bk}	(_{qt}			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / Ri	ffle Area			A _{bkfp} /A
Dim	Max Riffle Depth (d _{maxrif})	5.0	ft	Max P	ool Dep	th (d _{maxp})			ft	Max Riffle Dep	oth/Mean Rif	fle Dept	h	1.6
lan	Max Pool Depth/Mean Riffle D	epth		Point E	Bar Slop	e			ft/ft	Inner Berm W	idth (W _{ib})			ft
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Dept	h Ratio			W _{ib} /d _{ib} Inne	r Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean	/elocity	at Bank	full Sta	ge (u _{bkf})		1.	9	ft/s	Estimation Me	thod	Н	EC-R/	4S
	Streamflow: Estimated Discha	rge at B	Bankfull	Stage (Q _{bkf})		15	50	cfs	Drainage Area	139	9.3	mi²	
	Geometry	Mean	Min	Max		Dimensionless Geometry Ratios			Mean	Min	Max			
\square	Meander Wavelength (L _m)	2344	1	1	ft	Meande						86.9		
ern	Radius of Curvature (R _c)	234			ft	Radius o	of Curva	ture/Ri	ffle Wid	lth (R _c /W _{bkf})		8.7		
Pattern	Belt Width (W _{blt})	1408			ft	Meande	r Width	Ratio (W _{blt} /W _{bl}	d)		52.2		
lan	Individual Pool Length				ft	Pool Ler	ngth/Riff	le Wid	th					
Channel	Pool to Pool Spacing				ft	Pool to F	Pool Spa	icing/R	iffle Wid	dth				
Ū	Riffle Length				ft	Riffle Le	ngth/Rif	fle Wio	lth					
	Valley Slope (VS)		ft/ft	Averac	no Wate	or Surface	Slope (S)	[ft/ft	Sinuosity ((2/2)		!
		503	ft				Sinuosity (1.2				
	Low Bank Height start	1	ft	-	Max Rif	. ,	start		ft	T	ht Ratio (BF		star	1
	(LBH) end		ft		Depth		end		ft		x Riffle Dept		end	
	Facet Slopes	Mean	Min	Max			Dimer	sionle	ess Slo	pe Ratios		Mean	Min	Мах
Profile	Riffle Slope (S _{rif})	0.0	<u> </u>	<u> </u>	ft/ft	1	·	<u> </u>		rface Slope (Sr	• •	1.0		<u> </u>
	Run Slope (S _{run})		<u> </u>	<u> </u>	ft/ft	Run Slo	pe/Avera	age Wa	ater Sur	face Slope (S _{rur}	, / S)			<u> </u>
Channel	Pool Slope (S _p)		<u> </u>	<u> </u>	ft/ft		-	-		face Slope (Sp				<u> </u>
Che	Glide Slope (S _g)	<u> </u>	<u> </u>	<u> </u>	ft/ft	Glide Slo	ope/Ave	rage W	ater Su	rface Slope (S _g	/ S)			<u> </u>
	Feature Midpoint ^a	Mean	Min	Max	1.	Mey Diff				th Ratios		Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	5.0			ft	1				Depth (d _{maxrif} / d _t		1.6		<u> </u>
	Max Run Depth (d _{maxrun})		<u> </u>	+	ft		-			epth (d _{maxrun} / d _t				1
	Max Pool Depth (d _{maxp})		<u> </u>	1	ft					epth (d _{maxp} / d _{bk}				<u> </u>
	Max Glide Depth (d _{maxg})		<u> </u>	<u> </u>	ft	Iviax Glic	ie Depth	viviean	KITTIE L	Depth (d _{maxg} / d _b	kf)			!
_	Rea	ach ^b	Rif	fle ^c		Bar		Rea	ach ^b	Riffle ^c	Bar	Protru	sion H	leight ^d
<u>s</u>		98					D ₁₆	<.	001					mm
eria		2					D ₃₅	<.	001					mm
Mat	% Gravel	0					D ₅₀	<0	.001					mm
Inel	% Cobble	0					D ₈₄	0.0	017					mm
Channel Materials	% Boulder	0					D ₉₅	0.0	046					mm
Ŭ	% Bedrock	0					D ₁₀₀	4.	.75					mm
Min	, max, mean depths are ave. mid-p	oint valu		nt noolo:	tokon o	t deepeet	and of pr			^c Active bed of a	o rifflo			

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Rush Rive	er - 1 - 0.08		Station Number:	N/A	
LOCATION:	Rush Rive					
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	98944	acres	154.6	mi ² Drainage Area Mn ELEV:	869.61	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	E6]		HUC:		
	'	'BANKFU	LL" CHA	RACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	sis
Bankfull WIDTH (W _{bk}	_{(f})	37.4	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPT	H (d _{bkf})	3.3	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	111.1	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	36.0	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	r (u)	1.4	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	150.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	HARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	150.0	cfs
Recurrence Interval (Log	g-Pearson) <i>a</i>	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.2	yrs
From the	Annual Pea	k Flow Freq	uency Anal	vsis data for the Gage Station, detern	nine:	
1.5 Year R.I. Discharg	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	je=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAI	NDER G	EOMETRY		
Meander Length (L _m	n)		ft	Radius of Curvature (R _C)		ft
Belt Width (W _{blt})			ft	$\fbox{Meander Width Ratio (W_{blt}/W_{bkf})}$	0.0	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean I	Depth (d) & Me	an Velocity (ι	egression analyses of measured discharge (i), determine the <i>intercept coefficient</i> (a) and elected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope ex	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	$A = A / W_p$		ft	Manning's "n" at Bankfull Stage	0.04	Coeff.
	" n " = 1	.4865 [(Area	a)(Hydrauli	c Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI		/ DISCHAF	R	GE Estin	nates		
Site	Rush River	- 1 - 0.	08		Location	T	Rush Riv	er - 1 - 0.(08	
Date	9/29/2011	Stre	am Type	E6	Valley Ty	ур	e	X		
Observers	KP, AL				HUC	-				
	INPUT V		LES				OUTPU	T VARIA	BLES	
Bankfull	Cross-sectior	al	111.1	A _{bkf} (ft ²)	Bankfu	ull	Mean DE	PTH	3.3	D _{bkf} (ft)
Banl	(full WIDTH		37.4	W _{bkf}			I PERIME d _{bkf} + W _{bkf}	TER	43.9	W _p (ft)
D ₈	₄ @ Riffle	0.0055	Dia. (mm)	D ₈₄	m	ım / 304.8	=	0.00	D ₈₄ (ft)	
Bank	full SLOPE		0.0004	S _{bkf} (ft / ft)			ulic RADII _{okf} / W _p	JS	2.5	R (ft)
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)	Relat	tiv R (/e Roughr (ft) / D ₈₄ (ft)	iess	140176	
Drai	nage AREA		154.6	DA (mi²)	Sh u	าe u*	ar <u>Velo</u> cit =√gRS	у .	0.2	u* (ft / sec)
	ESTIMA	TION	METHO	os		E	Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{	}]u*		6.0	ft / sec	663	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	a) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =		1.4	ft / sec	159	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (I	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	Γ	3.2	ft / sec	359	cfs
	ation is for application					L		I		
2. Roughness		ım Type		= 1.4865* R 0.04	^{2/3*} S ^{1/2} /n		1.4	ft / sec	159	cfs
3. Other Metho HEC-RAS	ods (Hey, Darcy-W	leisbach	, Chezy C, etc	.)			1.4	ft / sec	150	cfs
3. Other Metho	ods (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)				ft / sec		cfs
4. Continuity Return	Equations: Period for Bankf		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1			ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A			ft / sec		cfs
Option 1. For	s for using the I sand-bed chan ostitute an avera	nels: M	easure the "p	rotrusion h	neight" (h _{sd}) c	of	sand dunes	above chan	nel bed eleva	
Option 2. For	boulder-dominations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	he for	eights" (h _{bo} the D ₈₄ terr) of boulders n in est. me	above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-domin ited surfaces abo term in estimatio	ated ch ive char	annels: Meas nnel bed eleva	sure severa	protrusion	۱ h	eights" (h _b	,) of rock sep	parations/step	s/joints/ eet) for the

Stream:	Rush River - 1 - 0.08		
Basin:	Red River Basin Drainage Area: 98944 acres	154.6	mi ²
Location:	Rush River - 1 - 0.08		
Twp.&Rge:	s - Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	9/29/201 1
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	37.4	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	3.3	ft
	Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	111.1	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	11.5	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		ft
	WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d _{mbk}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	91.7	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	2.5	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations	<0.001	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00043	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).		
	Stream E6 See Classificati Type (Figure 2-2	-	

Str	eam: Rush River - 1 - 0.	08				Lo	ocation:	Rush	River -	1 - 0.08				
Ob	servers: KP, AL			Date:	9/29/20	011		Valle	еу Туре:	Х	Strean	n Type:	E6	
_				Riv	er Read	ch Sum	mary I	Data						
\square	Mean Riffle Depth (d _{bkf})	3.3	ft	Riffle \	Width (W	/ _{bkf})	37	' .4	ft	Riffle Area	A _{bkf})	11	1.1	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W _t	_{bkfp})			ft	Pool Area (/	A _{bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Riff	ile Width	1		W _{bkfp} / W _{bkf}	Pool Area /	Riffle Area			A _{bkfp} /A _{bkf}
Din	Max Riffle Depth (d _{maxrif})	5.2	ft	Max P	ool Depth	h (d _{maxp})			ft	Max Riffle D	epth/Mean Rif	fle Dep	th	1.6
Channel	Max Pool Depth/Mean Riffle I	Depth		Point E	Bar Slope	9			ft/ft	Inner Berm	Width (W _{ib})			ft
Chai	Inner Berm Depth (d _{ib})		ft	Inner E	Berm Wie	dth/Dept	h Ratio			W _{ib} /d _{ib} In	ner Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean	Velocity	at Bank	full Sta	ge (u _{bkf})		1	.4	ft/s	Estimation I	Nethod	н	EC-R	AS
	Streamflow: Estimated Discha	arge at E	Bankfull	Stage (Q _{bkf})		1	50	cfs	Drainage Ar	ea	15	4.6	mi²
_	Geometry	Mean	Min	Max			Dime	ension	less Ge	eometry Rat	os	Mean	Min	Max
	Meander Wavelength (L _m)	0	<u> </u>	<u> </u>	ft	Meander	r Length	n Ratio	(L _m /W _{bk}	f)		0.0		
Pattern	Radius of Curvature (R _c)	0			ft	Radius c	of Curva	iture/Ri	ffle Wid	th (R _c /W _{bkf})		0.0		
	Belt Width (W _{blt})	0			ft	Meander	r Width	Ratio (W _{blt} /W _{bl}	(h		0.0		
Channel	Individual Pool Length			<u> </u>	ft	Pool Ler	ngth/Riff	le Widt	th					
မြီ	Pool to Pool Spacing				ft	Pool to F	Pool Spa	acing/R	iffle Wid	dth				
\bigcup	Riffle Length				ft	Riffle Le	ngth/Rif	fle Wic	dth					
\square	Valley Slope (VS)		ft/ft	Averag	je Water	Surface	Slope ((S)		ft/ft	Sinuosity (VS/S)		
	Stream Length (SL) 48	8503	ft	Valley	Length (VL)			39	164 ft	Sinuosity (S	SL/VL)		1.2
	Low Bank Height star (LBH) end		ft ft		Max Riff Depth	le	start end		ft ft		eight Ratio (BH /ax Riffle Dept		star enc	·
	Facet Slopes	Mean		Max	2 optil			i	1	pe Ratios		Mean	Min	Max
file	Riffle Slope (S _{rif})	0.0			ft/ft	Riffle Slo				rface Slope (S _{rif} / S)	1.0		
Profile	Run Slope (S _{run})				ft/ft	Run Slop	pe/Avera	age Wa	ater Sur	face Slope (S	S _{run} / S)			
lanc	Pool Slope (S _p)				ft/ft	Pool Slo	pe/Aver	age Wa	ater Sur	face Slope (S	S _p / S)			
Channel	Glide Slope (Sg)				ft/ft	Glide Slo	ope/Ave	rage W	ater Su	rface Slope (S _g / S)			
	Feature Midpoint ^a	Mean	Min	Max						th Ratios		Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	5.2	<u> </u>	<u> </u>						Depth (d _{maxrif} /		1.6		<u> </u>
	Max Run Depth (d _{maxrun})	<u> </u>	<u> </u>	<u> </u>						epth (d _{maxrun} /				<u> </u>
	Max Pool Depth (d _{maxp})		1	1 T						epth (d _{maxp} / d				<u> </u>
\Box	Max Glide Depth (d _{maxg})				ft	Max Glic	le Deptr	n/Mean	Riffle L	Depth (d _{maxg} /	d _{bkf})			
_	Re	ach ^b	Rit	ffle ^c	В	ar		Rea	ach ^b	Riffle ^c	Bar	Protru	ision H	leight ^d
<u>s</u>		99					D ₁₆		001					mm
Materials	% Sand	1					D ₃₅	<.	001					mm
	% Gravel	0					D ₅₀	<0.	.001					mm
Channel	% Cobble	0					D ₈₄	0.0	055					mm
Chai	% Boulder	0					D ₉₅	0.	.06					mm
Ŭ	% Bedrock	0					D ₁₀₀	0.	.25					mm
Min	max, mean depths are ave. mid-			nt noolo:	tokon at	deeneet	oort of p			^c Active bed	of a riffla			

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Red River-	8-521.18		Station Number:	N/A	
LOCATION:	Red River-	8-521.18				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	2189440	acres	3421	mi ² Drainage Area Mn ELEV:	902.14	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	C6c-			HUC:		
		'BANKFU	LL" CHA	ARACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	138.0	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	6.6	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	914.5	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	141.6	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.8	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	1650.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	1650.0	cfs
Recurrence Interval (Log	₃-Pearson)a	ssociated wit	h "field-de	termined" Bankfull Discharge	1.2	yrs
From the	Annual Pea	k Flow Freq	uency Ana	lysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAI	NDER (GEOMETRY		
Meander Length (Lm	,)	1298	ft	Radius of Curvature (R _C)	507.0	ft
Belt Width (W _{blt})		2568	ft	Meander Width Ratio (W _{blt} /W _{bkf})	18.6	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean I	Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)	······································				
Slope Exponent:	(b)					
Hydraulic Radius: R			ft	Manning's "n" at Bankfull Stage	0.035	Coeff.
	_ , , , v v p				0.035	
	" n " = 1	.4865 [(Area	a) (Hydraul	ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	kfull VE		/ DISCHAF	RGE Estir	nates		
Site	Red River-8-	521.1	8		Location	Red Rive	er-8-521.18	3	
Date	10/5/2011	Stre	am Type	C6c-	Valley Ty	/pe	X		
Observers	KD, JB				HUC				
	INPUT VA	RIAB	LES			OUTPU	T VARIA	BLES	
Bankfull	Cross-sectiona	al	914.5	A _{bkf} (ft ²)	Bankfu	ull Mean Di	EPTH	6.6	D _{bkf} (ft)
Bank	full WIDTH		138.0	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	151.3	W _p (ft)
D ₈₄ @ Riffle 3.2 Dia. (mm)					D ₈₄	mm / 304.8	3 =	0.01	D₈₄ (ft)
Bank	full SLOPE	0.0002	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	6.0	R (ft)	
Gravitatio	onal Acceleratio	on	32.2	g (ft / sec ²)		ive Roughr R (ft) / D ₈₄ (ft)	ness	576	
Draiı	nage AREA		3421.0	DA (mi²)	Sh	lear_ ∤/clo cit	ty	0.2	U* (ft / sec)
	ESTIMAT	ΓΙΟΝ	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	[2.83	+ 5.66Log	{	•]u*	3.2	ft / sec	2943	cfs
2. Roughness roughness (Fig	Coefficient: a) s. 2-18, 19) u = 1.4	Manni I865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	1.8	ft / sec	1611	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (US	SGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n =	5.9	ft / sec	5389	cfs
	tion is for applications ble-and boulder-don								
2. Roughness		n Type		= 1.4865* R 3 0.035	^{2/3*} S ^{1/2} /n	1.8	ft / sec	1611	cfs
3. Other Metho HEC-RAS	ds (Hev, Darcy-We	eisbach	<mark>, Chezy C, etc</mark>	.)		1.8	ft / sec	1650	cfs
3. Other Metho	ds (Hey, Darcy-We	eisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankful		jional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=0	Q / A		ft / sec		cfs
Option 1. For Sub	5 for using the D₂ sand-bed chann ostitute an average	els: Me e sand	easure the "p dune protrus	orotrusion h sion height (height" (h _{sd}) c h _{sd} in ft) for th	of sand dunes ie D ₈₄ term in	above chan est. method	nel bed eleva 1.	itions.
Option 2. For elev	boulder-dominativations. Substitute	t ed ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _{bc} or the D ₈₄ ter) of boulders m in est. me	above chanr thod 1.	nel bed
. uplif	bedrock-domina ted surfaces abov term in estimation	e char	nel bed eleva	sure several ations. Sub	l "protrusion stitute an ave	heights" (h _t rage bedrock	_{or}) of rock sep protrusion h	parations/step neight (h _{br} in f	eet) for the

Stream:	Red River-8-521.18		
Basin:	Red River BasinDrainage Area: 2E+06 acres	3421	mi ²
Location:	Red River-8-521.18		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/5/201
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	129.0	£1
	WIDTH OF the stream channel at bankfull stage elevation, in a nine section.	138.0	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	6.6	ft
	Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	914.5	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	20.8	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		ft
	WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d _{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	788.0	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	5.7	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.007	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00016	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.6	
	Stream C6c- See Classification (Figure 2-2)		

	ream: Red River-8-521.18	3				Lo	ocation:	Red R	iver-8-	521.18				
Ob	oservers: KD, JB			Date:	10/5/2	2011		Valle	у Туре:	Х	Stream	n Type:	C6c-	
				Riv	er Rea	ich Sum	mary I	Data						
\bigcap	Mean Riffle Depth (d _{bkf})	6.6	ft	Riffle V	Vidth (V	N _{bkf})	13	8.0	ft	Riffle Area (A _b	_{kf})	914	4.5	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft	Pool Area (A _{bk}	_{fp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / Rif	fle Area			A _{bkfp} /A
	Max Riffle Depth (d _{maxrif})	9.72	ft	Max Po	ool Dep	th (d _{maxp})			ft	Max Riffle Dep	oth/Mean Rif	fle Dept	th	1.5
Channel	Max Pool Depth/Mean Riffle D	epth		Point E	Bar Slop)e			ft/ft	Inner Berm W	idth (W _{ib})			ft
Chal	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Dept	h Ratio			W _{ib} /d _{ib} Inne	r Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean	/elocity	at Bank	full Sta	ge (u _{bkf})		1.	.8	ft/s	Estimation Me	thod	Н	EC-R/	AS
\bigcup	Streamflow: Estimated Discha	rge at B	ankfull	Stage (Q _{bkf})		16	50	cfs	Drainage Area		34	21	mi²
_	Geometry	Mean	Min	Max			Dime	ension	ess Ge	ometry Ratios	5	Mean	Min	Max
[_]	Meander Wavelength (L _m)	1298		<u> </u>	ft	Meander	r Length	Ratio	(L _m /W _{bk}	f)		9.4		
Pattern	Radius of Curvature (R _c)	507		<u> </u>	ft	Radius c	of Curva	ture/Ri	fle Wid	th (R _c /W _{bkf})		3.7		
	Belt Width (W _{blt})	2568			ft	Meander	Width	Ratio (N _{blt} /W _{bk}	()		18.6		
Channel	Individual Pool Length	<u> </u>		<u> </u>	ft	Pool Len	gth/Riff	le Widt	h					
Ch	Pool to Pool Spacing	<u> </u>		1	ft	Pool to F	Pool Spa	acing/R	iffle Wio	dth				
\bigcup	Riffle Length	<u> </u>			ft	Riffle Le	ngth/Rif	fle Wic	lth					
\bigcap	Valley Slope (VS)		ft/ft	Averag	e Wate	er Surface	Slope (S)		ft/ft	Sinuosity (\	/S/S)		
	Stream Length (SL) 138	3749	ft	Valley	Length	(VL)			53	266 ft	Sinuosity (S	SL/VL)		2.6
	Low Bank Height start (LBH) end		ft ft		Max Rif Depth		start end		ft ft		ht Ratio (B⊢ x Riffle Dept		star	
	Facet Slopes	Mean	Min	Max					i			,		Max
Profile	Riffle Slope (S _{rif})	0.0					Dimer	sionle	ss Slop	pe Ratios	•	Mean	Min	IVIAX
12		0.0	<u>i </u>		ft/ft	Riffle Slo				be Ratios rface Slope (S _{ri}		,		WIAX
	Run Slope (S _{run})				ft/ft ft/ft	1	ope/Ave	rage W	ater Su		, f / S)	Mean		
	Run Slope (S _{run}) Pool Slope (S _p)					Run Slop	ope/Ave oe/Avera	rage W age Wa	ater Su iter Surf	rface Slope (S _{ri}	_f / S) / S)	Mean		
Channel F					ft/ft	Run Slop Pool Slo	ope/Ave oe/Avera pe/Avera	rage W age Wa age Wa	ater Su ter Surf ater Sur	rface Slope (S _{ri} face Slope (S _{run}	, / S) / S) / S)	Mean		
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a	Mean	Min	Max	ft/ft ft/ft ft/ft	Run Slop Pool Slo Glide Slo	ppe/Ave pe/Avera pe/Avera ppe/Ave Dimer	rage W age Wa age Wa rage W sionle	ater Su Iter Surf ater Sur ater Su ss Dep	rface Slope (S _{ri} face Slope (S _{ru} face Slope (S _p face Slope (S _g th Ratios	/ S) / S) / S) / S)	Mean 1.0 Mean		Max
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})		Min	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slo Glide Slo Max Riff	ppe/Ave pe/Aver pe/Aver ppe/Ave Dimer le Depth	rage W age Wa age Wa rage W sionle n/Mean	ater Sur ater Sur ater Sur ater Su ss Dep Riffle D	rface Slope (S _{ri} face Slope (S _{ru} face Slope (S _p / rface Slope (S _g th Ratios Depth (d _{maxif} / d _b	(/ S) / S) / S) / S) / S)	Mean 1.0	Min	
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean	Min	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Rur	ppe/Ave pe/Aver ppe/Aver ppe/Ave Dimer le Depth	rage Wa age Wa age Wa rage W sionle n/Mean F	ater Sur ater Sur ater Sur ater Su ss Dep Riffle De	rface Slope (S _{ri} face Slope (S _{ru} face Slope (S _p frace Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxrin} / d _b	r / S) / S) / S) / S) / S) kt) kt)	Mean 1.0 Mean	Min	
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Pool Depth (dmaxp)	Mean	Min	Max	ft/ft ft/ft ft/ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Ave Dimer le Depth l Depth/ l Depth,	rage Wa age Wa age Wa rage W sionle Mean f /Mean f	ater Su tter Surf ater Sur ater Su ss Dep Riffle De Riffle De	rface Slope (S _{ri} face Slope (S _p / face Slope (S _p / rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxru} / d _b)	(/ S) / S) / S) / S) / S) kd))	Mean 1.0 Mean	Min	
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean	Min	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Ave Dimer le Depth l Depth/ l Depth,	rage Wa age Wa age Wa rage W sionle Mean f /Mean f	ater Su tter Surf ater Sur ater Su ss Dep Riffle De Riffle De	rface Slope (S _{ri} face Slope (S _{ru} face Slope (S _p frace Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxrin} / d _b	(/ S) / S) / S) / S) / S) kd))	Mean 1.0 Mean	Min	
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg}) Rea	Mean 9.7		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Ave Dimer le Depth l Depth/ l Depth/	rage W age Wa age Wa rage W sionle Mean f /Mean f /Mean f /Mean f /Mean f	ater Su tter Surf ater Sur ater Su ss Dep Riffle De Riffle De Riffle De Riffle D	rface Slope (S _{ri} face Slope (S _p / face Slope (S _p / rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxru} / d _b)	(/ S) / S) / S) / S) / S) kd))	Mean 1.0 Mean 1.5	Min	
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay	Mean 9.7 ach ^b 63		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimer le Depth d Depth/ d Depth/ le Depth	rage W age Wa age Wa rage W sionle Mean I Mean I Mean I Mean I Mean I Mean I	ater Su tter Surf ater Sur ater Su Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do	rface Slope (S _{ri} face Slope (S _p , face Slope (S _p , rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxr} / d _b depth (d _{maxg} / d _b)	(/ S) / S) / S) / S) kl) kl) d)	Mean 1.0 Mean 1.5	Min	Max
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay	Mean 9.7		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Ave Dimer le Depth d Depth/ le Depth	rage W age Wa age Wa rage W sionle Mean I Mean I Mean I Mean I Mean I Mean I	ater Su tter Surf ater Sur ater Su ss Dep Riffle De Riffle De Riffle De Riffle D	rface Slope (S _{ri} face Slope (S _p , face Slope (S _p , rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxr} / d _b depth (d _{maxg} / d _b)	(/ S) / S) / S) / S) kl) kl) d)	Mean 1.0 Mean 1.5	Min	Max Max
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Run Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxrif) Max	Mean 9.7		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimer le Depth d Depth/ d Depth/ le Depth	rage W age Wa age Wa rage W sionle /Mean I /Mean I /Mean I /Mean I /Mean 0.0	ater Su tter Surf ater Sur ater Su ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope (S _{ri} face Slope (S _p , face Slope (S _p , rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxr} / d _b depth (d _{maxg} / d _b)	(/ S) / S) / S) / S) kl) kl) d)	Mean 1.0 Mean 1.5	Min	Max Max leight ^d
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay % Sand % Cobble	Mean 9.7 ach ^b 53 25 12 0		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimer le Depth d Depth d Depth d Depth d Depth d Depth	rage W age Wa age Wa rage W sionle /Mean I /Mean I /Mean I /Mean I /Mean 0.0	ater Su tter Surf ater Surf ater Surf ater Su ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope (S _{ri} face Slope (S _p , face Slope (S _p , rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxr} / d _b depth (d _{maxg} / d _b)	(/ S) / S) / S) / S) kl) kl) d)	Mean 1.0 Mean 1.5	Min	Max Max leight ^d mm
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Rool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay % Sand % Gravel % Cobble	Mean 9.7		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Ave Dimer le Depth d Depth/ d Depth/ le Depth le Depth Das Das Das Das	rage Wa age Wa age Wa rage Wa sionle n/Mean I n/Mean I n/Mean I a/Mean I a/Ma a/Ma a/Ma a/Ma a/Ma a/Ma a/Ma a/M	ater Su tter Surf ater Sur ater Su ss Dep Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope (S _{ri} face Slope (S _p , face Slope (S _p , rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxr} / d _b depth (d _{maxg} / d _b)	(/ S) / S) / S) / S) kl) kl) d)	Mean 1.0 Mean 1.5	Min	Max Max leight ^d mm mm
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxrif) Ma	Mean 9.7 ach ^b 53 25 12 0		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Ave Dimer le Depth d Depth	rage Wa age Wa rage Wa sionle Mean I Mean I Mean I Mean I Mean I (Mean I 0.0 0.0 0.0	ater Su ter Sur ater Sur ater Sur ater Su ss Dep Riffle De Riffle De Riffle Do Riffle DO	rface Slope (S _{ri} face Slope (S _p , face Slope (S _p , rface Slope (S _g th Ratios Depth (d _{maxrif} / d _b epth (d _{maxr} / d _b depth (d _{maxg} / d _b)	(/ S) / S) / S) / S) kl) kl) d)	Mean 1.0 Mean 1.5	Min	Max Max leight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Red River-	7-492.47		Station Number:	N/A	
LOCATION:	Red River	7-492.47				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	2215040	acres	3461	mi ² Drainage Area Mn ELEV:	879.8	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X	
Stream Type:	C6c-			HUC:		
	I	'BANKFU	LL" CHA	RACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	120.8	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPT	H (d _{bkf})	8.9	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	1073.7	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	125.4	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	(u)	1.5	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	1650.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	1650.0	cfs
Recurrence Interval (Log	g-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.2	yrs
From the	Annual Pea	k Flow Freq	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharg	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEA	NDER G	EOMETRY		
Meander Length (L _m	,)	2002	ft	Radius of Curvature (R _C)	500.0	ft
Belt Width (W _{blt})		3121	ft	Meander Width Ratio (W _{blt} /W _{bkf})	25.8	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean I	Depth (d) & Me	an Velocity (ι	egression analyses of measured discharge (a), determine the <i>intercept coefficient</i> (a) and elected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)	·····				
Slope Exponent:	(b)					
Hydraulic Radius: R			ft	Manning's "n" at Bankfull Stage	0.035	Coeff.
	- ~ / vv _p			manning 5 n at Dankiun Stage	0.035	Coell.
	" n " = 1	.4865 [(Area	a)(Hydrauli	c Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI		/ DISCHAP	RGE Estir	nates		
Site	Red River-7	-492.4	7		Location	Red Rive	r-7-492.47	7	
Date	9/30/2011	Stre	am Type	C6c-	Valley Ty	/pe	x		
Observers	KD, JB				HUC				
	INPUT VA	RIAB	LES			OUTPU	T VARIA	BLES	
Bankfull	Cross-section	al	1073.7	A _{bkf} (ft ²)	Bankfu	ull Mean DE	EPTH	8.9	D _{bkf} (ft)
Bank	full WIDTH		120.8	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	138.6	W _p (ft)
D ₈	4 @ Riffle	1.0	Dia. (mm)	D ₈₄	mm / 304.8	3 =	0.0	D ₈₄ (ft)	
Bank	full SLOPE		0.0001	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	7.7	R (ft)
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Roughr R (ft) / D ₈₄ (ft)	ness	2271	
Drai	nage AREA		3461.0	DA (mi²)		lear Velocit u* =√gRS	ty	0.1	u* (ft / sec)
	ESTIMA	TION	METHO	DS		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{	}]u*	3.0	ft / sec	3197	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	i) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	1.4	ft / sec	1542	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	JSGS):		1.4865* R ^{2/:} ^{.16} n	^{3*} S ^{1/2} /n 6.6 ft / sec			7109	cfs
	ition is for application: Ible- and boulder-do C2 and E3.						J]]
2. Roughness c) Manning	s Coefficient: s 'n' from Strea	m Type		= 1.4865* R 0.035	^{2/3} *S ^{1/2} /n	1.4	ft / sec	1542	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	, Chezy C, etc	:.)		1.5	ft / sec	1650	cfs
3. Other Metho	ods (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfu		gional Curve arge	s u = (Q = 1.46			ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q / A		ft / sec		cfs
Option 1. For Sul	s for using the E sand-bed chan ostitute an avera	nels: M ge sand	easure the "p dune protrus	orotrusion height (height" (h _{sd}) o (h _{sd} in ft) for th	of sand dunes le D ₈₄ term in	above char est. method	nel bed eleva 1.	tions.
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion hei	" protrusion ght (h _{bo} in ft) f	heights" (h _{bo} or the D ₈₄ ter) of boulders m in est. me	above chani thod 1.	nel bed
' uplif	bedrock-domination ted surfaces about term in estimatio	ve char	nnel bed eleva	sure severa ations. Sub	l "protrusion stitute an ave	heights" (h _b rage bedrock	_r) of rock sep protrusion h	parations/step neight (h _{br} in f	eet) for the

Stream:	Red River-7-492.47		
Basin:	Red River Basin Drainage Area: 2E+06 acres	3461	mi ²
Location:	Red River-7-492.47		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	9/30/2011
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	120.8	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	8.9	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	1073.7	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	13.6	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	13.3	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkl}) =$ the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	404.0	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W _{fpa} / W _{bkf}) (riffle section).	3.3	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.025	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000075	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.6	
	Stream C6c- See Classification (Figure 2-2		

u	ream: Red River-7-492.47	7				Lo	cation:	Red R	iver-7-	-492.47				
Ob	servers: KD, JB			Date:	9/30/2	2011		Valle	у Туре:	Х	Stream	n Type:	C6c-	
				Riv	er Rea	ach Sum	mary [Data						
\square	Mean Riffle Depth (d _{bkf})	8.9	ft	Riffle V	Nidth (\	W _{bkf})	12).8	ft	Riffle Area (A _{bkf})	107	3.7	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (V	V _{bkfp})			ft	Pool Area (A	N _{bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	iffle Width			W _{bkfp} / W _{bkf}	Pool Area / I	Riffle Area			A _{bkfp} /A
	Max Riffle Depth (d _{maxrif})	13.3	ft	Max Po	ool Dep	oth (d _{maxp})			ft	Max Riffle D	epth/Mean Rit	fle Dept	th	1.5
Channel	Max Pool Depth/Mean Riffle D	epth		Point E	Bar Slop	be			ft/ft	Inner Berm	Width (W _{ib})			ft
Chai	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	/idth/Deptl	h Ratio			W _{ib} /d _{ib} Inr	ner Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean	Velocity	at Bank	full Sta	ge (u _{bkf}))	1.	5	ft/s	Estimation N	lethod	н	EC-R	AS
\Box	Streamflow: Estimated Discha	rge at E	Bankfull	Stage (Q _{bkf})		16	50	cfs	Drainage Ar	ea	34	61	mi²
	Geometry	Mean	Min	Max			Dime	ension	ess Ge	eometry Rati	os	Mean	Min	Max
[_]	Meander Wavelength (L _m)	2002	<u> </u>	<u> </u>	ft	Meander	r Length	Ratio	(L _m /W _{bk}	f)		16.6		
Pattern	Radius of Curvature (R _c)	500		<u> </u>	ft	Radius c	of Curva	ture/Ri	fle Wid	th (R _c /W _{bkf})		4.1		
	Belt Width (W _{blt})	3121	<u> </u>	<u> </u>	ft	Meander	Width	Ratio (\	N _{blt} /W _{bk}	⁴)		25.8		
Channel	Individual Pool Length	<u> </u>	<u> </u>	1	ft	Pool Len	igth/Riff	le Widt	h					<u> </u>
Ű	Pool to Pool Spacing		<u> </u>	i	ft	Pool to F				dth				<u> </u>
\Box	Riffle Length	ļ			ft	Riffle Le	ngth/Rif	fle Wid	th					
\square	Valley Slope (VS)		ft/ft	Averag	ge Wate	er Surface	Slope (S)		ft/ft	Sinuosity (VS/S)		
	Stream Length (SL) 74	148	ft	Valley	Length	(VL)			29	<mark>010</mark> ft	Sinuosity (SL/VL)		2.6
	Low Bank Height start (LBH) end		ft ft		Max Rif Deptł		start end		ft ft		eight Ratio (BH lax Riffle Dept		star enc	
	Facet Slopes	Mean	Min	Max					•	1)		
Profile	Riffle Slope (S _{rif})						Dimer	sionle	ss Slop	oe Ratios		Mean	Min	Max
1 21		0.0		•	ft/ft	Riffle Slo				pe Ratios rface Slope (•	,	Min	Max
	Run Slope (S _{run})	0.0		•	ft/ft ft/ft		ope/Ave	rage W	ater Su		S _{rif} / S)	Mean	Min	Max
	Run Slope (S _{run}) Pool Slope (S _p)	0.0		•	i	Run Slop	ope/Ave	rage W age Wa	ater Su ter Surf	rface Slope (S _{rif} / S) _{run} / S)	Mean	Min	Max
Channel Pr		0.0		•	ft/ft	Run Slop Pool Slop	ope/Ave oe/Avera pe/Avera	rage Wa age Wa age Wa	ater Su ter Surf ater Sur	rface Slope (face Slope (S	S _{rif} / S) _{run} / S) S _p / S)	Mean	Min	Max
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a	Mean	1	•	ft/ft ft/ft ft/ft	Run Slop Pool Slo Glide Slo	ppe/Ave pe/Avera pe/Avera ppe/Avera Dimen	rage Wa age Wa age Wa rage W sionle	ater Su ter Surf ater Sur ater Su ss Dep	rface Slope (face Slope (S face Slope (S rface Slope (th Ratios	S _{rif} / S) run / S) S _p / S) S _g / S)	Mean 1.0 Mean	Min	Max Max
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})		1	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slo Glide Slo Max Riff	ppe/Ave pe/Avera pe/Avera ppe/Avera Dimen le Depth	rage W age Wa age Wa rage W sionle n/Mean	ater Sur ter Surf ater Sur ater Su ss Dep Riffle D	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} /	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkt})	Mean 1.0		
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean	1	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Rur	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Ave Dimen le Depth/	rage W age Wa age Wa rage W sionle n/Mean F	ater Sur ter Surf ater Sur ater Su ss Dep Riffle De	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrun} /	S _{rif} / S) run / S) S _g / S) S _g / S) d _{bkf})	Mean 1.0 Mean		
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Pool Depth (dmaxp)	Mean	1	Max	ft/ft ft/ft ft/ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/ l Depth/ l Depth/	rage W age Wa age Wa rage W sionle Mean F Mean F	ater Su ter Surf ater Su ater Su ss Dep Riffle De Riffle De	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxp} / c	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkt}) d _{bkt})	Mean 1.0 Mean		
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean	1	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/ l Depth/ l Depth/	rage W age Wa age Wa rage W sionle Mean F Mean F	ater Sur ter Surf ater Sur ater Su ss Dep Riffle De Riffle De	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrun} /	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkt}) d _{bkt})	Mean 1.0 Mean		
	Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg})	Mean 13.3		Max	ft/ft ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Avera Dimen le Depth/ l Depth/ le Depth/ le Depth/	rage W age Wa age Wa rage W sionle Mean F Mean F Mean I Mean Rea	ater Su ter Sur ater Sur ater Su ss Dep Riffle De Riffle De Riffle De Riffle D	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxp} / c	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkt}) d _{bkt})	Mean 1.0 Mean 1.5	Min	Max Max
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Real % Silt/Clay	Mean 13.3 ach ^b 53		Max	ft/ft ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Run Max Glide	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/ le Depth/ le Depth/ le Depth/	rage W age Wa age Wa rage W sionle Mean F Mean F Mean I Mean A Mean A Me	ater Su ter Surf ater Sur ater Su Riffle De Riffle De Riffle De Riffle Do Riffle Do Riffle Do	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxg} /	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkf}) d _{bkf}) d _{bkf})	Mean 1.0 Mean 1.5	Min	Max
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Read % Silt/Clay % Sand	Mean 13.3 ach ^b 53		Max	ft/ft ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Run Max Glide	ppe/Ave pe/Avera ppe/Avera ppe/Avera Dimen le Depth/ l Depth/ le Depth/ le Depth/	rage Wa age Wa age Wa sionle Mean F Mean f Mean f Mean f Mean A a Mean A a Mean A a Mean A a Mean A a Mean A a Mean A a a a a a a a a a a a a a a a a a a a	ater Su ter Surf ater Surf ater Su ss Dep Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxg} /	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkf}) d _{bkf}) d _{bkf})	Mean 1.0 Mean 1.5	Min	Max Max
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxrif) Max Glide Depth (dmaxrif) M	Mean 13.3 13.3 2 2 2 3 47 0		Max	ft/ft ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Run Max Glide	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/ le	rage W age Wa age Wa rage W sionle Mean P Mean P Mean I Mean I Mean I Mean O 0.0	ater Su ter Surf ater Sur ater Su ss Dep Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxg} /	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkf}) d _{bkf}) d _{bkf})	Mean 1.0 Mean 1.5	Min	Max Max l
Channel	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg) Rea % Silt/Clay % Sand % Gravel % Cobble	Mean 13.3 13.3 2 2 3 47 0 0		Max	ft/ft ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Run Max Glide	ppe/Avera pe/Avera ppe/Avera ppe/Avera Dimen le Depth d Depth/ d Depth/ le Depth d Depth/ le Depth d Depth/ d Depth/ le Depth d Depth/ le Depth	rage Wa age Wa age Wa rage Wa sionle Mean F Mean F Mean I Mean A Mean A	ater Su ter Sur ater Sur ater Su ss Dep Riffle D Riffle D Riffle D Riffle D Riffle D 01 035 025 04	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxg} /	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkf}) d _{bkf}) d _{bkf})	Mean 1.0 Mean 1.5	Min	Max Max leight ^d mm
	Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxrif) Ma	Mean 13.3 13.3 2 2 2 3 47 0		Max	ft/ft ft/ft ft/ft ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Run Max Glide	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/ le	rage W age Wa age Wa rage W sionle Mean F Mean F Mean I Mean I Mean I (Mean I (Mean I (Mean I (Mean I (Mean I (Mean I (Mean I (Mean I (Mean I))) (Mean I (Mean I)) (Mean I) (Mean I) (M	ater Su ter Surf ater Sur ater Su ss Dep Riffle De Riffle De Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope (face Slope (S face Slope (S rface Slope (S th Ratios Depth (d _{maxrif} / epth (d _{maxru} / epth (d _{maxg} /	S _{rif} / S) run / S) S _p / S) S _g / S) d _{bkf}) d _{bkf}) d _{bkf})	Mean 1.0 Mean 1.5	Min	Max Max leight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

					Data/Records	for		
Station NAME:	Red River	- 6 - 470.23			Station	Number:	N/A	
LOCATION:	Red River	- 6 - 470.23						
Period of RECORD:	N	/A	yrs	Mea	n Annual DISCHAR	RGE:	N/A	cfs
Drainage AREA:	2298240	acres	3591	mi ²	Drainage Area M	n ELEV:	869.48	ft
Reference REACH SLO	PE:		ft/ft]	Valley Type:		Х]
Stream Type:	C6c-			HUC:				
	I	BANKFU	LL" CHA	RACTE	RISTICS			
Determined from	FIELD ME	ASUREME	NT	De	termined from Q	GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_{cf})	118.0	ft	Bankfu	ll WIDTH (W _{bkf})			ft
Bankfull Mean DEPT	H (d _{bkf})	9.3	ft	Bankfu	II MEAN DEPTH	(d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	1084.1	ft ²	Bankfu	II Xsec AREA (A _t	_{bkf})		ft ²
Wetted PERIMETER	(W _p)	124.0	ft	Wetteo	PERIMETER (W	V _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfu	II STAGE (Gage	Ht)		ft
Est. Mean VELOCITY	r (u)	1.7	ft/sec	Mean	/ELOCITY (u)			ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	1780.0	cfs	Bankfu	II DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined'	' Bankfull STAGE		1780.0	cfs
Recurrence Interval (Log	g-Pearson)a	associated wit	th "field-de	termined"	Bankfull Discharge	e	1.3	yrs
From the	Annual Pea	ak Flow Freq	uency Ana	lysis data	for the Gage Stat	ion, deter	mine:	
1.5 Year R.I. Discharg	e =	N/A	cfs	10 Yea	ar R.I. Discharge	=	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Yea	ar R.I. Discharge	=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Yea	ar R.I. Discharge	=	N/A	cfs
		MEAN	NDER G	BEOME	TRY			
Meander Length (L _n	n)	1310	ft	Radius	of Curvature (R	_c)	350.0	ft
Belt Width (W _{blt})		1880	ft	Meande	er Width Ratio(W _b	_{blt} /W _{bkf})	15.9	ft/ft
		HYDR	AULIC	GEOME	TRY			
Based on USGS Discharge parameters of Width (W), An (b) values for a power funct (Q).	rea (A), Mean	Depth (d) & Me	ean Velocity (u), determin	he the intercept coeffi hydraulic parameters	<i>icient</i> (a) an	d the slope ex	kponent
Intercept Coefficient:	(a)			<u>`</u>				
Slope Exponent:	(b)							
Hydraulic Radius: R	$= A / W_p$		ft	Mannir	ng's "n" at Bankful	I Stage	0.040	Coeff.
	" n " = 1	.4865 [(A rea	ı) (Hydraul	ic R adius	^{2/3}) (S lope ^{1/2})] /	Q _{bkf}		

		Ban	kfull VEI		/ DISCHAI	RG	E Esti	mat	es							
Site	Red River				Location	Re	ed Rive	er - (6 - 4	70	.2:	3				
Date	11/16/2010	Stre	am Type	C6c-	Valley Ty	/pe		Х								
Observers	KD, JB				HUC	0	90	2	0	1	() 4	0		5	0 1
	INPUT VA	RIAB	LES			C	Ουτρι	JT	VA	RI/	۱B	LES	3			
Bankfull	Cross-section	nal	1084.1	A _{bkf} (ft ²)	Bankfu	ull N	lean D	EPT	Ή			9.	3		D (bkf ft)
Bank	full WIDTH		118.0	W _{bkf}			PERIME _{kf} + W _{bkf}	ETEF	۲			136	5.5		W _p (ft)	
D ₈ ,	4 @ Riffle		0.0125	Dia. (mm)	D ₈₄	mm	/ 304.	8 =			0.0					84 ft)
Bankfull SLOPE 0.0001 Sbkf (ft/ft)					Hydraulic RADIUS A _{bkf} / W _p							7.	Э			R ft)
Gravitatio	nal Accelerat	ion	32.2	g (ft / sec ²)			Rough) / D ₈₄ (ft)		5			1936	527			
Drair	nage AREA		3591.0	DA (mi²)			Veloc √gRS	ity			Ľ	0.:	2			J* ′sec)
	ESTIMA	TION	METHO	DS		Ва	nkfull \	/ELO		ſY	Bank DISCH					
1. Friction Factor	Relative u = Roughness	= [2.83	3 + 5.66Log	{	}]u*		6.2	ft	/ se	c		669) 4		c	fs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.		ng's 'n' from f 2 ^{/3*} S ^{1/2} /n		r / relative =		1.7	ft	/ se	c		189) 1		c	fs
	'n' from Jarrett (l		n = 0.39S ^{.38} R ⁻		=	7.3 ft/sec				c		789) 3		C	fs
	tion is for applications ble- and boulder-do C2 and E3.															
2. Roughness		ım Type		= 1.4865* R	^{2/3} *S ^{1/2} /n		1.7	ft	/ se	c		189) 1		c	fs
3. Other Metho HEC-RAS	ds (Hev. Darcv-W	/eisbacl	n <mark>. Chezy C. etc</mark>	c.)			1.7	ft	/ se	c		178	0.0		c	fs
3. Other Metho	ds (Hey, Darcy-W	/eisbacl	n, Chezy C, etc	c.)				ft	/ se	c					С	fs
4. Continuity Return	Equations: Period for Bankfi	-	gional Curve harge	$\begin{array}{c} \mathbf{S} & \mathbf{u} = 0 \\ \mathbf{Q} = & 1.46 \end{array}$	Q / A Yr.			ft	/ se	c					c	fs
4. Continuity	Equations:	b) US	GS Gage Da	ta u =	Q / A			ft	/ se	c					c	fs
Option 1. For Sub	for using the D sand-bed chan ostitute an average	nels: M ge sand	easure the " r I dune protrus	protrusion l sion height (h eight" (h _{sd}) ((h _{sd} in ft) for th	of sa ne D	and dune ₈₄ term i	es abe n est	ove (me	cha thoo	nne d 1	el bec	d ele	eva	tions	
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pr	sure several otrusion hei	" protrusion ght (h _{bo} in ft)	heig for th	ghts" (h ne D ₈₄ te	_{bo}) of erm in	bou est	lder . me	s a eth	above od 1.	cha	ann	el be	ed
. uplif	bedrock-domin ted surfaces abc D ₈₄ term in estim	ove cha	nnel bed elev	sure severa ations. Sub	Il " protrusion ostitute an ave	hei erage	ghts" (h e bedroo	n _{br}) of k pro	rocl trus	k se ion	epa hei	ratior ight (l	ıs/stı ı _{br} ir	ep: n fe	s/joir et) f	nts/ [:] or

Stream:	Red River of the North		
Basin:	Red River BasinDrainage Area: 2298240 acres	3591	mi ²
Location:	Red River - 6 - 470.23		
Twp.&Rge:	: - Sec.&Qtr.: -		
Cross-Sect	tion Monuments (Lat./Long.): -	Date	: 11/16/201
Observers	: KD, JB	Valley Type	: X
	Bankfull WIDTH (W _{bkf})		
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	118.0	ft
]
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section ($d_{bkf} = A / W_{bkf}$).	9.3	ft
			-
	Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.		
		1084.1	ft ²
	Width Donth Botio (N/ /d)		-
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	12.7	ft/ft
		12.1	
	Maximum DEPTH (d _{mbkf})		
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	16.2	ft
			_
	WIDTH of Flood-Prone Area (W_{fpa})		
	Twice maximum DEPTH, or $(2 \times d_{mbid})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	404.7	ft
]
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W _{foa} /W _{bkf})		
	(riffle section).	3.4	ft/ft
	Channel Materials (Particle Size Index) D ₅₀		
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled		
	from the channel surface, between the bankfull stage and Thalweg elevations.		
		0.0017	mm
	Water Surface SLOPE (S)		1
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in		
	length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00014	£+./£+
		0.00014	ft/ft
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope	/	
	(VS / S).	2.3	
			- 1
	Stream C6c- See Classificatio	-	
	Type (Figure 2-2	1)	

Str	eam: Red River of the N	orth				Lo	cation:	RM66.	89-66.	.07					
Ob	servers: KD, JB			Date:	11/16	/2010		Valley	/ Туре:	x		Stream	n Type:	C6c-	
				Rive	er Rea	ch Sum	mary I	Data							
\bigcap	Mean Riffle Depth (d _{bkf})	9.3	ft	Riffle V	Nidth (\	W _{bkf})	11	8.0	ft	Riffle Are	ea (A _l	_{bkf})	108	4.1	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (V	V _{bkfp})			ft	Pool Area	a (A _{bl}	_{kfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	iffle Width	n		W _{bkfp} / W _{bkf}	Pool Area	a / Ri	ffle Area			A _{bkfp} / A _{bkf}
Dim	Max Riffle Depth (d _{maxrif})	16.2	ft	Max P	ool Dep	oth (d _{maxp})			ft	Max Riffle	e De	pth/Mean Rif	fle Dep	th	1.7
Channel	Max Pool Depth/Mean Riffle D	epth		Point E	Bar Slop	De			ft/ft	Inner Ber	m W	'idth (W _{ib})			ft
Cha	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Dept	h Ratio			W_{ib}/d_{ib}	Inne	r Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean \	/elocity	at Banl	kfull Sta	ige (u _{bkf}	;)	1.	7	ft/s	Estimatio	n Me	ethod	Н	EC-R	AS
	Streamflow: Estimated Discha	rge at l	Bankfull	Stage ((Q _{bkf})		17	80	cfs	Drainage	Area	a	35	91	mi²
_	Geometry	Mean	Min	Max		-	Dime	ensionle	ess Ge	ometry R	atio	s	Mean	Min	Max
$\left[\right]$	Meander Wavelength (L _m)	1310			ft	Meander	r Length	Ratio (L _m /W _{bk}	ď)			11.1		
Pattern	Radius of Curvature (R _c)	350			ft					Ith (R _c /W _b	_{okf})		3.0		
	Belt Width (W _{bit})	1880			ft	Meander	r Width	Ratio (V	N _{blt} /W _b	_{kf})			15.9		
Channel	Individual Pool Length				ft	Pool Ler	igth/Riff	le Widt	h						
Ü	Pool to Pool Spacing				ft	Pool to F	Pool Spa	acing/Ri	ffle Wi	dth					
\bigcup	Riffle Length				ft	Riffle Le	ngth/Ri	fle Wid	th						
\bigcap	Valley Slope (VS)		ft/ft	Averag	je Wate	er Surface	Slope	(S)		ft/	/ft	Sinuosity (\	/S/S)		
	Stream Length (SL) 684	433	ft	Valley	Length	(VL)			304	431 ft		Sinuosity (S	SL/VL)		2.2
	Low Bank Height start	 	ft		Max Rif		start		ft			ght Ratio (B⊢		star	t
	(LBH) end		ft		Depth	1	end	i	ft		I/Ma	x Riffle Dept	·	enc	
<u> </u>	Facet Slopes Riffle Slope (S _{rif})	Mean 0.0	Min	Max	ft/ft	Riffle Slo				be Ratios	be (S	rif / S)	Mean 1.0	Min	Max
Profile	Run Slope (S _{run})				ft/ft	-		-		face Slope					
Lel P	Pool Slope (S _p)				ft/ft			•		face Slop					
Chan	Glide Slope (S _g)				ft/ft					Inface Slop					
ျပ	Feature Midpoint ^a	Mean	Min	Мах				-		th Ratios			Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	16.2			ft	Max Riff				Depth (d _{ma}		l _{bkf})	1.7		
	Max Run Depth (d _{maxrun})				ft	Max Rur	n Depth	/Mean F	Riffle De	epth (d _{maxr}	_{run} / d	l _{bkf})			
	Max Pool Depth (d _{maxp})				ft	Max Poo	l Depth	/Mean F	Riffle D	epth (d _{max}	_p / d _b	_{skf})			
1 I		i	1		ft	Max Glic	le Depti	n/Mean	Riffle D	Depth (d _{ma}	_{xg} / d	_{bkf})			İ
\cup	Max Glide Depth (d _{maxg})	ļ		-											
		uch ^b		flo ^C		Bar		Pac	ch ^b	Diffie	c	Bar	Protect	sion L	loight ^d
	Rea	ich ^b	Rif	fle ^c	I	Bar	D ₁₆	Rea <.0		Riffle	c	Bar	Protru	sion H	leight ^d mm
rials	Rea % Silt/Clay 9		Rif	fle ^c	E	Bar	D ₁₆		01	Riffle	C	Bar	Protru	sion H	
Materials	Rea % Silt/Clay 9 % Sand	5	Rif	fle ^c		Bar		<.0	01 01	Riffle	c	Bar	Protru	sion H	mm
nel Materials	Rea % Silt/Clay 9 % Sand 9 % Gravel 0	5 5	Rif	fle ^c		Bar	D ₃₅	<.0 <.0	01 01 165	Riffle	c	Bar	Protru	sion H	mm mm
hannel Materials	Real % Silt/Clay 9 % Sand 9 % Gravel 0 % Cobble 0	5 5 0	Rif	fle ^c		Bar	D ₃₅ D ₅₀	<.0 <.0 0.00	01 01 165 125	Riffle	c	Bar	Protru	sion H	mm mm mm
Channel Materials	Real % Silt/Clay 9 % Sand 9 % Gravel 0 % Cobble 0	5 5 0 0	Rif	fle ^c		Bar	D ₃₅ D ₅₀ D ₈₄	<.0 <.0 0.00	01 01 165 125	Riffle	C	Bar	Protru	sion H	mm mm mm

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Red River-	5-463.56		Station Number:	N/A	
LOCATION:	Red River-	5-463.56				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	3585920	acres	5603	mi ² Drainage Area Mn ELEV:	864.46	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	C6c-			HUC:		
	I	BANKFU	LL" CHA	RACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_f)	143.1	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTI	H (d _{bkf})	11.1	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	1581.4	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	149.3	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	1.5	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	2380.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	2380.0	cfs
Recurrence Interval (Log	g-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.3	yrs
From the	Annual Pea	k Flow Freq	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharg	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER G	EOMETRY		
Meander Length (L _m	,)	2449	ft	Radius of Curvature (R _C)	449.0	ft
Belt Width (W _{blt})		1646	ft	Meander Width Ratio (W _{blt} /W _{bkf})	11.5	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	ea (A), Mean I	Depth (d) & Me	an Velocity (egression analyses of measured discharge (a), determine the <i>intercept coefficient</i> (a) and elected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	oonent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
· · ·			4		0.025	Cooff
Hydraulic Radius: R	= A / VV _p		ft	Manning's "n" at Bankfull Stage	0.035	Coeff.
	" n " = 1	.4865 [(A rea	ı) (Hydrauli	c Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI			RGE Estii	mates		
Site	Red River-5-4	63.5	6		Location	Red Rive	er-5-463.50	6	
Date	10/6/2011	Stre	am Type	C6c-	Valley Ty	/pe	X		
Observers	KD, JB				HUC				
	INPUT VAR	IAB	LES			OUTPL	JT VARIA	BLES	
Bankfull	Cross-sectional		1581.4	A _{bkf} (ft ²)	Bankfu	ull Mean Di	EPTH	11.1	D _{bkf} (ft)
Bank	full WIDTH		143.1	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	165.2	W _p (ft)
D ₈	4 @ Riffle		0.005	Dia. (mm)	D ₈₄ I	mm / 304.8	3 =	0.00002	D ₈₄ (ft)
Bank	full SLOPE		0.00005	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	9.6	R (ft)
Gravitatio	onal Acceleration	۱	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)	ness	583548	
Draiı	nage AREA		5603.0	DA (mi²)		lear Veloci u* =√gRS	ty	0.1	u* (ft / sec)
	ESTIMAT	ON	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = [Roughness	2.83	+ 5.66Log	{	•]u*	4.4	ft / sec	6884	cfs
	Coefficient: a) M s. 2-18, 19) u = 1.48				r / relative =	1.3	ft / sec	2117	cfs
	'n' from Jarrett (US		n = 0.39S ^{.38} R		=	7.5	ft / sec	11853	cfs
	tion is for applications in ble-and boulder-domi								
2. Roughness		Туре		= 1.4865* R 3	^{2/3*} S ^{1/2} /n	1.3	ft / sec	2117	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-Weis	sbach	, Chezy C, etc	.)		1.5	ft / sec	2380	cfs
3. Other Metho	ds (Hey, Darcy-Weis	sbach	, Chezy C, etc	.)			ft / sec		cfs
4. Continuity Return	Equations: a Period for Bankfull		gional Curves arge	s <u>u = 0</u> Q = 1.46	1		ft / sec		cfs
4. Continuity	Equations: b) US(GS Gage Dat	a u=0	Q / A		ft / sec		cfs
Option 1, For	for using the D₈₄ sand-bed channe ostitute an average	ls: M	easure the "p	rotrusion h	neight" (h _{sd}) o	of sand dunes	s above char	nnel bed eleva	
Option 2. For elev	boulder-dominate ations. Substitute	ed ch an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _{bo} or the D ₈₄ ter) of boulders m in est. me	above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-dominate ted surfaces above term in estimation r	ed ch char	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	or) of rock se	parations/step	s/joints/ eet) for the

Stream:	Red River-5-463.56		
Basin:	Red River BasinDrainage Area:4E+06acres	5603	mi ²
Location:	Red River-5-463.56		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/6/2011
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	143.1	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	11.1	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	1581.4	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	12.9	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.		ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkl})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	949.0	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	6.6	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.001	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000049	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.4	
	Stream C6c- See Classification (Figure 2-2		

	ream: Red River-5-463.50	6				Lo	ocation:	Red F	River-5	-463.56				
Ob	servers: KD, JB			Date:	10/6/2	011		Valle	еу Туре:	Х	Strean	n Type:	C6c-	
				Riv	er Rea	ch Sum	mary [Data						
\square	Mean Riffle Depth (d _{bkf})	11.1	ft	Riffle V	Vidth (V	V _{bkf})	14	3.1	ft	Riffle Area (A	_{okf})	158	1.4	ft ²
	Mean Pool Depth (d _{bkfp})	!	ft	Pool W	/idth (W	/ _{bkfp})	 		ft	Pool Area (A _{bl}	_{(tp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	fle Width			W _{bkfp} / W _{bkf}	Pool Area / Ri	ffle Area			A _{bkfp} /A _{bkf}
Din	Max Riffle Depth (d _{maxrif})	17.6	ft	Max Po	ool Dep	th (d _{maxp})			ft	Max Riffle De	oth/Mean Rif	fle Dept	h	1.6
Channel	Max Pool Depth/Mean Riffle D	epth		Point E	Bar Slop	e			ft/ft	Inner Berm W	idth (W _{ib})			ft
Chai	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Deptl	h Ratio			W _{ib} /d _{ib} Inne	r Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean	/elocity	at Bank	full Sta	ge (u _{bkf})		1.	.5	ft/s	Estimation Me	ethod	Н	EC-R/	4S
	Streamflow: Estimated Discha	rge at B	Bankfull	Stage (၃ _{bkf})		23	80	cfs	Drainage Area	ì	56	03	mi²
	Geometry	Mean	Min	Max			Dime	ension	less Ge	eometry Ratio	S	Mean	Min	Max
	Meander Wavelength (L _m)	<mark>2449</mark>			ft	Meander	r Length	Ratio	(L _m /W _{bk}	(_t		17.1		
Pattern	Radius of Curvature (R _c)	449			ft	Radius c	of Curva	ture/Ri	ffle Wid	th (R _c /W _{bkf})		3.1		
	Belt Width (W _{blt})	<mark>1646</mark>			ft	Meander	r Width	Ratio (W _{blt} /W _{bl}	(t _b		11.5		
Channel	Individual Pool Length				ft	Pool Len	ngth/Riff	le Widt	h					
Cha	Pool to Pool Spacing				ft	Pool to F	Pool Spa	acing/R	iffle Wio	dth				
	Riffle Length	-			ft	Riffle Le	ngth/Rif	fle Wic	lth					
\square	Valley Slope (VS)		ft/ft	Averag	e Wate	r Surface	Slope (S)		ft/ft	Sinuosity (/S/S)		
		116	ft		Length			,	27	371 ft	Sinuosity (,		2.4
	Low Bank Height star		ft 44		Max Rif Depth		start		ft 44		ght Ratio (BH	IR)	star	
	(LBH) end	Mean	ft Min	Max	Вери	1	end	sionle	ft ss Slo	pe Ratios		Mean	enc Min	Max
ile	Riffle Slope (S _{rif})	0.0			ft/ft	Riffle Slo				rface Slope (Sr	_{if} / S)	1.0		
Profile	Run Slope (S _{run})				ft/ft	Run Slop	pe/Avera	age Wa	ater Sur	face Slope (S _{ru}	, / S)			
lei	Pool Slope (S _p)				ft/ft	Pool Slo	pe/Aver	age Wa	ater Sur	face Slope (S _p	/ S)			
Channel	Glide Slope (S _g)				ft/ft	Glide Slo	ope/Ave	rage W	ater Su	rface Slope (Sg	/ S)			
	Feature Midpoint ^a	Mean	Min	Max						th Ratios		Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	17.6			ft	Max Riff	le Depth	n/Mean	Riffle D	Depth (d _{maxrif} / d	_{okf})	1.6		
	Max Run Depth (d _{maxrun})				ft					epth (d _{maxrun} / d				
	Max Pool Depth (d _{maxp})				ft	1				epth (d _{maxp} / d _{bk}				
	Max Glide Depth (d _{maxg})				ft	Max Glic	le Depth	/Mean	Riffle D	Depth (d _{maxg} / d _t	_{kf})			
	Ra	ach ^b	Rif	fle ^c	F	Bar		Res	ach ^b	Riffle ^c	Bar	Protru	sion F	leight ^d
6		00					D ₁₆		001					mm
srials	% Sand	0					D ₃₅	<.	001					mm
Mate	% Gravel	0					D ₅₀	0.	001					mm
lel	% Cobble	0					D ₈₄	0.	005					mm
Channel Materials	% Boulder	0					D ₉₅	0.0	095					mm
C	% Bedrock	0					D ₁₀₀	0.	.12					mm
	, max, mean depths are ave. mid-p									^c Active bed of				

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

		USGS (REAM CH								
Station NAME:	Red River	at Fargo, N	ID			[:	Station Numbe	er:	N/A	
		- 4 - 452.52								
Period of RECORD:	Ν	/A	yrs		ean	Annual DI	SCHARGE:		N/A	cfs
Drainage AREA:	3659520	acres	5718	mi ²		Drainage	Area Mn ELE	V:	862.9	ft
Reference REACH SLO	PE:		ft/ft]		Valley	′ Туре:		Х]
Stream Type:	C6c-			HU):		_	-		
	I	'BANKFU	LL" CH		TE	RISTIC	S			
Determined from	FIELD ME	ASUREME	NT		Det	ermined	from GAGE	DA	TA Analys	sis
Bankfull WIDTH (W _{bk}	,)	159.5	ft	Ban	kfull	WIDTH	(W _{bkf})			ft
Bankfull Mean DEPTH	H (d _{bkf})	10.3	ft	Ban	kfull	MEAN C	DEPTH (d _{bkf})			ft
Bankfull Xsec AREA	(A _{bkf})	1633.0	ft ²	Ban	kfull	Xsec AR	REA (A _{bkf})			ft ²
Wetted PERIMETER	(W _p)	164.4	ft	Wet	ted	PERIME	FER (W _p)			ft
Bankfull STAGE (Gag	ge Ht)		ft	Ban	kfull	STAGE	(Gage Ht)			ft
Est. Mean VELOCITY	′ (u)	1.5	ft/sec	Mea	n V	ELOCITY	′ (u)			ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	2380.0	cfs	Ban	kfull	DISCHA	RGE (Q _{bkf})			cfs
Bankfull DISCH	IARGE ass	ociated with	"field-de	termin	ed"	Bankfull	STAGE		2380.0	cfs
Recurrence Interval (Log	-Pearson)a	ssociated wit	h " field-de	termine	d" E	Bankfull Di	scharge		1.26	yrs
From the	Annual Pea	k Flow Freq	uency Ana	alysis da	ta fo	or the Gag	ge Station, de	tern	nine:	
1.5 Year R.I. Discharge	ə =	N/A	cfs	10	Year	R.I. Disc	:harge =	-	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	20	Year	R.I. Disc	charge=	:	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50	Year	R.I. Disc	:harge =	-	N/A	cfs
		MEAN	NDER	GEON	IET	RY				
Meander Length (Lm)	2750	ft	Rac	ius d	of Curvat	ure(R _C)		581.0	ft
Belt Width (W _{blt})		1890	ft	Mea	nder	Width Ra	atio(W _{blt} /W _{bkf})	11.85	ft/ft
		HYDR	AULIC	GEO	ME	TRY				
Based on USGS Discharge parameters of Width (W), And values for a power function of	ea (A), Mean I	Depth (d) & Me	an Velocity	(u), deter selected	mine	the <i>interce</i> aulic param	pt coefficient (a) eters and X is a) and	the slope ex	ponent (b)
Intercept Coefficient:	(a)				()		<u></u>			
Slope Exponent:	(b)									
Hydraulic Radius: R	= A / W _p		ft	Ma	ning	g's "n " at	Bankfull Stage	ə	0.035	Coeff.
						-				
	" n " = 1	.4865 [(Area	a) (Hydrau	ilic Radi	us ^{2/:}	³) (S lope	^{1/2})] / Q _{bkf}			

		Ba	nkfull VE	LOCITY		RGI	E Estir	nate	es						
Site	Red River				Location	Re	ed Rive	er - 4	1 - 4	52	.52	2			
Date	11/16/2010	Stre	am Type	C6c-	Valley Ty	pe		Х							
Observers	KD, JB				HUC	0	<mark>9</mark> 0	2	0	1	(0 4	0	5	0 6
	INPUT VA		LES				Ουτρι	י דנ	VAI	RI/	AB	LES			
Bankfull Cro	ss-sectional A	AREA	1633.0	A _{bkf} (ft ²)	Bankfu	A IIL	/lean D	EPT	Ή			10.	3	D (bkf it)
Banl	cfull WIDTH		159.5	W _{bkf}			PERIME _{skf} + W _{bkf}	TEF	۲			180	.1	w	, (ft)
D ₈	4 @ Riffle		0.6	Dia. (mm)	D ₈₄	mm	n / 304.8	8 =				0.00)2		84 ft)
Bank	full SLOPE		0.0002	S _{bkf} (ft / ft)			ic RAD / W _P	IUS				9.1			२ ít)
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)			Rough) / D ₈₄ (ft)		3			468	5		
Drai	nage AREA		5718.0	DA (mi ²)			r <u>Velo</u> ci ⊧√gRS	ty				0.2	2	-	* sec)
	ESTIMA		METHO	os		Ba	ankfull \	/ELC		ſY			Banl	cfull	
1. Friction Factor	Relative u = Roughness	[2.83	+ 5.66Log{	r / d ₈₄ }]	u*		5.3	ft	/ se	с		858	9	c	s
2. Roughness roughness (Figs	Coefficient: a) a. 2-18, 19) u = 1.4	Manning 1865*R ^{2/}	g's 'n' from fric ^{3*} S ^{1/2} /n		relative =		2.4	ft	/ se	с		393	2	c	s
	n' from Jarrett (U		= 0.39S ^{.38} R ¹⁶		=		8.3	ft	/ se	с		135	93	c	s
	ion is for applications Ider-dominated strea														
2. Roughness	Coefficient: s 'n' from Strear	n Type	u = ⁻ n = 0	1.4865* R^{2/3*} 0.035	*S ^{1/2} /n	Γ	2.4	ft	/ se	с		393	2	c	s
3. Other Method HEC-RAS	ds (Hey, Darcy-We	eisbach,	Chezy C, etc.)				1.5	ft	/ se	с		238	0	c	s
3. Other Method	ds (Hev. Darcv-We	eisbach.	Chezv C. etc.)					ft	/ se	с				c	s
4. Continuity Return	Equations: Period for Bankfu		onal Curves Irge	u = Q / Q = 1.46	A Yr.			ft	/ se	с				c	s
4. Continuity	Equations:	b) USG	S Gage Data	u = Q /	Α			ft	/ se	с				c	s
Option 1. For Sub	ns for using the sand-bed chanr ostitute an averag	nels: Me je sand	asure the " pr dune protrusio	otrusion he i on height (h _s	ight" (h _{sd}) of s _d in ft) for the l	and D ₈₄ 1	dunes a term in es	bove st. me	cha ethoo	nne 11.	el be	ed elev	atior	IS.	
Option 2. For elev	boulder-domina ations. Substitute	i ted cha e an ave	nnels: Measu boulder prot	re several "	protrusion he t (h _{bo} in ft) for	ight the	: s" (h _{bo}) o D ₈₄ term	of bou in es	ulder t. me	s a etho	bov od 1	e chai	nnel	bed	
uplif	bedrock-domina ted surfaces abor in estimation me	ve chani	nnels: Measu nel bed elevat	ure several " ions. Subst	protrusion he itute an averaç	eigh ge b	t s" (h _{br}) edrock p	of roc rotrus	ck se sion	epai hei	ratic ght	ons/ste (h _{br} in	eps/jc feet)	ints/ for th	e D ₈₄

Stream:	Red River		
Basin:	Red River Basin Drainage Area: 3659520 acres	5718	mi ²
Location:	Red River - 4 - 452.52		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	11/16/201
Observers	KD, JB	Valley Type	: X
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	159.5	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	10.3	ft
	Bankfull X-Section AREA (A _{kf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	1633.0	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	15.5	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	15.0	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times q_{nbkl})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	709	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{pa}/W_{bkf}) (riffle section).	4.4	ft/ft
	Channel Materials (Particle Size Index) \mathbf{D}_{30} The \mathbf{D}_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.0027	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00017	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.2	
	Stream C6c- See Classificatio (Figure 2-21]

Str	eam: Red River				Lo	ocation:	Red R	liver -	4 - 452.52				
Ob	servers: KD, JB			Date: 11/16	/2010		Valle	у Туре:	Х	Strea	am Type:	C6c-	
				River Read	ch Sumn	nary D	ata						
	Mean Riffle Depth (d _{kf})	10.3	ft	Riffle Width (W _{bkf})	15	9.5	ft	Riffle Area	(A _{bkf})	163	3.0	ft ²
	Mean Pool Depth (d _{kfp})		ft	Pool Width (V	V _{bkfp})	ĺ		ft	Pool Area (A _{bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool Width/R	iffle Width	ו		W _{bkfp} / W _{bkf}	Pool Area /	Riffle Area			A _{bkfp} / A _{bkf}
Ĩ	Max Riffle Depth (d _{naxrif})	15.0	ft	Max Pool Dep	pth (d _{naxp})			ft	Max Riffle [Pepth/Mean R	iffle Dept	h	1.5
lel	Max Pool Depth/Mean Riffle I	Depth		Point Bar Slo	ре			ft/ft	Inner Berm	Width (W _{ib})			ft
Channel	Inner Berm Depth (d _b)		ft	Inner Berm W	/idth/Dep	th Ratic			W _{ib} /d _{ib} In	ner Berm Area	a (A _{ib})		ft ²
"	Streamflow: Estimated Mean	Velocity a	it Bankf	ull Stage (ຟູ _{kf})		1	.5	ft/s	Estimation	Vethod	HE	C-RA	S
	Streamflow: Estimated Discha	arge at Ba	nkfull S	itage (Q _{skf})		23	80	cfs	Drainage A	rea	571	8	mi ²
_	Geometry	Mean	Min	Max		Dim	ension	less Ge	eometry Rat	ios	Mean	Min	Мах
٦	Meander Wavelength (L _m)	2750		ft	Meande						17.2		
ern	Radius of Curvature (R_{e})	581		ft	Radius	of Curva	ature/R	iffle Wio	th (R _c /W _{bkf})		3.6		
Pattern	Belt Width (W _{blt})	1890		ft	Meande	r Width	Ratio (W _{blt} /W _b	_{kf})		11.9		
land	Individual Pool Length			ft	Pool Le	ngth/Rif	fle Wid	th					
Channel	Pool to Pool Spacing			ft	Pool to Pool Spacing/Riffle Width								
	Riffle Length			ft	Riffle Le	ength/Ri	ffle Wic	lth					
	Valley Slene (VS)		ft/ft	Average Wet	or Surfaa		(8)	ł	ft/ft	Cipuppity (() (C (C)		
	Valley Slope (VS)	8061	ft	Average Wate Valley Length		e Slope	(3)	22	157 ft	Sinuosity (,		2.2
			in Ift			start		ft	i	Sinuosity (star	2.2
	Low Bank Height start (LBH) end		ft	Max Ri Depti		end		ft		leight Ratio (E Max Riffle De	,	end	
	Facet Slopes	Mean	Min	Мах		Dime	nsionle	ss Slo	pe Ratios		Mean	Min	Max
Profile	Riffle Slope (S _{tif})	0.0	<u> </u>	ft/ft	Riffle SI	ope/Ave	erage V	Vater Su	urface Slope	(Ş _{if} / S)	1.0		
	Run Slope (S _{run})			ft/ft	Run Slo	pe/Ave	age W	ater Su	rface Slope	(Ş _{un} / S)			
nnel	Pool Slope (S _p)		!	ft/ft	Pool Slo	pe/Ave	rage W	ater Su	rface Slope	(Ş, / S)			-
Chai	Glide Slope (Sg)		<u> </u>	ft/ft	Glide Sl	ope/Av	erage V	Vater S	urface Slope	(Sg / S)			
	Feature Midpoint ^a	Mean	Min	Max	1				th Ratios		Mean	Min	Max
	Max Riffle Depth (d _{naxrif})	15.0	<u> </u>	ft					Depth (daxrif/		1.5		<u> </u>
	Max Run Depth (d _{maxrun})	<u> </u>	<u> </u>	ft					epth (chaxrun /				1
	Max Pool Depth (d _{naxp})		<u> </u>	ft					Pepth (d _{axp} /				<u> </u>
	Max Glide Depth (d _{maxg})			ft	Max Gli	de Dept	n/Mear	n Riffle	Depth (d _{haxg} /	d _{bkf})			
	R	each ^b	Ri	ffle ^c	Bar		Rea	ach ^b	Riffle ^c	Bar	Protrus	sion H	eight ^d
s	% Silt/Clay	77				D ₁₆		001					mm
<u>srial</u> :	% Sand	23				D ₃₅	<.(001					mm
Mate	% Gravel	0				D ₅₀	0.0	027					mm
Channel Materials	% Cobble	0				D ₈₄	0.	59					mm
than	% Boulder	0				D ₉₅	1.	39					mm
9	% Bedrock	0	1			D ₁₀₀		2					mm

D₁₀₀

2

mm

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Red River-	-3-440.57		Station Number:	N/A	
LOCATION:	Red River-	-3-440.57				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	3688320	acres	5763	mi ² Drainage Area Mn ELEV:	856.05	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	C6c-			HUC:		
	"	'BANKFU	LL" CH/	ARACTERISTICS		
Determined from	FIELD ME		NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bk}	_{(f})	136.0	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTI	H (d _{bkf})	9.8	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	1333.7	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	141.1	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	۲ (u)	1.8	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGI	E (Q _{bkf})	2380.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	HARGE ass	ociated with	"field-de	termined" Bankfull STAGE	2380.0	cfs
Recurrence Interval (Log	ȝ-Pearson)a	ssociated wit	h "field-de	termined" Bankfull Discharge	1.3	yrs
From the	Annual Pea	k Flow Freq	uency Ana	lysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER (GEOMETRY		
Meander Length (Lm	<u>۱)</u>	1901	ft	Radius of Curvature (R _C)	280.0	ft
Belt Width (W _{blt})		2945	ft	Meander Width Ratio (W _{blt} /W _{bkf})	21.7	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean [Depth (d) & Me	ean Velocity (regression analyses of measured discharge ((u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)		2 op (u)			
Slope Exponent:	(b)					
Hydraulic Radius: R				Manning's "n" at Bankfull Stage	0.02	Coeff.
	= A / VV _p		ft	Manning's "n" at Bankfull Stage	0.03	Coen.
	" n " = 1	.4865 [(Area	ı) (Hydraul	lic Radius ^{2/3}) (S lope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI		/ DISCHAP		stimates		
Site	Red River-3	-440.5	7		Location	Red R	iver-3-440.5	7	
Date	10/4/2011	Stre	am Type	C6c-	Valley Ty	/pe	X		
Observers	KD, JB				HUC				
	INPUT V		LES			OUT	PUT VARI	ABLES	
Bankfull	Cross-sectior	al	1333.7	A _{bkf} (ft ²)	Bankfu	ull Mean	DEPTH	9.8	D _{bkf} (ft)
Bank	vfull WIDTH		136.0	W _{bkf}		d PERII * d _{bkf} + W		155.6	W _p (ft)
D ₈	4 @ Riffle		0.11	Dia. (mm)	D ₈₄	mm / 30	4.8 =	0.0	D ₈₄ (ft)
Bank	full SLOPE		0.0001	S _{bkf} (ft / ft)		aulic RA А _{ькf} / W _p	DIUS	8.6	R (ft)
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rou R (ft) / D ₈₄		23752	
Drai	nage AREA		5763.0	DA (mi²)	Sh ı	ear Velo ı* =√gR	ocity	0.1	u* (ft / sec)
	ESTIMA	TION	METHO	DS		Bankfu		Banl DISCH	
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{]u*	3.8	ft / sec	5026	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	a) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	1.7	ft / sec	2275	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (l	JSGS):		1.4865* R ^{2/3} .16 n	^{3*} S ^{1/2} /n	7.1	ft / sec	9485	cfs
	ation is for application ble- and boulder-do C2 and E3.] [J
2. Roughness c) Manning	s Coefficient: 's 'n' from Strea	ım Type		= 1.4865* R 0.03	^{2/3*} S ^{1/2} /n	1.7	ft / sec	2275	cfs
3. Other Metho HEC-RAS	ods (Hey, Darcy-W	leisbach	, Chezy C, etc	:.)		1.8	ft / sec	2380	cfs
3. Other Metho	ods (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankf		gional Curve arge	s u = 0 Q = 1.46	Q/A Yr.		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	:a u = (Q / A		ft / sec		cfs
Option 1. For	s for using the I sand-bed chan ostitute an avera	nels: M	easure the " p	protrusion h	neight" (h _{sd}) c	of sand du	nes above cha	innel bed eleva	
Option 2. For elev	boulder-dominations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" or the D ₈₄	(h _{bo}) of boulder term in est. me	s above chan ethod 1.	nel bed
Option 3. For uplif	bedrock-domin ited surfaces abo term in estimatio	ated ch we cha	annels: Meas nnel bed eleva	sure severa	protrusion	heights"	(h _{br}) of rock se	eparations/step	os/joints/ eet) for the

Stream:	Red River-3-440.57		
Basin:	Red River BasinDrainage Area:4E+06acres	5763	mi ²
Location:	Red River-3-440.57		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	10/4/2011
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	136.0	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	9.8	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	1333.7	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	13.9	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	13.5	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	619.3	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W _{fpa} / W _{bkf}) (riffle section).	4.6	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.026	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000068	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.2	
	Stream C6c- See Classification (Figure 2-2)		

Str	eam: Red River-3-440.57	7				Lo	ocation:	Red R	iver-3	-440.57				
Ob	servers: KD, JB			Date:	10/4/2	2011		Valle	у Туре:	X	Stream	n Type:	C6c-	
				Riv	er Rea	ach Sum	mary I	Data						
\bigcap	Mean Riffle Depth (d _{bkf})	9.8	ft	Riffle V	Nidth (\	W _{bkf})	13	6.0	ft	Riffle Area (A	_{bkf})	133	3.7	ft ²
_	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (N	V _{bkfp})			ft	Pool Area (A _b	_{kfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / R	iffle Area			A _{bkfp} /A _{bkf}
	Max Riffle Depth (d _{maxrif})	13.5	ft	Max Po	ool Dep	oth (d _{maxp})			ft	Max Riffle De	pth/Mean Rif	fle Dep	th	1.4
Channel	Max Pool Depth/Mean Riffle D	epth		Point E	Bar Slop	De	e ft/ft Inner Berm Width (W _{ib}) idth/Depth Ratio W _{ib} /d _{ib} Inner Berm An			/idth (W _{ib})			ft	
Cha	Inner Berm Depth (d _{ib})		ft			•				er Berm Area	ea (A _{ib})		ft ²	
	Streamflow: Estimated Mean	/elocity	at Bank	full Stage (u _{bkf}) 1.8			.8	ft/s	Estimation Me	ethod	Н	EC-R	AS	
\bigcup	Streamflow: Estimated Discha	rge at E	ankfull	Stage (Q _{bkf})		23	80	cfs	Drainage Area	a	5763 mi ²		
	Geometry Mean Min Max Dimensionless G Meander Weander Image: Comparison of the second seco									eometry Ratio	s	Mean	Min	Max
[_]	Meander Wavelength (L _m)	1901		<u> </u>	ft	Meander	r Length	Ratio	(L _m /W _{bk}	(t)		14.0		
Pattern	Radius of Curvature (R _c)	280	<u> </u>	<u> </u>	ft	Radius c	of Curva	ture/Ri	ffle Wid	th (R _c /W _{bkf})		2.1		
	Belt Width (W _{blt})	2945		<u> </u>	ft	Meander	r Width	Ratio (N _{blt} /W _{bl}	_{kf})		21.7		
Channel	Individual Pool Length	<u> </u>	<u> </u>	<u> </u>	ft	Pool Len	ngth/Riff	le Widt	h					
ເຮັ	Pool to Pool Spacing		<u> </u>	i	ft		Pool to Pool Spacing/Riffle Width							
	Riffle Length				ft	Riffle Length/Riffle Width								
\square	Valley Slope (VS)		ft/ft	Averag	ge Wate	er Surface	Slope (S)		ft/ft	Sinuosity (VS/S)		
	Stream Length (SL) 108				Length	(\/L)			50	295 ft	0: :. //			
1				(VL)			50		Sinuosity (SL/VL)		2.2		
	Low Bank Height start (LBH) end		ft	-	Max Rif	ffle	start end		ft	Bank-Hei	ght Ratio (Bhax Riffle Dept	IR)	star	t
			ft ft	-	Max Rif	ffle	end	nsionle	ft ft	Bank-Hei	ght Ratio (BF	IR)	star enc Min	t
file	(LBH) end		ft ft	Max	Max Rif	ffle n	end Dimer		ft ft ss Sloj	Bank-Hei (LBH/Ma	ght Ratio (BH ax Riffle Dept	IR) h)	enc	t 1
Profile	(LBH) end	Mean	ft ft	Max	Max Rif Depth	ffle n Riffle Slo	end Dimer ope/Ave	rage W	ft ft ss Slo ater Su	Bank-Hei (LBH/Ma	ght Ratio (BH ax Riffle Dept _{rif} / S)	HR) h) Mean	enc	t 1
	(LBH) end Facet Slopes Riffle Slope (S _{rif})	Mean	ft ft	Max	Max Rif Depth	ffle n Riffle Slo	end Dimer ope/Ave pe/Avera	rage W age Wa	ft ft ss Slo j ater Su ter Suri	Bank-Hei (LBH/Ma pe Ratios	ght Ratio (BF ax Riffle Dept _{rif} / S) _n / S)	HR) h) Mean	enc	t 1
Channel Profile	(LBH) end Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run})	Mean	ft ft	Max	Max Rif Depth ft/ft ft/ft	ffle Riffle Slo Run Slop Pool Slo	end Dimer ope/Ave oe/Avera	rage W age Wa age Wa	ft ft ater Su ater Sur ater Sur	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _n	ght Ratio (Br ax Riffle Dept _{rif} / S) _n / S) / S)	HR) h) Mean	enc	t 1
	(LBH) end Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a	Mean 0.0	ft ft	Max Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft/ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo	end Dimer ppe/Ave pe/Avera ppe/Avera Dimer	rage W age Wa age Wa rage W nsionle	ft ft ater Su ater Sur ater Sur ater Sur ater Su	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _r face Slope (S _p rface Slope (S th Ratios	ght Ratio (Br ax Riffle Dept nf / S) n / S) / S) g / S)	IR) h) Mean 1.0 Mean	enc	t 1
	(LBH) end Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})	Mean 0.0	ft ft	Max Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft/ft	Riffle Slo Run Slop Pool Slo Glide Slo	end Dimer ppe/Ave pe/Aver ppe/Aver ppe/Aver Dimer le Depth	rage W age Wa age Wa rage W nsionle	ft ft ater Su ater Sur ater Sur ater Su ss Dep Riffle D	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _{ru} face Slope (Sp Irface Slope (S bth Ratios Depth (d _{maxif} / d	ght Ratio (BF ax Riffle Dept _{rif} / S) _n / S) / S) _g / S) 	HR) h) 1.0	enc Min	Max
	(LBH) end Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean 0.0	ft ft	Max Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Rur	end Dimer ppe/Aver pe/Aver ppe/Aver ppe/Aver Dimer le Depth	rage Wa age Wa age Wa rage W nimissionle ni/Mean f	ft ft ss Sloj ater Sur ater Sur ater Sur ater Su ss Dep Riffle De	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _r face Slope (S _p rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrif} / d	ght Ratio (Br ax Riffle Dept nif / S) n / S) / S) g / S) bkf)	IR) h) Mean 1.0 Mean	enc Min	Max
	(LBH) end Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxp})	Mean 0.0	ft ft	Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft/ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Rur Max Poo	end Dimer ope/Aver pe/Aver ope/Aver ope/Aver Dimer le Depth n Depth/	rage W age Wa age Wa rage W nsionle n/Mean f /Mean f	ft ft ss Slop ater Sur ater Sur ater Su ss Dep Riffle De Riffle De	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _{ru} face Slope (Sp Irface Slope (S oth Ratios Depth (d _{maxruf} / d epth (d _{maxru} / d _b	ght Ratio (Br ax Riffle Dept _{nff} / S) / S) 	IR) h) Mean 1.0 Mean	enc Min	Max
	(LBH) end Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean 0.0	ft ft	Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Rur Max Poo	end Dimer ope/Aver pe/Aver ope/Aver ope/Aver Dimer le Depth n Depth/	rage W age Wa age Wa rage W nsionle n/Mean f /Mean f	ft ft ss Slop ater Sur ater Sur ater Su ss Dep Riffle De Riffle De	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _r face Slope (S _p rface Slope (S th Ratios Depth (d _{maxrif} / d epth (d _{maxrif} / d	ght Ratio (Br ax Riffle Dept _{nff} / S) / S) 	IR) h) Mean 1.0 Mean	enc Min	Max
	Image: Constraint of game end Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Glide Depth (dmaxg) Readed to the format of the format	Mean 0.0	ft ft Min Min	Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft ft ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Rur Max Poo	end Dimer ope/Aver pe/Aver ope/Aver ope/Aver Dimer le Depth n Depth/	rage Wa age Wa rage Wa sionle Masionle Mean f Mean f Mean Mean	ft ft ss Sloj ater Sur ater Sur ater Sur ater Sur ater Sur ater Su Riffle De Riffle De Riffle De Riffle De	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _{ru} face Slope (Sp Irface Slope (S oth Ratios Depth (d _{maxruf} / d epth (d _{maxru} / d _b	ght Ratio (Br ax Riffle Dept _{nff} / S) / S) 	HR) h) 1.0 1.0 Mean 1.4	enc Min Min	Max
Channel	(LBH) end Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxg) Real % Silt/Clay	Mean 0.0 Mean 13.5 Ach ^b	ft ft Min Min	Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft ft ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver pe/Aver ope/Aver ope/Aver Dimer le Depth n Depth/	rage W age Wa age Wa rage W sionle n/Mean f /Mean f /Mean f /Mean f /Mean f 0.0	ft ft ss Slop ater Su tter Sur ater Sur ater Su ater Su Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _r face Slope (S _p rface Slope (S th Ratios Depth (d _{maxrin} / d epth (d _{maxry} / d _b Depth (d _{maxg} / d	ght Ratio (Br ax Riffle Dept _{nif} / S) 	HR) h) 1.0 1.0 Mean 1.4	enc Min Min	Max Max Max
Channel	Image: Constraint of the second se	Mean 0.0 Mean 13.5 13.5	ft ft Min Min	Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft ft ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer le Depth of Depth de Depth	rage Wa age Wa rage Wa sionle m/Mean f /Mean f /Mean f /Mean f 0.0	ft ft ss Slog ater Sur ater Su	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _r face Slope (S _p rface Slope (S th Ratios Depth (d _{maxrin} / d epth (d _{maxry} / d _b Depth (d _{maxg} / d	ght Ratio (Br ax Riffle Dept _{nif} / S) 	HR) h) 1.0 1.0 Mean 1.4	enc Min Min	Max Max Max
Channel	(LBH) end Facet Slopes Riffle Slope (Srif) Run Slope (Srif) Run Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxg) Ready % Silt/Clay % Sand % Gravel	Mean 0.0 Mean 13.5 13.5 15 2	ft ft Min Min	Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft ft ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ppe/Ave pe/Avera ppe/Avera ppe/Avera Dimer le Depth de Depth de Depth de Depth	rage Wa age Wa age Wa rage W sionle /Mean I /Mean I /Mean I /Mean I /Mean 0.0	ft ft ss Slo ater Su tter Sur ater Sur ater Sur ater Sur ater Su Riffle Do Riffle Do	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _r face Slope (S _p rface Slope (S th Ratios Depth (d _{maxrin} / d epth (d _{maxry} / d _b Depth (d _{maxg} / d	ght Ratio (Br ax Riffle Dept _{nif} / S) 	HR) h) 1.0 1.0 Mean 1.4	enc Min Min	Max Max Max Max
Channel	Image: Constraint of game of the sector o	Mean 0.0 Mean 13.5 13.5	ft ft Min Min	Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft ft ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver ope/Aver ope/Aver Dimer le Depth of Depth de Depth de Depth	rage Wa age Wa age Wa rage Wa sionle m/Mean I m/Mean I Mean	ft ft ss Slog ater Sur ater Su	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _r face Slope (S _p rface Slope (S th Ratios Depth (d _{maxrin} / d epth (d _{maxry} / d _b Depth (d _{maxg} / d	ght Ratio (Br ax Riffle Dept _{nif} / S) 	HR) h) 1.0 1.0 Mean 1.4	enc Min Min	Max Max Max Height ^d mm
	Image: Constraint of game end Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxrun) Max Glide Depth (dmaxrun) Max Glide Depth (dmaxrun) Max Glide Depth (dmaxrun) <td>Mean 0.0 Mean 13.5 13.5 15 2</td> <td>ft ft Min Min</td> <td>Max Max</td> <td>Max Rif Depth ft/ft ft/ft ft/ft ft ft ft ft ft</td> <td>ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid</td> <td>end Dimer ope/Aver ope/Aver ope/Aver Dimer le Depth of Depth/ de Depth de Depth de Depth de Depth de Depth</td> <td>rage Wa age Wa rage Wa rage Wa sionle Mean I Mean I Mean I Mean I Mean I 0.0 0.0</td> <td>ft ft ss Slo ater Su tter Sur ater Sur ater Sur ater Sur ater Su Riffle Do Riffle Do</td> <td>Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S_r face Slope (S_p rface Slope (S th Ratios Depth (d_{maxrin} / d epth (d_{maxry} / d_b Depth (d_{maxg} / d</td> <td>ght Ratio (Br ax Riffle Dept _{nif} / S) </td> <td>HR) h) 1.0 1.0 Mean 1.4</td> <td>enc Min Min</td> <td>Max Max Max Max</td>	Mean 0.0 Mean 13.5 13.5 15 2	ft ft Min Min	Max Max	Max Rif Depth ft/ft ft/ft ft/ft ft ft ft ft ft	ffle Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver ope/Aver ope/Aver Dimer le Depth of Depth/ de Depth de Depth de Depth de Depth de Depth	rage Wa age Wa rage Wa rage Wa sionle Mean I Mean I Mean I Mean I Mean I 0.0 0.0	ft ft ss Slo ater Su tter Sur ater Sur ater Sur ater Sur ater Su Riffle Do Riffle Do	Bank-Hei (LBH/Ma pe Ratios Irface Slope (S face Slope (S _r face Slope (S _p rface Slope (S th Ratios Depth (d _{maxrin} / d epth (d _{maxry} / d _b Depth (d _{maxg} / d	ght Ratio (Br ax Riffle Dept _{nif} / S) 	HR) h) 1.0 1.0 Mean 1.4	enc Min Min	Max Max Max Max

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Red River-	-2-419.14		Station Number:	N/A	
LOCATION:	Red River-	·2-419.14				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	7068160	acres	11044	mi ² Drainage Area Mn ELEV:	840.54	ft
Reference REACH SLOP	PE:		ft/ft	Valley Type:	X]
Stream Type:	C6c-			HUC:		
		'BANKFU	LL" CH	ARACTERISTICS		
Determined from	FIELD ME	<mark>ASUREME</mark> I	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bkt}	_f)	150.6	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	11.5	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA ((A _{bkf})	1725.4	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	156.9	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	je Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	2.5	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	4280.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-de	termined" Bankfull STAGE	4280.0	cfs
Recurrence Interval (Log	J-Pearson)a	ssociated wit	h "field-de	termined" Bankfull Discharge	1.21	yrs
From the	Annual Pea	<mark>k Flow Freq</mark>	uency Ana	lysis data for the Gage Station, deterr	nine:	
1.5 Year R.I. Discharge	ә =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER	GEOMETRY		
Meander Length (L _m)	2248	ft	Radius of Curvature (R _C)	769.0	ft
Belt Width (W _{blt})		3639	ft	Meander Width Ratio (W _{blt} /W _{bkf})	24.16	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Are	ea (A), Mean I	Depth (d) & Me	an Velocity	regression analyses of measured discharge ((u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	I the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	= A / W _p		ft	Manning's "n" at Bankfull Stage	0.025	Coeff.
		.4865 [(A rea	۱) (Hydrau	lic Radius ^{2/3}) (S lope ^{1/2})] / Q _{bkf}]

		Bar	nkfull VEI		/ DISCHAP	RGE Esti	mates				
Site	Red River-2	-419.1	4		Location	Red Rive	er-2-419.14	4			
Date	9/29/2011	Stre	am Type	C6c-	Valley Ty	/pe	X				
Observers	KD, JB				HUC		- <mark></mark>		·		
	INPUT V		LES			OUTPUT VARIABLES					
Bankfull	Cross-sectior	nal	1725.4	A _{bkf} (ft ²)	Bankfu	ull Mean D	11.5	D _{bkf} (ft)			
Banl	vfull WIDTH		150.6	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	173.6	W _p (ft)		
D ₈₄ @ Riffle 0.0031 Dia. (mm)					D ₈₄	mm / 304.8	3 =	0.0	D ₈₄ (ft)		
Bank	full SLOPE	0.0001	S _{bkf} (ft / ft)		aulic RADI A_{bkf} / W p	US	9.9	R (ft)			
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)	ness	977363			
Drai	nage AREA		11044.0	DA (mi²)		lear Veloci u* =√gRS	ty	0.2	u* (ft / sec)		
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bankfull DISCHARGE			
1. Friction Factor	Relative u = Roughness	= [2.83	3 + 5.66Log [.]	{	}]u*	5.5	ft / sec	9512	cfs		
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	a) Manni .4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	2.3	ft / sec	3979	cfs		
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (I	JSGS):		1.4865* R ^{2/:} ¹⁶ n	^{3*} S ^{1/2} /n	8.1	ft / sec	13938	cfs		
	ation is for application ble- and boulder-do					<u> </u>	<u> </u>	I			
2. Roughness c) Manning	s Coefficient: 's 'n' from Strea	ım Type		= 1.4865* R 0.025	^{2/3} *S ^{1/2} /n	2.3	ft / sec	3979	cfs		
3. Other Metho HEC-RAS	ods (Hey, Darcy-W	/eisbach	<mark>ı, Chezy C, etc</mark>	.)		2.5	ft / sec	4280	cfs		
3. Other Metho	ods (Hey, Darcy-W	/eisbach	<mark>n, Chezy C, etc</mark>	:.)			ft / sec		cfs		
4. Continuity Return	Equations: Period for Bankf		gional Curve harge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	Q/A Yr.		ft / sec		cfs		
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q / A		ft / sec		cfs		
Option 1. For	s for using the I sand-bed chan bstitute an avera	nels: M	easure the "p	rotrusion h	neight" (h _{sd}) c	of sand dunes	s above char	nnel bed eleva			
Option 2. For	boulder-dominations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _b or the D ₈₄ ter) of boulders m in est. me	s above chanr thod 1.	nel bed		
Option 3. For uplif	bedrock-domin ited surfaces abo term in estimatio	ated ch ove char	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	_{or}) of rock se	parations/step	s/joints/ eet) for the		

Stream:	Red River-2-419.14									
Basin:	Red River Basin Drainage Area: 7E+06 acres	11044	mi ²							
Location:	Red River-2-419.14									
Twp.&Rge:	- Sec.&Qtr.: -									
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	9/29/2011							
Observers:	KD, JB	Valley Type:	Х							
	Bankfull WIDTH (W _{bkf})									
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	150.6	ft							
	Bankfull DEPTH (d _{bkf})									
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a									
	riffle section ($d_{bkf} = A / W_{bkf}$).	11.5	ft							
	Bankfull X-Section AREA (A _{bkf})									
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.		• 2							
		1725.4	ft ²							
	Width/Depth Ratio (W _{bkf} / d _{bkf})									
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	13.1	ft/ft							
	Maximum DEPTH (d _{mbkf})									
	Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		<i>•</i> .							
		16.6	ft							
	WIDTH of Flood-Prone Area (W _{fpa})									
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	790.5	ft							
		100.0								
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W _{fpa} / W _{bkf})									
	(riffle section).	5.2	ft/ft							
	Channel Materials (Particle Size Index) D ₅₀									
	The D_{50} particle size index represents the mean diameter of channel materials, as									
	sampled from the channel surface, between the bankfull stage and Thalweg elevations.									
		<0.001	mm							
	Water Surface SLOPE (S)									
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient									
	at bankfull stage.	0.000070	ft/ft							
	Channel SINUOSITY (k)									
	Sinuosity is an index of channel pattern, determined from a ratio of stream length									
	divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).									
		2.2								
	Stream C6c- See Classification	on Key								
	Type (Figure 2-21)									

Str	eam: Red River-2-419.14	1				Lo	ocation:	Red F	liver-2	-419.14				
Ob	servers: KD, JB			Date:	9/29/2	2011		Valle	у Туре:	Х	Str	eam Type	C6c-	
				Riv	er Rea	ach Sum	mary I	Data						
	Mean Riffle Depth (d _{bkf})	11.5	ft	Riffle \	Nidth (\	W _{bkf})	15	0.6	ft	Riffle Area	(A _{bkf})	17	25.4	ft ²
_	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (V	V _{bkfp})			ft	Pool Area	(A _{bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	iffle Width			W _{bkfp} / W _{bkf}	Pool Area	Riffle Area			A _{bkfp} /A
Dim	Max Riffle Depth (d _{maxrif})	16.6	ft	Max Po	ool Dep	oth (d _{maxp})			ft	Max Riffle	Depth/Mean	n Riffle De	iffle Depth	
lei	Max Pool Depth/Mean Riffle D	epth		Point E	3ar Slop	be			ft/ft	Inner Berm	n Width (W _{ib})		
Channel	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	/idth/Deptl	h Ratio			W _{ib} /d _{ib} II	nner Berm A	Area (A _{ib})	a (A _{ib}) fr	
	Streamflow: Estimated Mean	/elocity	at Bank	full Stage (u _{bkf})			2	.5	ft/s	Estimation	Method	ŀ	IEC-R	AS
	Streamflow: Estimated Discha	rge at B	ankfull	Stage (Q _{bkf})			42	80	cfs	Drainage A	11	044	mi ²	
	Geometry	Mean	Min	Max			Dime	ension	less Ge	eometry Ra	tios	Mean	Min	Max
\square	Meander Wavelength (L _m)	2248		•	ft	Meander						14.9		
ern	Radius of Curvature (R _c)	769			ft	Radius c	of Curva	iture/Ri	ffle Wid	th (R _c /W _{bkf})		5.1	1	
Pattern	Belt Width (W _{blt})	3639			ft	Meander	Width	Ratio (N _{blt} /W _{bl}	_{kf})		24.2		
land	Individual Pool Length				ft	Pool Len	gth/Riff	le Widt	'n					
Channel	Pool to Pool Spacing				ft	Pool to F	ool Spa	acing/R	iffle Wio	dth				
Ū	Riffle Length				ft Riffle Length/Riffle Width									
$\overline{\neg}$	Valley Slene (VS)		ft/ft	Averag		r Surfage	Slope ((8)	1	ft/f	Sinungi	+, /\/ <u>C</u> /C)		ļ
	Valley Slope (VS)				Average Water Surface Slope (S)				ft/ft Sinuosity (V 25772 ft Sinuosity (S				j.	
	Stream Length (SL) 56175 ft				Valley Length (VL)				25	772 44	Cinucoi	+, (CL /)/L)		2.2
		1		-	-		start			1			star	2.2
	Low Bank Height start (LBH) enc		ft ft ft	-	Length Max Rit Depth	ffle	start end		25 ft ft	Bank-I	Sinuosi Ieight Ratio Max Riffle D	(BHR)	star	t
	Low Bank Height start		ft ft	-	Max Ri	ffle	end	nsionle	ft ft	Bank-I	leight Ratio	(BHR)	en	t
ofile	Low Bank Height start (LBH) enc Facet Slopes Riffle Slope (S _{rif})		ft ft		Max Ri	ffle	end Dimer		ft ft ss Slo	Bank-F (LBH/	leight Ratio Max Riffle D	(BHR) Depth)	en	t 1
l Profile	Low Bank Height start (LBH) enc Facet Slopes	Mean	ft ft		Max Rit Depth	ffle h Riffle Slo	end Dimer ope/Ave	rage W	ft ft ss Slo ater Su	Bank-H (LBH/ pe Ratios	Height Ratio Max Riffle D (S _{rif} / S)	(BHR) Depth) Mean	en	t 1
	Low Bank Height start (LBH) enc Facet Slopes Riffle Slope (S _{rif})	Mean	ft ft		Max Rit Depti	ffle h Riffle Slo Run Slop Pool Slo	end Dimer ope/Ave oe/Avera	rage W age Wa age Wa	ft ft ater Sur ater Sur	Bank-ł (LBH/ pe Ratios rface Slope (face Slope (Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) S _p / S)	(BHR) Depth) Mean	en	t 1
Channel Profile	Low Bank Height start (LBH) enc Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run})	Mean	ft ft		Max Rit Depti ft/ft ft/ft	ffle h Riffle Slo Run Slop Pool Slo	end Dimer ope/Ave oe/Avera	rage W age Wa age Wa	ft ft ater Sur ater Sur	Bank-H (LBH/ pe Ratios Irface Slope face Slope (Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) S _p / S)	(BHR) Depth) Mean	en	t 1
	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a	Mean 0.0	ft ft		Max Rit Deptf ft/ft ft/ft ft/ft ft/ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo	end Dimer ppe/Ave pe/Aver ppe/Aver ppe/Ave	rage Wa age Wa age Wa rage W nsionle	ft ft ater Su ater Sur ater Sur ater Sur ater Su ater Su	Bank-I (LBH/ pe Ratios rface Slope (face Slope (rface Slope rface Slope	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _p / S) (S _g / S)	(BHR) Depth) 1.0	en Min	t 1
	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxtif})	Mean 0.0	ft ft	Max Max Max	Max Rit Deptl ft/ft ft/ft ft/ft ft/ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff	end Dimer ppe/Ave pe/Aver ppe/Aver ppe/Aver Dimer le Depth	rage W age Wa age Wa rage W nsionle	ft ft ater Sur ater Sur ater Sur ater Su ater Su Riffle D	Bank-I (LBH/ pe Ratios rface Slope (face Slope (rface Slope rface Slope th Ratios Depth (d _{maxif}	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) / d _{bkl})	(BHR) Depth) 1.0	en Min	Max
	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (Srif) Run Slope (Sp) Glide Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun)	Mean 0.0	ft ft	Max Max	Max Rif Deptl ft/ft ft/ft ft/ft ft/ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Rur	end Dimer ppe/Aver pe/Aver ppe/Aver ppe/Aver Dimer le Depth	rage Wa age Wa age Wa rage W nsionle n/Mean Mean I	ft ft sater Su ater Sur ater Sur ater Sur ater Su ater Su Riffle De	Bank-I (LBH/ pe Ratios rrface Slope (face Slope (face Slope (rface Slope (rface Slope (rface Slope (dreaxrift Depth (dreaxrift)	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _p / S) (S _g / S) (S _g / S) / d _{bkf})	(BHR) Depth) 1.0	en Min	Max
	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (S _{rif}) Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxron})	Mean 0.0	ft ft	Max Max	Max Rit Deptl ft/ft ft/ft ft/ft ft/ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer le Depth o Depth/	rage W age Wa age Wa rage W nsionle n/Mean I /Mean I /Mean I	ft ft ss Slop ater Sur ater Sur ater Su ss Dep Riffle De Riffle De	Bank-I (LBH/ pe Ratios rface Slope (face Slope (face Slope (rface Slope th Ratios Depth (d _{maxrif} epth (d _{maxru} /	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) (S _g / S) / d _{bkf}) d _{bkf})	(BHR) Depth) 1.0	en Min	Max
	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun)	Mean 0.0	ft ft	Max Max	Max Rif Deptl ft/ft ft/ft ft/ft ft/ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer le Depth o Depth/	rage W age Wa age Wa rage W nsionle n/Mean I /Mean I /Mean I	ft ft ss Slop ater Sur ater Sur ater Su ss Dep Riffle De Riffle De	Bank-I (LBH/ pe Ratios rrface Slope (face Slope (face Slope (rface Slope (rface Slope (rface Slope (dreaxrift Depth (dreaxrift)	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) (S _g / S) / d _{bkf}) d _{bkf})	(BHR) Depth) 1.0	en Min	Max
	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (Srif) Run Slope (Sp) Glide Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Pool Depth (dmaxp) Max Glide Depth (dmaxg)	Mean 0.0	ft ft Min Min	Max Max	Max Rit Deptf ft/ft ft/ft ft/ft ft/ft ft ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer le Depth o Depth/	rage W age Wa rage W nsionle n/Mean /Mean n/Mean	ft ft ss Slop ater Sur ater Sur ater Su ss Dep Riffle De Riffle De	Bank-I (LBH/ pe Ratios rface Slope (face Slope (face Slope (rface Slope th Ratios Depth (d _{maxrif} epth (d _{maxru} /	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) / d _{bkl}) / d _{bkl}) / d _{bkl})	(BHR) Depth) Mean 1.0 Mean 1.4	end Min Min	Max Max Max
Channel	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxg) Res	Mean 0.0 Mean 16.6	ft ft Min Min	Max Max	Max Rit Deptf ft/ft ft/ft ft/ft ft/ft ft ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer le Depth o Depth/	rage Wa age Wa rage Wa rage Wa nsionle n/Mean n/Mean n/Mean N/Mean	ft ft ss Slop ater Sur ater Sur ater Sur ater Sur ater Sur ater Su Riffle Do Riffle Do Riffle Do Riffle Do	Bank-I (LBH/ pe Ratios rface Slope (face Slope (face Slope (rface Slope (rface Slope (draxrin epth (draxrin epth (draxrin epth (draxrin pepth (draxrin	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) / d _{bkl}) / d _{bkl}) / d _{bkl})	(BHR) Depth) Mean 1.0 Mean 1.4	end Min Min	Max
Channel	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sg) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Glide Depth (dmaxg) Reg % Silt/Clay Silt/Clay	Mean 0.0 Mean 16.6	ft ft Min Min	Max Max	Max Rit Deptf ft/ft ft/ft ft/ft ft/ft ft ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver ope/Aver ope/Aver Dimer le Depth d Depth le Depth	rage W age Wa age Wa rage W nsionle n/Mean I /Mean I /Mean I /Mean I /Mean I /Mean I	ft ft ss Slop ater Sur ater Su	Bank-I (LBH/ pe Ratios rface Slope (face Slope (face Slope (rface Slope (rface Slope (draxrin epth (draxrin epth (draxrin epth (draxrin pepth (draxrin	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) / d _{bkl}) / d _{bkl}) / d _{bkl})	(BHR) Depth) Mean 1.0 Mean 1.4	end Min Min	Max Max Max
Channel	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sg) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Glide Depth (dmaxg) Reg % Silt/Clay Sand	Mean 0.0 Mean 16.6	ft ft Min Min	Max Max	Max Rit Deptf ft/ft ft/ft ft/ft ft/ft ft ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver ope/Aver ope/Aver ope/Aver Dimer le Depth/ le Depth/ le Depth/ le Depth/ le Depth/	rage Wa age Wa rage Wa nsionle m/Mean I /Mean I n/Mean N/Mean Rea <.(ft ft ss Slop ater Su ater Sur ater Sur ater Su ater Su Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	Bank-I (LBH/ pe Ratios rface Slope (face Slope (face Slope (rface Slope (rface Slope (draxrin epth (draxrin epth (draxrin epth (draxrin pepth (draxrin	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) / d _{bkl}) / d _{bkl}) / d _{bkl})	(BHR) Depth) Mean 1.0 Mean 1.4	end Min Min	Max Max Max
Channel	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (Srif) Run Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrun) Max Rol Depth (dmaxrun) Max Glide Depth (dmaxrun) Ree % Silt/Clay Sand % Gravel Sand	Mean 0.0 Mean 16.6	ft ft Min Min	Max Max	Max Rit Deptf ft/ft ft/ft ft/ft ft/ft ft ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver ope/Aver ope/Aver Dimer le Depth d Depth d Depth le Depth	rage W age Wa age Wa rage W nsionle n/Mean I /Mean I /Mean I /Mean N/Mean C.(C.(C)	ft ft ss Slog ater Sur ater Su	Bank-I (LBH/ pe Ratios rface Slope (face Slope (face Slope (rface Slope (rface Slope (draxrin epth (draxrin epth (draxrin epth (draxrin pepth (draxrin	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) / d _{bkl}) / d _{bkl}) / d _{bkl})	(BHR) Depth) Mean 1.0 Mean 1.4	end Min Min	Max Max Max Height ^d
	Low Bank Height (LBH) start enc Facet Slopes Riffle Slope (Srif) Run Slope (Srun) Pool Slope (Sg) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Riffle Depth (dmaxrif) Max Roll Depth (dmaxrif) Max Glide Depth (dmaxrif) Max Glide Depth (dmaxrif) Res % Silt/Clay S % Gravel % % Cobble S	Mean 0.0 Mean 16.6 39 1 0	ft ft Min Min	Max Max	Max Rit Deptf ft/ft ft/ft ft/ft ft/ft ft ft ft ft	ffle h Riffle Slo Run Slop Pool Slo Glide Slo Max Riff Max Run Max Run Max Glid	end Dimer ope/Aver ope/Aver ope/Aver Dimer le Depth Depth/ le Depth le Depth Das Das Das Das	rage Wa age Wa age Wa rage Wa sionle m/Mean Mean Mean Mean Mean Mean Mean	ft ft ss Slop ater Sur ater Su	Bank-I (LBH/ pe Ratios rface Slope (face Slope (face Slope (rface Slope (rface Slope (draxrin epth (draxrin epth (draxrin epth (draxrin pepth (draxrin	Height Ratio Max Riffle D (S _{rif} / S) S _{run} / S) (S _g / S) (S _g / S) / d _{bkl}) / d _{bkl}) / d _{bkl})	(BHR) Depth) Mean 1.0 Mean 1.4	end Min Min	Max Max Max

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^c Active bed of a riffle.

^b Composite sample of riffles and pools within the designated reach.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Red River-	-1-410.65		Station Number:	N/A	
LOCATION:	Red River-	1-410.65			·	
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	7850880	acres	12267	mi ² Drainage Area Mn ELEV:	836.35	ft
Reference REACH SLOP	PE:		ft/ft	Valley Type:	X]
Stream Type:	C6c-	I		HUC:		
		'BANKFU	LL" CH/	ARACTERISTICS		
Determined from	FIELD ME	ASUREMEI	NT	Determined from GAGE DA	TA Analys	is
Bankfull WIDTH (W _{bkf}	_{.f})	185.2	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	11.9	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA ((A _{bkf})	2156.7	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	187.4	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	je Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	2.2	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	Ξ (Q _{bkf})	4700.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	termined" Bankfull STAGE	4700.0	cfs
Recurrence Interval (Log	J-Pearson)a	ssociated wit	h "field-def	termined" Bankfull Discharge	1.19	yrs
From the	Annual Pea	<mark>k Flow Freq</mark>	uency Ana	lysis data for the Gage Station, detern	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER (GEOMETRY		
Meander Length (Lm	,)	2066	ft	Radius of Curvature (R _C)	433.0	ft
Belt Width (W _{blt})		2330	ft	Meander Width Ratio (W _{blt} /W _{bkf})	12.6	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Are	rea (A), Mean D	Depth (d) & Me	ean Velocity (regression analyses of measured discharge ((u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	d the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R			ft	Manning's "n" at Bankfull Stage	0.025	Coeff.
	F	.4865 [(Area		lic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

		Bar	nkfull VEI		/ DISCHA	RGE Esti	mates				
Site	Red River-1	-410.6	5		Location	Red Rive	er-1-410.6	5			
Date	9/28/2011	Stre	am Type	C6c-	Valley Ty	уре	X				
Observers	KD, JB				HUC						
	INPUT VA	RIAB	LES			OUTPUT VARIABLES					
Bankfull	Cross-section	al	2156.7	A _{bkf} (ft ²)	Bankfu	ull Mean D	11.9	D _{bkf} (ft)			
Bank	full WIDTH		185.2	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	208.9	W _p (ft)		
D ₈	D ₈₄ @ Riffle 0.027 Dia. (mm)					mm / 304.8	3 =	0.0001	D ₈₄ (ft)		
Bank	Bankfull SLOPE 0.0001 Sbkf (ft / ft)					aulic RADI А_{ькf} / W_p	US	10.3	R (ft)		
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		tive Rough R (ft) / D ₈₄ (ft)	ness	116545			
Drai	nage AREA		12267.0	DA (mi²)	Sh	near_ ∖∕elo ci	ty	0.1	u* (ft / sec)		
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bankfull DISCHARGE			
1. Friction Factor	Relative u = Roughness	[2.83	8 + 5.66Log [.]	{	}]u*	4.6	ft / sec	9863	cfs		
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.) Manni 4865*R	ng's 'n' from fi . ^{2/3*} S ^{1/2} /n		r / relative =	2.2	ft / sec	4840	cfs		
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	JSGS):		1.4865* R ^{2/:} ^{.16} n	^{3*} S ^{1/2} /n	8.2	ft / sec	17751	cfs		
	tion is for application ble-and boulder-do C2 and E3.					·	<u> </u>				
2. Roughness c) Manning	s Coefficient: s 'n' from Strea	m Type		= 1.4865* R 0.025	^{2/3} *S ^{1/2} /n	2.2	ft / sec	4840	cfs		
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)		2.2	ft / sec	4700	cfs		
3. Other Metho	ods (Hey, Darcy-W	eisbach	n, Chezy C, etc	.)			ft / sec		cfs		
4. Continuity Return	Equations: Period for Bankfu		gional Curve arge	s u = (Q = 1.46			ft / sec		cfs		
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q / A		ft / sec		cfs		
Option 1. For Sul	s for using the E sand-bed chan ostitute an avera	nels: M ge sanc	easure the " p I dune protrus	sion height (height" (h _{sd}) o (h _{sd} in ft) for th	of sand dunes ne D ₈₄ term in	s above char est. method	nnel bed eleva 1.	tions.		
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion hei	"protrusion ght (h _{bo} in ft) f	heights" (h _b or the D ₈₄ ter) of boulders m in est. me	above chanr thod 1.	nel bed		
Option 3. For uplif	bedrock-domination ted surfaces abo term in estimatio	ated ch ve cha	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	or) of rock se	parations/step	eet) for the		

Stream:	Red River-1-410.65		
Basin:	Red River Basin Drainage Area: 8E+06 acres	12267	mi ²
Location:	Red River-1-410.65		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	9/28/2011
Observers:	KD, JB	Valley Type:	Х
	Bankfull WIDTH (W _{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	185.2	ft
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	11.9	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	2156.7	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	15.6	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	17.9	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	683.3	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	3.7	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.0018	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000063	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.0	
	Stream C6c- See Classification (Figure 2-2		

00	eam: Red River-1-410.65	5				Lo	ocation:	Red R	River-1	-410.65				
Ob	servers: KD, JB			Date:	9/28/2	2011		Valle	еу Туре:	Х	Stream	n Type:	C6c-	
				Riv	er Rea	ich Sum	mary [Data						
\bigcap	Mean Riffle Depth (d _{bkf})	11.9	ft	Riffle V	Vidth (V	N _{bkf})	18	5.2	ft	Riffle Area (At	_{kf})	215	6.7	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft Pool Area (A _{bkfp})		_{fp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	ffle Width			W _{bkfp} / W _{bkf}	Pool Area / Rit	fle Area			A _{bkfp} /A _{bkf}
	Max Riffle Depth (d _{maxrif})	17.9	ft	Max Po	ool Dep	th (d _{maxp})			ft	Max Riffle Dep	oth/Mean Rif	fle Dept	h	1.5
Channel	Max Pool Depth/Mean Riffle D	epth		Point E	Bar Slop	e	e ft/ft Inner Berm Width (W _{ib}) dth/Depth Ratio W _{ib} /d _{ib} Inner Berm Area			Inner Berm Width (W _{ib})				ft
Cha	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Dept				(A _{ib})		ft ²		
	Streamflow: Estimated Mean	/elocity	at Bank	full Sta	ull Stage (u _{bkf})			2	ft/s	ft/s Estimation Method			EC-RA	S
\bigcup	Streamflow: Estimated Discha	rge at B	ankfull	Stage (Q _{bkf}) 4700 cfs Drainage Area					122	:67	mi²			
	Geometry	Mean	Min	Max			Dime	ension	less Ge	eometry Ratios	5	Mean	Min	Max
[_]	Meander Wavelength (L _m)	2066			ft	Meander	eander Length Ratio (L _m /W _{bkf})				11.2			
Pattern	Radius of Curvature (R _c)	433	1	<u> </u>	ft	1				th (R _c /W _{bkf})		2.3		
	Belt Width (W _{blt})			ft	Meander	Width	Ratio (W _{blt} /W _{bl}	(t)		12.6			
Channel	Individual Pool Length	<u> </u>	1	<u> </u>	ft	Pool Len	<u> </u>							
	Pool to Pool Spacing	<u> </u>		1	ft	Pool to Pool Spacing/Riffle Width								
\Box	Riffle Length				ft	Riffle Length/Riffle Width								
$\overline{\bigcap}$	Valley Slope (VS) ft/ft Average Water Surface Slope (S) ft/ft Sinuosity									Sinuosity (\	/S/S)			
	Stream Length (SL) 65	270	ft	Valley Length (VL)					33364 ft Sinuosity (SL/VL)		2.0
	Low Bank Height start (LBH) end		ft ft		Max Rif Depth		start end		ft ft		jht Ratio (B⊢ x Riffle Dept		start end	
	Facet Slopes	Mean	Min	Max								,		i
Profile	Riffle Slope (S _{rif})		1	ft/ft Riffle Slope/Average Wate				sionle	55 210	pe Ratios		Mean	Min	Max
191				ft/ft	Riffle Slo						,	Min	Max	
	Run Slope (S _{run})	0.0			ft/ft ft/ft	1	ope/Ave	rage W	ater Su		, f / S)	Mean	Min	Max
		0.0				Run Slop Pool Slo	ope/Ave oe/Avera pe/Avera	rage W age Wa age Wa	'ater Su ater Sur ater Sur	rface Slope (S _{ri} face Slope (S _{rur} face Slope (S _p	f / S) / S) / S)	Mean	Min	Max
Channel Pr	Run Slope (S _{run})	0.0			ft/ft	Run Slop Pool Slo	ope/Ave oe/Avera pe/Avera	rage W age Wa age Wa	'ater Su ater Sur ater Sur	rface Slope (S _{ri} face Slope (S _{rur}	f / S) / S) / S)	Mean	Min	Max
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a	Mean	Min	Max	ft/ft ft/ft ft/ft	Run Slop Pool Slo Glide Slo	ppe/Ave pe/Avera pe/Avera ppe/Avera Dimen	rage W age Wa age Wa rage W sionle	'ater Su ater Sur ater Sur 'ater Su ss Dep	rface Slope (S _{rr} face Slope (S _{ru} face Slope (S _p face Slope (S _g th Ratios	/ S) / S) / S) / S)	Mean 1.0 Mean	Min	Max Max
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif})		Min	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slo Glide Slo Max Riff	ppe/Ave pe/Avera pe/Avera ppe/Avera Dimen le Depth	rage W age Wa age Wa rage W sionle	'ater Sur ater Sur ater Sur 'ater Su 'ater Su ss Dep Riffle D	rface Slope (S _{ri} face Slope (S _{ru} face Slope (S _p , rface Slope (S _g th Ratios Depth (d _{maxrif} / d _t	/ S) / S) / S) / S) / S)	Mean 1.0		
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean	Min	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Rur	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/	rage Wa age Wa age Wa rage W sionle n/Mean F	'ater Sur ater Sur ater Sur 'ater Su ss Dep Riffle De	rface Slope (S _{rr} face Slope (S _r face Slope (S _p rface Slope (S _g th Ratios Depth (d _{maxrif} / d _t epth (d _{maxrin} / d _t	r / S) / S) / S) / S) / S) kd)	Mean 1.0 Mean		
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp})	Mean	Min	Max	ft/ft ft/ft ft/ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimental le Depth/ l Depth/ l Depth/	rage Wa age Wa age Wa rage W sionle Mean f /Mean f	ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De	rface Slope (S _{rr} face Slope (S _r face Slope (S _p face Slope (S _g th Ratios Depth (d _{maxrif} / d _t epth (d _{maxru} / d _b	r / S) / S) / S) / S) / S) k() k()	Mean 1.0 Mean		
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun})	Mean	Min	Max	ft/ft ft/ft ft/ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimental le Depth/ l Depth/ l Depth/	rage Wa age Wa age Wa rage W sionle Mean f /Mean f	ater Sur ater Sur ater Sur ater Sur ss Dep Riffle De Riffle De	rface Slope (S _{rr} face Slope (S _r face Slope (S _p rface Slope (S _g th Ratios Depth (d _{maxrif} / d _t epth (d _{maxrin} / d _t	r / S) / S) / S) / S) / S) k() k()	Mean 1.0 Mean		
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxg}) Max Glide Depth (d _{maxg})	Mean 17.9		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slop Glide Slop Max Riff Max Run Max Poo	ppe/Ave pe/Avera ppe/Avera ppe/Avera Dimen le Depth/ l Depth/ le Depth/ le Depth/	rage W age Wa age Wa rage W sionle Mean f /Mean f /Mean f /Mean f /Mean f	ater Sur ater Sur ater Sur ater Sur ater Su ss Dep Riffle De Riffle De Riffle De Riffle De	rface Slope (S _{rr} face Slope (S _r face Slope (S _p face Slope (S _g th Ratios Depth (d _{maxrif} / d _t epth (d _{maxru} / d _b	r / S) / S) / S) / S) / S) k() k()	Mean 1.0 Mean	Min	Max
Channel	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxp}) Max Glide Depth (d _{maxg})	Mean 17.9 ach ^b 98		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/ le Depth/ le Depth/ le Depth/ le Depth/	rage W age Wa age Wa rage W sionle Mean I Mean I Mean I Mean I Mean I Mean I	ater Sur ater Sur ater Sur ater Sur ater Su ss Dep Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do Riffle Do	rface Slope $(S_{rr}$ face Slope (S_{pr}) face Slope (S_{pr}) rface Slope (S_{gr}) rface Slope (S_{gr}) th Ratios Depth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) Depth (d_{maxrf} / d_{br})	r / S) / S) / S) / S) / S) kt) kt)))	Mean 1.0 Mean 1.5	Min	Max
Channel	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Glide Depth (d _{maxg}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand	Mean 17.9 ach ^b 98		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Avera pe/Avera ppe/Avera ppe/Avera Dimen le Depth Depth/ le Depth/ le De	rage Wa age Wa age Wa rage Wa sionle Masionle Mean I Mean I Mean I Mean A Mean	ater Sur ater Sur ater Sur ater Sur ater Su ss Dep Riffle D Riffle D Riffle D Riffle D Riffle D Riffle D Riffle D Riffle D	rface Slope $(S_{rr}$ face Slope (S_{pr}) face Slope (S_{pr}) rface Slope (S_{gr}) rface Slope (S_{gr}) th Ratios Depth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) Depth (d_{maxrf} / d_{br})	r / S) / S) / S) / S) / S) kt) kt)))	Mean 1.0 Mean 1.5	Min	Max eight ^d
Channel	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Pool Depth (d _{maxrp}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel	Mean 17.9 17.9 2 2 0		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/ le	rage W age Wa age Wa rage W sionle /Mean I /Mean I /Mean I /Mean I /Mean I /Mean I /Mean I /Mean I /Mean I	ater Sur ater Sur ater Sur ater Sur ater Sur ater Sur ass Dep Riffle Do Riffle DO Riff	rface Slope $(S_{rr}$ face Slope (S_{pr}) face Slope (S_{pr}) rface Slope (S_{gr}) rface Slope (S_{gr}) th Ratios Depth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) Depth (d_{maxrf} / d_{br})	r / S) / S) / S) / S) / S) kt) kt)))	Mean 1.0 Mean 1.5	Min	Max Max eight ^d
Channel	Run Slope (Srun) Pool Slope (Sp) Glide Slope (Sg) Feature Midpoint ^a Max Riffle Depth (dmaxrif) Max Run Depth (dmaxrif) Max Pool Depth (dmaxrif) Max Glide Depth (dmaxg) Rea % Silt/Clay % Sand % Gravel % Cobble	Mean 17.9 ach ^b 98 2 0 0		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Avera pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth d Depth/ d pth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/ depth/	rage Wa age Wa age Wa rage Wa sionle n/Mean I n/Mean I n/Mean I a/Mean I a/Ma	ater Sur ater Sur ater Sur ater Sur ater Sur ater Su ss Dep Riffle D Riffle D RI RI RI RI RI RI RI RI RI RI RI RI RI	rface Slope $(S_{rr}$ face Slope (S_{pr}) face Slope (S_{pr}) rface Slope (S_{gr}) rface Slope (S_{gr}) th Ratios Depth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) Depth (d_{maxrf} / d_{br})	r / S) / S) / S) / S) / S) kt) kt)))	Mean 1.0 Mean 1.5	Min	Max eight ^d mm
	Run Slope (S _{run}) Pool Slope (S _p) Glide Slope (S _g) Feature Midpoint ^a Max Riffle Depth (d _{maxrif}) Max Run Depth (d _{maxrun}) Max Ool Depth (d _{maxrun}) Max Glide Depth (d _{maxg}) Rea % Silt/Clay % Sand % Gravel % Boulder	Mean 17.9 17.9 2 2 0		Max	ft/ft ft/ft ft/ft ft ft ft	Run Slop Pool Slo Glide Slo Max Riff Max Run Max Poo Max Glid	ppe/Ave pe/Avera ppe/Avera ppe/Avera ppe/Avera Dimen le Depth/ le	rage Wa age Wa rage Wa sionle Mean I Mean I Mean I Mean I Mean I (Mean I (Mean I (Mean I 0.0 0.0	ater Sur ater Sur ater Sur ater Sur ater Sur ater Sur ass Dep Riffle Do Riffle DO Riff	rface Slope $(S_{rr}$ face Slope (S_{pr}) face Slope (S_{pr}) rface Slope (S_{gr}) rface Slope (S_{gr}) th Ratios Depth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) epth (d_{maxrf} / d_{br}) Depth (d_{maxrf} / d_{br})	r / S) / S) / S) / S) / S) kt) kt)))	Mean 1.0 Mean 1.5	Min	Max Max eight ^d mm mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Maple Rive	er - 2 - 11.39	9	Station Number:	N/A	
LOCATION:		er - 2 - 11.39				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	934400	acres	1460	mi ² Drainage Area Mn ELEV:	885.5	ft
Reference REACH SLO	PE:		ft/ft	Valley Type:	X]
Stream Type:	E6	l				
	'	'BANKFU	LL" CH/	ARACTERISTICS		
Determined from	FIELD ME	ASUREMEI	NT	Determined from GAGE DA	ATA Analys	sis
Bankfull WIDTH (W _{bk}	_f)	72.1	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	6.5	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	463.0	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	77.0	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	(u)	1.4	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	650.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	650.0	cfs
Recurrence Interval (Log	₃-Pearson)a	ssociated wit	h "field-def	termined" Bankfull Discharge	1.16	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Anal	lysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER (GEOMETRY		
Meander Length (Lm	,)	1831	ft	Radius of Curvature (R _C)	261.0	ft
Belt Width (W _{blt})		2333	ft	Meander Width Ratio (W _{blt} /W _{bkf})	32.4	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean I	Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope ex	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	$= A / W_p$		ft	Manning's "n" at Bankfull Stage	0.03	Coeff.
	" n " = 1	.4865 [(A rea	ı) (Hydraul	ic Radius ^{2/3}) (S lope ^{1/2})] / Q _{bkf}		

		Bar	kfull VEI			R	GE Estin	nates		
Site	Maple River	- 2 - 1	1.39		Location	1	Maple Riv	/er - 2 - 1 [/]	1.39	
Date	11/20/2010	Stre	am Type	E6	Valley Ty	yp	e	X		
Observers	KP, AL			•	HUC	-				
	INPUT VA		LES				OUTPU	T VARIA	BLES	
Bankfull	Cross-section	al	463.0	A _{bkf} (ft ²)	Bankfull Mean DEPTH				6.5	D _{bkf} (ft)
Bank	full WIDTH		72.1	W _{bkf}		Wetted PERIMETER ~ 2 * d _{bkf} + W _{bkf}				W _p (ft)
D ₈	D ₈₄ I	m	ım / 304.8	=	0.0	D ₈₄ (ft)				
Bank	Bankfull SLOPE 0.0001 Sbkf (ft / ft)						ulic RADII _{okf} / W _p	JS	5.4	R (ft)
Gravitatio	onal Accelerati	on	32.2	g (ft / sec ²)			/e Roughr (ft) / D ₈₄ (ft)	iess	92181	
Drai	nage AREA		1460.0	DA (mi²)			ar Velocit =√gRS	у .	0.1	u* (ft / sec)
	ESTIMA	TION	METHO	os		E	Bankfull V	ELOCITY	Bankfull DISCHARGE	
1. Friction Factor	Relative u = Roughness	[2.83	8 + 5.66Log	{	}]u*		3.4	ft / sec	1573	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.		ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =		1.3	ft / sec	589	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (L	ISGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	Γ	4.9	ft / sec	2268	cfs
	tion is for applications ble-and boulder-do					Ļ]		
2. Roughness		т Туре		= 1.4865* R	^{2/3} *S ^{1/2} /n		1.3	ft / sec	589	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)			1.4	ft / sec	650	cfs
3. Other Metho	ods (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	:.)				ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfu		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1			ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A			ft / sec		cfs
Option 1, For	s for using the D sand-bed chan ostitute an averag	nels: M	easure the "p	rotrusion h	neight" (h _{sd}) o	of	sand dunes	above chan	nel bed eleva	d 1. tions.
Option 2. For elev	boulder-domina ations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	"protrusion ght (h _{bo} in ft) fe	he for	eights" (h _{bo} the D ₈₄ terr) of boulders n in est. me	above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-domina ted surfaces abo term in estimation	ated ch ve char	annels: Meas nnel bed eleva	sure severa	"protrusion	h h	eights" (h _b	,) of rock sep	parations/step	s/joints/ eet) for the

Stream:	Maple River - 2 - 11.39		
Basin:	Red River Basin Drainage Area: 934400 acres	1460	mi ²
Location:	Maple River - 2 - 11.39		
Twp.&Rge:	: - Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	11/20/2010
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	72.1	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	6.5	ft
	Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	463.0	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	11.1	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	9.0	ft
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	672.0	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	9.3	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.001	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.000069	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.7	
	Stream E6 See Classification (Figure 2-2)		

Str	eam: Maple River - 2 - 11	.39				Lo	cation:	Maple	River	- 2 - 11.39				
Ob	servers: KP, AL			Date:	11/20/	2010		Valle	еу Туре:	<u>x</u>	Stream	n Type:	E6	
_				Riv	er Rea	ch Sum	mary [Data						
$\left[\right]$	Mean Riffle Depth (d _{bkf})	6.5	ft	Riffle \	Vidth (V	V _{bkf})	72	.1	ft	Riffle Area (A	A _{bkf})	46	3.0	ft ²
۲	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (W	/ _{bkfp})			ft	Pool Area (A _{bkfp})				ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Rif	fle Width			W _{bkfp} / W _{bkf}	Pool Area / R	liffle Area			A _{bkfp} /A _{bkf}
Ē	Max Riffle Depth (d _{maxrif})	9.0	ft	Max Po	ool Dep	th (d _{maxp})			ft	Max Riffle De	epth/Mean Rif	iffle Depth		1.4
Channel	Max Pool Depth/Mean Riffle De	epth		Point E	3ar Slop	e			ft/ft	Inner Berm V	Vidth (W _{ib})			ft
Chai	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Deptl	n Ratio			W _{ib} /d _{ib} Inn	er Berm Area	(A _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity/	at Bank	full Sta	ge (u _{bkf})		1.	.4	ft/s	Estimation M	ethod	Н	EC-R/	AS
	Streamflow: Estimated Dischar	rge at E	Bankfull	Stage (Q _{bkf})		65	50	cfs	Drainage Are	a	14	60	mi²
	Geometry Mean Min Max Dimensionless Geometry Ratios Meander Wavelength (L _m) 1831 ft Meander Length Ratio (L _m /W _{bkf})											Mean	Min	Max
	Meander Wavelength (L _m)	1831			ft	Meander	Length	Ratio	(L _m /W _{bk}	f)		25.4		
Pattern	Radius of Curvature (R _c)	261			ft	Radius o	of Curva	ture/Ri	ffle Wid	th (R _c /W _{bkf})		3.6		
	Belt Width (W _{blt})	2333	<u> </u>		ft	Meander	Width	Ratio (W _{blt} /W _{bk}	4)		32.4		
Channel	Individual Pool Length				ft	Pool Len	gth/Riff	le Widt	h					
Cha	Pool to Pool Spacing				ft	Pool to F	ool Spa	acing/R	iffle Wio	dth				
	Riffle Length	<u> </u>			ft	Riffle Le	ngth/Rif	fle Wic	lth					
\square	Valley Slope (VS)		ft/ft	Averag	je Wate	r Surface	Slope (S)		ft/ft	Sinuosity (/S/S)		
	Stream Length (SL) 348	852	ft	Valley	Length	(VL)			20	900 ft	Sinuosity (SL/VL)		1.7
	Low Bank Height start (LBH) end		ft		Max Rif Depth		start		ft		ight Ratio (BH ax Riffle Dept		start	
	(LBH) end Facet Slopes	Mean	ft Min	Max	Depti	1	end	sionle	ft ss Slor	pe Ratios		Mean	end Min	Max
ile	Riffle Slope (S _{rif})	0.0			ft/ft	Riffle Slo				rface Slope (S	S _{rif} / S)	1.0		
Profile	Run Slope (S _{run})				ft/ft	Run Slop	be/Avera	age Wa	ater Surf	face Slope (S _r	_{un} / S)			
lan	Pool Slope (S _p)	ļ			ft/ft	Pool Slo	pe/Avera	age Wa	ater Sur	face Slope (S _r	, / S)			
Channel	Glide Slope (S _g)				ft/ft	Glide Slo	pe/Ave	rage W	ater Su	rface Slope (S	S _g / S)			
Ŭ	Feature Midpoint ^a	Mean	Min	Max		1			-	th Ratios		Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	9.0	<u> </u>		ft					Depth (d _{maxrif} / d		1.4		<u> </u>
	Max Run Depth (d _{maxrun})		<u> </u>	<u> </u>	ft					epth (d _{maxrun} / d				
	Max Pool Depth (d _{maxp})		<u> </u>	<u> </u>	ft					epth (d _{maxp} / d _t				<u> </u>
	Max Glide Depth (d _{maxg})				ft	Max Glid	e Depth	n/Mean	Riffle D	Depth (d _{maxg} / c	l _{bkf})			
	Rea	ich ^b	Rif	ffle ^c	F	Bar		Rea	ach ^b	Riffle ^c	Bar	Protru	ision H	leight ^d
s)7					D ₁₆		001					mm
Materials	% Sand	3					D ₃₅	<.	001					mm
Mat	% Gravel	0					D ₅₀	0.	001					mm
	% Cobble	0					D ₈₄	0.0	018					mm
Channel	% Boulder	0					D ₉₅	0.	.07					mm
Ľ	% Bedrock	0					D ₁₀₀	4.	.75					mm
Min	max, mean depths are ave. mid-po	aint valu		ntnaalai	tokon o	t de en est r	ort of pr			^c Active bed of	o rifflo			

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

Worksheet 2-1. Gage station and field data (Rosgen and Silvey, 2007).

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Maple Riv	er-1-0.78		Station Number:	N/A	
LOCATION:	Maple Riv	er-1-0.78				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	948480	acres	1482	mi ² Drainage Area Mn ELEV:	874.5	ft
Reference REACH SLO	1		ft/ft	Valley Type:	X	
Stream Type:	E6					
		BANKFU	LL" CH	ARACTERISTICS		
Determined from	FIELD ME	ASUREME	NT	Determined from GAGE DA	ATA Analys	is
Bankfull WIDTH (W _{bk}	_{cf})	68.5	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPT	H (d _{bkf})	5.8	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA	(A _{bkf})	399.1	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	72.5	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	Y (u)	1.6	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARG	E (Q _{bkf})	650.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	HARGE ass	ociated with	"field-det	termined" Bankfull STAGE	650.0	cfs
Recurrence Interval (Log	g-Pearson)a	ssociated wit	h "field-de	termined" Bankfull Discharge	1.2	yrs
From the	Annual Pea	k Flow Freq	uency Ana	lysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharg	e =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharg	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharg	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEA	NDER (GEOMETRY		
Meander Length (Ln	n)	739	ft	Radius of Curvature (R _C)	153.0	ft
Belt Width (W _{blt})		1284	ft	Meander Width Ratio (W _{blt} /W _{bkf})	18.7	ft/ft
		HYDR	AULIC	GEOMETRY		
parameters of Width (W), Ar	rea (A), Mean	Depth (d) & Me	an Velocity (regression analyses of measured discharge (iu), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	$= A / W_p$		ft	Manning's "n" at Bankfull Stage	0.030	Coeff.
	" n " = 1	.4865 [(A rea	a) (Hydrau	lic R adius ^{2/3}) (S lope ^{1/2})] / Q _{bkf}		

Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

		Bar	kfull VEI		/ DISCHA	RGE Estir	nates		
Site	Maple River-	-1-0.7	3		Location	Maple Ri	ver-1-0.78	}	
Date	11/16/2010	Stre	am Type	E6	Valley Ty	/pe	Х		
Observers	KP, AL				HUC		- <mark></mark>		·
	INPUT VA	RIAB	LES			OUTPU	IT VARIA	BLES	
Bankfull	Cross-section	al	399.1	A _{bkf} (ft ²)	Bankfu	ull Mean Di	EPTH	5.8	D _{bkf} (ft)
Bank	full WIDTH		68.5	W _{bkf}		ed PERIME * d _{bkf} + W _{bkf}	TER	80.2	W _p (ft)
D ₈	4 @ Riffle		1.1	Dia. (mm)	D ₈₄	mm / 304.8	3 =	0.0	D ₈₄ (ft)
Bank	full SLOPE		0.0001	S _{bkf} (ft / ft)		aulic RADI A_{bkf} / W p	US	5.0	R (ft)
Gravitatio	onal Accelerati	on	32.2	g (ft / sec ²)		ive Roughr R (ft) / D ₈₄ (ft)	ness	1380	
Drai	nage AREA		1482.0	DA (mi²)		near Velocit u* =√gRS	ty	0.1	u* (ft / sec)
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	[2.83	+ 5.66Log	{	}]u*	2.8	ft / sec	1102	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	1.5	ft / sec	610	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (U	ISGS):		1.4865* R ^{2/:} ¹⁶ n	^{3*} S ^{1/2} /n =	4.8	ft / sec	1925	cfs
	tion is for applications ble-and boulder-do						•	Ļ	,
2. Roughness		т Туре		= 1.4865* R	^{2/3*} S ^{1/2} /n	1.5	ft / sec	610	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	<mark>eisbac</mark> h	<mark>, Chezy C, etc</mark>	.)		1.6	ft / sec	650	cfs
3. Other Metho	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankfu		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	a u=(Q/A		ft / sec		cfs
Option 1. For Sub	for using the D sand-bed chan ostitute an averag	nels: M ge sand	easure the " p dune protrus	sion height (height" (h _{sd}) o h _{sd} in ft) for th	of sand dunes ie D ₈₄ term in	s above chan est. method	nel bed eleva 1.	tions.
Option 2. For elev	boulder-domina ations. Substitut	ited ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) f	heights" (h _{bc} or the D ₈₄ ter) of boulders m in est. me	above chani thod 1.	nel bed
Option 3. For uplif	bedrock-domina ted surfaces abo term in estimation	ated ch ve char	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	,) of rock se	parations/step	es/joints/ eet) for the

Worksheet 2-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen , 2006b).

Stream:	Maple River-1-0.78								
Basin:	Red River Basin Drainage Area: 948480 acres	1482	mi ²						
_ocation:	Maple River-1-0.78								
Fwp.&Rge:	: - Sec.&Qtr.: -								
Cross-Sect	ion Monuments (Lat./Long.): -	Date	: 11/16/201						
Observers:	KP, AL	Valley Type	: X						
	Bankfull WIDTH (W _{bkf})								
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	68.5	ft						
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	5.8	ft						
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	399.1	ft ²						
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	11.7	ft/ft						
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	9.1	ft						
	WIDTH of Flood-Prone Area (W _{fpa}) Twice maximum DEPTH, or $(2 \times d_{mbid})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	377.3	ft						
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W _{fpa} / W _{bkf}) (riffle section).	5.5	ft/ft						
	Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.0091	mm						
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00011	ft/ft						
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	2.2							
	Stream E6 See Classification Key (Figure 2-21)								

Str	eam: Maple River-1-0.78					Lo	ocation:	Maple	River	1-0.78				
Ob	servers: KP, AL			Date:	11/16/	/2010		Valle	у Туре:	Х	Stream	n Type:	E6	
_				Riv	er Rea	ach Sum	mary [Data						
\square	Mean Riffle Depth (d _{bkf})	5.8	ft	Riffle \	Vidth (\	N _{bkf})	68	.5	ft	Riffle Area	a (A _{bkf})	39	9.1	ft ²
	Mean Pool Depth (d _{bkfp})		ft	Pool W	/idth (N	V _{bkfp})			ft	Pool Area	i (A _{bkfp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width			W _{bkfp} / W _{bkf}	Pool Area	/ Riffle Area			A _{bkfp} /A _{bkf}
Ē	Max Riffle Depth (d _{maxrif})	9.1	ft	Max P	ool Dep	th (d _{maxp})			ft	Max Riffle	e Depth/Mean Ri	iffle Depth		1.6
Channel	Max Pool Depth/Mean Riffle De	epth		Point E	3ar Slop	be			ft/ft	Inner Ber	m Width (W _{ib})			ft
Chai	Inner Berm Depth (d _{ib})		ft	Inner E	Berm W	idth/Deptl	h Ratio			W _{ib} /d _{ib}	Inner Berm Area	a (A _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity/	at Bank	full Sta	ge (u _{bkf}))	1.	6	ft/s	Estimation	n Method	Н	EC-R/	AS
	Streamflow: Estimated Dischar	rge at E	Bankfull	Stage (Q _{bkf})		65	50	cfs	Drainage	Area	14	82	mi²
	Geometry	Mean	Min	Max			Dime	ension	ess Ge	eometry R	atios	Mean	Min	Max
	Meander Wavelength (L _m)	739			ft	Meander	r Length	Ratio	(L _m /W _{bkl}	f)		10.8		
Pattern	Radius of Curvature (R _c)	153			ft	Radius c	of Curva	ture/Ri	fle Wid	th (R _c /W _{bkl}	F)	2.2		
	Belt Width (W _{blt})	1284			ft	Meander	Width	Ratio (\	N _{blt} /W _{bk}	t)		18.7		
Channel	Individual Pool Length				ft	Pool Len	gth/Riff	le Widt	h					
Cha	Pool to Pool Spacing				ft	Pool to F	Pool Spa	cing/Ri	iffle Wio	dth				
	Riffle Length				ft	Riffle Le	ngth/Rif	fle Wid	lth					
\square	Valley Slope (VS)		ft/ft	Avera	e Wate	er Surface	Slope (S)		ft/	ft Sinuosity (VS/S)		
		138	ft		Length			,	16	792 ft	Sinuosity (2.2
	Low Bank Height start		ft		Max Rif	ffle	start		ft	Bank	Height Ratio (Bl		start	
	(LBH) end		ft		Depth	<u>ו</u>	end		ft	(LBH	I/Max Riffle Dep	th)	end	
e la	Facet Slopes Riffle Slope (S _{rif})	Mean 0.0	Min	Max	ft/ft	Riffle Sk				be Ratios rface Slope	a (S / S)	Mean 1.0	Min	Max
Profile	Run Slope (S _{run})	0.0	<u> </u> 	<u> </u> 	ft/ft			-		face Slope	,	1.0		<u> </u>
	Pool Slope (S _p)	<u> </u> 	<u> </u> 	<u>i</u> i	ft/ft	-		<u> </u>		face Slope	,	<u> </u> 		<u> </u>
Channel	Glide Slope (S_q)	 	<u> </u> 	<u> </u>	ft/ft			-		rface Slope	· F ,			<u> </u>
Ö	Feature Midpoint ^a	Mean	Min	Max	IUIT	Onde Ore		-		th Ratios	(0 _g , 0)	Mean	Min	Max
	Max Riffle Depth (d _{maxrif})	9.1			ft	Max Riff			-	Depth (d _{maxi}	rif / d _{bkf})	1.6		
	Max Run Depth (d _{maxrun})				ft	Max Rur	Depth/	Mean F	Riffle De	epth (d _{maxru}	_n / d _{bkf})			
	Max Pool Depth (d _{maxp})				ft	Max Poo	l Depth	/Mean I	Riffle De	epth (d _{maxp}	/ d _{bkf})			
	Max Glide Depth (d _{maxg})				ft	Max Glid	le Depth	/Mean	Riffle D	epth (d _{maxe}	g / d _{bkf})			
_		, b				Por			b		C Der	Dest	aler 1	d diama di
\square		ich ^b 57	Rif	ffle ^c		Bar	D ₁₆		ach ^b 001	Riffle	c Bar	Protru	Ision F	leight ^d mm
rials	% Sand 3	3	<u>.</u>				D ₃₅		019					mm
Materials	% Gravel	0					D ₅₀		091				_	mm
	% Cobble	0					D ₈₄	1	.1				_	mm
Channel	% Boulder	0					D ₉₅	2.	96					mm
0		0	-				D ₁₀₀	4.	75					mm
$\underline{}$	max, mean depths are ave. mid-po	·								C A	d of a riffle.			•

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

		<i>USGS</i> (REAM CH							for			
Station NAME:	Lower Rus	sh River-2-6	6.03] [5	Station	Number	: 1	N/A	
LOCATION:	Lower Rus	sh River-2-6	6.03				.					
Period of RECORD:	N	/A	yrs		Mea	n Ar	nnual DI	SCHAF	RGE:		N/A	cfs
Drainage AREA:	34144	acres	53.4		mi ²	D	rainage /	Area N	In ELEV	:	N/A	ft
Reference REACH SLO	PE:		ft/ft				Valley	Type:			X]
Stream Type:	B6c	BANKFU		1 V						-]		
Determined from					r				GAGE I	DA ⁻	TA Analys	sis
Bankfull WIDTH (W _{bk}	_f)	63.1	ft		Bankfu	ull M	VIDTH (W _{bkf})				ft
Bankfull Mean DEPTH	H (d _{bkf})	1.6	ft		Bankfu	ull N	IEAN D	EPTH	(d _{bkf})			ft
Bankfull Xsec AREA	(A _{bkf})	108.6	ft ²	I	Bankfu	ıll X	sec AR	EA (A	_{bkf})			ft ²
Wetted PERIMETER	(W _p)	63.6	ft	I	Wettee	d PE	ERIMET	ER (V	V _p)			ft
Bankfull STAGE (Gag	ge Ht)		ft	I	Bankfu	ıll S	TAGE (Gage	Ht)			ft
Est. Mean VELOCITY	′ (u)	0.7	ft/sec	I	Mean	VEL		(u)				ft/sec
Est. Bkf. DISCHARGE	∃ (Q _{bkf})	60.0	cfs		Bankfu	ull D	ISCHA	RGE (Q _{bkf})			cfs
Bankfull DISCH	IARGE ass	ociated with	"field-d	ete	ermined	" Ba	ankfull S	STAGE	=		60.0	cfs
Recurrence Interval (Log	J-Pearson)a	ssociated wit	h " field-d	lete	ermined"	Bar	nkfull Dis	charge	9		1.1	yrs
From the	Annual Pea	k Flow Freq	uency Ar	naly	/sis data	for	the Gag	e Stati	ion, dete	erm	nine:	
1.5 Year R.I. Discharge	ə =	N/A	cfs		10 Yea	ar R	R.I. Disc	harge.	=		N/A	cfs
2.0 Year R.I. Discharge	e=	N/A	cfs		25 Ye	ar F	R.I. Disc	harge.	=		N/A	cfs
5.0 Year R.I. Discharge	e=	N/A	cfs		50 Yea	ar R	R.I. Disc	harge.	=		N/A	cfs
		MEAN	NDER	G	EOME	TR	Y					
Meander Length (Lm)	1532	ft		Radius	s of	Curvatu	ıre (R	ε _c)		230.0	ft
Belt Width (W _{blt})		663	ft		Meand	er V	Vidth Rat	tio (W	_{blt} /W _{bkf})		10.5	ft/ft
		HYDR	AULIC		GEOM	ETF	٦Y					
Based on USGS Discharge parameters of Width (W), And values for a power function of	ea (A), Mean	Depth (d) & Me	an Velocity	y (u ie si	ı), determir	ne th draul	e intercep	o <i>t coeffi</i> eters an	cient (a) a	and	the slope exp	oonent (b)
Intercept Coefficient:	(a)			,		,	,					
Slope Exponent:	(b)			_		_						
Hydraulic Radius: R	= A / W _p		ft		Manni	ng's	s "n" at l	 3ankfu	II Stage		0.06	Coeff.
	" n " = 1	.4865 [(A rea) (Hydra	auli	c Radius	^{2/3})	(S lope	^{1/2})] /	Q _{bkf}			

		Bar	kfull VE		/ DISCHAF	RGE Estir	nates		
Site	Lower Rush R	iver	-2-6.04		Location	Lower R	ush River	-2-6.03	
Date	11/18/2010	Stre	am Type	B6c	Valley Ty	rpe	Х		
Observers	KP, AL				HUC				
	INPUT VAR	IAB	LES			OUTPU	JT VARIA	BLES	
Bankfull Cro	ss-sectional AR	EA	108.6	A _{bkf} (ft ²)	Bankfu	Ill Mean DI	EPTH	1.6	D _{bkf} (ft)
Bank	full WIDTH		63.1	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	TER	66.4	W _p (ft)
D ₈	4 @ Riffle		0.032	Dia. (mm)	D ₈₄	mm / 304.8	3 =	0.0001	D ₈₄ (ft)
Bank	full SLOPE		0.0001	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	1.6	R (ft)
Gravitatio	onal Acceleration		32.2	g (ft / sec ²)		ive Roughi R (ft) / D ₈₄ (ft)	ness	15588	
Draii	nage AREA		53.4	DA (mi ²)		ear <u>Velo</u> ci ı* =√gRS	ty	0.06	u* (ft / sec)
	ESTIMATI	ON	МЕТНО	os		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = [2 Roughness	2.83	+ 5.66Log	{]u*	1.6	ft / sec	171	cfs
2. Roughness roughness (Figs	Coefficient: a) Ma s. 2-18, 19) u = 1.486	annin 5*R ²	g's 'n' from fr ^{//3} *S ^{1/2} /n		/ relative =	0.3	ft / sec	33	cfs
	n' from Jarrett (USG		n = 0.39S ^{.38} R		=	1.8	ft / sec	196	cfs
	tion is for applications invo Ilder-dominated stream								
2. Roughness c) Manning	Coefficient: s 'n' from Stream 1	уре		1.4865* R 2	^{//3*} S ^{1/2} /n	0.3	ft / sec	33	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-Weisl	bach,	Chezy C, etc.	.)		0.7	ft / sec	60	cfs
3. Other Metho	ds (Hey, Darcy-Weisl	bach,	Chezy C, etc	.)			ft / sec		cfs
4. Continuity Return	Equations: a) Period for Bankfull D	-	ional Curves arge	$\begin{array}{c} \mathbf{s} \qquad \mathbf{u} = \mathbf{Q} \\ \mathbf{Q} = \qquad 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations: b)	USG	S Gage Dat	a u=C	2/A		ft / sec		cfs
Option 1. For	<mark>s for using the D₈₄ sand-bed</mark> channels ostitute an average s	s: Me	asure the "p	rotrusion h	eight" (h _{sd}) of	sand dunes	above chanr	nel bed elevat	
Option 2. For elev	boulder-dominated ations. Substitute a	d cha n ave	annels: Meas e. boulder pro	ure several trusion heig	" protrusion h ht (h _{bo} in ft) fo	eights" (h _{bo}) r the D ₈₄ tern) of boulders n in est. meth	above channe nod 1.	el bed
Option 3. For uplif	bedrock-dominated ted surfaces above term in estimation m	d cha chan	annels: Meas nel bed eleva	sure several	"protrusion	heights" (h _{br}) of rock sep	arations/steps	/joints/ et) for the

Stream:	Lower Rush River		.2
Basin:	Red River BasinDrainage Area:34144acres	53.4	mi ²
Location:	Lower Rush River-2-6.03		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	tion Monuments (Lat./Long.): -	Date:	11/18/2
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	63.1	ft
			1
	Bankfull DEPTH (d _{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section ($d_{bkf} = A / W_{bkf}$).	1.6	ft
			1
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.		
		108.6	ft ²
]
	Width/Depth Ratio (W _{bkf} / d _{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	20 7	£4./£4
		38.7	ft/ft
	Maximum DEPTH (d _{mbkf})		
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	2.0	<i>c</i> .
		2.9	ft
	WIDTH of Flood-Prone Area (W _{fpa})		
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	90.5	ft
		30.3	lir
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	1.4	ft/ft
	· ·	1.4	
	Channel Materials (Particle Size Index) D ₅₀		
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.		
	. , , , , , , , , , , , , , , , , , , ,	0.0019	mm
	Water Surface SLOPE (S)		1
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths		
	in length, with the "riffle-to-riffle" water surface slope representing the gradient at		
	bankfull stage.	0.000066	ft/ft
	Channel SINUOSITY (k)		1
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided		
	by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).		
		1.3	
	Stream B6c See Classification	on Kev]
	Stream B6c See Classification Type (Figure 2-2)		

Str	eam: Lower Rush	River					Lo	ocation:	Lowe	r Rush	River-2-6.03	3			
Ob	servers: KP, AL				Date:	11/18	/2010		Valle	у Туре:	X	Stream	n Type:	B6c	
							ch Sum	mary	Data						
	Mean Riffle Depth (d _{bkf})		1.6	ft		Vidth (V		63	8.1	ft	Riffle Area (At		10	8.6	ft ²
	Mean Pool Depth (d _{bkfp})			ft	Pool W	/idth (V	V _{bkfp})			ft	Pool Area (A _b	_{kfp})			ft ²
Dimension	Mean Pool Depth/Mean Depth	Riffle		d _{bkfp} / d _{bkf}	Pool W	/idth/Ri	ffle Width	า		W _{bkfp} / W _{bkf}	Pool Area / Ri	ffle Area			A _{bkfp} / A _{bkf}
Dir	Max Riffle Depth (d _{maxrif})	2.9	ft	Max P	ool Dep	th (d _{maxp})			ft	Max Riffle Dep	oth/Mean Ri	ffle Dept	th	1.8
lane	Max Pool Depth/Mean F	Riffle Dep	pth		Point E	Bar Slop	be			ft/ft	Inner Berm W	'idth (W _{ib})			ft
Channel	Inner Berm Depth (d _{ib})			ft	Inner E	Berm W	idth/Dep	th Ratio			W _{ib} /d _{ib} Inne	r Berm Area	a (A _{ib})		ft ²
	Streamflow: Estimated	Mean Ve	elocity	at Ban	kfull Sta	age (u _{bki}	_f)	0	.7	ft/s	Estimation Me	ethod	H	EC-R/	۹S
\cup	Streamflow: Estimated	Dischar	ge at E	Bankfull	Stage	(Q _{bkf})		6	0	cfs	Drainage Area	a	53	3.4	mi²
	Geometry		Mean	Min	Max			Dim	ension	less Ge	eometry Ratio	5	Mean	Min	Max
\square	Meander Wavelength (L	_m)	1532	ĺ		ft	Meande	r Lengtł	n Ratio	(L _m /W _b ⊧	(t)		24.3		
Pattern	Radius of Curvature (R	c)	230			ft	Radius	of Curva	ture/Ri	ffle Wid	lth (R _c /W _{bkf})		3.6		
	Belt Width (W _{blt})		663	ft Meander Width Ratio (W _{bit} /W _{bkf})				10.5							
Channel	Individual Pool Length			ft Pool Length/Riffle Width											
Cha	Pool to Pool Spacing			ft Pool to Pool Spacing/Riffle Width											
$ \cup$	Riffle Length				ft Riffle Length/Riffle Width										
\square	Valley Slope (VS)			ft/ft	Averac	e Wate	er Surface	e Slope	(S)	l	ft/ft	Sinuosity (VS/S)		
	Stream Length (SL)	371:	33	ft		Length		•	()	29	667 ft	Sinuosity (1.3
	Low Bank Height (LBH)	start end		ft ft		Max Rif Depth		start end		ft ft	-	pht Ratio (Bl x Riffle Dep	'	start end	
	Facet Slopes		Mean	Min	Max	D op (·			!	be Ratios		Mean	Min	Max
file	Riffle Slope (S _{rif})		0.0			ft/ft	Riffle Sl				urface Slope (S	_{rif} / S)	1.0		
Profile	Run Slope (S _{run})					ft/ft	Run Slo	pe/Avei	age Wa	ater Sur	face Slope (S _{rt}	_{un} / S)			
land	Pool Slope (S _p)					ft/ft	Pool SIC	pe/Ave	rage W	ater Su	rface Slope (S _p	, / S)			
Channel	Glide Slope (Sg)					ft/ft	Glide Sl	ope/Ave	erage V	/ater Su	urface Slope (S	_g / S)			
	Feature Midpoint ^a		Mean	Min	Max	•	ł				th Ratios		Mean	Min	Max
	Max Riffle Depth (d _{maxrif}		2.9	1	i	ft					Depth (d _{maxrif} / d		1.8		<u> </u>
	Max Run Depth (d _{maxrun})			1	I	ft		•			epth (d _{maxrun} / d	,		-	
	Max Pool Depth (d _{maxp})				<u>.</u>	ft					epth (d _{maxp} / d _b				
	Max Glide Depth (d _{maxg}))				ft	Max Glio	de Dept	h/Mean	Riffle D	Depth (d _{maxg} / d	_{bkf})			
	% Silt/Clay	Reac 97	ch ^b	Riffle ^c Bar Reach ^b Riffle ^c Bar Protrusion Heig											
als	% Sand	37		D ₃₅ <.001					_	mm					
Materials	% Gravel	0		D ₅₀ 0.0019					1		mm				
N N N	% Cobble	0		D ₅₀ 0.0019 D ₈₄ 0.032							mm				
Channel	% Boulder	0						D ₈₄)52			1	_	mm
။ ၂ ၂	, Douldor	0						295	0.0		1	ļ	1		

D₁₀₀

2

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

0

% Bedrock

^c Active bed of a riffle.

^d Height of roughness feature above bed.

mm

Worksheet 2-1. Gage station and field data (Rosgen and Silvey, 2007).

				TATION Data/Records for CLASSIFICATION		
Station NAME:	Lower Rus	sh River-1-1	1.10	Station Number:	N/A	
LOCATION:	Lower Rus	sh River-1-1	1.10			
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs
Drainage AREA:	38009.6	acres	59.4	mi ² Drainage Area Mn ELEV:	880.9	ft
Reference REACH SLOP	PE:		ft/ft	Valley Type:	X	
Stream Type:	B6c	1		HUC:		
		BANKFU	LL" CHA	RACTERISTICS		
Determined from	FIELD ME			Determined from GAGE DA	ATA Analys	sis
Bankfull WIDTH (W _{bkf}	;)	45.3	ft	Bankfull WIDTH (W _{bkf})		ft
Bankfull Mean DEPTH	H (d _{bkf})	1.8	ft	Bankfull MEAN DEPTH (d _{bkf})		ft
Bankfull Xsec AREA ((A _{bkf})	80.5	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²
Wetted PERIMETER	(W _p)	45.8	ft	Wetted PERIMETER (W _p)		ft
Bankfull STAGE (Gag	je Ht)		ft	Bankfull STAGE (Gage Ht)		ft
Est. Mean VELOCITY	′ (u)	0.8	ft/sec	Mean VELOCITY (u)		ft/sec
Est. Bkf. DISCHARGE	E (Q _{bkf})	65.0	cfs	Bankfull DISCHARGE (Q _{bkf})		cfs
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	65.0	cfs
Recurrence Interval (Log	-Pearson)a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.1	yrs
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Anal	ysis data for the Gage Station, deter	mine:	
1.5 Year R.I. Discharge	э =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs
2.0 Year R.I. Discharge	э=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs
5.0 Year R.I. Discharge	э=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs
		MEAN	NDER G	EOMETRY		
Meander Length (L_m)		ft	Radius of Curvature (R _C)		ft
Belt Width (W _{blt})			ft	$\fbox{Meander Width Ratio (W_{blt}/W_{bkf})}$	0.00	ft/ft
		HYDR		GEOMETRY		
parameters of Width (W), Are	ea (A), Mean I	Depth (d) & Me	an Velocity (u	egression analyses of measured discharge (a), determine the <i>intercept coefficient</i> (a) and elected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope ex	ponent (b)
Intercept Coefficient:	(a)					
Slope Exponent:	(b)					
Hydraulic Radius: R	$= A / W_p$		ft	Manning's "n" at Bankfull Stage	0.05	Coeff.
		.4865 [(A rea	۱) (Hydrauli	c Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}		

Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

		Bar	kfull VEI			RGE Esti	mates		
Site	Lower Rush	River	-1-1.10		Location	Lower R	ush River	-1-1.10	
Date	9/29/2011	Stre	am Type	B6c	Valley Ty	/pe	x		
Observers	KP, AL			-	HUC				
	INPUT V		LES			OUTPL	JT VARIA	BLES	
Bankfull	Cross-sectior	al	80.5	A _{bkf} (ft ²)	Bankfu	III Mean D	EPTH	1.8	D _{bkf} (ft)
Bank	full WIDTH		45.3	W _{bkf}		d PERIME * d _{bkf} + W _{bkf}	TER	48.9	W _p (ft)
D ₈	4 @ Riffle		0.0022	Dia. (mm)	D ₈₄ I	mm / 304.8	3 =	0.0	D ₈₄ (ft)
Bank	full SLOPE		0.0003	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	1.6	R (ft)
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)		228195	
Draii	nage AREA		59.4	DA (mi²)		ear Veloci ı* =√gRS	ty	0.1	u* (ft / sec)
	ESTIMA	TION	METHO	DS		Bankfull V	ELOCITY	Bank DISCH	
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log	{]u*	4.5	ft / sec	360	cfs
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	a) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	0.8	ft / sec	62	cfs
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (l	JSGS):		1.4865* R ^{2/3} ^{.16} n	^{3*} S ^{1/2} /n	2.2	ft / sec	178	cfs
	tion is for application ble- and boulder-do					<u></u>		·	I
2. Roughness		ım Type		= 1.4865* R 3 050	^{2/3*} S ^{1/2} /n	0.8	ft / sec	62	cfs
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	leisbach	, Chezy C, etc	:.)		0.8	ft / sec	65	cfs
3. Other Metho	ds (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs
4. Continuity Return	Equations: Period for Bankf		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs
4. Continuity	Equations:	b) US	GS Gage Dat	:a u = 0	Q/A		ft / sec		cfs
Option 1. For	for using the I sand-bed chan ostitute an avera	nels: M	easure the " p	protrusion h	neight" (h _{sd}) c	f sand dunes	s above char	nnel bed eleva	
Option 2. For elev	boulder-dominations. Substitut	ated ch te an av	annels: Meas e. boulder pro	ure several otrusion heig	" protrusion ght (h _{bo} in ft) fe	heights" (h _b or the D ₈₄ ter	 o) of boulders m in est. me 	above chanr thod 1.	nel bed
Option 3. For uplif	bedrock-domin ted surfaces abo term in estimatio	ated ch ive char	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	_{br}) of rock se	parations/step	s/joints/ eet) for the

Worksheet 2-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen , 2006b).

Stream:	Lower Rush River-1-1.10		
Basin:	Red River BasinDrainage Area:38010acres	59.4	mi ²
Location:	Lower Rush River-1-1.10		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	9/29/2011
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})]
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	45.3	ft
	Bankfull DEPTH (d _{bkf})		1
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ($d_{bkf} = A / W_{bkf}$).	1.8	ft
	Bankfull X-Section AREA (A _{bkf})]
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	80.5	ft ²
	Width/Depth Ratio (W _{bkf} / d _{bkf})]
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	25.5	ft/ft
	Maximum DEPTH (d _{mbkf})		-
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull	I	
	stage and Thalweg elevations, in a riffle section.	2.9	ft
	WIDTH of Flood-Prone Area (W _{fpa})		
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area		
	WIDTH is determined in a riffle section.	72.2	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf})		
	(riffle section).	1.6	ft/ft
	Channel Materials (Particle Size Index) D_{50}		
	The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.		
	sumpled from the original surface, between the bankfull stage and manwey elevations.	<0.001	mm
			4 ·····
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient		
	at bankfull stage.	0.0003	ft/ft
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length		
	divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).		
] 1
	Stream B6c See Classification		
	Type (Figure 2-2	:1)	

	eam: Lower Rush River	-1-1.10	1			Lo	ocation:	Lowe	r Rush	River-1-1.10)			
Ob	servers: KP, AL			Date:	9/29/2	2011		Valle	у Туре:	Х	Strean	n Type:	B6c	
_				Riv	er Rea	ach Sum	mary I	Data						
\square	Mean Riffle Depth (d _{bkf})	(d _{bkf}) 1.8 1			Riffle Width (W _{bkf})			45.3 ft		Riffle Area (A	_{bkf})	80).5	ft ²
	Mean Pool Depth (d _{bkfp})	Mean Pool Depth (d _{bkfp}) f Mean Pool Depth/Mean Riffle d			Pool Width (W_{bkfp})				ft	Pool Area (A _{bkfp})				ft ²
Dimension	Mean Pool Depth/Mean Riffle Depth				Pool Width/Riffle Width Wokfp/ Pool Area / Riff					iffle Area			A _{bkfp} /A _{bkf}	
Ē	Max Riffle Depth (d _{maxrif})	2.9	ft	Max Pool Depth (d _{maxp})					ft	Max Riffle De	iffle Depth		1.6	
Channel	Max Pool Depth/Mean Riffle Depth			Point E	Bar Slop	Slope ft/ft Inner Berm Width (W _{ib})								ft
Chai	Inner Berm Depth (d _{ib})	ft	Inner E	Berm W	/idth/Dept	h Ratio			W _{ib} /d _{ib} Inne	er Berm Area	a (A _{ib})		ft ²	
	Streamflow: Estimated Mean	Velocity	at Bank	full Sta	ge (u _{bkf}))	0	.8	ft/s	Estimation M	ethod	HEC-RAS		
	Streamflow: Estimated Discha	arge at E	Bankfull	Stage (၃ _{bkf})		6	5	cfs	Drainage Are	a	59).4	mi²
	Geometry Mean Min Max Dimensionless Geometry Ratios Mean Min Ma												Max	
	Meander Wavelength (L _m)	0			ft	Meander	r Length	n Ratio	(L _m /W _{bk}	f)		0.0		
Pattern	Radius of Curvature (R _c)				ft	Radius o	of Curva	iture/Ri	ffle Wid	th (R _c /W _{bkf})		0.0		
	Belt Width (W _{blt})	0			ft	Meander	Meander Width Ratio (W _{blt} /W _{bkf})							
Channel	Individual Pool Length			<u> </u>	ft	Pool Len	gth/Riff	le Widt	h					
မြို	Pool to Pool Spacing				ft	Pool to F	Pool to Pool Spacing/Riffle Width							
\cup	Riffle Length				ft Riffle Length/Riffle Width									
\square	Valley Slope (VS)	Averag	Average Water Surface Slope (S) ft/ft Sinuosity (VS/S)											
	Stream Length (SL) 37133 ft			Valley Length (VL) 29667 ft Sinuosity						Sinuosity (SL/VL)		1.3	
	Low Bank Height star (LBH) end		ft ft		Max Riffle Depth			start ft Bank-Height Rati end ft (LBH/Max Riffle					t 1	
	Facet Slopes	Mean		Max				i	1	be Ratios	·	Mean	Min	Max
Profile	Riffle Slope (S _{rif})	0.0			ft/ft	Riffle Slo	ope/Ave	rage W	ater Su	rface Slope (S	_{rif} / S)	1.0		
Pro	Run Slope (S _{run})				ft/ft	Run Slop	pe/Average Water Surface Slope (S _{run} / S)							
lann	Pool Slope (S _p)				ft/ft	Pool Slope/Average Water Surface Slope (S $_p$ / S)				/ S)				
Channel	Glide Slope (Sg)				ft/ft	Glide Slo	ope/Ave	rage W	ater Su	rface Slope (S	g / S)			
	Feature Midpoint ^a Mean Mir			Max Dimensionless Depth Ratios							Mean	Min	Max	
	Max Riffle Depth (d _{maxrif})	2.9		<u> </u>	ft Max Riffle Depth/Mean Riffle Depth (d _{maxrif} / d _{bk})							1.6		
	Max Run Depth (d _{maxrun})		1	<u> </u>	ft									
	Max Pool Depth (d _{maxp})		1	1 T	ft					· ·				
	Max Glide Depth (d _{maxg})	<u> </u>	İ	1	ft	Max Glic	le Deptr	1/IVIean	KITTIE D	Depth (d _{maxg} / d	okf)			
_		ach ^b	Ri	ffle ^c		Bar		Rea	ach ^b	Riffle ^c	Bar	Protru	ision H	leight ^d
<u>s</u>	% Silt/Clay	99					D ₁₆		001					mm
Materials	% Sand	1					D ₃₅		001					mm
	% Gravel	0					D ₅₀		001					mm
Channel	% Cobble	0					D ₈₄	0.0	022					mm
Chai	% Boulder	0					D ₉₅	0.0	028					mm
	% Bedrock	0					D ₁₀₀	0	.2					mm
			-		-		•	_	_			_		-

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.

Worksheet 2-1. Gage station and field data (Rosgen and Silvey, 2007).

				TATION Data/Records for CLASSIFICATION					
Station NAME:	Wolverton	Creek-2-2.	02	Station Number:	N/A				
		Creek-2-2.			•				
Period of RECORD:	N	/A	yrs	Mean Annual DISCHARGE:	N/A	cfs			
Drainage AREA:	63443.2	acres	99.13	mi ² Drainage Area Mn ELEV:	893.45	ft			
Reference REACH SLOP			ft/ft	Valley Type:	X]			
Stream Type:	E6			HUC:					
		'BANKFU	LL" CHA	RACTERISTICS					
Determined from	ATA Analys	is							
Bankfull WIDTH (W _{bkf}	_f)	24.2	ft	Bankfull WIDTH (W _{bkf})		ft			
Bankfull Mean DEPTH	H (d _{bkf})	3.2	ft	Bankfull MEAN DEPTH (d _{bkf})		ft			
Bankfull Xsec AREA ((A _{bkf})	73.1	ft ²	Bankfull Xsec AREA (A _{bkf})		ft ²			
Wetted PERIMETER	(W _p)	27.4	ft	Wetted PERIMETER (W _p)		ft			
Bankfull STAGE (Gag	ge Ht)		ft	Bankfull STAGE (Gage Ht)		ft			
Est. Mean VELOCITY	′ (u)	1.8	ft/sec	Mean VELOCITY (u)		ft/sec			
Est. Bkf. DISCHARGE	Est. Bkf. DISCHARGE (Q _{bkf}) 130.0 cfs Bankfull DISCHARGE (Q _{bkf})								
Bankfull DISCH	IARGE ass	ociated with	"field-det	ermined" Bankfull STAGE	130.0	cfs			
Recurrence Interval (Log	J-Pearson) a	ssociated wit	h "field-det	ermined" Bankfull Discharge	1.2	yrs			
From the	Annual Pea	<mark>k Flow Freq</mark> i	uency Anal	ysis data for the Gage Station, deter	mine:				
1.5 Year R.I. Discharge	ə =	N/A	cfs	10 Year R.I. Discharge =	N/A	cfs			
2.0 Year R.I. Discharge	e=	N/A	cfs	25 Year R.I. Discharge=	N/A	cfs			
5.0 Year R.I. Discharge	e=	N/A	cfs	50 Year R.I. Discharge =	N/A	cfs			
		MEAN	NDER G	GEOMETRY					
Meander Length (Lm)	625	ft	Radius of Curvature (R _C)	171.0	ft			
Belt Width (W _{blt})		207	ft	Meander Width Ratio (W_{blt}/W_{bkf})	8.6	ft/ft			
		HYDR	AULIC	GEOMETRY					
parameters of Width (W), Are	ea (A), Mean I	Depth (d) & Me	an Velocity (egression analyses of measured discharge (u), determine the <i>intercept coefficient</i> (a) and selected hydraulic parameters and X is a give Area (A) Velocity (u)	the slope exp	ponent (b)			
Intercept Coefficient:	(a)	Vildar (12)	Boput (2)						
Slope Exponent:	(b)								
Hydraulic Radius: R	= A / W _p		ft	Manning's "n" at Bankfull Stage	0.035	Coeff.			
		.4865 [(A rea		ic Radius ^{2/3}) (Slope ^{1/2})] / Q _{bkf}					

Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

		Bar	kfull VEI			RGE Esti	mates						
Site	Wolverton C	reek-	2-2.02		Location Wolverton Creek-2-2.02								
Date	9/28/2011	Stre	am Type	E6	Valley Type X								
Observers	KP, AL												
	INPUT VA	RIAB	LES		OUTPUT VARIABLES								
Bankfull	Cross-section	al	73.1	Bankfu	III Mean D	EPTH	3.2	D _{bkf} (ft)					
Bank	full WIDTH		24.2		d PERIME * d _{bkf} + W _{bkf}	TER	30.5	W _p (ft)					
D ₈	4 @ Riffle		0.039	Dia. (mm)	D ₈₄ I	mm / 304.8	3 =	0.00	D ₈₄ (ft)				
Bank	full SLOPE		0.0011	S _{bkf} (ft / ft)		aulic RADI A _{bkf} / W _p	US	2.4	R (ft)				
Gravitatio	onal Accelerat	ion	32.2	g (ft / sec ²)		ive Rough R (ft) / D ₈₄ (ft)	ness	18714					
Drai	nage AREA		99.1	DA (mi²)		ear Veloci u* =√gRS	0.3	u* (ft / sec)					
	ESTIMA	TION	METHO	os		Bankfull V	ELOCITY	Bankfull DISCHARGE					
1. Friction Factor	Relative u = Roughness	= [2.83	8 + 5.66Log [.]	{	•]u*	7.9	ft / sec	575	cfs				
2. Roughness roughness (Fig	Coefficient: a s. 2-18, 19) u = 1.	i) Manni 4865*R	ng's 'n' from fi ^{2/3*} S ^{1/2} /n		r / relative =	2.5	ft / sec	184	cfs				
2. Roughness b) Manning's	Coefficient: 'n' from Jarrett (l	JSGS):		1.4865* R ^{2/3} ¹⁶ n	^{3*} S ^{1/2} /n	3.5	ft / sec	253	cfs				
	tion is for application ble-and boulder-do					L	_]	L]				
2. Roughness c) Manning	s Coefficient: s 'n' from Strea	m Type		= 1.4865* R 0.035	^{2/3} *S ^{1/2} /n	2.5	ft / sec	184	cfs				
3. Other Metho HEC-RAS	ds (Hey, Darcy-W	eisbach	<mark>, Chezy C, etc</mark>	.)		1.8	ft / sec	130	cfs				
3. Other Metho	ods (Hey, Darcy-W	leisbach	<mark>, Chezy C, etc</mark>	:.)			ft / sec		cfs				
4. Continuity Return	Equations: Period for Bankf		gional Curve arge	$\begin{array}{c} s & u = 0 \\ Q = & 1.46 \end{array}$	1		ft / sec		cfs				
4. Continuity Equations: b) USGS Gage Data u = Q / A ft / sec cfs													
Option 1. For	s for using the [sand-bed chan ostitute an average	nels: M	easure the "p	rotrusion h	neight" (h _{sd}) c	of sand dunes	above char	nnel bed eleva					
Option 2. For elev	boulder-dominations. Substitut	ated ch e an av	annels: Meas e. boulder pro	ure several otrusion heig	"protrusion ght (h _{bo} in ft) fo	heights" (h _{bo} or the D ₈₄ ter) of boulders m in est. me	s above chani thod 1.	nel bed				
Option 3. For uplif	bedrock-domin ted surfaces abo term in estimatio	ated ch ive chai	annels: Meas nnel bed eleva	sure severa	protrusion	heights" (h	or) of rock se	parations/step	os/joints/ eet) for the				

Worksheet 2-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen , 2006b).

Stream:	Wolverton Creek-2-2.02		
Basin:	Red River Basin Drainage Area: 63443 acres	99.13	mi ²
Location:	Wolverton Creek-2-2.02		
Twp.&Rge:	- Sec.&Qtr.: -		
Cross-Sect	ion Monuments (Lat./Long.): -	Date:	9/28/201
Observers:	KP, AL	Valley Type:	Х
	Bankfull WIDTH (W _{bkf})		
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	24.2	ft
	Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d _{bkf} = A / W _{bkf}).	3.2	ft
	Bankfull X-Section AREA (A _{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	73.1	ft ²
	Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	7.6	ft/ft
	Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankful stage and Thalweg elevations, in a riffle section.		ft
	WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d _{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	129.0	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section).	5.3	ft/ft
	Channel Materials (Particle Size Index) D_{50} The D ₅₀ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	0.0016	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.0011	ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.3	
	Stream E6 See Classification (Figure 2-2		

	eam: Wolverton Creek-2	-2.02				Lo	ocation:	Wolve	erton C	reek-2-2	2.02				
Ob	servers: KP, AL			Date:	9/28/2	2011		Valle	у Туре:	<u>X</u>	_	Stream	n Type:	E6	
				Riv	er Rea	ach Sum	mary [Data							-
	Mean Riffle Depth (d _{bkf})	3.2	ft	Riffle \	Riffle Width (W _{bkf})			24.2 ft		Riffle Ar			73.1		ft ²
_	Mean Pool Depth (d _{bkfp})		ft	Pool W	Pool Width (W _{bkfp})				ft	Pool Area (A _{bkfp})		_{(fp})			ft ²
Dimension	Mean Pool Depth/Mean Riffle d Depth d			Pool Width/Riffle Width W_{bkfp}/W_{bkf} Pool Area / Riffle Area								A _{bkfp} /A			
	Max Riffle Depth (d _{maxrif})	4.8	ft	Max Pool Depth (d _{maxp})					ft	Max Riffle Depth/Mean Rif			ffle Depth		1.5
Channel	Max Pool Depth/Mean Riffle Depth			Point E	Bar Slo	pe			ft/ft	Inner Be	erm W	idth (W _{ib})			ft
Cha	Inner Berm Depth (d _{ib}) ft			Inner E	Berm W	/idth/Deptl	h Ratio			W _{ib} /d _{ib}	Inne	r Berm Area	a (A _{ib})		ft ²
	Streamflow: Estimated Mean V	elocity	at Bank	full Sta	ge (u _{bkf})	1.	.8	ft/s	Estimati	on Me	thod	Н	EC-R/	AS
	Streamflow: Estimated Dischar	ge at E	Bankfull	Stage (Q _{bkf})		13	30	cfs	Drainag	e Area	1	99).1	mi²
	Geometry	Mean	Min	Max		-				ometry	Ratio	5	Mean	Min	Max
	Meander Wavelength (L _m)	625	<u> </u>		ft	Meander	r Length	Ratio	(L _m /W _{bk}	f)			25.8		
Pattern	Radius of Curvature (R _c)	171	<u> </u>	<u> </u>	ft					th (R _c /W		7.1		<u> </u>	
	Belt Width (W _{blt})	<u> </u>	<u> </u>	ft		Meander Width Ratio (W _{blt} /W _{bkf})						8.6			
Channel	Individual Pool Length			<u> </u>	ft	Pool Len	-								<u> </u>
Ü	Pool to Pool Spacing			<u> </u>	ft	Pool to F				dth					<u> </u>
	Riffle Length	Length ft Riffle Length/Riffle Width													
\square	Valley Slope (VS)		ft/ft	Averag	ge Wate	er Surface	r Surface Slope (S) ft/ft Sinuosity						/S/S)		
	Stream Length (SL) 23172 ft			Valley	Valley Length (VL) 18342 ft Sinuosity							Sinuosity (SL/VL)		1.3
	Low Bank Height start (LBH) end		ft ft		Max Ri Dept		start end		ft ft			ght Ratio (B⊦ x Riffle Dept		start end	•
	Facet Slopes	Mean	Min	Max			Dimer	sionle	ss Slop	be Ratios	S		Mean	Min	Max
Profile	Riffle Slope (S _{rif})	0.0			ft/ft	Riffle Slo	ope/Ave	rage W	ater Su	rface Slo	pe (S _r	_{if} / S)	1.0		
	Run Slope (S _{run})	Run Slope (S _{run})			ft/ft Run Slope/Average Water Surface Slope (S _{run} / S)										
Channel	Pool Slope (S _p)		<u> </u>	<u> </u>	ft/ft	Pool Slope/Average Water Surface Slope (S _p / S)							1		
Cha	Glide Slope (S _g)		<u> </u>	<u> </u>	ft/ft	Glide Slope/Average Water Surface Slope (S $_g$ / S)						/ S)			<u> </u>
	Feature Midpoint ^a Max Riffle Depth (d _{maxrif})	Max Dimensionless Depth Ratios ft Max Riffle Depth/Mean Riffle Depth (d _{maxif} / d _{bkf})							Mean	Min	Max				
	Max Run Depth (d _{maxrin})	4.8	<u> </u>	1	ft	Max Rine Depth/Mean Riffle Depth (d_{maxrif} / d_{bkf}) Max Run Depth/Mean Riffle Depth (d_{maxrun} / d_{bkf})							1.5	_	
	Max Pool Depth (d _{maxp})		<u> </u>	<u> </u> 	ft	-	Pool Depth/Mean Riffle Depth (d _{maxrun} / d _{bkf})								
	Max Glide Depth (d _{maxp})				ft	Max Glid	-				· ·				
			<u> </u>	i	<u> </u>					· · · (4ma	axy , Ob	N/		_	<u> </u>
\square		ich ^b	Rif	ffle ^c	1	Bar			ach ^b	Riffl	e ^c	Bar	Protru	ision H	leight ^d
als		1	<u> </u>				D ₁₆		001						mm
Materials)	 				D ₃₅		016			1			mm
		<u> </u>					D ₅₀		016						mm
Channel) 	 		 		D ₈₄		039						mm
ا بخ ا	% Boulder	0			!		D ₉₅	0.	22	ļ					mm
0	% Bedrock	0	·		i		D ₁₀₀	A	75	l					mm

^a Min, max, mean depths are ave. mid-point values except pools: taken at deepest part of pool.

^b Composite sample of riffles and pools within the designated reach.

^c Active bed of a riffle.