

FINAL DESIGN REPORT FOR SAND CREEK RESTORATION

Prepared For:

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Mixed Flow Analysis for GSB Design

JR Response: Summary Table has been revised to only include sections relevant to the GSB Calcs.

HEC-RAS Plan: PROP - Shear River: Sand Creek Reach: Reach 1-3

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear LOB (lb/sq ft)	Shear Chan (lb/sq ft)	Shear ROB (lb/sq ft)	Shear Total (lb/sq ft)
Reach 1-3	12465	2-YR	154.80	7177.88	7178.61	7178.61	7178.93	0.030420	6.96	41.58	64.16	1.44	1.23	1.37	1.19	1.23
Reach 1-3	12465	5-YR	475.50	7177.88	7179.32	7179.32	7179.97	0.026123	10.15	88.42	68.89	1.50	2.10	2.33	2.00	2.08
Reach 1-3	12465	100-YR	1643.00	7177.88	7180.95	7180.95	7182.35	0.021154	15.19	207.29	74.10	1.53	3.56	4.04	3.50	3.59
Reach 1-3	12366		Culvert													
Reach 1-3	12253	2-YR	154.80	7168.00	7171.46		7171.46	0.000084	1.04	246.90	78.44	0.10	0.02	0.02	0.02	0.02
Reach 1-3	12253	5-YR	475.50	7168.00	7173.17		7173.21	0.000200	2.09	387.71	85.37	0.16	0.05	0.06	0.05	0.06
Reach 1-3	12253	100-YR	1643.00	7168.00	7176.23		7176.40	0.000477	4.41	667.79	97.68	0.27	0.18	0.25	0.19	0.20
Reach 1-3	12070	2-YR	154.80	7168.31	7171.20		7171.37	0.001757	4.03	73.24	51.57	0.43	0.09	0.30	0.14	0.15
Reach 1-3	12070	5-YR	475.50	7168.31	7172.74	7171.68	7173.03	0.002101	5.93	170.81	69.96	0.51	0.22	0.55	0.30	0.31
Reach 1-3	12070	100-YR	1643.00	7168.31	7175.41	7173.79	7176.03	0.002822	9.50	372.93	81.57	0.64	0.60	1.21	0.79	0.77
Reach 1-3	11880	2-YR	154.80	7165.99	7167.13	7166.96	7167.44	0.022922	8.19	44.92	59.63	1.35	1.18	1.63	0.99	1.08
Reach 1-3	11880	5-YR	475.50	7165.99	7167.90	7167.90	7168.45	0.024415	11.92	103.07	89.83	1.52	1.92	2.91	1.63	1.75
Reach 1-3	11880	100-YR	1643.00	7165.99	7169.24	7169.24	7170.29	0.024519	17.01	234.62	104.53	1.66	3.52	4.97	3.32	3.42
Reach 1-3	11569	2-YR	154.80	7159.96	7160.56	7160.41	7160.68	0.021267	5.15	60.99	108.23	1.17	0.75	0.80	0.75	0.75
Reach 1-3	11569	5-YR	475.50	7159.96	7161.21	7160.88	7161.43	0.016137	7.31	134.07	116.84	1.15	1.12	1.26	1.19	1.15
Reach 1-3	11569	100-YR	1643.00	7159.96	7162.43	7161.98	7163.02	0.018608	12.33	284.92	183.68	1.38	2.34	2.86	2.64	2.48
Reach 1-3	11368	2-YR	154.80	7153.99	7155.09	7155.09	7155.56	0.029398	9.06	34.56	39.74	1.52	1.49	2.02	1.80	1.65
Reach 1-3	11368	5-YR	475.50	7153.99	7156.03	7156.03	7157.00	0.029471	13.67	75.69	66.36	1.69	2.52	3.75	3.06	2.77
Reach 1-3	11368	100-YR	1643.00	7153.99	7158.33	7158.33	7159.43	0.016147	16.75	260.10	142.36	1.42	2.58	4.38	2.23	2.50
Reach 1-3	11206	2-YR	154.80	7151.03	7153.22	7152.81	7153.42	0.003125	4.22	66.72	70.43	0.54	0.13	0.37	0.19	0.18
Reach 1-3	11206	5-YR	475.50	7151.03	7154.77	7153.83	7154.97	0.001922	4.93	224.81	137.95	0.47	0.17	0.41	0.19	0.19
Reach 1-3	11206	100-YR	1643.00	7151.03	7156.19	7155.63	7156.69	0.003815	8.76	454.11	174.08	0.70	0.58	1.15	0.52	0.62
Reach 1-3	11103	2-YR	154.80	7150.00	7151.47	7151.22	7151.78	0.013942	7.55	42.92	38.45	1.10	1.16	1.28	0.65	0.96
Reach 1-3	11103	5-YR	475.50	7150.00	7151.95	7151.95	7153.35	0.045519	16.48	62.81	44.51	2.08	4.89	5.53	2.80	3.97
Reach 1-3	11103	100-YR	1643.00	7150.00	7153.69	7153.69	7154.54	0.019817	16.66	283.22	143.67	1.53	2.40	4.57	2.34	2.43
Reach 1-3	10925	2-YR	154.80	7148.00	7149.06	7148.97	7149.27	0.014420	3.68	42.10	68.49	0.83		0.55		0.55
Reach 1-3	10925	5-YR	475.50	7148.00	7149.87	7149.61	7150.15	0.009001	4.22	112.74	104.87	0.72		0.60		0.60
Reach 1-3	10925	100-YR	1643.00	7148.00	7150.98	7150.75	7151.66	0.010242	6.61	248.49	129.57	0.84		1.22		1.22
Reach 1-3	10797	2-YR	154.80	7145.39	7147.43	7147.17	7147.59	0.011767	3.24	47.85	59.02	0.63	0.07	0.60		0.59
Reach 1-3	10797	5-YR	475.50	7145.39	7148.14	7147.91	7148.55	0.018364	5.17	93.64	117.85	0.78	0.29	1.55	0.52	1.40
Reach 1-3	10797	100-YR	1643.00	7145.39	7149.35	7149.14	7149.97	0.017191	7.00	284.94	156.61	0.77	1.00	2.74	1.61	1.94
Reach 1-3	10713	2-YR	154.80	7144.30	7146.46		7146.63	0.011196	3.33	49.44	107.80	0.67		0.52	0.05	0.32
Reach 1-3	10713	5-YR	475.50	7144.30	7147.27		7147.45	0.008697	3.75	155.78	145.09	0.54		0.80	0.39	0.58
Reach 1-3	10713	100-YR	1643.00	7144.30	7148.40		7148.77	0.010588	5.59	371.61	212.30	0.61	0.53	1.71	1.13	1.15
Reach 1-3	10617	2-YR	154.80	7143.44	7145.51		7145.64	0.010027	2.94	52.66	68.26	0.59		0.48		0.48
Reach 1-3	10617	5-YR	475.50	7143.44	7146.31		7146.56	0.010761	4.07	138.59	194.63	0.58	0.19	1.01	0.14	0.48
Reach 1-3	10617	100-YR	1643.00	7143.44	7147.56		7147.86	0.008825	5.16	414.87	235.18	0.55	0.74	1.51	0.72	0.97
Reach 1-3	10543	2-YR	154.80	7142.46	7144.87		7144.99	0.007069	2.87	54.39	81.05	0.57		0.35	0.02	0.29
Reach 1-3	10543	5-YR	475.50	7142.46	7145.60		7145.83	0.008151	3.97	142.32	166.60	0.58	0.06	0.74	0.33	0.43
Reach 1-3	10543	100-YR	1643.00	7142.46	7146.85		7147.21	0.008072	5.50	392.82	213.49	0.59	0.63	1.36	0.80	0.92

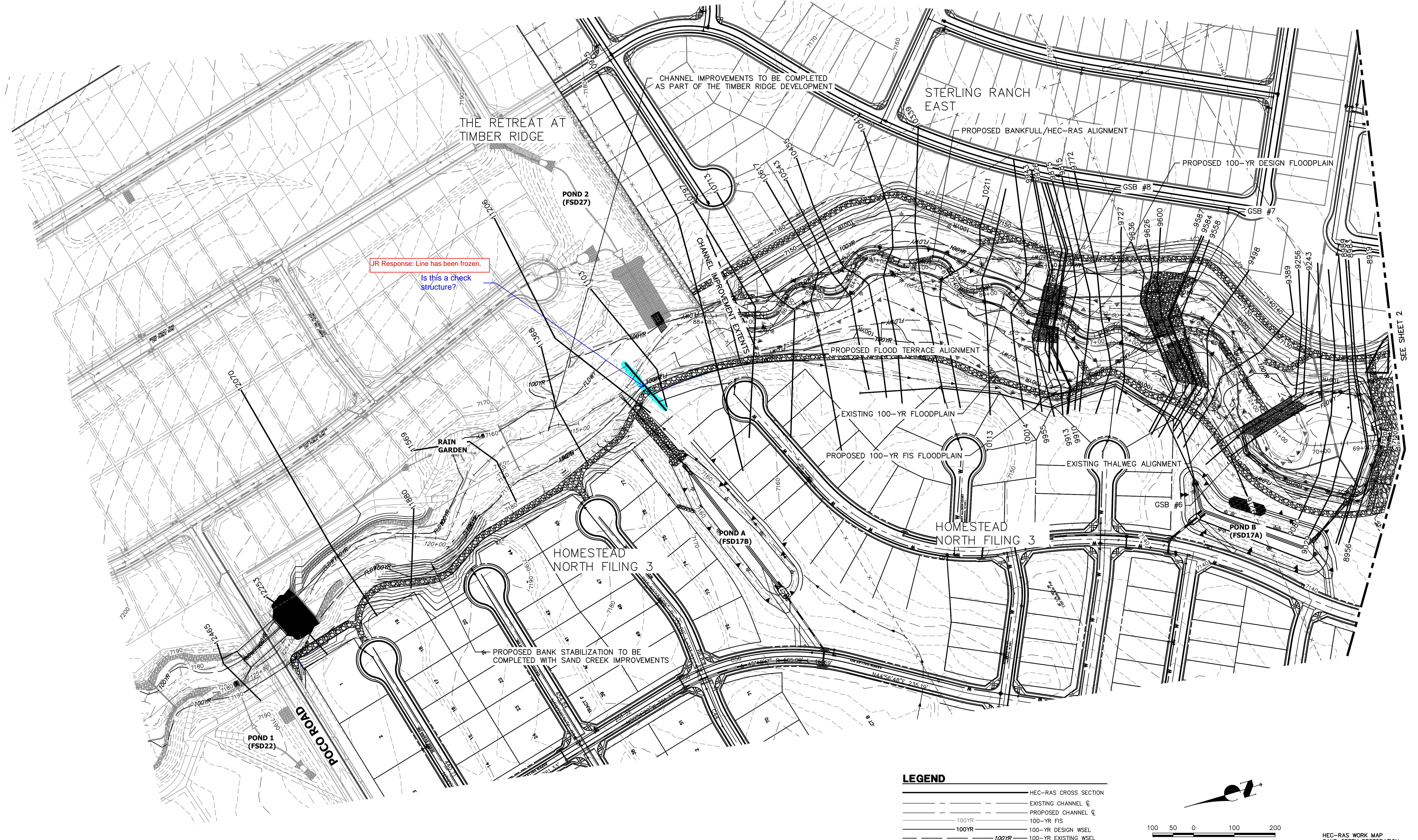
Sub-critical flow analysis for Shear/Velocity evaluation of Naturalized Channel Design

JR Response: Per discussions with the County, This area is adjacent to the Timber Ridge development. A summary table to directly compare with previous analysis was included in the appendix, pg 243. There was slight revisions to the modeling for this area. As seen in the site investigations for the Timber Ridge channel design, this portion of channel is currently stable. The district/county will monitor this area as part of maintenance program and can determine if degradation is occurring and further armoring or vegetation is prudent.

HEC-RAS Plan: PROP - Shear River: Sand Creek Reach: Reach 1-3

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear LOB (lb/sq ft)	Shear Chan (lb/sq ft)	Shear ROB (lb/sq ft)	Shear Total (lb/sq ft)
Reach 1-3	12465	5-YR	475.50	7177.88	7179.32	7179.32	7179.97	0.026123	10.15	88.42	68.89	1.50	2.10	2.33	2.00	2.08
Reach 1-3	12465	100-YR	1643.00	7177.88	7180.95	7180.95	7182.35	0.021154	15.19	207.29	74.10	1.53	3.56	4.04	3.50	3.59
Reach 1-3	12465	FIS	2600.00	7177.88	7181.73	7181.73	7183.86	0.024157	18.86	264.83	74.32	1.70	5.08	5.78	5.02	5.13
Reach 1-3	12366		Culvert													
Reach 1-3	12253	5-YR	475.50	7168.00	7173.17		7173.21	0.000200	2.09	387.71	85.37	0.16	0.05	0.06	0.05	0.06
Reach 1-3	12253	100-YR	1643.00	7168.00	7176.23		7176.40	0.000477	4.41	667.79	97.68	0.27	0.18	0.25	0.19	0.20
Reach 1-3	12253	FIS	2600.00	7168.00	7177.89		7178.16	0.000628	5.72	834.91	104.36	0.32	0.27	0.39	0.29	0.30
Reach 1-3	12070	5-YR	475.50	7168.31	7172.74		7173.03	0.002101	5.93	170.81	69.96	0.51	0.22	0.55	0.30	0.31
Reach 1-3	12070	100-YR	1643.00	7168.31	7175.41	7173.79	7176.03	0.002822	9.50	372.93	81.57	0.64	0.60	1.21	0.79	0.77
Reach 1-3	12070	FIS	2600.00	7168.31	7176.83		7177.69	0.003201	11.46	493.61	87.66	0.70	0.85	1.65	1.11	1.07
Reach 1-3	11880	5-YR	475.50	7165.99	7167.90	7167.90	7168.45	0.024415	11.92	103.07	89.83	1.52	1.92	2.91	1.63	1.75
Reach 1-3	11880	100-YR	1643.00	7165.99	7169.24	7169.24	7170.29	0.024519	17.01	234.62	104.53	1.66	3.52	4.97	3.32	3.42
Reach 1-3	11880	FIS	2600.00	7165.99	7170.00	7170.00	7171.39	0.024399	19.54	316.99	109.70	1.72	4.37	6.12	4.30	4.37
Reach 1-3	11569	5-YR	475.50	7159.96	7161.21	7160.88	7161.43	0.016137	7.31	134.07	116.84	1.15	1.12	1.26	1.19	1.15
Reach 1-3	11569	100-YR	1643.00	7159.96	7162.43	7161.98	7163.02	0.018608	12.33	284.92	183.68	1.38	2.34	2.86	2.64	2.48
Reach 1-3	11569	FIS	2600.00	7159.96	7163.29	7162.67	7164.03	0.016394	14.13	405.84	208.71	1.37	2.60	3.40	3.08	2.80
Reach 1-3	11368	5-YR	475.50	7153.99	7156.03	7156.03	7157.00	0.029471	13.67	75.69	66.36	1.69	2.52	3.75	3.06	2.77
Reach 1-3	11368	100-YR	1643.00	7153.99	7158.33	7158.33	7159.43	0.016147	16.75	260.10	142.36	1.42	2.58	4.38	2.23	2.50
Reach 1-3	11368	FIS	2600.00	7153.99	7159.15	7159.15	7160.55	0.016977	19.28	348.35	156.38	1.50	3.46	5.47	2.96	3.31
Reach 1-3	11206	5-YR	475.50	7151.03	7154.77		7154.97	0.001922	4.93	224.81	137.95	0.47	0.17	0.41	0.19	0.19
Reach 1-3	11206	100-YR	1643.00	7151.03	7156.19		7156.69	0.003815	8.76	454.11	174.08	0.70	0.58	1.15	0.52	0.62
Reach 1-3	11206	FIS	2600.00	7151.03	7157.10		7157.70	0.003990	10.04	615.28	182.16	0.74	0.81	1.43	0.65	0.83
Reach 1-3	11103	5-YR	475.50	7150.00	7151.95	7151.95	7153.35	0.045519	16.48	62.81	44.51	2.08	4.89	5.53	2.80	3.97
Reach 1-3	11103	100-YR	1643.00	7150.00	7153.69	7153.69	7154.54	0.019817	16.66	283.22	143.67	1.53	2.40	4.57	2.34	2.43
Reach 1-3	11103	FIS	2600.00	7150.00	7154.34	7154.34	7155.42	0.020994	19.08	378.68	153.43	1.62	3.23	5.68	3.03	3.22
Reach 1-3	10925	5-YR	475.50	7148.00	7149.87		7150.15	0.009001	4.22	112.74	104.87	0.72		0.60		0.60
Reach 1-3	10925	100-YR	1643.00	7148.00	7150.98		7151.66	0.010242	6.61	248.49	129.57	0.84		1.22		1.22
Reach 1-3	10925	FIS	2600.00	7148.00	7151.60	7151.38	7152.56	0.010090	7.90	330.21	134.40	0.88	0.18	1.59	0.18	1.54
Reach 1-3	10797	5-YR	475.50	7145.39	7148.14	7147.91	7148.55	0.018364	5.17	93.64	117.85	0.78	0.29	1.55	0.52	1.40
Reach 1-3	10797	100-YR	1643.00	7145.39	7149.35	7149.14	7149.97	0.017191	7.00	284.94	156.61	0.77	1.00	2.74	1.61	1.94
Reach 1-3	10797	FIS	2600.00	7145.39	7149.94	7149.76	7150.80	0.019038	8.34	382.70	170.55	0.83	1.52	3.74	2.33	2.66
Reach 1-3	10713	5-YR	475.50	7144.30	7147.27		7147.45	0.008697	3.75	155.78	145.09	0.54		0.80	0.39	0.58
Reach 1-3	10713	100-YR	1643.00	7144.30	7148.40		7148.77	0.010588	5.59	371.61	212.30	0.61	0.53	1.71	1.13	1.15
Reach 1-3	10713	FIS	2600.00	7144.30	7149.03		7149.50	0.010786	6.40	506.88	221.23	0.63	0.91	2.16	1.49	1.53
Reach 1-3	10617	5-YR	475.50	7143.44	7146.31		7146.56	0.010761	4.07	138.59	194.63	0.58	0.19	1.01	0.14	0.48
Reach 1-3	10617	100-YR	1643.00	7143.44	7147.56		7147.86	0.008825	5.16	414.87	235.18	0.55	0.74	1.51	0.72	0.97
Reach 1-3	10617	FIS	2600.00	7143.44	7148.24		7148.60	0.008239	5.70	579.19	247.66	0.54	1.00	1.75	0.94	1.20
Reach 1-3	10543	5-YR	475.50	7142.46	7145.60		7145.83	0.008151	3.97	142.32	166.60	0.58	0.06	0.74	0.33	0.43
Reach 1-3	10543	100-YR	1643.00	7142.46	7146.85		7147.21	0.008072	5.50	392.82	213.49	0.59	0.63	1.36	0.80	0.92
Reach 1-3	10543	FIS	2600.00	7142.46	7147.52		7147.97	0.008055	6.26	542.80	232.97	0.60	0.94	1.69	0.92	1.17

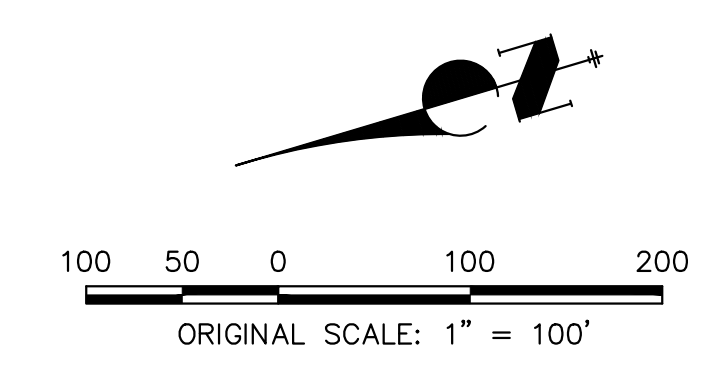
SAND CREEK RESTORATION WORK MAP



JR Response: Line has been frozen.
Is this a check structure?

LEGEND

———	HEC-RAS CROSS SECTION
----	EXISTING CHANNEL C
----	PROPOSED CHANNEL C
---	100YR 100-YR FIS
---	100YR 100-YR DESIGN WSEL
---	100YR 100-YR EXISTING WSEL



SEE SHEET 2

X:\2510000\2518804\HEC-RAS\HEC-RAS\HEC-RAS\Work Map_Angl Layout (3).rvt 7/17/2023 4:13:34 PM, VaughnD