TECHNICAL MEMORANDUM

J·R ENGINEERING

To: **Jeff Rice, PE, El Paso County**

From: **Mike Bramlett, PE, JR Engineering, Engineer of Record**

Date: **December 28,2023**

Subject: Sand Creek Channel Resubmittal – Design Support Memo

Mr. Rice,

The objective of this memo is to formally state JR's confidence in the stability of our channel design and to specifically discuss your mid-September concerns regarding Hec-Ras model results for cross sections between stations 11103 to 11880 and the potential need for additional improvements in this area when reviewing the shears shown in the JR model run "Sub-critical flow analysis for Shear/Velocity evaluation for Natural Channel Design".

This area of concern is adjacent to the Timber Ridge Development and was previously analyzed by CCES and deemed stable. Channel stabilization using check dam structures was approved by El Paso County. These check structures are located just below the area of concern and near the top end of the area of concern and provide channel grade control in the event of localized erosion. In addition, east bank stabilization was proposed and installed by CCES to below JR cross section 11880. In addition, west bank stabilization is proposed by the current JR design in the outside curve to below JR station 11880.

This reach of the channel is highly vegetated and is not proposed for any improvements other than the check structures and upper reach bank stabilization mentioned above. While JR's objective when incorporating this reach into our modeling was to recreate the CCES model results, the variances shown below highlight how difficult it is to replicate model results due to small variations in cross section points and alignments. JR also evaluated the channel under several different scenarios, shear/velocity (lightly vegetated – lower N values) and channel water surface elevation (established vegetation – higher N values). CCES analyzed this reach as undisturbed and highly vegetated (established vegetation – higher N values), therefore, JR believes the most apples to apples comparison to CCES modeling is with our model run "Sub-critical flow analysis for water surface evaluation for Natural Channel Design at FIS Flow Rate only" as our Mannings N values and flow rate were consistent with CCES modeling. A JR to CCES comparison of the Hec-Ras stations and the respective model results is shown below;

Cross Section Comparison of JR vs CCES Modeling

JR Cross Section	CCES Cross Section
	Check Str. 3
12070	20+83.66
11880	18+79.67
11569	15+07.91
	Check Str. 2
11368	11+45.05
11206	Not modeled
11103	9+02.80
10925	5+20.2
	Check Str. 1

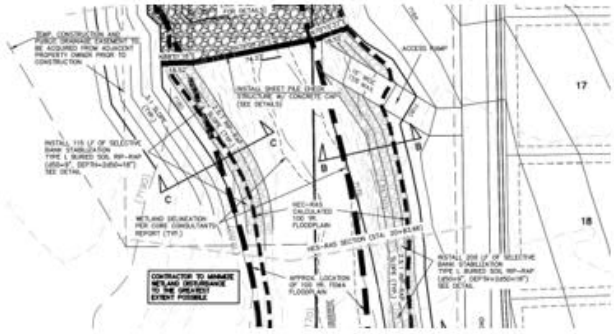
Comparison of JR vs CCES Modeling FIS WSEL Model

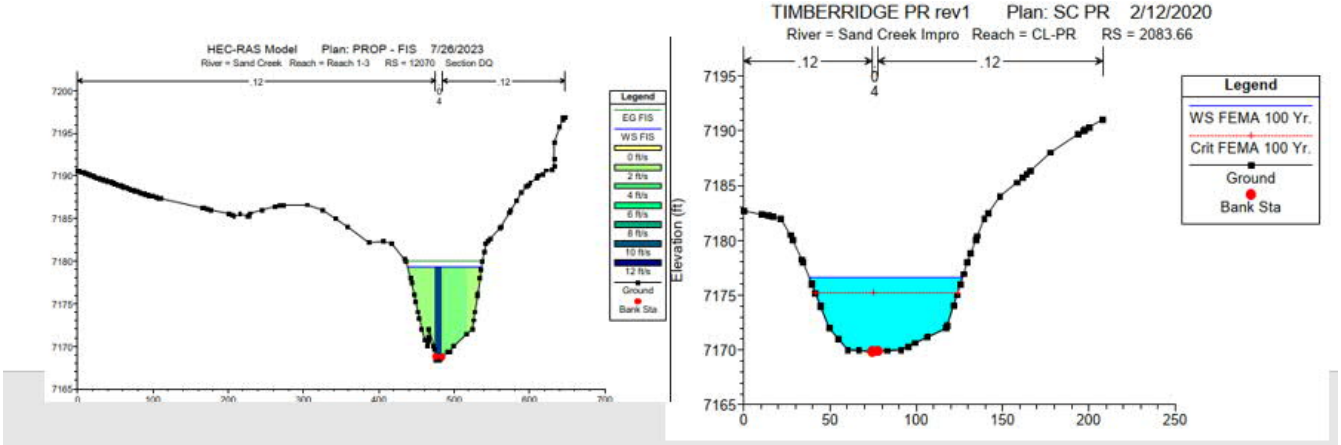
JR Cross Section	12070	11880	11569	11368	11103	10925
CCES Cross Section	20+83.66	18+79.67	15+07.91	11+45.05	9+02+80	5+20.20
Min Ch. Elev. JR	7168.31	7165.52	7159.96	7153.99	7150.00	7148.00
Min. Ch. Elel CCES	7169.86	7165.99	7159.96	7153.97	7149.99	7147.98
WSEL JR	7179.30	7171.62	7165.28	7160.00	7155.43	7154.93
WSEL CCES	7176.67	7171.19	7164.39	7160.24	7156.18	7153.90
Velocity JR	3.60	5.63	3.48	5.74	4.68	3.03
Velocity CCES	5.56	5.75	3.62	4.11	3.77	3.70
Shear JR	1.44	5.98	2.72	4.67	5.17	0.65
Shear CCES	5.90	6.80	3.12	3.71	3.20	2.94
Froude JR	0.44	0.95	0.53	1.07	0.70	0.27
Froude CCES	0.64	0.96	0.47	0.69	0.55	0.44
Flow Area JR	722.99	348.13	746.49	452.92	555.70	857.76
Flow Area CCES	487.69	451.84	718.84	632.55	689.09	703.30
Top Width JR	98.57	106.92	249.28	175.32	170.22	189.28
Top Width CCES	89.07	117.40	233.19	188.76	188.94	164.34

Based upon JR's review of the CCES and JR models, it is JR's opinion that no further improvements need to be constructed in this area. While the shear values are elevated, JR believes the significant existing vegetation can adequately handle short term shears of this magnitude. However, this area should be monitored closely after overall construction to identify any areas that exhibit signs of excessive erosion and those areas should be addressed quickly as part of the channel maintenance program.

Below is a more detailed discussion of the each specific cross section;

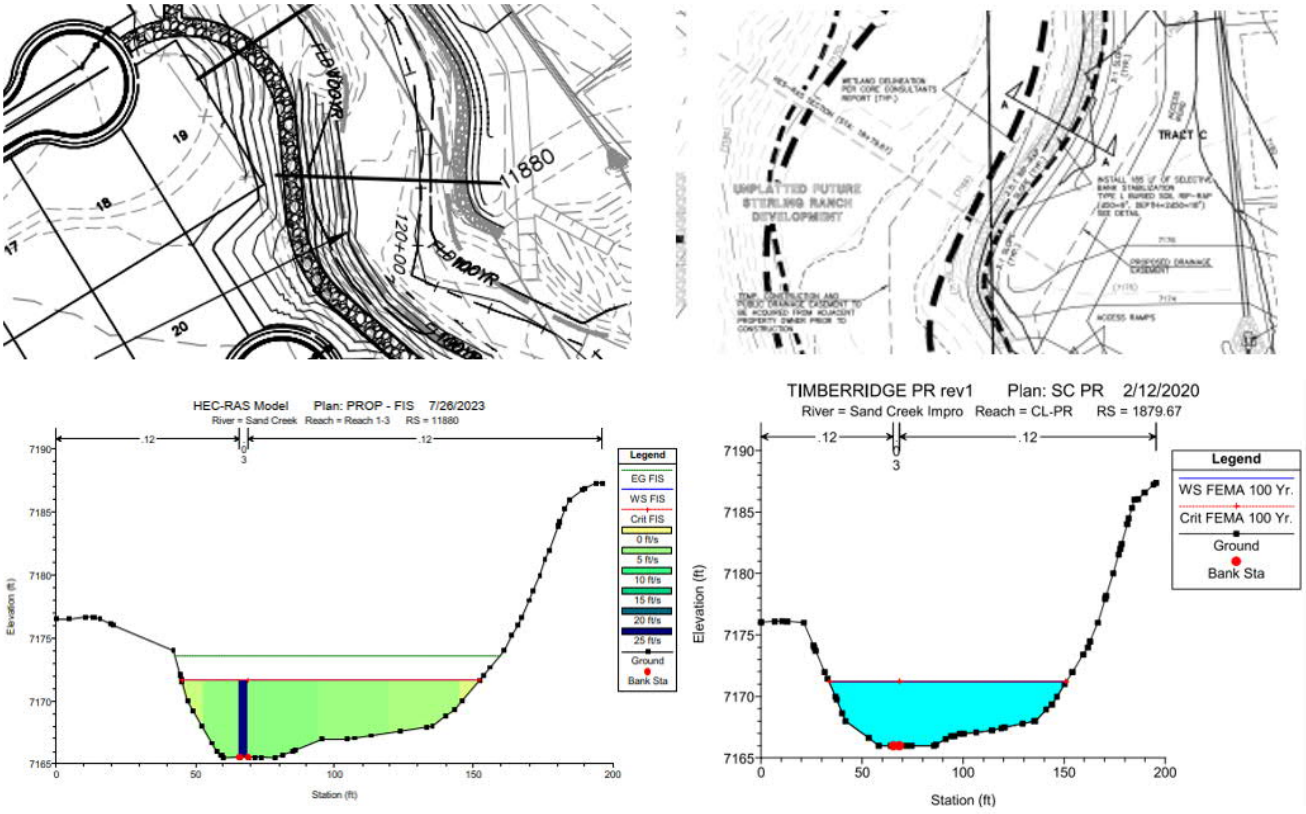
JR Cross Section 12070 – CCES Cross Section 20+83.66





This cross section is below the grade control structure placed at the end of the POCO road culvert improvements and it is evident the cross sections are slightly different between the two models leading to the larger than anticipated variation in results.

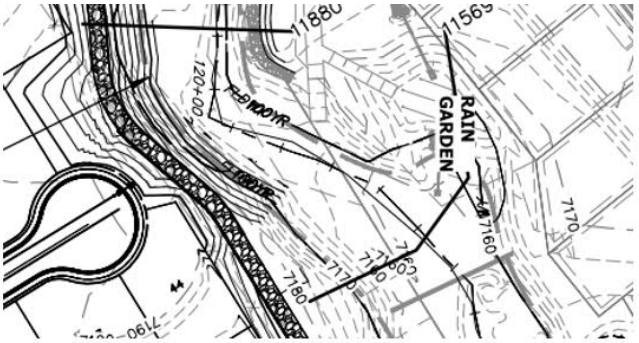
JR Cross Section 11880 – CCES Cross Section 18+79.67

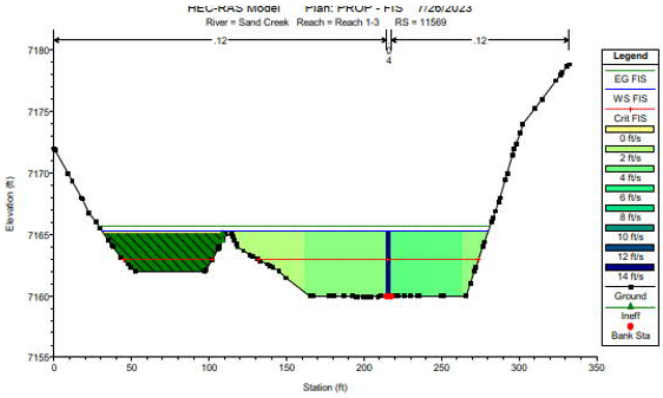


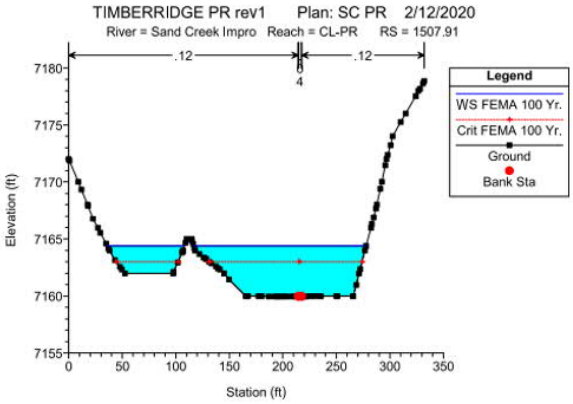
This cross section is above grade the grade control structure no 2 and near the end of the bank stabilization and it is evident the cross sections reasonably consistent, hence the consistent results between the two models.

JR Cross Section 11569 – CCES Cross Section 15+07.91

(see next page)

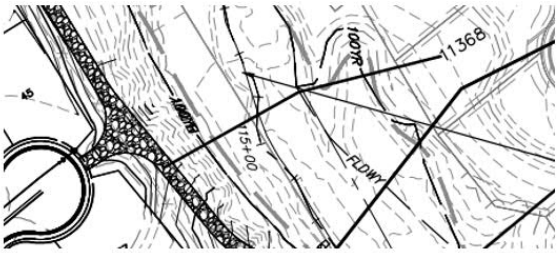


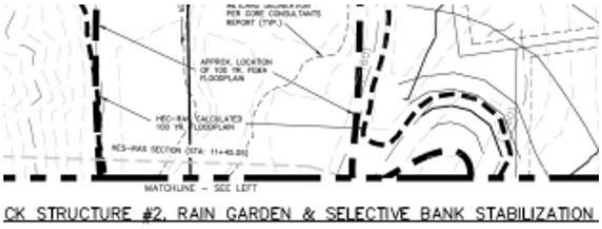


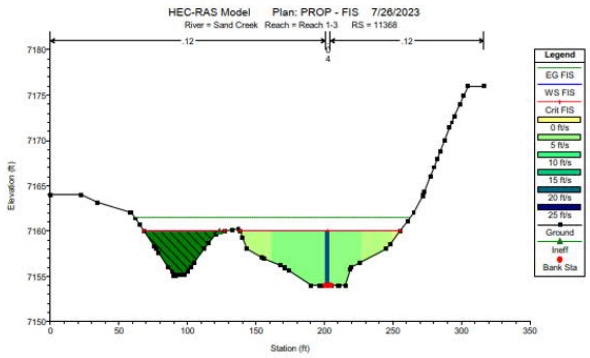


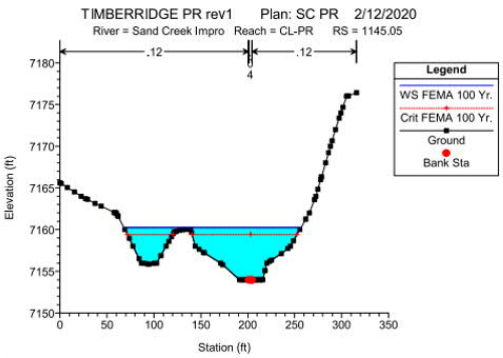
This cross section is just above grade control structure 2 and JR's model shows ineffective flow area while CCES model does not which lead to higher WSEL in the JR model and minor variations in results.

JR Cross Section 11368 – CCES Cross Section 11+45.05



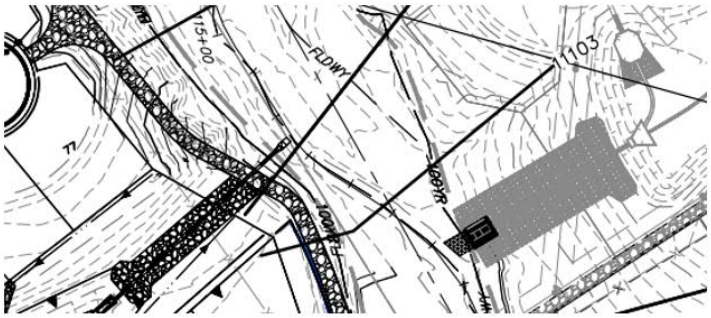


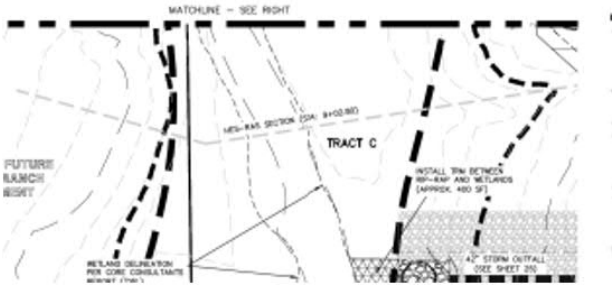


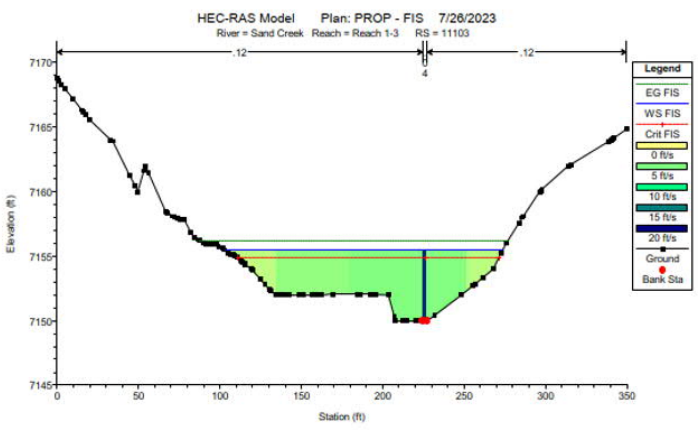


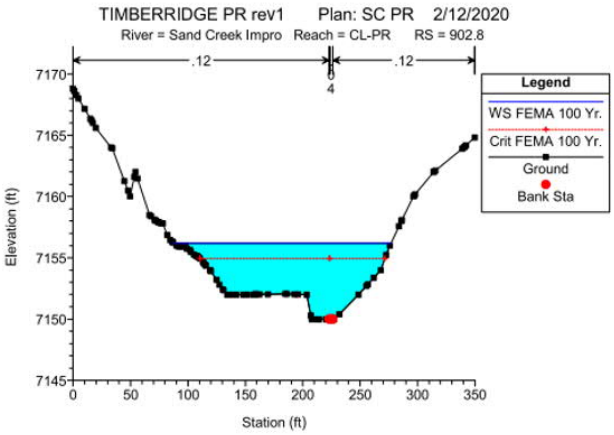
This cross section is below grade control structure 2 and JR's model shows ineffective flow area while CCES model does not which lead to a much smaller Flow Area in the JR model and larger than anticipated variations in results.

JR Cross Section 11103 – CCES Cross Section 9+02.80



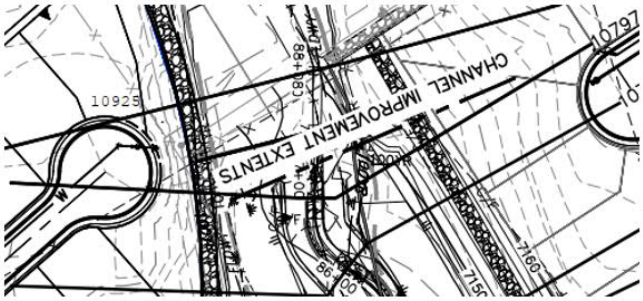


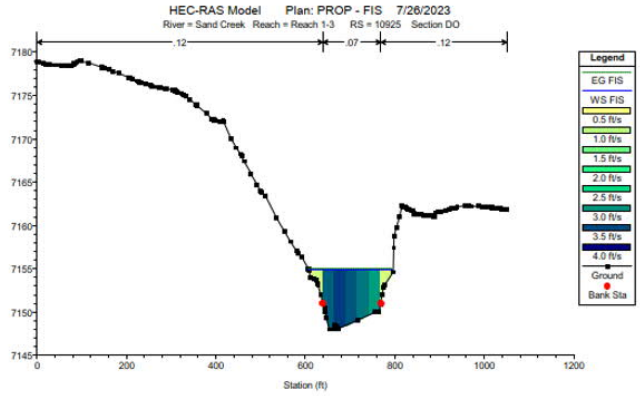


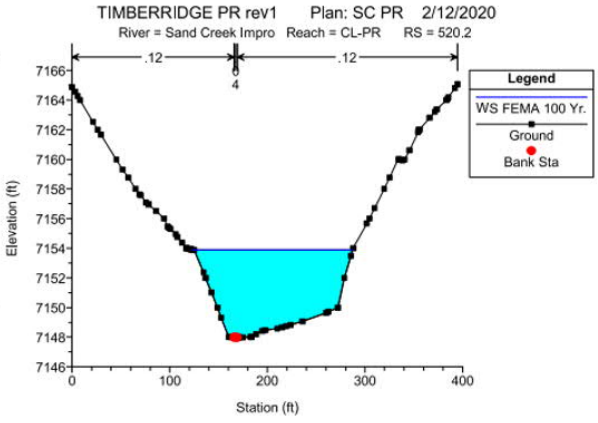


This cross section is below grade control structure 2 and while the cross sections appear similar, the WSEL and Flow area different between the models, causing a variation in results.

JR Cross Section 10925 – CCES Cross Section 5+20.20







This cross section is above grade control structure 1 improvements and it is evident the cross sections are slightly different between the two models leading to the larger than anticipated variation in results.

In summary, JR's professional opinion is the design, reports and channel drawings as presented in the 12/29/23 EDARP submittal will create a stable natural channel within Sterling Ranch and is therefore requesting EPC plan approval with this resubmittal.

Sincerely,

Mike Bramlett, P.E.
Engineer of Record
Colorado PE #32314