MVE, INC.
ENGINEERS' SURVEYORS
1903 lelaray street, suite 200
colorado springs, co 80909
719.635.5736

Master Development Drainage Plan / Preliminary Drainage Report

Eagle Rising

Project No. 61145

January 4, 2024

PCD File No.: SP205

something is missing from this sentence

1950's. The Ponds 1 & 2 helped attenuate the stormwater flows in Cottonwood Creek over the years from the 1950's which most likely aided in the growth of the wetlands. Also, with the ponds constructed not to drain all stored water, most likely provided ground water was extended downstream and promoted growth of the wetlands. The Cottonwood Creek channel within the area designated as the "Reinstated Preliminary Plan" for Eagle Rising is a stabilizing feature for the creek and supports the existing wetlands and the beneficial features and functions of a wetlands channel. Furthermore, U.S. Army Corps of Engineers (USACE) staff viewed the site and cottonwood creek on April 27, 2023. Based on the site visit, USACE staff verbally recommended that the creek not be disturbed.

The 100-year storm water flow level has been established by this study and used to provide the no build easements above said 100-year storm water levels for the Lots that are impacted in the Eagle Rising Reinstated Preliminary Plan.

The impact of the creek on the proposed lots is inundation by 100-year flows. The impacted areas are encompassed in a no-build area consisting of the 100-year storm water inundation area plus the adjacent area determined by adding 2 vertical feet to the 100-year water surface elevation as calculated. The No Build Limit Line is shown on the "Reinstated Preliminary Plan" for Eagle Rising and more than encompasses the area inundated by the 100-year storm water level. Potential Geologic Hazards also included within the no-build area of the creek include floodplain, ponded water, seasonal shallow ground water, potentially seasonal shallow groundwater and downslope creep.

Existing Ponds 1 & 2 are not used for storm water detention of the increase in existing Eagle Rising site storm water flows compared to the Eagle Rising developed storm water flow. The existing north Pond 1 has a 12" outlet culvert with control gate and overflow riser with trash rack. The south Pond 2 has an 18" culvert structure. Both outlet control structures release Eagle Rising storm water flows at their existing historic rate. The ponds are considered useful for detention on the channel even though this is not required for the Eagle Rising Development project. Flow attenuation effects of the ponds are not considered in the engineering analysis. Owner/Developer will elect the lots size fee reduction as provided in the Drainage Criteria Manual.

A brief description of each developed drainage basin including developed runoff rates, drainage patterns and any drainage facilities for each basin is provided in this section of the report. A summary of peak developed runoff for the basins and designated design points are depicted on the Proposed Hydrologic Map (on-site) in the **Appendix**. The site has been divided into twenty-two developed drainage basins described as follows:

Design Point 6 (DP 6) storm water flows (Q5=22.5 cfs, Q100=134.7 cfs) are generated from off-site **DP 4** and **DP 5,** and on-site developed basins B and C consisting totally of 71.87 acres. The summation of these flows at **DP 6** are combined in an existing small local depression area. The depression appears to be man-made, possibly for livestock watering. The current condition of the depression appears to hold some water at certain times of year but not continually. The downstream end of the depression area is a small bank to trap the water in the existing natural swale. The depression area is proposed to be left intact, non-disturbed, and is within a drainage easement. Developed storm water

At this time, proposed home pads and ancillary structures (sheds, animal corals, etc.) locations are not known. It shall be the responsibility of the home builder and subsequently the homeowner to ensure flows from stormwater are appropriately routed around said structures to prevent flooding and damage to property. This can be accomplished using broad swales as opposed to ditches which tend to concentrate flows and are therefore more susceptible to erosion. Swales shall be protected from erosion until such time that vegetation is established. A civil engineer can aid in determination of swale placement and erosion control measures to be used.

4.2.4. Hydraulic Analysis

The Hydraulic Analysis of Cottonwood Creek in this report is prepared with cross sectional and longitudinal slope data from the topographic mapping of the project. Longitudinal slopes for the project reach range between 1% to 2%, except behind pond embankments and pond emergency spillways where they are milder or steeper. Ignoring the emergency spillways, the average slope is 1.2%. Manning's roughness coefficients are estimated using the Composite Roughness procedure and values selected from Table 10-1 of the DCM Volume 1 based on field observation of actual conditions. The majority of the project reach is well vegetated with mature willows, brush, trees and native grasses. These areas are assigned Manning's n value of 0.155. The areas better characterized as native grasses or cattails are assigned Manning's n of 0.069. All overbank areas have a mixture of native grasses, brush and trees with shallower flow depths. The overbank areas are assigned a Manning's n value of 0.075 throughout the reach. Standard expansion and contraction coefficients of 0.1 and 0.3 are utilized. Peak 100-year flow rates for the analysis are taken from the referenced 2019 DBPS. Flow rates in the creek range from 410 cfs at the upstream end to 820 cfs at the downstream end.

Resulting flow depths in Cottonwood Creek for the 100-year rainfall event generally range between 2 to 4 feet with depths up to 9 feet at locations immediately upstream of the pond embankments. Ignoring the ponding areas, flow depths in the creek average 3.1 feet. Channel flow velocities range from 0.4 fps to 4.5 fps, except at the pond emergency spillway where they are higher. The average flow velocity in the reach is 2.3 fps. Froude Numbers range from 0.03 to 0.42, except at the pond emergency spillways where they are higher. The average Froude Number for the reach is 0.30. The pond emergency spillways either have existing riprap protection installed as noted in this report or will have it installed at the time of filing the plat for Eagle Rising Filing No. 2 since the creek and ponds are included in the land parcel set aside for Filing No. 2. Velocities and Froude Numbers are compliant with DCM criteria for allowance of natural vegetative linings. Additional information concerning the specific types of vegetation present in this reach of Cottonwood Creek would extend allowable velocities in this reach in accordance with a Deviation Request for the vegetative lining consisting of willows and grasses that are not addressed in the DCM, but present at the site. Details and analysis of Cottonwood Creek hydraulic conditions will also be provided with the applicable Final Drainage Report.

Supplemental information concerning permissible velocities and permissible shear stresses for channel lining materials is included in the appendix. The information includes suggested permissible values for the native grasses, willows and trees that grow in the project reach. Live willow stakes are included and listed to have permissible velocities of 3 to 10 f/sec with permissible shear stress of 2.10 to 3.10 lbs/sf. However, the supplemental information assumes that the vegetation is newly planted, as in Reed Plantings, Hardwood Tree Plantings and Live Willow Stakes. In this case, the vegetative cover throughout the site is not plantings or stakes, but well established, robust and dense cover that has served to stabilize the creek bed and banks. The upper end of the permissible value range applies in this project reach.

4.2.6. Maintenance and Maintenance Access for Cottonwood Creek

Natural, well-established creeks typically do not require maintenance. The creek bed and banks within the subdivision are well-established with dense vegetation as detailed above. However, access for any needed maintenance within Cottonwood Creek is provided within the Public Utility, Drainage and Maintenance Access Easements which are located along each side front, side and rear lot line. Said Easements will be 10' wide on all side lot lines, 15' wide on all front lines and 10' wide on all rear lot lines. A Creek Access Exhibit is included in the appendix of this report to illustrate potential access routes within the easements where terrain is amenable for this use. Maintenance of the access easements is vested with the individual property owner. The property owners will preserve the creek bed and vegetation as required through an HOA or individually.

It is questionable that ECM Section 3.3.3.K which requires construction of 15' wide access roads, was intended to be applicable to natural drainages in a rural residential setting. Even so, Section 3.3.3.K.2 provides that 15' wide access roads on both sides of the channel can be omitted: *"Exclusion of Access Road. When the lack of an access road is not considered detrimental to the maintenance and integrity of the channel, the access road can be omitted under the following conditions:*

• *Where suitable exit-entry ramps are provided to intermediate channels with a minimum bottom width of 8 feet at roadway crossings and at other approved, needed locations to facilitate travel or maintenance of emergency vehicles in the channel bottom. At a minimum, one access ramp must be provided at each end of a channel."*

• *Where vehicular access to the channel on a maximum spacing of 1,000 feet and at other approved, needed locations is provided to small channels with a bottom width of less than 8 feet*." In the case of Eagle Rising the lack of constructed access roads is not detrimental to maintenance or integrity of the channel since access will be provided through easements along lot lines. Access to the creek bed is practically attainable at several locations throughout the reach utilizing the easements and not constructed roadways.

a channel maintenance agreement

These private roadside ditches are being used as Receiving Pervious Area (RPA) as detailed in the **BMP Area ID** map attached in the **Appendix**. The RPA has established vegetation. The slope at the UIA/RPA interface prevents any accumulation of sediment from interfering with runoff entering the existing private roadway ditch. The site is exempted from the use of WQCV BMPs by ECM I.7.1.B.5 by virtue of the large lot rural residential nature of the site having percent imperviousness of less than 10%. The runoff generated from the impervious areas of the gravel road will be treated for water quality by the RPA's.

Areas being used as RPA constitute vegetated areas down-gradient of impervious areas as specified in Water Quality Control Volume reduction procedure detailed in Chapter 4, Fact Sheet T-00 "Quantifying Runoff Reduction" of the Urban Storm Drainage Criteria Manual, Volume 3[13]. Permanent seeding will follow the proposed construction, and temporary irrigation will establish a grass cover. The volume reduction calculation was made with the aid of the "UD-BMP_v3.07" spreadsheet developed by Mile High Flood District and is attached in the **Appendix**[14] showing a WQCV reduction more than 60%.

According to the updated Volume 1 of the County's Drainage Criteria Manual, Chapter 6, Section 2.3, based on a technical memorandum prepared for the City titled "Water Quality Capture Volume Analysis for Colorado Springs" (Wright Water Engineers 2011) that highlighted the high similarity between the MHFD data and the data from the Colorado Springs gages, the County's Drainage Criteria Manual states that "***the UDFCD results and methods for the WQCV are acceptable for determining the WQCV in Colorado Springs***"[15]. Based on that recommendation, the **WQCV Rainfall Depth** of 0.6 inches was used. The assumption of 0.6 inches for WQCV Rainfall Depth is a conservative assumption for the El Paso County region as the data from the Colorado Springs Analysis shows. The Depth of Average Runoff Producing Storm, d_6, of 0.42 inches was used corresponding to the El Paso County region in the Mean Annual Storm Precipitation Depths Map (Driscoll et.al., 1989) provided in the "UD-BMP_v3.07" spreadsheet.

2. Drainage paths within the proposed lots have been stabilized with the addition of riprap protection. Locations are indicated on the Drainage Map and details for the riprap are included in the appendix.

   The results of the hydraulic analysis contained in this report indicate four locations that exhibit channel flow velocities that approach or exceed 6 fps

[13] USDCM-V.3, Chapter 3, Section 4.3
[14] UD-BMP-Worksheet-v3.07
[15] DCM, Chapter 6, Section 2.3

and/or have Froude Number values that equal or exceed 1.0. The affected locations are the pond emergency spillways which are protected with riprap as indicated on the Drainage Map. The presence of dense vegetation through much of the project reach serves to provide additional stabilization. The existing boulder structure, located upstream of the pond at DP 104 provides stabilization. Portions of the banks inside the DP 104 pond are lined with large boulders. The boulders have been in place for many years and are well embedded and incorporated into the creek terrain. No further improvements are needed in the creek.

State that details and analysis will be provided with the applicable FDR

3. The project contains no potentially hazardous uses. The site is exempted from the use of WQCV BMPs by ECM I.7.1.B.5 by virtue of the large lot rural residential nature of the site having actual percent imperviousness of less than 10%. The runoff generated from the impervious areas of the gravel road will be treated for water quality by utilizing the runoff reduction standard. Stormwater runoff from the proposed roadway will be collected in the roadside ditches and will infiltrate into the ground, evaporate, or evapotranspire a quantity of water equal to at least 60% of what the calculated WQCV would be if all impervious area for the applicable development site discharged without infiltration. Runoff Reduction calculations are included in the appendix.
4. The rural residential development is not anticipated to contain storage of potentially harmful substances or use of potentially harmful substances. No site specific or other source control BMPs are required.

5. Drainage and Bridge Fees

The site is located within the Cottonwood Creek Drainage Basin of Fountain Creek, El Paso Basin Number FOMO2200, which was last studied in 1994. 2022 fees associated with this basin are Drainage Fees of $21,134 per impervious acre and Bridge Fees of $1,156 per impervious acre. The percent Imperviousness of the 2.5-acre Rural Residential site is 11% for purposes of drainage fee calculation in accordance with El Paso County Engineering Criteria Manual Appendix L Table 3-1. Also, reduction in the per acre Drainage Fee are allowed pursuant to El Paso County Resolution 99-383 in the amount of 25% for lots 2.5 acres or larger will be utilized for this project.

Fees will be calculated in accordance with the future final plat.

6. Conclusion

This Master Development Drainage Plan / Preliminary Drainage Report presents existing and proposed drainage conditions for the proposed Eagle Rising project. The development contains 70.8+/- acres with seventeen (17) 2.5-acre single family residential lots, and associated roadways which will have negligible and inconsequential effects on the existing site drainage and drainage conditions downstream. The proposed project

3

Looking upstream, from Cottonwood Creek DBPS Design Point 84.

September 27, 2022

4

Does bare area need to be vegetated?

Looking downstream, from 200 feet downstream of Cottonwood Creek DBPS Design Point 84.

September 27, 2022

5

as-builts will be required to verify usefullness

Looking upstream, from Cottonwood Creek DBPS Design Point 102.

September 27, 2022

6

Looking upstream, from Cottonwood Creek DBPS Design Point 102.

September 27, 2022

7

as-builts will be required to verify usefullness

Looking upstream, from Cottonwood Creek DBPS Design Point 102.

September 27, 2022

8

Looking upstream tributary stream, from Cottonwood Creek DBPS Design Point 102.

September 27, 2022

13

as-builts will be required

Buried and partially buried riprap at emergency overflow, from Cottonwood Creek DBPS Design Point 104.

September 27, 2022

14

Looking at heavy vegetation downstream, from Design Point 6C.

September 27, 2022

15

riprap not shown on plans?

Looking at riprap upstream tributary flow, from Design Point 6B.

September 27, 2022

16

Looking southwest across stream, from 450 feet downstream of Cottonwood Creek DBPS Design Point 104.

September 27, 2022

17

Is bank stabilization required?

Looking up stream, from 450 feet downstream of Cottonwood Creek DBPS Design Point 104.

September 27, 2022

18

Looking upstream, from 300 feet upstream of Cottonwood Creek DBPS Design Point 124.

September 27, 2022

19

Looking west across channel, from 100 feet upstream of Cottonwood Creek DBPS Design Point 124.

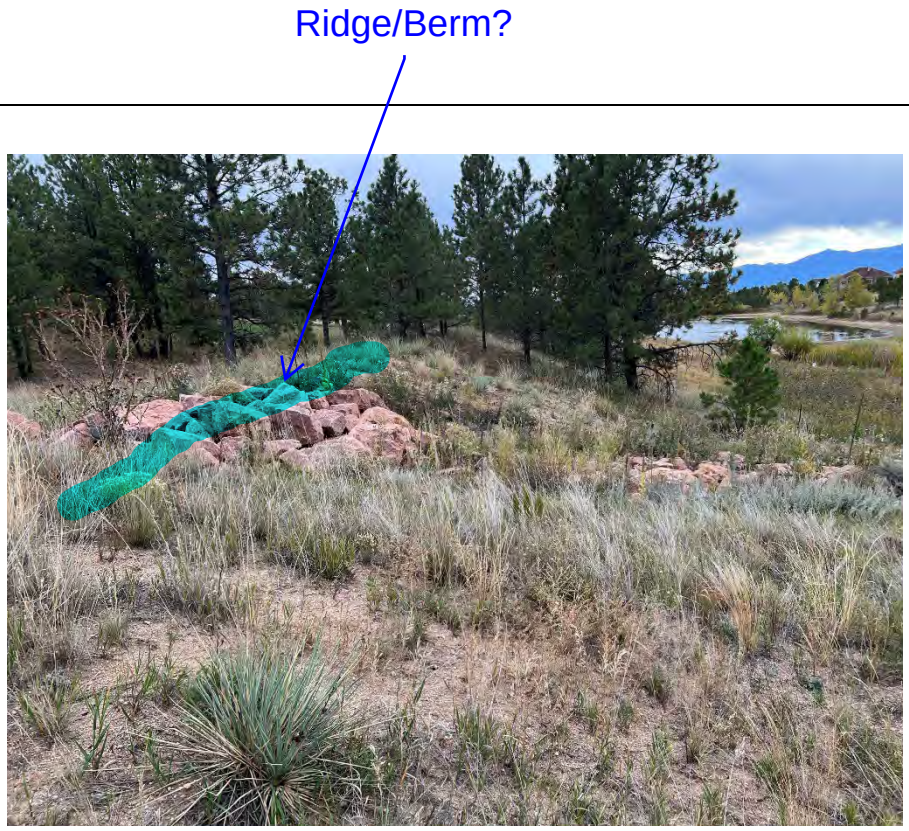
September 27, 2022

20

Is bank stabilization required?

Looking downstream at the upper banks, from 100 feet upstream of Cottonwood Creek DBPS Design Point 124.

September 27, 2022



25

Looking downstream towards offsite pond and riprap, from Cottonwood Creek DBPS Design Point 126.

September 27, 2022

26

Looking upstream, from Cottonwood Creek DBPS Design Point 126.

September 27, 2022

Ridge/Berm?

27

Looking upstream towards riprap for emergency overflow, from east bank 550 feet downstream of Design Point 10.

September 27, 2022

28

Looking across channel, from east bank 550 feet downstream of Design Point 10.

September 27, 2022

Ridge/Berm?

31

as-builts will be required to verify usefullness

Riprap lining downstream from DP8A, from 100 feet north of Design Point 12.

September 27, 2022

32

as-builts will be required to verify usefullness

Looking northwest up tributary stream, from 100 feet northwest of Design Point 9.

September 27, 2022

33

Looking east, on west bank of creek, from 100 feet northwest of Design Point 9.

September 27, 2022

34

as-builts will be required to verify usefullness

Riprap lined swale from barn area to creek, in need of additional riprap, from 450 feet downstream of Cottonwood Creek DBPS Design Point 104.

September 27, 2022

35

as-builts will be required to verify usefullness

Looking west, existing riprap lined swale in need of additional riprap from Design Point 6A.

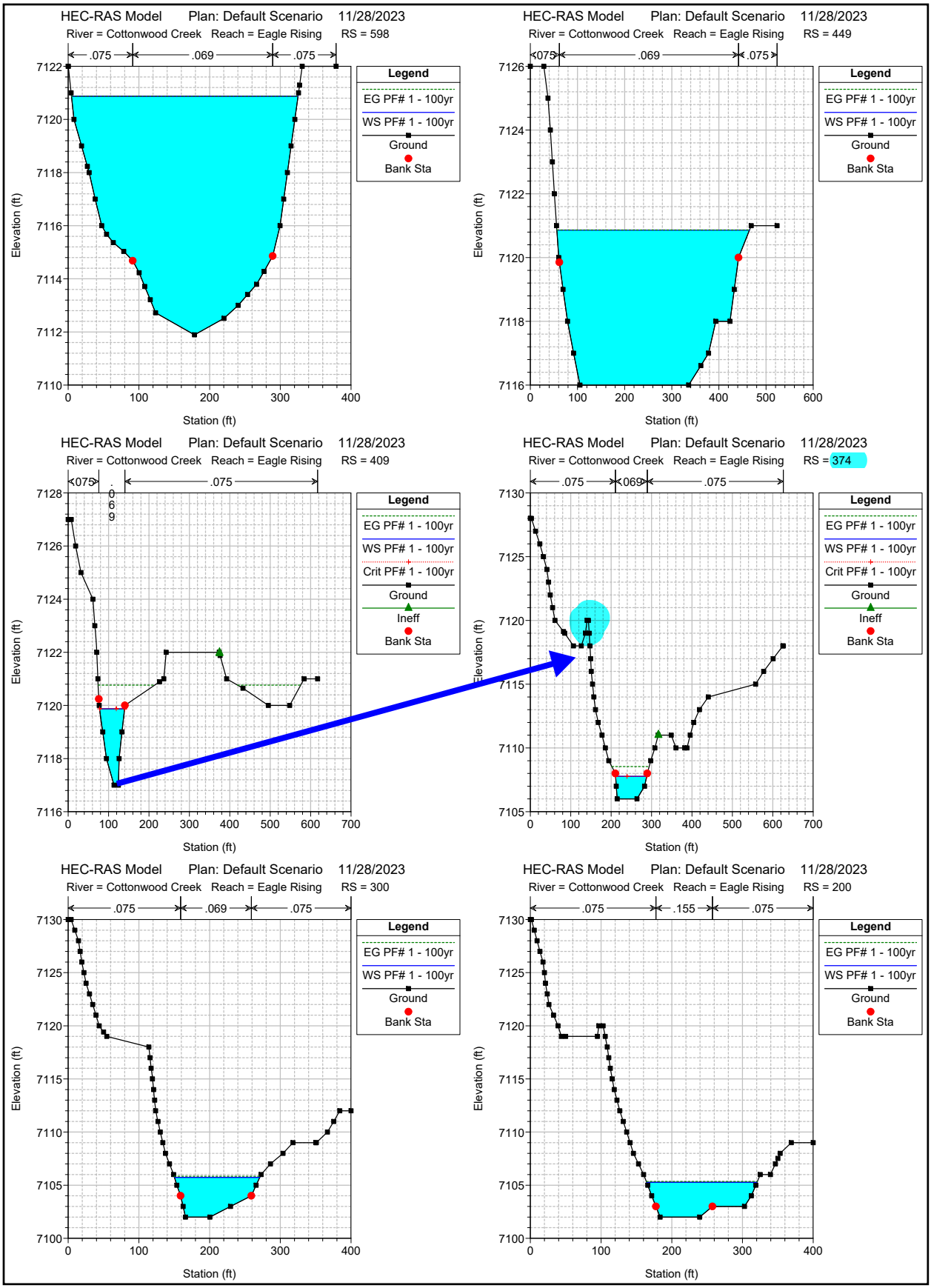
September 27, 2022

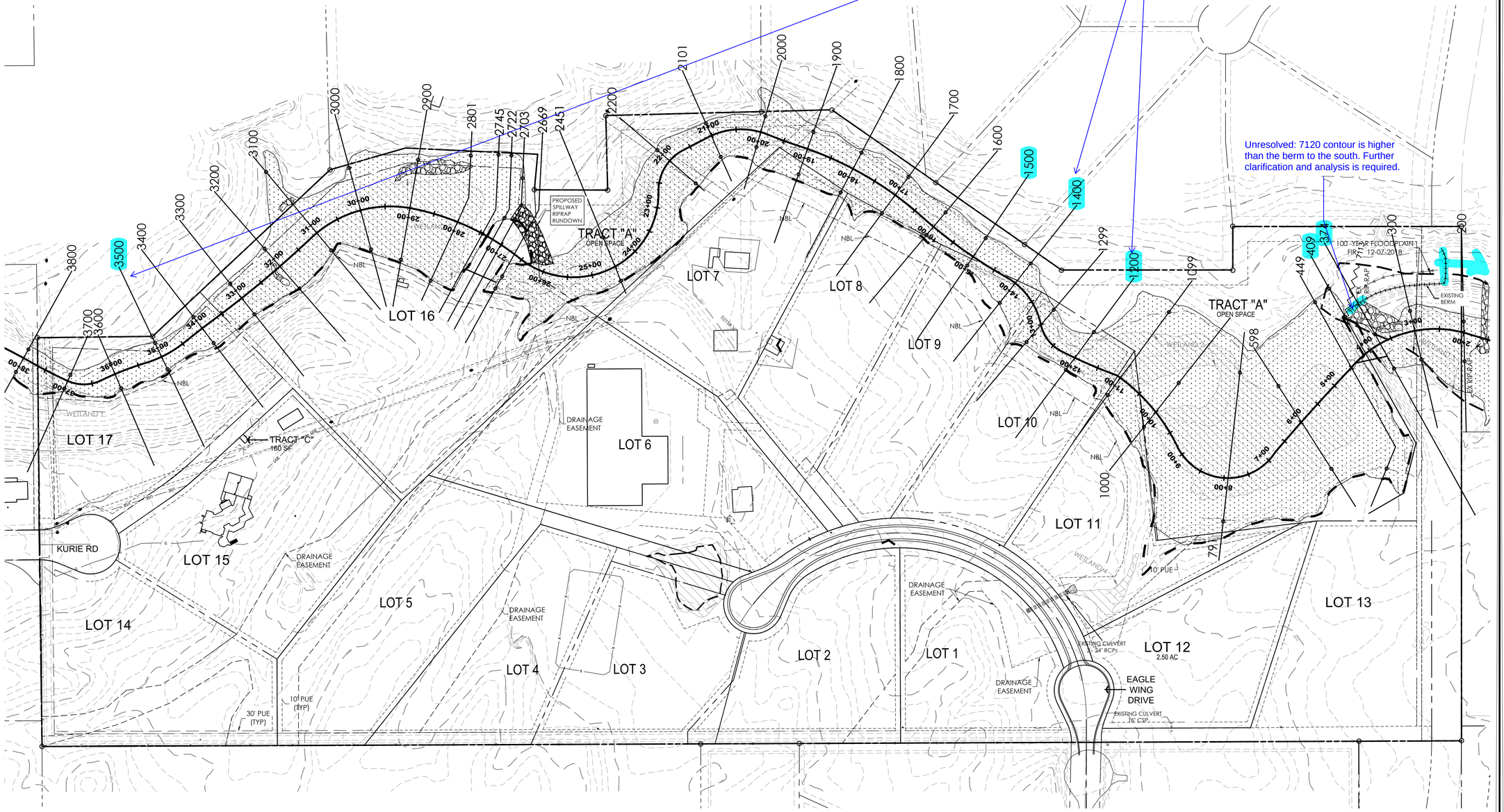
36

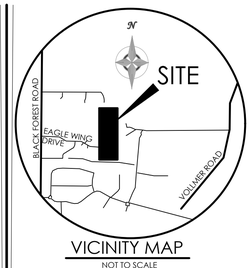
riprap not shown on plans?

Looking at riprap on tributary flow upstream of DP6B, from Design Point 6A.

September 27, 2022


HEC-RAS Model Plan: Default Scenario 11/28/2023
River = Cottonwood Creek Reach = Eagle Rising RS = 598
.075 .069 .075
Legend
EG PF# 1 - 100yr
WS PF# 1 - 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 11/28/2023
River = Cottonwood Creek Reach = Eagle Rising RS = 449
.075 .069 .075
Legend
EG PF# 1 - 100yr
WS PF# 1 - 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 11/28/2023
River = Cottonwood Creek Reach = Eagle Rising RS = 409
.075 .069 .075
Legend
EG PF# 1 - 100yr
WS PF# 1 - 100yr
Crit PF# 1 - 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 11/28/2023
River = Cottonwood Creek Reach = Eagle Rising RS = 374
.075 .069 .075
Legend
EG PF# 1 - 100yr
WS PF# 1 - 100yr
Crit PF# 1 - 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 11/28/2023
River = Cottonwood Creek Reach = Eagle Rising RS = 300
.075 .069 .075
Legend
EG PF# 1 - 100yr
WS PF# 1 - 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 11/28/2023
River = Cottonwood Creek Reach = Eagle Rising RS = 200
.075 .155 .075
Legend
EG PF# 1 - 100yr
WS PF# 1 - 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)





VICINITY MAP
NOT TO SCALE

BENCHMARK

N

10 0 50 100 200
1" = 100' 1:200

MVE, INC
ENGINEERS, SURVEYORS
1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

DESIGNED BY
DRAWN BY
CHECKED BY
AS-BUILTS BY
CHECKED BY

EAGLE RISING
FILING NO.1

PROPOSED
DRAINAGE MAP
HECRAS SECTIONS

MVE PROJECT 61145
MVE DRAWING DRN-MAP-HECRAS

JANUARY 3, 2024
SHEET 1 **OF** 1

HEC-RAS Plan: Default Scenario River: Cottonwood Creek Reach: Eagle Rising Profile: PF# 1 - 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Max Chl Dpth	Hydr Depth C	Flow Area	Top Width	Vel Chnl	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(sq ft)	(ft)	(ft/s)	
Eagle Rising	3800	PF# 1 - 100yr	410.00	7161.00	7164.33		7164.42	0.012711	3.33	3.05	179.57	71.09	2.27	0.23
Eagle Rising	3700	PF# 1 - 100yr	410.00	7159.00	7162.45		7162.64	0.026309	3.45	3.20	118.96	48.11	3.34	0.33
Eagle Rising	3600	PF# 1 - 100yr	410.00	7157.27	7161.39		7161.44	0.006493	4.12	3.73	222.05	71.58	1.85	0.17
Eagle Rising	3500	PF# 1 - 100yr	470.00	7157.00	7159.99		7160.14	0.031700	2.99	2.51	151.54	70.40	3.14	0.35
Eagle Rising	3400	PF# 1 - 100yr	470.00	7155.00	7158.31		7158.38	0.010977	3.31	3.02	223.42	87.66	2.10	0.21
Eagle Rising	3300	PF# 1 - 100yr	470.00	7154.18	7156.69		7156.79	0.024985	2.51	2.21	183.95	94.39	2.57	0.30
Eagle Rising	3200	PF# 1 - 100yr	470.00	7153.23	7155.34		7155.45	0.008299	2.11	1.62	175.00	114.71	2.71	0.37
Eagle Rising	3100	PF# 1 - 100yr	470.00	7151.73	7155.23		7155.24	0.000754	3.50	2.25	463.81	209.88	1.02	0.12
Eagle Rising	3000	PF# 1 - 100yr	560.00	7151.44	7155.16		7155.18	0.000539	3.72	3.09	535.70	187.26	1.06	0.11
Eagle Rising	2900	PF# 1 - 100yr	560.00	7149.78	7155.14		7155.15	0.000168	5.36	3.94	814.41	222.89	0.69	0.06
Eagle Rising	2801	PF# 1 - 100yr	560.00	7148.27	7155.14		7155.14	0.000041	6.87	5.08	1372.09	277.02	0.41	0.03
Eagle Rising	2745	PF# 1 - 100yr	700.00	7153.00	7155.05		7155.13	0.005050	2.05	1.75	353.61	303.25	2.23	0.30
Eagle Rising	2722	PF# 1 - 100yr	700.00	7153.00	7154.69		7154.91	0.018323	1.69	1.45	189.71	138.50	3.74	0.55
Eagle Rising	2703	PF# 1 - 100yr	700.00	7152.00	7153.75	7153.75	7154.30	0.057231	1.75	1.27	123.44	121.53	6.05	0.95
Eagle Rising	2669	PF# 1 - 100yr	700.00	7144.00	7147.02	7147.02	7147.88	0.036000	3.01	2.72	105.69	64.40	7.94	0.85
Eagle Rising	2451	PF# 1 - 100yr	700.00	7138.00	7141.73		7141.82	0.015229	3.73	2.87	295.45	124.04	2.39	0.25
Eagle Rising	2200	PF# 1 - 100yr	700.00	7135.00	7138.19		7138.27	0.013177	3.19	2.98	310.59	113.77	2.27	0.23
Eagle Rising	2101	PF# 1 - 100yr	750.00	7133.00	7136.38		7136.54	0.023985	3.38	3.16	237.65	83.18	3.18	0.32
Eagle Rising	2000	PF# 1 - 100yr	750.00	7131.00	7134.86		7134.95	0.010763	3.86	3.39	317.91	143.59	2.24	0.21
Eagle Rising	1900	PF# 1 - 100yr	820.00	7130.00	7133.36		7133.48	0.020468	3.36	2.93	291.05	115.98	2.81	0.29
Eagle Rising	1800	PF# 1 - 100yr	820.00	7128.00	7131.87		7131.96	0.011762	3.86	3.60	339.50	106.37	2.43	0.23
Eagle Rising	1700	PF# 1 - 100yr	820.00	7127.00	7130.42		7130.53	0.017473	3.42	3.25	298.06	99.09	2.77	0.27
Eagle Rising	1600	PF# 1 - 100yr	820.00	7124.00	7129.11		7129.22	0.010166	5.11	4.64	309.26	83.90	2.68	0.22
Eagle Rising	1500	PF# 1 - 100yr	820.00	7123.00	7127.56		7127.73	0.023743	4.56	3.54	243.72	78.56	3.40	0.32
Eagle Rising	1400	PF# 1 - 100yr	820.00	7121.00	7125.55		7125.65	0.018124	4.55	2.92	315.34	128.16	2.63	0.27
Eagle Rising	1299	PF# 1 - 100yr	820.00	7120.00	7124.37		7124.45	0.008395	4.37	4.09	368.78	104.32	2.24	0.20
Eagle Rising	1200	PF# 1 - 100yr	820.00	7119.00	7122.13	7121.42	7122.45	0.093104	3.13	1.92	182.69	112.72	4.51	0.57
Eagle Rising	1099	PF# 1 - 100yr	820.00	7119.00	7120.92		7121.00	0.005259	1.92	1.73	374.74	242.74	2.25	0.30
Eagle Rising	1000	PF# 1 - 100yr	820.00	7116.00	7120.88		7120.90	0.000310	4.88	4.50	962.51	292.58	1.03	0.09
Eagle Rising	791	PF# 1 - 100yr	820.00	7113.94	7120.88		7120.88	0.000031	6.94	6.34	2092.44	391.78	0.41	0.03
Eagle Rising	598	PF# 1 - 100yr	820.00	7111.89	7120.87		7120.87	0.000027	8.98	7.93	2044.51	320.39	0.45	0.03
Eagle Rising	449	PF# 1 - 100yr	820.00	7116.00	7120.86		7120.87	0.000081	4.86	4.25	1625.56	408.60	0.51	0.04
Eagle Rising	409	PF# 1 - 100yr	820.00	7117.00	7119.87	7119.87	7120.77	0.059146	2.87	1.75	108.23	61.67	7.58	1.01
Eagle Rising	374	PF# 1 - 100yr	820.00	7106.00	7107.77	7107.77	7108.54	0.061974	1.77	1.52	116.40	76.79	7.04	1.01
Eagle Rising	300	PF# 1 - 100yr	820.00	7102.00	7105.74		7105.84	0.003267	3.74	3.08	326.32	120.64	2.60	0.26
Eagle Rising	200	PF# 1 - 100yr	820.00	7102.00	7105.28		7105.36	0.007656	3.28	3.13	390.62	156.13	1.79	0.18
Eagle Rising	100	PF# 1 - 100yr	820.00	7102.00	7103.63	7102.91	7103.77	0.049885	1.63	1.59	281.53	183.33	2.92	0.41

Area of concern is highlighted - direction of flow (unresolved)

Velocity, Froude Number & Shear Stress at Selected Channel Sections

Hydraulic Data from HEC-RAS Analysis, M.V.E., Inc.

Shear Stress $\tau = \gamma RS$

Froude No. $Fr = \frac{V}{\sqrt{gD}}$

τ = Shear Stress (Lbs/sf)

γ = Weight Density of Water (lb/cf) = 62.4

R = Hydraulic Radius = Area/Wetted Perimeter (ft)

S = Energy Grade Slope (ft/ft)

V = Channel Velocity (ft/sec)

D = Hydr Depth = Flow Area / Top Width

g = Accereration of gravity = 32.2 ft/sec^2

Channel Section	Q100 (cfs)	S Energy Slope (ft/ft)	Max Channel Depth (ft)	D Hydraulic (Ave) Depth (ft)	P Wetted Perimeter (ft)	R Hydraulic Radius R (ft)	A Flow Area (sf)	W Top Width (ft)	V Channel Velocity (ft/sec)	Fr Froude No.	τ Shear Stress (lbs/sf)	Notes:
3800	410	0.013	3.3	2.5	72	2.5	180	71	2.3	0.25	1.98	dense vegetation existing
3700	410	0.026	3.5	2.5	49	2.4	119	48	3.3	0.37	3.98	dense vegetation existing
3600	410	0.007	4.1	3.1	73	3.1	222	72	1.9	0.19	1.26	dense vegetation existing
3500	470	0.079	3.0	2.2	71	2.1	152	70	3.1	0.38	10.52	dense vegetation existing
3400	470	0.010	3.3	2.5	88	2.5	223	88	2.1	0.23	1.58	dense vegetation existing
3300	470	0.011	2.5	1.9	95	1.9	184	94	2.6	0.32	1.34	dense vegetation existing
3200	470	0.008	2.1	1.5	115	1.5	175	115	2.7	0.39	0.79	boulder check existing
3100	470	0.001	3.5	2.2	210	2.2	464	210	1.0	0.12	0.10	native grasses and pond existing
3000	560	0.001	3.7	2.9	188	2.9	536	187	1.1	0.11	0.10	native grasses and pond existing
2900	560	0.000	5.4	3.7	223	3.6	814	223	0.7	0.06	0.04	native grasses and pond existing
2801	560	0.000	6.9	5.0	278	4.9	1372	277	0.4	0.03	0.01	native grasses and pond existing
2745	700	0.005	2.1	1.2	303	1.2	354	303	2.2	0.36	0.37	native grasses and pond existing
2722	700	0.018	1.7	1.4	139	1.4	190	139	3.7	0.56	1.56	native grasses and pond existing
2703	700	0.057	1.8	1.0	122	1.0	123	122	6.1	1.06	3.62	spillway riprap proposed
2669	700	0.036	3.0	1.6	65	1.6	106	64	7.9	1.09	3.66	spillway riprap proposed
2451	700	0.015	3.7	2.4	125	2.4	295	124	2.4	0.27	2.25	dense vegetation existing
2200	700	0.013	3.2	2.7	115	2.7	311	114	2.3	0.24	2.23	dense vegetation existing
2101	750	0.024	3.4	2.9	84	2.8	238	83	3.2	0.33	4.22	dense vegetation existing
2000	750	0.011	3.9	2.2	144	2.2	318	144	2.2	0.27	1.48	dense vegetation existing
1900	820	0.020	3.4	2.5	117	2.5	291	116	2.8	0.31	3.19	dense vegetation existing
1800	820	0.012	3.9	3.2	107	3.2	340	106	2.4	0.24	2.33	dense vegetation existing
1700	820	0.018	3.4	3.0	100	3.0	298	99	2.8	0.28	3.26	dense vegetation existing
1600	820	0.010	5.1	3.7	85	3.6	309	84	2.7	0.25	2.33	dense vegetation existing
1500	820	0.026	4.6	3.1	80	3.1	244	79	3.4	0.34	5.01	dense vegetation existing
1400	820	0.035	4.6	2.5	129	2.4	315	128	2.6	0.30	5.34	dense vegetation existing
1299	820	0.005	4.4	3.5	105	3.5	369	104	2.2	0.21	1.19	dense vegetation existing
1200	820	0.036	3.1	1.6	113	1.6	183	113	4.5	0.62	3.64	dense vegetation existing
1099	820	0.005	1.9	1.5	243	1.5	375	243	2.3	0.32	0.51	native grass existing
1000	820	0.000	4.9	3.3	293	3.3	963	293	1.0	0.10	0.06	native grasses and pond existing
791	820	0.000	6.9	5.3	393	5.3	2092	392	0.4	0.03	0.01	native grasses and pond existing
598	820	0.000	9.0	6.4	321	6.4	2045	320	0.5	0.03	0.01	native grasses and pond existing
449	820	0.000	4.9	4.0	409	4.0	1626	409	0.5	0.05	0.02	native grasses and pond existing
409	820	0.059	2.9	1.8	62	1.7	108	62	7.6	1.01	6.42	spillway riprap
374	820	0.062	1.8	1.5	77	1.5	116	77	7.0	1.01	5.82	spillway riprap
300	820	0.003	3.7	2.7	121	2.7	326	121	2.6	0.28	0.55	dense vegetation existing
200	820	0.008	3.3	2.5	157	2.5	391	156	1.8	0.20	1.19	dense vegetation existing
100	820	0.050	1.6	1.5	184	1.5	282	183	2.9	0.42	4.77	dense vegetation existing

bare area in pictures?

Describe in the report how these values are stable for the specific areas

(Unresolved) regrading appears to be needed to direct flow into the spillway

Areas of concern are highlighted