WYOMING ESTATES SUBDIVISION

FINAL DRAINAGE REPORT

PREPARED BY
Mike Bartusek
RESPEC
3520 Austin Bluffs Parkway, Suite 102
Colorado Springs, CO 80831
719-266-5212

PREPARED FOR
Home Run Restorations, Inc.
5090 Wiley Road
Peyton, CO 80904
719-325-6155

SEPTEMBER 27, 2019

Project Number 03433

PCD File No. MS 196

RESPEC

ENGINEER'S STATEMENT:
The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports, and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____
Michael A. Bartusek, P.E. #23329

DEVELOPER'S STATEMENT:
I, the Developer, have read and will comply with all of the requirements specified in this drainage report and plan.

By: _____
Shawn Shafer
Title: Owner

Address: Home Run Restorations, Inc.
5090 Wiley Road
Peyton, CO 80904

Filed in accordance the El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

_____ _____
Jennifer Irvine, County Engineer/ECM Administrator Date

Conditions:

Review 1 comment:
Per the County GIS this lot is located in the Curtis Ranch (CHWS1000) and Livestock Company (CHWS0400) drainage basins.
Review 2: Unresolved. Please revise the narrative per review 1 comment above.

Review 1 comment:
Per the Plat submitted this should be Range 64 West
Review 2: Unresolved. Please revise per the comment above.

FINAL DRAINAGE REPORT
WYOMING ESTATES SUBDIVISION

PROJECT DESCRIPTION

This drainage report is for the development of the Wyoming Estates Subdivision. The currently vacant 40.01 acre site is located west of Curtis Road approximately 2.5 mile north of SH 94. It is further described as the southern portion of Section 33, Township 13 South, Range 66 West of the 6th Principal Meridian in El Paso County, Colorado.

All of this lot is located in Squirrel Creek drainage basin. Flows from the site drain into the west ditch of Curtis Road and flow north to the West Fork of Squirrel Creek.

SOILS

The soil on the site can be described as having a rapid permeability, medium-surface runoff, and moderate to high hazard of erosion. The soils within the site are:

- 8 Blakeland Loamy Sand
- 95 Truckton Sandy Loams

review 1 comment: Per FEMA website the FEMA map No. is 08041C0568G.
Review 2: Unresolved. Please revise the FEMA map # and also add # 08041C0785G.

FLOODPLAIN STATEMENT

No portion of the developed site is located within a designated FEMA 100-year floodplain according to the information published in the Federal Emergency Management Agency Flood Plain Map No. 08041C0754G, dated December 7, 2018.

METHOD OF COMPUTATION

The methodology utilized for this report is in accordance with the *El Paso County Drainage Criteria Manual, Volumes 1*, dated May 2014. The Rational Method for computation of runoff was used for determining Sub-Basin flows.

$Q = cia$

Where
- Q = maximum rate of runoff in cubic feet per second
- c = runoff coefficient representing drainage area characteristics
- i = average rainfall intensity, in inches per hour, for the duration required for the runoff to become established
- a = drainage basin size in acres

EXISTING DRAINAGE CONDITIONS

The existing site is undeveloped except for a gravel road located along the north property line located within a 60 ft. Access Easement. Approximately 90% of the parcel is covered with rangeland grasses with slopes varying from 2% to 8%. The parcel generally slopes to the northeast except for the southwest corner which drains to the southwest. Also a large 2.5' deep sump area exists in the south central portion of the site. The overflow swale for this sump area directs the flows to the northeast.

Sub-Basin Aex contains 3.66 acres and drains the southwest corner of the site. It produces flows of 0.9 cfs for the 5-year storm and 7.1 cfs for the 100-year storm. These flows travel off the site to the south.

Sub-Basin B1ex contains 20.62 acres and drains the southcentral area of the site. This area drains to the east and northeast and is tributary Sub-Basin OS1 which contains the west ditch

Review 1 comment: Please identify the basins and/or design points that make up these combined flows **Review 2 unresolved. Please state the basins that make up the DP1 flows**

review 1 comment: Shouldn't this be basin B2EX. **review 2: unresolved. It appears that basin OS2 flows into Sub-Basin B2EX as there is no basin B2 in the existing drainage conditions plan. Please revise.**

along Curtis Road. This sub-basin produces flows of 4.6 cfs for the 5-year storm and 35.4 cfs for the 100-year storm.

Sub-basin OS1 contains 2.72 acres and is located east of the site and contains the Curtis Road ROW. Sub-basin will produce flows of 1.0 cfs and 5.7 cfs respectively. The combined flows into the basin at DP1 will be 5.5 cfs for the 5-year storm and 40.3 cfs for the 100-year storm.

Sub-basin OS2 contains 6.86 acres and is located in the northwest area of the site. This undeveloped area sheet flows onto the site and produces flows of 4.2 cfs for the 5-year storm and 16.6 cfs for the 100-year storm. These flows sheet flow into Bub-Basin B2.

Sub-Basin B2ex contains 13.02 acres and drains the northeast portion of the site. This area drains to the east and southeast toward the existing ditch along the existing gravel access road which serves the properties to the west. This sub-basin produces flows of 3.5 cfs for the 5-year storm and 22.1 cfs for the 100-year storm. These flows will combine with the flows from Sub-basin OS2 at DP2 to produce flows of 7.0 cfs for the 5-year storm and 36.0 cfs for the 100-year storm.

The flows from DP1 and DP2 will combine at DP3 to produce flows of 12.3 cfs for the 5-year storm and 74.7 cfs for the 100-year storm. These flows will continue within the west Curtis Road ditch to the West Fork of Squirrel Creek.

This appears to be the east/southeast portion of the site.

DEVELOPED DRAINAGE CONDITIONS

The proposed subdivision will consist of four (4) lots with Lot 1 containing 5.15 acres, Lot 2 containing 5.08 acres, Lot 3 containing 5.06 acres and Lot 4 containing 21.19 acres. It will also contain an asphalt cul-de-sac located across from Patton Drive with a private gravel road extending from the cul-de-sac and connecting to the existing access road to the west. These new lots are assumed to be developed with 3000 sf homes and 12 ft gravel drives. No overlot grading will take place within the proposed subdivision.

Review 1 comment: Please identify the basins that make up these combined flows **Review 2 unresolved.**

Sub-Basin A contains 3.66 acres and will continue to drain to the southwest corner of the site. It produces flows of 0.9 cfs for the 5-year storm and 7.1 cfs for the 100-year storm. These flows travel off the site to the south.

Sub-Basin B1 contains 5.36 acres and drains the southcentral area of the site and will remain undeveloped. This area drains to the east and northeast and is tributary Sub-Basin OS1 which contains the west ditch along Curtis Road. This sub-basin produces flows of 1.6 cfs for the 5-year storm and 11.3 cfs for the 100-year storm.

Sub-basin OS1A contains 2.02 acres and is located east of the site and contains the Curtis Road ROW. Sub-basin will produce flows of 1.4 cfs and 5.5 cfs respectively. The combined flows into the basin at DP1 will be 3.0 cfs for the 5-year storm and 16.5 cfs for the 100-year storm.

Sub-basin OS2A contains 1.26 acres and is located in the northwest area of the site. This undeveloped area sheet flows onto the site and produces flows of 0.4 cfs for the 5-year storm and 2.7 cfs for the 100-year storm. These flows sheet flow into Bub-Basin B2.

typo

Sub-Basin B2 contains 17.94 acres and drains the northcentral portion of the site and contains a large portion of Lots 3 and 4 and a small portion of Lot 1. This area drains to the east and

The flow arrows on shown on this basin indicate that the majority of the flow is going to the northeast. Revise

Please state that the flow goes to the ditch along the new gravel access road and Teleo Point

southeast toward the proposed ditch along the new gravel access road. This sub-basin produces flows of 4.5 cfs for the 5-year storm and 31.3 cfs for the 100-year storm. These flows will combine with the flows from Sub-basin OS2A at DP2 to produce flows of 4.8 cfs for the 5-year storm and 33.5 cfs for the 100-year storm. These ditch flow continue east toward the Curtis Road ditch and combines with the flows from DP1 at the proposed public 38"x24" RCEP culvert under the Teleo Point cul-de-sac. The combined flows of DP1 and DP2 at DP3 will be 7.2 cfs for the 5-year storm and 47.2 cfs for the 100-year storm. These flows continue north into Sub-Basin OS1B.

DP2

Sub-basin OS2B contains 5.60 acres and is located in the northwest area of the site. This undeveloped area sheet flows onto the site and produces flows of 1.4 cfs for the 5-year storm and 10.6 cfs for the 100-year storm. These flows sheet flow into Bub-Basin B3.

typo

Sub-Basin B3 contains 4.56 acres and drains the northwestern portion of the site and contains a large portion of Lot 1. This area drains to the east toward the proposed ditch and sump along the new gravel access road. This sub-basin produces flows of 1.8 cfs for the 5-year storm and 9.8 cfs for the 100-year storm. These flows will combine with the flows from Sub-basin OS2B at DP4 to produce flows of 2.9 cfs for the 5-year storm and 18.7 cfs for the 100-year storm. These flows travel into Sub-Basin B4 through a private 30" cmp.

northeastern

Sub-Basin B4 contains 5.78 acres and drains the southeastern portion of the site and contains a Lot 2. This area drains to the east toward the existing ditch along the west property line. This sub-basin produces flows of 2.8 cfs for the 5-year storm and 13.3 cfs for the 100-year storm. These flows will combine with the flows from DP4 at DP5 to produce flows of 4.7 cfs for the 5-year storm and 26.5 cfs for the 100-year storm. These flows travel into Sub-Basin OS1B.

Sub-basin OS1B contains 0.70 acres and is located east of the site and north of Teleo Point cul-de-sac and contains th
respectively. The com
storm and 70.8 cfs for
Road ditch to the Wes

Review 1 comment: per the drainage plan and as stated above, this area drains to the east away from the west property line. Please revise.
Review 2: Unresolved. The ditch is along the east property line.Per the drainage plan, it appears that they flow may enter a pond before it enters the ditch. Please address this in your narrative.

WATER QUALITY AND DETENTION

Although water quality basins are not required for subdivisions containing lots greater than 5.0 acres, a temporary sedimentation to mitigate sediment from the construction of the public cul-de-sac and private access road. This basin will be located in the northeast area of the site with diversion ditches directing the site flows into the basin until the roadways are completed.

Per recent changes to the ECM Appendix I and correspondence with the State, large SFD residential lots greater than or equal to 2.5 acres may be excluded from water quality (see ECM Appendix I.7.1.B.5) but the roadways are not excluded and a permanent storm water quality control measure must be provided. The permanent control measure shall meet one of the base design standards described in I.7.1.C. Also please address detention for the development.

PRIVATE DRAINAGE FACILIT

The proposed drainage impr
private culvert and ditch imp
responsibility of Wyoming E

DRAINAGE BASIN FEES

The proposed development is located within t
drainage basin fee.

Review 1 comment:
Livestock Company drainage basin has basin and bridge fees. Please revise.
Review 2: Unresolved. Fees are due as a portion of the site is within a fee basin. Please revise accordingly.

Based on the disturbance shown on the GEC plan it appears that the disturbance for the roadways (including ditches) is greater than 2.2 acres. Also please see previous comment regarding water quality and revise this section accordingly

CONCLUSION

The proposed development and subsequer [illegible] mandated by the EPA as follows:

Step 1: Employ runoff reduction practices

Runoff has been reduced by disconnecting impervious areas where possible, eliminating "unnecessary" impervious areas and encouraging infiltration into suitable soils.

- Impervious areas have been directed to the existing earth swales and ditches to encourage infiltration.
- A gravel roadway has been used for the upper portion of the project to reduce the impervious of the areas.

Step 2: Stabilize drainageways

All drainageways, ditches and channels have been stabilized by the following methods:

- Tributaries have been left in their relatively natural state where possible.
- New ditches have been stabilized with either riprap or erosion control fabric depending on the erosion potential.

Step 3: Provide water quality capture volume (WQCV)

The proposed development will disturb approximately 2.2 acres for the asphalt and gravel roadway construction which will be mitigated through a temporary sedimentation basin.

Step 4: Consider need for industrial and commercial BMP's.

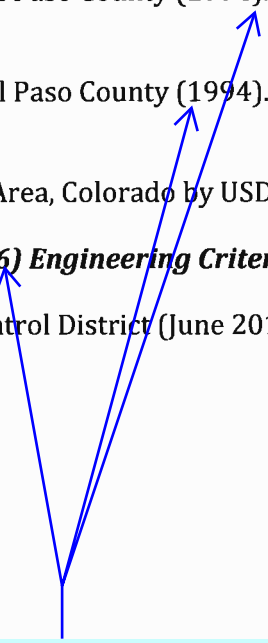
No industrial and commercial development is proposed for the site.

Review 1 comment:
Include a narrative in your conclusion indicating whether or not the development runoff meets historic and whether or not the development will adversely affect the downstream or surrounding properties.

Review 2: Unresolved. Please address the review #1 comment above. Be sure to list the historic flows compared to the developed flows of the site.

REFERENCES

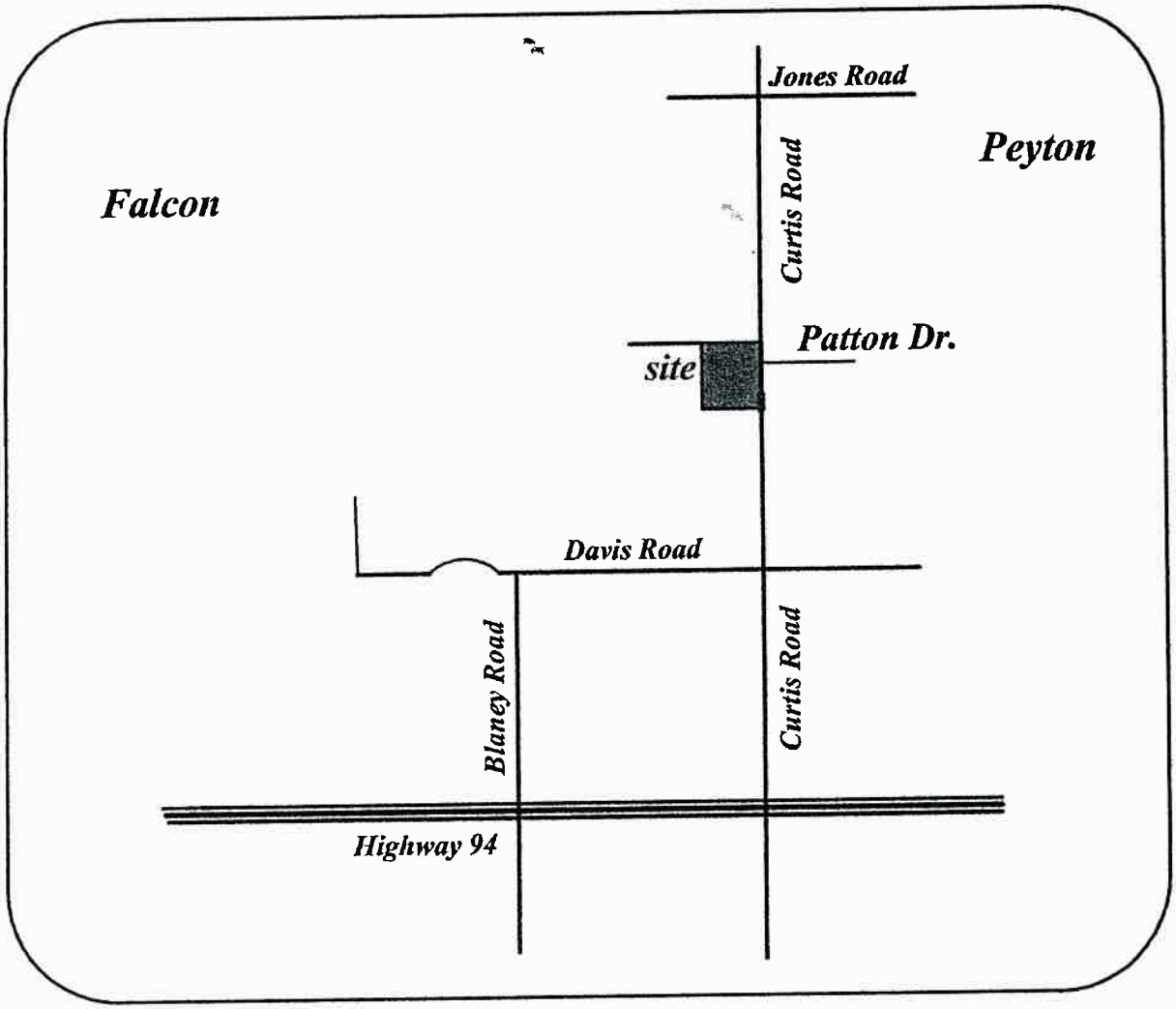
1. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume 1*** (DCM).
2. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume II*** (DCM).
3. Soil Survey of El Paso County Area, Colorado by USDA, NRCS.
4. ***El Paso County (January 2006) Engineering Criteria Manual***.
5. Urban Drainage and Flood Control District (June 2011). ***Urban Storm Drainage Criteria Manual, Volume 1-3***.



Review 1 comment:
Update the references to reflect the latest update/revisions to the County criteria.
Review 2: Unresolved.

APPENDIX A

MAPS



N

VICINITY MAP

N.T.S.

RESPEC

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N

SOILS MAP

N.T.S.

RESPEC

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National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represe an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/26/2019 at 9:19:46 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX B

DESIGN CALCULATIONS

WYOMING ESTATES SUBDIVISION
C FACTOR CALCULATION SHEET

Per table 6-6 of City DCM vol 1 this should be 90% impervious for roofs. It appears that the coefficients are correct

EXISTING CONDITIONS
RUNOFF COEFICIENT
TYPE A/B SOILS

LAND USE	Imperv %	5 YR	100 YR
UNDEV	0	0.08	0.35
GRAVEL ROAD	80	0.59	0.7
ASPHALT ROAD	100	0.9	0.96
ROOFS	100	0.73	0.81

AREA DESIG.	TOTAL AREA (acre)	SURFACE CONDITION AREAS				CALCULATED C	
		UNDEV	GRAVEL ROAD	ASPHALT ROAD	ROOFS	5 YR	100 YR
Aex	3.66	3.66	0.00	0.00	0.00	**0.08**	**0.35**
B1ex	20.62	20.62	0.00	0.00	0.00	**0.08**	**0.35**
B2ex	13.02	12.47	0.55	0.00	0.00	**0.10**	**0.36**
OS1	2.72	2.36	0.00	0.36	0.00	**0.19**	**0.43**
OS2	6.20	6.20	0.00	0.00	0.00	**0.08**	**0.35**
Aex-B2ex	37.30	36.75	0.55	0.36	0.00		
	0.8	0.00	0.44	0.36	0.00		
	Imperviousness = (0.44)/37.29 = 2.2%						

DEVELOPED CONDITIONS
RUNOFF COEFICIENT
TYPE A/B SOILS

LAND USE	Imperv %	5 YR	100 YR
UNDEV	0	0.08	0.35
GRAVEL ROAD	80	0.59	0.7
ASPHALT ROAD	100	0.9	0.96
ROOFS	100	0.73	0.81

Developed Conditions

AREA DESIG.	TOTAL AREA (acre)	SURFACE CONDITION AREAS				CALCULATED C	
		UNDEV	GRAVEL ROAD	ASPHALT ROAD	ROOFS	5 YR	100 YR
A	3.66	3.66	0.00	0.00	0.00	**0.08**	**0.35**

B1	5.36	5.23	0.06	0.00	0.07	**0.09**	**0.36**
B2	17.94	17.56	0.12	0.19	0.07	**0.09**	**0.36**
B3	4.56	4.24	0.25	0.00	0.07	**0.12**	**0.38**
B4	5.78	5.17	0.33	0.21	0.07	**0.15**	**0.40**
OS1A	2.02	1.72	0.00	0.30	0.00	**0.20**	**0.44**
OS1B	0.70	0.58	0.00	0.12	0.00	**0.22**	**0.45**
OS2A	1.26	1.26	0.00	0.00	0.00	**0.08**	**0.35**
OS2B	5.60	5.60	0.00	0.00	0.00	**0.08**	**0.35**
Avg House = 3000 sf w/ avg 250'x12' gravel driveway							
	Sub Area		Impervious Acreage				
A-B4	37.30	35.86	0.76	0.40	0.28		
	1.29	0.00	0.61	0.40	0.28		
	Imperviousness = (1.94)/37.29 = 5.2%						

Wyoming Estates Subdivision

PROJ. #03433

DRAINAGE CALCULATION SHEET

file:curtis rd dr

09/20/19

							Initial Tci			Travel Time								length	vel.		
AREA DESIG.	AREA (acre)	C5 (5 yr)	C100 (100 yr)	C5 X A	C100 X A	L (ft)	Slope (%)	ti (min)	L (ft)	Slope (%)	V (fps)	Tt (min)	TC (min)	I5 (in/hr)	I100 (in/hr)	Q5 (cfs)	Q100 (cfs)	L (feet)	V (fps)	^t (min)	AREA DESIG.
EXISTING CONDITIONS																					
Aex	3.66	0.08	0.35	0.29	1.28	100	3.00	13.27	440	4.50	2.00	3.67	16.94	3.18	5.55	0.93	7.11				Aex
B1ex	20.62	0.08	0.35	1.65	7.22	100	3.50	12.62	1270	6.00	2.40	8.82	21.43	2.81	4.90	4.63	35.39				B1ex
OS1	2.72	0.11	0.37	0.30	1.01	100	7.00	9.74	1230	4.40	3.20	6.41	16.15	3.25	5.68	0.97	5.72				OS1
DP1	23.34			1.95	8.22								21.43	2.81	4.90	5.47	40.32				DP1
OS2	6.86	0.19	0.43	1.30	2.95	100	3.00	11.84	500	3.00	1.80	4.63	16.47	3.22	5.63	4.20	16.60				OS2
B2ex	13.02	0.10	0.36	1.30	4.69	100	3.00	13.01	1330	5.50	2.20	10.08	23.09	2.69	4.71	3.51	22.06				B2ex
DP2	19.88			2.61	7.64								23.09	2.69	4.71	7.02	35.95				DP2
DP3	43.22			4.55	15.86								23.09	2.69	4.71	12.27	74.66				DP3
DEVELOPED CONDITIONS																					
A	3.66	0.08	0.35	0.29	1.28	100	3.00	13.27	440	4.50	2.00	3.67	16.94	3.18	5.55	0.93	7.11				A
B1	5.36	0.09	0.36	0.48	1.93	100	3.50	12.49	450	7.70	2.80	2.68	15.17	3.35	5.86	1.62	11.31				B1
OS1A	2.02	0.20	0.44	0.40	0.89	100	7.00	8.86	890	4.40	3.20	4.64	13.49	3.55	6.20	1.43	5.51				OS1A
DP1	7.38			0.89	2.82								15.17	3.35	5.86	2.97	16.52				DP1
OS2A	1.26	0.08	0.35	0.10	0.44	100	3.00	13.27	100	3.00	1.80	0.93	14.20	3.46	6.05	0.35	2.67				OS2A
B2	17.94	0.09	0.36	1.61	6.46	100	3.00	13.14	1150	5.40	2.20	8.71	21.86	2.78	4.85	4.48	31.33				B2
DP2	19.20			1.72	6.90								21.86	2.78	4.85	4.76	33.47				DP2
DP3	26.58			2.60	9.72								21.86	2.78	4.85	7.23	47.15	340	2.10	2.70	DP3
OS2B	5.60	0.08	0.35	0.45	1.96	100	3.00	13.27	500	3.00	1.80	4.63	17.90	3.09	5.39	1.38	10.57	450	3.40	2.21	OS2B
B3	4.56	0.12	0.38	0.55	1.73	100	5.00	10.77	650	3.40	1.90	5.70	16.48	3.22	5.63	1.76	9.75				B3
DP4	10.16			1.00	3.69								20.11	2.91	5.07	2.89	18.74	800	2.30	5.80	DP4
B4	5.78	0.15	0.40	0.87	2.31	100	5.00	10.44	750	6.00	2.30	5.43	15.88	3.28	5.73	2.84	13.25				B4
DP5	15.94			1.86	6.00								25.91	2.53	4.41	4.70	26.49				DP5
OS1B	0.70	0.22	0.45	0.15	0.32	80	6.00	8.15	250	2.00	2.10	1.98	10.13	4.03	7.04	0.62	2.22				OS1B
DP6	43.22			4.62	16.04								25.91	2.53	4.41	11.66	70.75				DP6

PROJECT: Wyoming Estates Sub

STATION: 0+30

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: MNB / 9/25/19

REVIEWER / DATE: _____ / _____

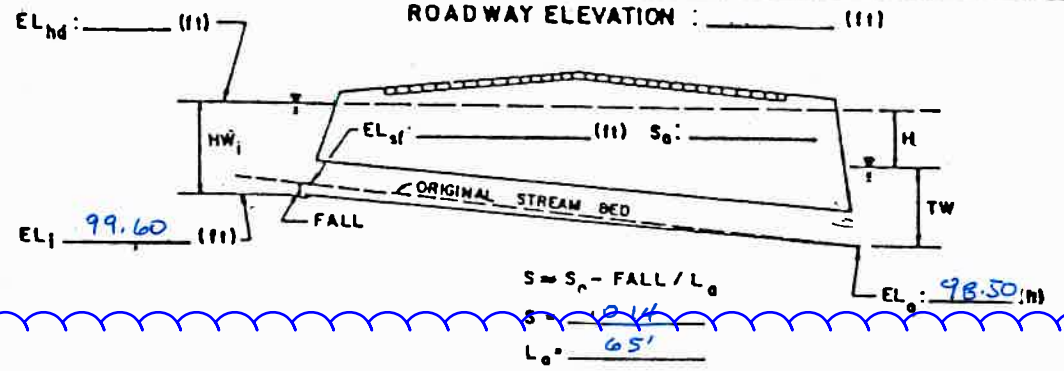
HYDROLOGICAL DATA

SEE ADD'L SHTS.

- ☐ METHOD: Rational
- ☐ DRAINAGE AREA: 26.50 ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: TRAP
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
5	7.2	
100	47.2	



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
12 CSP - 36" x 24" w/ FES	7.2	7.2	0.51	1.02												
" "	47.2	47.2	1.9	3.8												

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- e. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho. HEADWATER IN OUTLET CONTROL
- i INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT DESIGNED FOR 5YR STORM SINCE IT WILL NEED TO BE RELOCATED WHEN CURTIS RD IS REBUILT AS AN ARTERIAL ROADWAY

CULVERT
SIZE: ____
SHAPE: ____
MATERIAL: ____
ENTRANCE: ____

Review 1: Please provide complete calculations. Additionally provide calculations showing that you meet the overtopping criteria per DCM Vol. 1 table 6-1
Review 2: unresolved

Clarify what this culvert calculation is for. It appears to be flow from design point 5 yet the drainage plan does not show a culvert in the vicinity of DP5. If this is for the culvert at DP 4 the flow at that Design point is 3/18.7 cfs for the 5yr/100 yr flow. Revise accordingly.

PROJECT: _____ FORM

SHEET _____ OF _____

DESIGNER / DATE: MB / 9/25/19

REVIEWER / DATE: _____ / _____

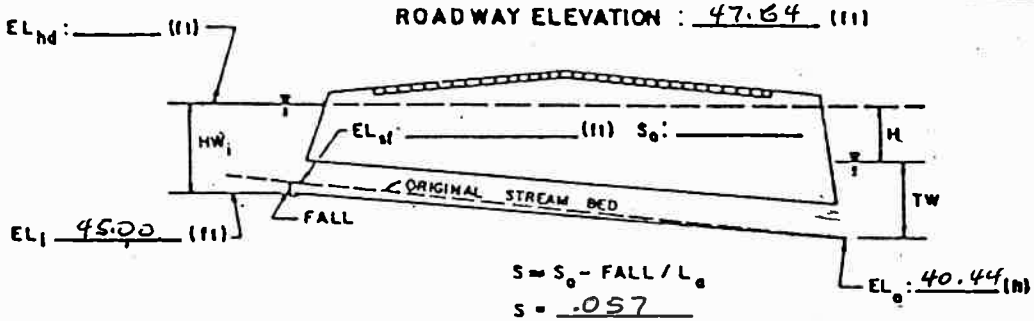
HYDROLOGICAL DATA

SEE ADD'L SHTS.

- ☐ METHOD: Rational
- ☐ DRAINAGE AREA: 15.94 ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: Trap.
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
5	4.7	
100	26.5	



$S \approx S_o - FALL / L_o$

$S = .057$

$L_o = 80'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	d_c+D/2	h_o (6)	h_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
-30" w/FES	4.7	4.7	0.4	1.0												
	26.5	26.5	1.1	2.75												

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29 n^2 L) / R^{1.33}\right] V^2 / 2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- e. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho HEADWATER IN OUTLET CONTROL
- i INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: _____

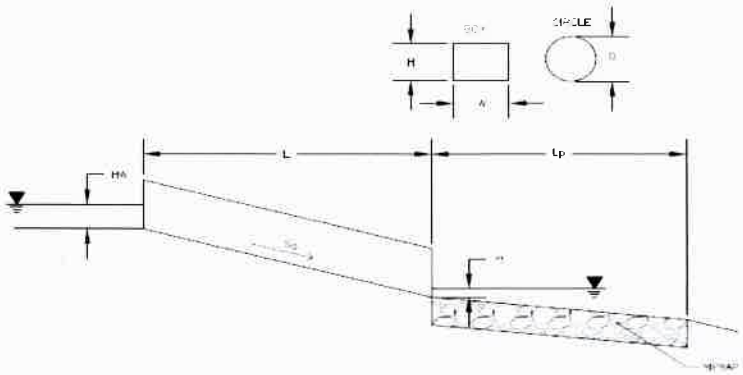
SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

Determination of Culvert Headwater and Outlet Protection

Project: **Wyoming Subdivision**
Basin ID: **Basin OS1A**



The culvert at Teleo Point is conveying 47.2 CFS. Revise accordingly

Soil Type:
Choose One:
◉ Sandy
○ Non-Sandy

Supercritical Flow! Using Ha to calculate protection type.

Design Information (Input):

	Design Discharge	Q = 7.2	cfs
Circular Culvert:			
	Barrel Diameter in Inches	D =	inches
	Inlet Edge Type (Choose from pull-down list)		
Box Culvert:		OR	
	Barrel Height (Rise) in Feet	Height (Rise) = 2	ft
	Barrel Width (Span) in Feet	Width (Span) = 3.17	ft
	Inlet Edge Type (Choose from pull-down list)		
	Number of Barrels	No = 1	
	Inlet Elevation	Elev IN = 6499.5	ft
	Outlet Elevation OR Slope	Elev OUT = 6498.8	ft
	Culvert Length	L = 65	ft
	Manning's Roughness	n = 0.012	
	Bend Loss Coefficient	k_b = 0	
	Exit Loss Coefficient	k_x = 1	
	Tailwater Surface Elevation	Elev Y_t = 6499.8	ft
	Max Allowable Channel Velocity	V = 5	ft/s

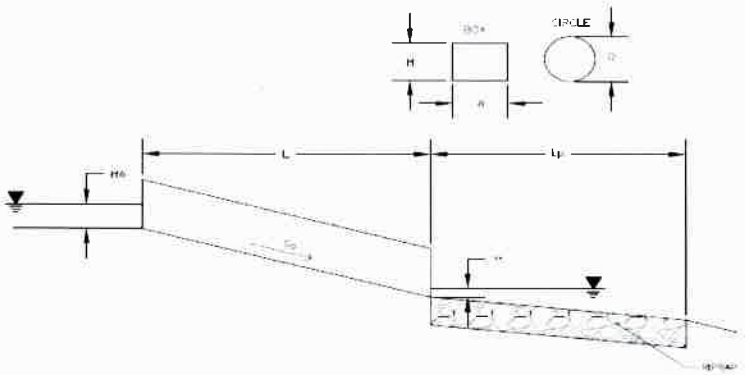
Required Protection (Output):

	Tailwater Surface Height	Y_t = 1.00	ft
	Flow Area at Max Channel Velocity	A_t = 1.44	ft^2
	Culvert Cross Sectional Area Available	A = 6.34	ft^2
	Entrance Loss Coefficient	k_e = 0.20	
	Friction Loss Coefficient	k_f = 0.68	
	Sum of All Losses Coefficients	k_s = 1.88	ft
	Culvert Normal Depth	Y_n = 0.38	ft
	Culvert Critical Depth	Y_c = 0.54	ft
	Tailwater Depth for Design	d = 1.27	ft
	Adjusted Diameter OR Adjusted Rise	H_a = 1.19	ft
	Expansion Factor	1/(2*tan(Θ)) = 6.65	
	Flow/Diameter$^{2.5}$ OR Flow/(Span * Rise$^{1.5}$)	Q/WH^1.5 = 0.80	$ft^{0.5}/s$
	Froude Number	Fr = 1.68	Supercritical!
	Tailwater/Adjusted Diameter OR Tailwater/Adjusted Rise	Yt/H = 0.84	
	Inlet Control Headwater	HW_I = 0.82	ft
	Outlet Control Headwater	HW_O = 0.61	
	Design Headwater Elevation	**HW =** 6,500.32	ft
	Headwater/Diameter OR Headwater/Rise Ratio	**HW/H =** 0.41	
	Minimum Theoretical Riprap Size	d_{50} = 0	in
	Nominal Riprap Size	d_{50} = 6	in
	UDFCD Riprap Type	**Type =** VL	
	Length of Protection	**L_p =** 6	ft
	Width of Protection	**T =** 5	ft

Determination of Culvert Headwater and Outlet Protection

Project: **Wyoming Subdivision**

Basin ID: **Basin B3**



Soil Type:

Choose One:
- (•) Sandy
- ( ) Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

Design Information (Input):

	Design Discharge	Q =	18.7	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =	30	inches
	Inlet Edge Type (Choose from pull-down list)			
Box Culvert:			OR	
	Barrel Height (Rise) in Feet	Height (Rise) =		ft
	Barrel Width (Span) in Feet	Width (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	No =	1	
	Inlet Elevation	Elev IN =	6545	ft
	Outlet Elevation **OR** Slope	Elev OUT =	6540.44	ft
	Culvert Length	L =	80	ft
	Manning's Roughness	n =	0.024	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	Elev Y_t =	6540.94	ft
	Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.50	ft
Flow Area at Max Channel Velocity	A_t =	3.74	ft^2
Culvert Cross Sectional Area Available	A =	4.91	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	2.50	
Sum of All Losses Coefficients	k_s =	3.70	ft
Culvert Normal Depth	Y_n =	1.02	ft
Culvert Critical Depth	Y_c =	1.47	ft
Tailwater Depth for Design	d =	1.98	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.76	ft
Expansion Factor	1/(2*tan(Θ)) =	3.85	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	1.89	$ft^{0.5}/s$
Froude Number	Fr =	1.99	Supercritical!
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.28	
Inlet Control Headwater	HW_I =	2.06	ft
Outlet Control Headwater	HW_O =	-1.74	
Design Headwater Elevation	**HW =**	**6,547.06**	ft
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.82**	
Minimum Theoretical Riprap Size	d_{50} =	10	in
Nominal Riprap Size	d_{50} =	12	in
UDFCD Riprap Type	**Type =**	**M**	
Length of Protection	L_p =	20	ft
Width of Protection	T =	8	ft

APPENDIX C

DESIGN CHARTS

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Figure 6-25. Estimate of Average Concentrated Shallow Flow

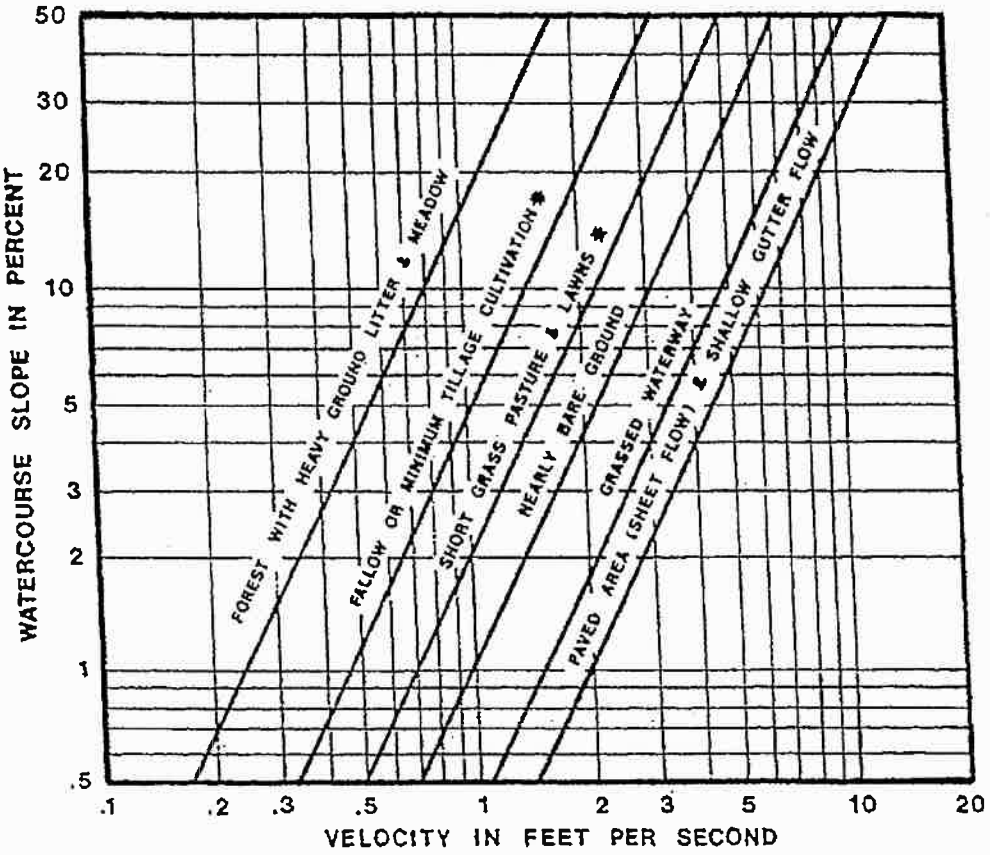
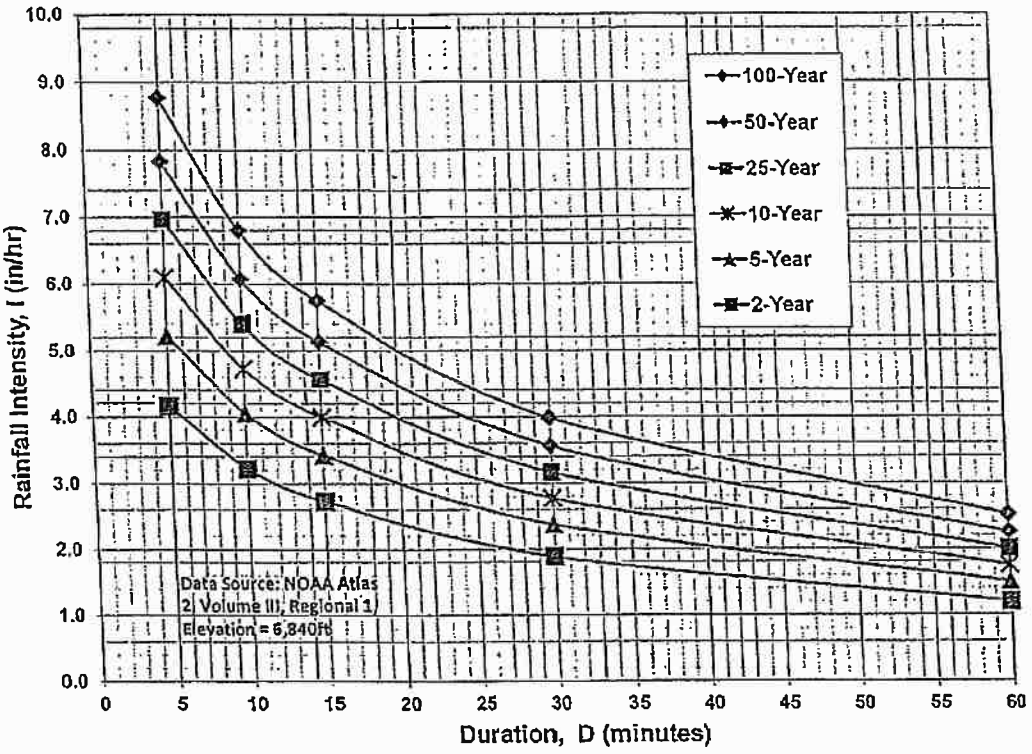


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

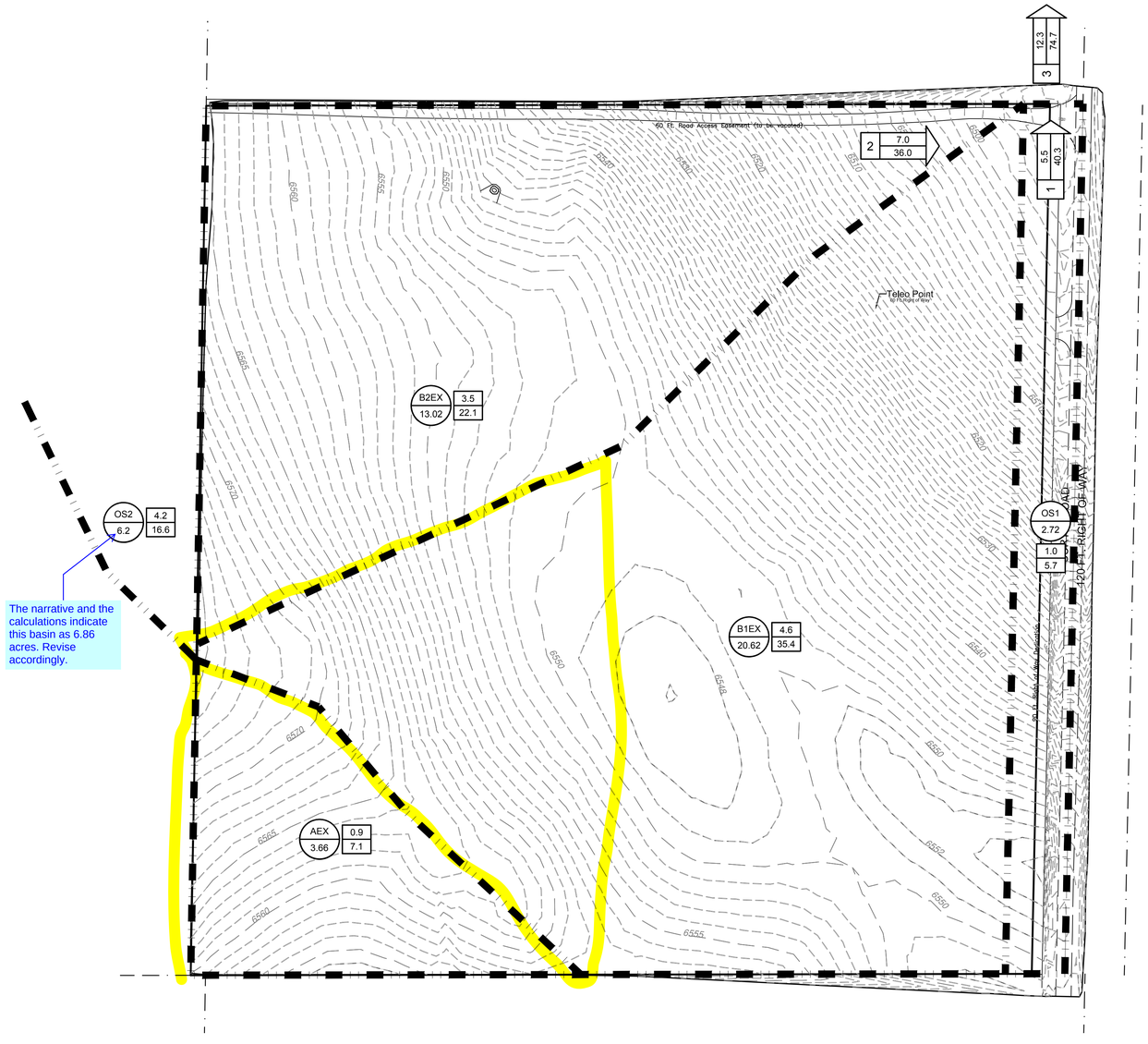
$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_5 = -1.50 \ln(D) + 7.583$

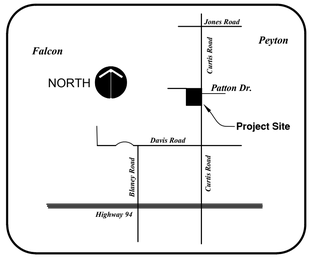
$I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.



The narrative and the calculations indicate this basin as 6.86 acres. Revise accordingly.

VICINITY MAP:



LEGEND

- A1A / XX — BASIN DESIGNATION; BASIN AREA, ACRES
- XX / XX — 5 YEAR STORM, CFS; 100 YEAR STORM, CFS
- DESIGN POINT — XX / XX.X / XX.X — 5 YEAR ACCUMULATED FLOW, CFS; 100 YEAR ACCUMULATED FLOW, CFS
- SUB–BASIN BOUNDARY
- DIRECTION OF DRAINAGE FLOW

Review 1: Please show flow arrows on the drainage plan. Review 2: Unresolved

EXISTING CONDITIONS			
AREA DESIGNATION	Q5	Q100	ACRES
AEX	0.9	7.1	3.66
B1EX	4.6	35.4	20.62
B2EX	3.5	22.1	13.02
OS1	1.0	5.7	2.72
OS2	4.2	16.6	6.86
DP1(B1EX&OS1)	5.5	40.3	23.34
DP2(B2EX&OS2)	7.0	36.0	19.88
DP3(DP1&DP2)	12.3	74.7	43.22

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

PCD PROJECT NO. MS196

REVISION			
DESIGNED	MAB		
DRAWN	HJG		
CHECKED	MAB		
DATE	09/27/2019		

RESPEC (FORMERLY ADP)
3520 AUSTIN BLUFFS PKWY
SUITE 102
COLORADO SPRINGS, CO 80918
PHONE (719) 266-5212

STAMP

Know what's below. Call before you dig.

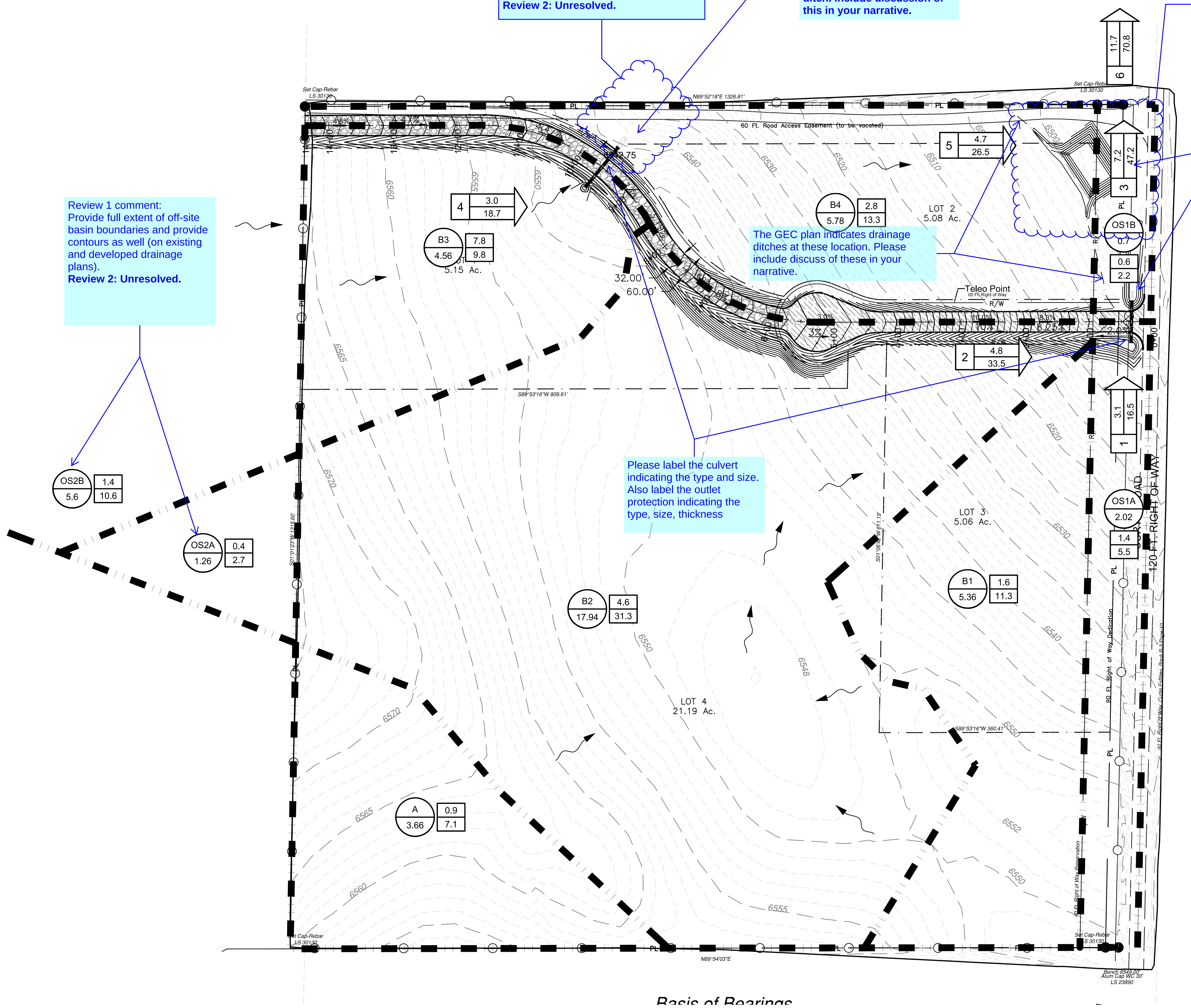
PROJ NO. 03433
DWG NM. 03433-GrdgEros

HOME RUN RESTORATIONS, INC
5090 WILEY RD
PEYTON, CO 80831

WYOMING ESTATES
SUBDIVISION
EL PASO COUNTY, CO

DRAINAGE PLAN
EXISTING CONDITIONS

DRAWING NUMBER:
C
SHEET 1



Review 1 comment:
Based on the contours the outflow from design from DP4 is discharged to the property to the north and does not appear to flow to the east as indicated in the narrative. Revise.

Review 2: Unresolved.

Review 1 comment: Provide analysis from the culvert outfall to the suitable outfall i.e. roadside ditch.

review 2: unresolved. Please provide analysis from this outfall to the roadside ditch. include discussion of this in your narrative.

Please address any permanent stormwater quality control measure in your narrative and provide discussion on how the developed runoff will be conveyed to the permanent control measure. Additionally provide the appropriate construction documents for any permanent water quality facilities.

Relocate this design point label to the RCEP outfall as this design point does not include flows from basin OS1B

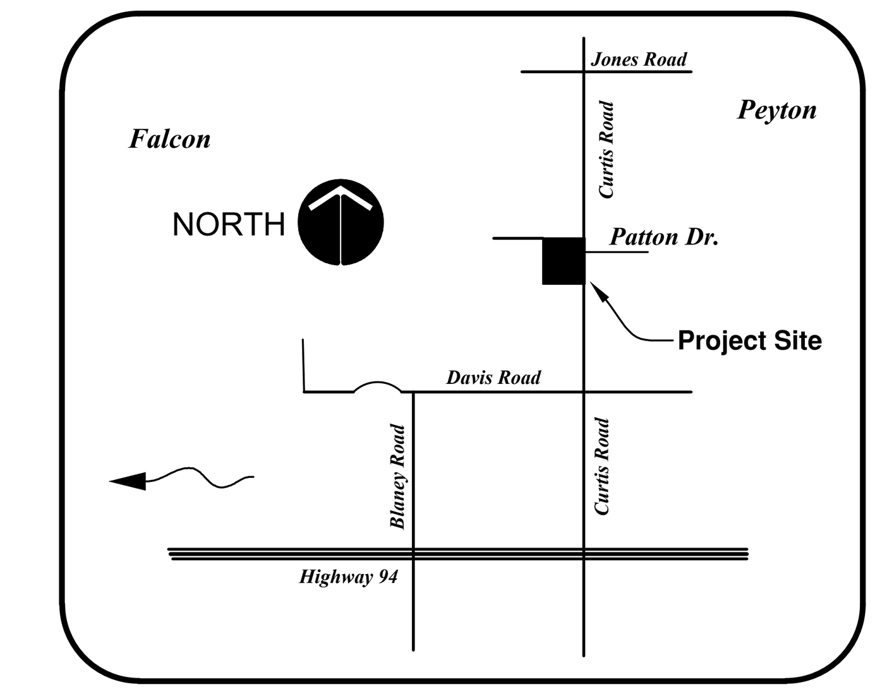
Review 1 comment:
Provide full extent of off-site basin boundaries and provide contours as well (on existing and developed drainage plans).
Review 2: Unresolved.

The GEC plan indicates drainage ditches at these location. Please include discuss of these in your narrative.

Review 1 comment:
Provide calculations for the road side ditches, existing and proposed.
Review 2: Unresolved

Please label the culvert indicating the type and size. Also label the outlet protection indicating the type, size, thickness

VICINITY MAP:



LEGEND

- A1A / XX — BASIN DESIGNATION / BASIN AREA, ACRES
- XX / XX — 5 YEAR STORM, CFS / 100 YEAR STORM, CFS
- DESIGN POINT XX | XX.X / XX.X — 5 YEAR ACCUMULATED FLOW, CFS / 100 YEAR ACCUMULATED FLOW, CFS
- SUB-BASIN BOUNDARY
- DIRECTION OF DRAINAGE FLOW

GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

PROPOSED CONDITIONS

AREA DESIGNATION	Q5	Q100	ACRES
A	0.9	7.1	3.66
B1	1.6	11.3	5.36
B2	4.5	31.3	17.94
B3	1.8	9.8	4.56
B4	2.8	13.3	5.78
OS1A	1.4	5.5	2.02
OS1B	0.6	2.2	0.70
OS2A	0.4	2.7	5.50
OS2B	1.4	10.6	1.25
DP1(OS1A&B1)	3.0	16.5	7.38
DP2(OS2A&B2)	4.8	33.5	19.20
DP3(DP1&DP2)	7.2	47.2	26.58
DP4(OS2B&B3)	2.9	18.7	10.16
DP5(DP4&B4)	4.7	26.5	15.94
DP1(DP5&OS1B)	11.7	70.8	43.22

PCD PROJECT NO. MS196

REVISION

DESIGNED MAB
DRAWN HJG
CHECKED MAB
DATE 02/28/2019

RESPEC (FORMERLY ADP)
3520 AUSTIN BLUFFS PKWY
SUITE 102
COLORADO SPRINGS, CO 80918
PHONE (719) 266-5212

STAMP

811 Know what's below. Call before you dig.

PROJ NO. 03433
DWG NM. 03433-GrdgEros

HOME RUN RESTORATIONS, INC
5090 WILEY RD
PEYTON, CO 80831

WYOMING ESTATES SUBDIVISION
EL PASO COUNTY, CO

DRAINAGE PLAN DEVELOPED CONDITIONS

DRAWING NUMBER:
C
SHEET 2

NAME: K:\LAND PROJECTS\2018\03433-3050 CURTIS ROAD\DWG\03433-DRNGDEV.DWG
PLOT DATE: September 30, 2019 1:21 PM, BY: JIM GILL