

**Draft Drainage Report
For
Weston Estates**

Date: August 31, 2023

Prepared by: Vortex Engineering, Inc.
861 Rood Avenue
Grand Junction, CO 81505
970-245-9051
VEI # F20-009

Submitted To: City of Fruita
250 N. 5th Street
Grand Junction, CO 81501

Type of Design: Major Subdivision Final Plan

Applicant: M & D ENTERPRISES LLC
PO BOX 1968
GRAND JUNCTION, CO 81502

Property Address: 1877 J 2/10 RD
FRUITA, CO 81521

Tax Schedule No.: 2697-164-00-129
2697-164-00-074
2697-164-00-050

"I hereby certify that this *Final Drainage Report* for the design of Weston Estates Subdivision located at 1826 to 1892 Broadway Grand Junction, Colorado was prepared by me (or under my direct supervision) in accordance with the provisions of the *Stormwater Management Manual* for the owners thereof. I understand that the (local jurisdiction) does not and will not assume liability for drainage facilities designed by others."

Stephen E. Swindell, P.E.
Registered Professional Engineer,
State of Colorado No. 57688

I, _____ hereby certify that the drainage facilities for Weston Estates Subdivision shall be constructed according to the design presented in this report. I understand that the City of Fruita does not and will not assume liability for the drainage facilities designed and/or certified by my engineer. I understand that the City of Fruita reviews drainage plans but cannot, on behalf of Weston Estates Major Subdivision, guarantee that final drainage design review will absolve Russ Little and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Final Plat and/or Final Development Plan does not imply approval of my engineer's drainage design.

Authorized Signature Date

Authorized Signature Date

Authorized Signature Date

Table of Contents

I. Introduction	5
A. Background	5
B. Project Location	5
C. Property Description	5
D. Previous Investigations	5
II. Drainage System Description	6
A. Existing Drainage Conditions	6
B. Master Drainage Plan	6
C. Offsite Tributary Area	6
D. Proposed Drainage system Description	6
E. Drainage Facility Maintenance	7
III. Drainage Analysis and Design Criteria	8
A. Regulations and Development Criteria	8
B. Hydrologic and Hydraulics	8
C. HGL Analysis	8
IV. Conclusions	8
V. Limitations/Restrictions	8
VI. References	9
Appendix A – Location Map	10
Appendix B – NCRS Soils Map	11
Appendix C – FEMA FIRM Maps	12
Appendix D – Calculations	13
Appendix E – Checklists	14
Appendix F – Drainage Maps	15

I. Introduction

A. Background

This Final Drainage Report has been prepared by Vortex Engineering, Inc., and is required as part of the Major Subdivision development process. This Drainage Report has been created in accordance with Mesa County Stormwater Management Manual. This drainage report is prepared for all the phases of the project.

B. Project Location

The Weston Estates subdivision consists of three parcels of land totaling approximately 27.7 acres in size, located at the corner of J Road and 19 Road. To the north the project borders J 2/10 right-of-way. To the west the site is abutting residential/agricultural parcels. To the east and the south the site is adjacent to 19 Road and J Road, respectively.

C. Property Description

Currently the site is being used for agricultural purposes, with a residential single-family house and 2 outbuildings located in the north east corner of the west parcel. It is proposed for this house and the outbuildings to be demolished in the second phase of the project.

The Natural Resources Conservation Service (NRCS) lists the following soils within the development boundary: Turley clay loam (Soil No. Tr) with slopes of 0 to 2 percent. This soil is hydrologic group C. This soil occupies the middle of the site. On the eastern and western outskirts of the site is Fruitland sandy clay loam (Soil No. Rc) hydrologic group B. Hydrologic group C shall be used for the entire area in this study.

D. Previous Investigations

One previous drainage study has been conducted the Weston Estates Filing 1 Final Drainage Report dated October 17, 2007, by Vortex Engineering. The layout and additional area added to the project has changed in this version warranting the new study.

II. Drainage System Description

A. Existing Drainage Conditions

At the present time the site is used for agricultural purposes with one residence situated in the northwest of the site. The runoff is intercepted by tailwater irrigation ditches along the southern boundaries, and conveying it to the west along J Road into a Grand Valley Drainage District (GVDD) Coup Drain. The drain carries the runoff southwards to its ultimate discharge point in the Colorado River. The bellosed table is the summary of the existing runoff from the site.

DRAINAGE AREA	2-Yr. Q (cfs) Basin Runoff	100-Yr. Q (cfs) Basin Runoff
EX-100	0.24	7.49
EX-200	0.54	16.58

B. Master Drainage Plan

The site is located in Basin 117 of the Mesa County Master Drainage Plan. The basin discharges into the Colorado River.

C. Offsite Tributary Area

The offsite basins associated with this site consist of the runoff from the half 19 Road right-of-way along the project, half of the J 2/10 Road right-of-way along the project and half of Rich Avenue adjacent to the site. The runoff from the above offsite basins is intercepted in proposed storm sewer inlets, ditches and diverted to the discharge point in the GVDD Coup Drain.

D. Proposed Drainage system Description

The proposed conditions on the site consist of 126 lots, the right-of-way, various tracts, and the open space. The lots vary in size between 4600 sf and 7700 sf. The right-of-way amounts to approximately 6 acres whereas the lots, open space and detention ponds amount to approximately 21.7 acres. The on-site storm water system consists of overland flow, gutter flow, storm sewer inlets and two detention ponds. The ponds 100 and 200 are designed to provide 2-stage detention and water quality volume. The runoff from the lots is routed via gutters and storm sewer into the detention ponds, where the runoff is treated and attenuated prior to the release thru the respective outlet structures. The outlet structures from the ponds direct the treated outfall into the proposed storm sewer in J Road toward the intersection of Rich Avenue and J Road where when combined in storm sewer manhole 300, the outfall is discharged into the GVDD Coup drain just south of J Road.

Proposed Basin Runoff Table:

DRAINAGE AREA	2-Yr. Q (cfs) Basin Runoff	100-Yr. Q (cfs) Basin Runoff
100	0.33	2.03
101	1.83	10.30
102	2.35	13.74
103	0.21	1.49
104	0.29	2.01
200	0.39	2.51
201	1.31	7.77
202	2.05	11.85
OS-W	0.88	3.74
OS-E1	0.16	0.68
OS-W	0.26	1.10

No FEMA jurisdictional flood plain was identified in the vicinity of the project site.. (see Appendix C).

E. Drainage Facility Maintenance

All facilities will be accessible for maintenance and occasional cleaning. The Home Owners Association is responsible for routine maintenance, any workmanship defects, and for removal and clean-up of debris, dirt and mud in the system. The facilities will be inspected at least once a year by a certified SWMP administrator to determine adequacy of the performance of the structures. The HOA will follow inspection recommendations for maintenance of the storm sewer facilities.

III. Drainage Analysis and Design Criteria

A. Regulations and Development Criteria

The analysis and design were prepared in accordance with the provisions of the Mesa County Stormwater Management Manual (SWMM) guidelines.

B. Hydrologic and Hydraulics

The hydrologic and hydraulic analysis proposed is to use procedures per the SWMM guidelines.

The supporting drainage design and calculations were performed in accordance with the Mesa County/City of Grand Junction Stormwater Management Manual (SWMM) and the UDFCD "Urban Storm Drainage Criteria Manual, Volume 1.

C. HGL Analysis

See Appendix D of this report.

IV. Conclusions

The proposed drainage plan for the Weston Estates Subdivision complies with the adopted SWMM for Mesa County. No variance from the said regulations is anticipated at this time. Adherence to this drainage report will not cause any negative impacts to this site or to downstream of the site. The SWMM checklist for the Drainage Report and Drainage Plan are included in Appendix E.

V. Limitations/Restrictions

This report is a site-specific design for drainage and is applicable only for the client for whom out work was performed. Use of this report under other circumstances is not an appropriate application of this document. This report is a product of Vortex Engineering & Architecture Incorporated and is to be taken in its entirety. Excerpts from this report may be taken out of context and may not convey the true intent of the report. It is the owner's and owner's agent's responsibility to read this report and become familiar with recommendations and design guidelines contained herein.

The recommendations and design guidelines outlined in this report are based on: 1) the proposed Site Development and Grading Plan prepared by Vortex Engineering & Architecture Inc., 2) the site conditions disclosed at the specific time of the site investigation of reference, and 3) the boundary and topographic survey prepared by Vortex Engineering, Inc. assumes no liability for the accuracy or completeness of information furnished by the client. Site conditions are subject to external environmental effects and may change over time. Use of this plan under different site conditions is inappropriate. If it becomes apparent that current site conditions vary from those anticipated, the design engineer should be contracted to develop any required design modifications. Vortex Engineering & Architecture,

Inc. is not responsible and accepts no liability for any variation in assumed design parameters.

Vortex Engineering, Inc. represents this report has been prepared within the limits prescribed by the owner and in accordance with the current accepted practice of the civil engineering profession in the area.

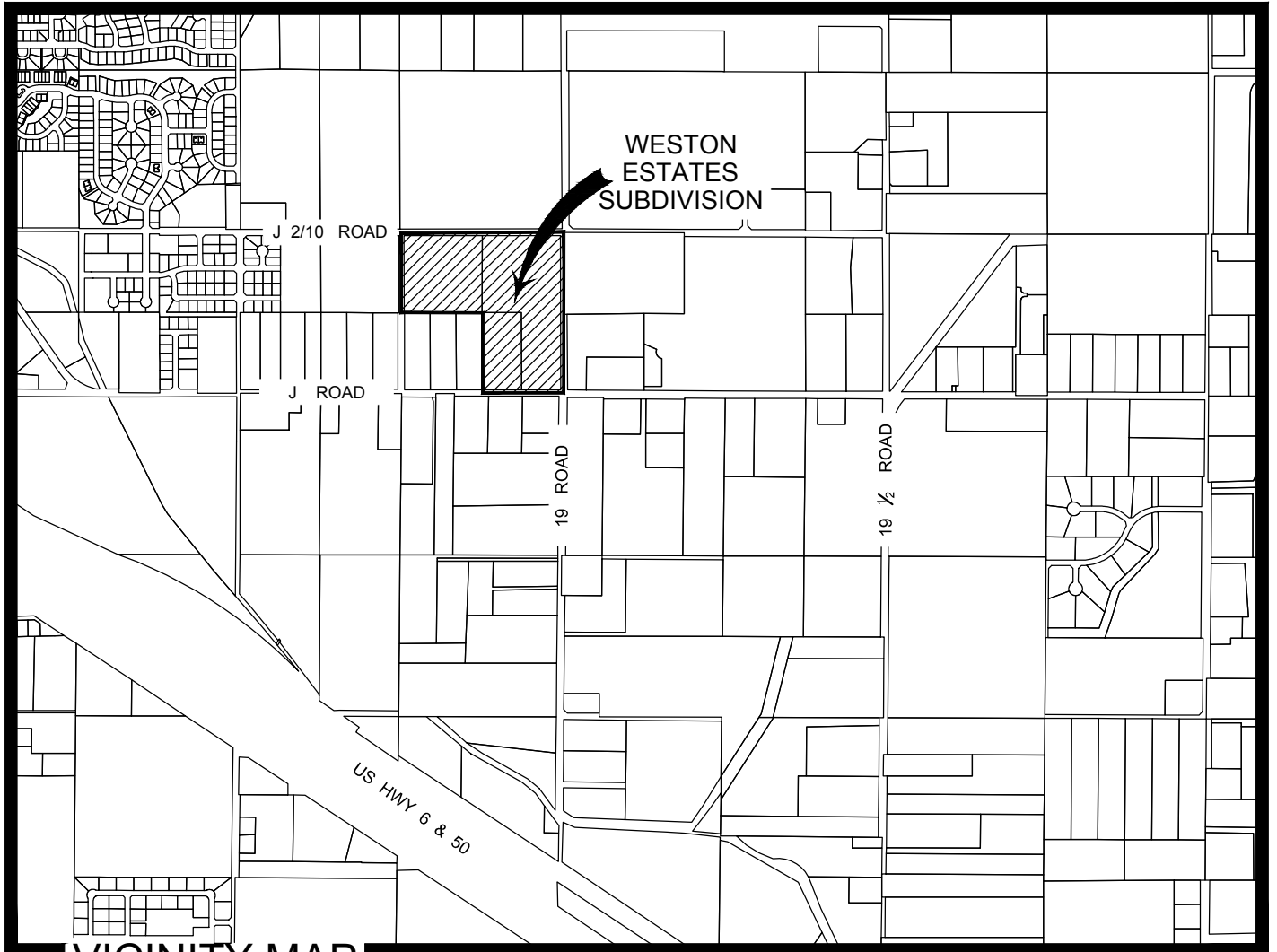
No warranty or representation either expressed or implied is included or intended in this report or in any of our contracts.

VI. References

The following manuals and computer programs were used for this drainage report:

- Mesa County Stormwater Management Manual (SWMM), dated December 2007
- NRCS Soils Survey
- Federal Emergency Management Agency, Flood Insurance Rate Map, Mesa County, Colorado and Unincorporated Areas, Map No. 08077C0439F

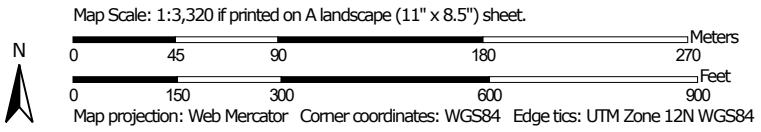
Appendix A – Location Map



VICINITY MAP


Appendix B – NCRS Soils Map

Soil Map—Mesa County Area, Colorado



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
 Survey Area Data: Version 11, Jun 8, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 13, 2010—Aug 8, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Rc	Fruitland sandy clay loam, 0 to 2 percent slopes	11.7	40.4%
Tr	Turley clay loam, 0 to 2 percent slopes	17.3	59.6%
Totals for Area of Interest		29.1	100.0%

Mesa County Area, Colorado

Rc—Fruitland sandy clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: k0d0
Elevation: 4,490 to 4,890 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Fruitland and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fruitland

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Cretaceous source alluvium derived from sandstone and shale

Typical profile

Ap - 0 to 8 inches: sandy clay loam
C1 - 8 to 30 inches: gravelly sandy loam
C2 - 30 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.71 to 2.13 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: B
Ecological site: R034BY115UT - Desert Sandy Loam (Indian Ricegrass)

Hydric soil rating: No

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 11, Jun 8, 2020

Mesa County Area, Colorado

Tr—Turley clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: k0d8
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Turley and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Turley

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Cretaceous slope alluvium derived from sandstone and shale

Typical profile

Ap - 0 to 10 inches: clay loam
C1 - 10 to 20 inches: fine sandy loam
C2 - 20 to 30 inches: clay loam
C3 - 30 to 60 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.21 to 0.71 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 5e

Hydrologic Soil Group: C
Ecological site: R034BY106UT - Desert Loam (Shadscale)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 11, Jun 8, 2020

Appendix C – FEMA FIRM Maps

National Flood Hazard Layer FIRMette



108°42'32"W 39°9'24"N



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, Areas 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 D

GENERAL STRUCTURES

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

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
- 17.5 Coastal Transect
- 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

The pin displayed on the map is an approximate point selected by the user and does not represent 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 10/19/2020 at 2:39 PM 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 D – Calculations

Detention Pond Calculations

Elevation [ft.]	Area [ft ²]	Stage Volume [cf]	Change in Elevation [ft]	Cumulative Volume [cf]	Cumulative Volume [acre-ft]
4533.56	-	-	-	-	-
4534.00	1,057	155	0	155	0.00
4535.00	3,987	2,366	1	2,521	0.06
4536.00	5,468	4,708	1	7,229	0.17
4537.00	7,036	6,236	1	13,464	0.31
4538.00	8,692	7,849	1	21,314	0.49
4539.00	10,434	9,550	1	30,863	0.71
4540.00	17,305	13,725	1	44,589	1.02

$$WQCV = K(a(0.91I^3 - 1.19I^2 + 0.78I))$$

Where:

$$K = \text{adjustment to equation for Mesa County} = d_6 / 0.43 = 0.65$$

$$a = \text{Adjustment for BMP's drain Time (for 40hrs } a=1.0) = 1.00$$

$$I = \text{watershed Imperviousness in decimal} = 0.55$$

$$d_6 = \text{Depth of average producing storm } d_6 = 0.28$$

$$\text{Watershed area} = 14.72$$

WQCV =	0.143 in	
Req'd storage WQCV =	7,633 cf	
120% sediment adjustment =	9,159 cf	4536.31

Req'd 10 yr Volume:

$$K_{10} = (0.95P - 1.90)(X_{10}/1000) = 0.0190$$

$$V_{10} = K_{10}A = 0.280 \text{ ac-ft}$$

$$V_{10} = 12,186 \text{ cf}$$

Where:

$$P = \text{Developed Basin Imperviousness (\%)}$$

$$X = \text{Mesa Co. adjustment factor } X_{10}=0.38, X_{100}=0.48$$

for imperviousness $\geq 50\%$ (SWMM Table 1401)

$$A = \text{Tributary Area (ac)}$$

$$V = \text{Volume (ac-ft)}$$

Req'd 100 yr Volume:

$$K_{100} = (1.78P - 0.002P^2 - 3.56)(X_{100}/900) = 0.0468$$

$$V_{100} = K_{100}A = 0.689 \text{ ac-ft}$$

$$V_{100} = 30003 \text{ cf}$$

		WSEL (ft)
10 yr Volume + WQCV =	21,345 cf	4538.00
100 yr Volume =	30,003 cf	4539.11

Allowable Peak Discharge (SWMM table 1402)

$$10 \text{ yr} = 1.77 \text{ cfs}$$

$$100 \text{ yr} = 7.36 \text{ cfs}$$

* Water surface elevation thru linear interpolation

** Water Surface by hydrograph routing

WQCV Orifice Plate Area

Per UDFCD Volume 2, SO-13a, pg SO-12

$$A_o = \frac{88V^{(0.95/H^{0.085})}}{T_D S^{0.09} H^{(2.65/0.8)}}$$

A_o = area per row of orifice spaced on 4" centers (in²)

V = design volume (WQCV, ac-ft)

T_D = Time to drain the prescribed volume (hrs)

H = Depth of Volume (ft)

S = slope (ft/ft)

V = 0.21027 ac-ft

T_D = 40 hrs

H = 2.75 ft

S = 0.005 ft/ft

A_o = 0.9007 in²

of columns = 1

area per hole in a row (in²) = 0.9007

hole diameter (in) = 1.0709

USE 1 1/8 "

DIA. HOLES

10 Year Orifice

$Q_{10} = 1.77 \text{ cfs}$

Allowable Discharge (cfs)=	1.77
Orifice Coefficient $C_d =$	0.65
10yr Water Surface Elevation (ft)=	4538.00
Orifice Invert Elevation (ft)=	4536.31
Total Head (ft)=	1.69
Orifice Required Area (ft ²)=	0.26
Diameter (in)=	6.91

Orifice Diameter = 7 "

100 Year Rectangular Weir

$Q_{100} = 7.36 \text{ cfs}$

Allowable Discharge (cfs)=	5.59
Weir Coefficient $C_w =$	3.33
100 yr WS Elevation (ft)=	4539.11
Weir Invert Elevation (ft)=	4538.00
Total Head (ft)=	1.10
Weir Base Width (ft)=	1.45

$Q_{100} - Q_{10}$

Weir width = 17 3/8"

Detention Pond Calculations

Elevation [ft.]	Area [ft ²]	Stage Volume [cf]	Change in Elevation [ft]	Cumulative Volume [cf]	Cumulative Volume [acre-ft]
4533.40	-	-	-	-	-
4534.00	6,620.00	1,324	1	1,324	0.03
4535.00	7,572.00	7,091	1	8,415	0.19
4536.00	8,578.00	8,070	1	16,484	0.38
4537.00	9,638.00	9,103	1	25,587	0.59
4538.00	21,350.00	15,111	1	40,698	0.93

$$WQCV = K(a(0.91I^3 - 1.19I^2 + 0.78I))$$

Where:

K = adjustment to equation for Mesa County = $d_6/0.43$ = 0.65

a = Adjustment for BMP's drain Time (for 40hrs a=1.0) = 1.00

I = watershed Imperviousness in decimal = 0.55

d_6 = Depth of average producing storm d_6 = 0.28

Watershed area = 13.01

WQCV = 0.143 in
Req'd storage WQCV = 6,746 cf
120% sediment adjustment = 8,095 cf 4534.96

Req'd 10 yr Volume:

$K_{10} = (0.95P - 1.90)(X_{10}/1000)$ 0.0190
 $V_{10} = K_{10}A$ 0.247 ac-ft
 $V_{10} =$ 10,770 cf

Where:

P = Developed Basin Imperviousness (%)
X = Mesa Co. adjustment factor $X_{10}=0.38$, $X_{100}=0.48$
for imperviousness $\geq 50\%$ (SWMM Table 1401)
A = Tributary Area (ac)
V = Volume (ac-ft)

Req'd 100 yr Volume:

$K_{100} = (1.78P - 0.002P^2 - 3.56)(X_{100}/900)$ 0.0468
 $V_{100} = K_{100}A$ 0.609 ac-ft
 $V_{100} =$ 26518 cf

10 yr Volume + WQCV = 18,866 cf WSEL (ft) 4536.56
100 yr Volume = 26,518 cf 4537.10

Allowable Peak Discharge (SWMM table 1402)

10 yr = 1.56 cfs (C Soils Hydrologic Group)
100 yr = 6.51 cfs

WQCV Orifice Plate Area

Per UDFCD Volume 2, SO-13a, pg SO-12

$$A_o = \frac{88V^{(0.95/H^{0.085})}}{T_D S^{0.09} H^{(2.65/0.8)}}$$

A_o = area per row of orifice spaced on 4" centers (in²)

V = design volume (WQCV, ac-ft)

T_D = Time to drain the prescribed volume (hrs)

H = Depth of Volume (ft)

S = slope (ft/ft)

V = 0.18585 ac-ft

T_D = 40 hrs

H = 1.56 ft

S = 0.005 ft/ft

A_o = 0.7568 in²

of columns = 1

area per hole in a row (in²) = 0.7568

hole diameter (in) = 0.9816

USE 1 " DIA. HOLES

10 Year Rectangular Weir

$Q_{100} = 1.56$ cfs

Allowable Discharge (cfs)=	1.56
Weir Coefficient $C_w =$	3.33
10 yr WS Elevation (ft)=	4536.56
Weir Invert Elevation (ft)=	4534.96
Total Head (ft)=	1.59
Weir Base Width (ft)=	0.23

Use 2 3/4 " wide weir

100 Year Rectangular Weir

$Q_{100} = 6.51$ cfs

Allowable Discharge (cfs)=	4.94	$Q_{100} - Q_{10}$
Weir Coefficient $C_w =$	3.33	
100 yr WS Elevation (ft)=	4537.10	
Weir Invert Elevation (ft)=	4536.56	
Total Head (ft)=	0.55	
Weir Base Width (ft)=	3.67	

Use 3.67 ft wide weir

Basin 100

Reach	Distance (ft.)	Flow Type	Cover Type	K	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	55.00	Overland Flow	Grass, Pasture	0.4	2.00	na	7.4
2		Shalow Concentrated	Curb and Gutter		na		
3	421.00	Gutter/Channel Flow	Curb and Gutter		0.500	1.10	6.4
4	0.00	ditch flow	Grass Ditch		1.000	0.70	0.0
Total	476.00						13.80

Total Time of Concentration = 14 minutes

Basin 101

Reach	Distance (ft.)	Flow Type	Cover Type	K	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	131.00	Overland Flow	Grass, Pasture	0.9	0.70	na	4.6
2		Shalow Concentrated	Curb and Gutter		na		
3	1,121.00	Gutter/Channel Flow	Curb and Gutter	na	0.80	1.50	12.5
4		ditch flow	Roadside ditch		na		
Total	1,252.00						17.10

Total Time of Concentration = 17 minutes

Basin 102

Reach	Distance (ft.)	Flow Type	Cover Type	K or C _s	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	207.00	Overland Flow	Grass, Pasture	0.9	0.80	na	5.6
2		Shalow Concentrated	Curb and Gutter		na		
3	860.00	Gutter/Channel Flow	Curb and Gutter		0.70	1.50	9.6
4		ditch flow	Roadside ditch		na		
Total	1,067.00						15.14

Total Time of Concentration = 15 minutes

Basin 103

Reach	Distance (ft.)	Flow Type	Cover Type	K or C _s	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	93.00	Overland Flow	Grass, Pasture	0.4	2.00	na	9.6
2		Shalow Concentrated	Curb and Gutter		na		
3	292.00	Gutter/Channel Flow	Curb and Gutter		0.80	1.50	3.2
4		ditch flow	Roadside ditch		na		
Total	385.00						12.89

Total Time of Concentration = 13 minutes

Basin 104

Reach	Distance (ft.)	Flow Type	Cover Type	K or C _s	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	86.00	Overland Flow	Grass, Pasture	0.4	2.00	na	9.3
2		Shalow Concentrated	Curb and Gutter		na		
3	684.00	Gutter/Channel Flow	Curb and Gutter		0.80	1.50	7.6
4		ditch flow	Roadside ditch		na		
Total	770.00						16.87

Total Time of Concentration = 17 minutes

Basin 200

Reach	Distance (ft.)	Flow Type	Cover Type	K or C _s	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	175.00	Overland Flow	Grass, Pasture	0.4	3.00	na	11.6
2		Shalow Concentrated	Curb and Gutter		na		
3	1,119.28	Gutter/Channel Flow	Curb and Gutter		1.00	1.50	12.4
4		ditch flow	Roadside ditch		na		
Total	1,294.28						23.99

Total Time of Concentration = 24 minutes

Basin 201

Reach	Distance (ft.)	Flow Type	Cover Type	K or C _s	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	166.00	Overland Flow	Grass, Pasture	0.4	1.50	na	14.2
2		Shalow Concentrated	Curb and Gutter		na		
3	1,472.00	Gutter/Channel Flow	Curb and Gutter		0.70	1.50	16.4
4		ditch flow	Roadside ditch		na		
Total	1,638.00						30.54

Total Time of Concentration = 31 minutes

Basin 202

Reach	Distance (ft.)	Flow Type	Cover Type	K or C _s	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	102.00	Overland Flow	Grass, Pasture	0.4	3.00	na	8.8
2		Shallow Concentrated	Curb and Gutter		na		
3	740.94	Gutter/Channel Flow	Curb and Gutter		0.70	1.50	8.2
4		ditch flow	Roadside ditch		na		
Total	842.94						17.06

Total Time of Concentration = 17 minutes

Basin OS-W

Reach	Distance (ft.)	Flow Type	Cover Type	K or C _s	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	62.00	Overland Flow	Grass, Pasture	0.9	2.00	na	2.2
2		Shallow Concentrated	Curb and Gutter		na		
3	1,867.00	Gutter/Channel Flow	Curb and Gutter		0.60	2.00	15.6
4		ditch flow	Roadside ditch		na		
Total	1,929.00						17.81

Total Time of Concentration = 18 minutes

Basin OS-E1

Reach	Distance (ft.)	Flow Type	Cover Type	K/C _s	Slope %	Velocity (ft./sec.)	Travel Time (min.)
1	52.00	Overland Flow	Grass, Pasture	0.4	2.30	na	6.9
2		Shallow Concentrated	Curb and Gutter		na		
3	428.00	Gutter/Channel Flow	Curb and Gutter		0.65	1.50	4.8
4		ditch flow	Roadside ditch		na		
Total	480.00						11.64

Total Time of Concentration = 12 minutes

Weston Estates

Vortex Engineering, Inc.

Basin Runoff Calculation

September 25, 2020

DRAINAGE	INLET/DP	Area	'C ₂ '	'C ₁₀₀ '	T _c	2-Yr. Storm Intensity	100-Yr. Storm Intensity	2-Yr. Q (cfs)	100-Yr. Q (cfs) Basin	Inlet Type for Minor Storm
BASIN	#	(ac)	Weighted	Weighted	(min)	(in/hr)	(in/hr)	Basin Runoff	Runoff	
100		0.96	0.43	0.66	14	0.81	3.21	0.33	2.03	Detention pond 100
101		5.12	0.49	0.70	17	0.73	2.90	1.83	10.30	Inlet 101
102		6.62	0.46	0.68	15	0.78	3.07	2.35	13.74	Inlet 102
103		0.75	0.34	0.60	13	0.84	3.31	0.21	1.49	
104		1.15	0.34	0.60	17	0.74	2.91	0.29	2.01	
200		1.63	0.39	0.63	24	0.61	2.42	0.39	2.51	
201		5.51	0.45	0.67	31	0.54	2.11	1.31	7.77	Inlet 201
202		6.00	0.46	0.68	17	0.74	2.90	2.05	11.85	Inlet 202
Total on site basins =		27.74								
OS-W		1.37	0.89	0.96	18	0.72	2.84	0.88	3.74	
OS-E1		0.20	0.89	0.96	12	0.88	3.46	0.16	0.68	
OS-E2		0.38	0.89	0.96	16	0.77	3.02	0.26	1.10	

5 K:\Weston Estates_F20-052\Cad Drawings\references\Weston Estates-SOURCE.dwg
 6

7
 8 *****

9 Element Count

10 *****

11 Number of rain gages 0
 12 Number of subcatchments ... 0
 13 Number of nodes 22
 14 Number of links 19
 15 Number of pollutants 0
 16 Number of land uses 0
 17

18 *****

19 Node Summary

20 *****

21	22	23	24	25	26	27	28
Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow		
25	POND 100-OUTLET	JUNCTION	4533.39	5.51	0.0	Yes	
26	POND 200-OUTLET	JUNCTION	4533.42	2.21	0.0	Yes	
27	MH-302	JUNCTION	4538.32	5.55	0.0		
28	MH-301	JUNCTION	4533.30	7.59	0.0		
29	MH-306	JUNCTION	4533.17	5.18	0.0		
30	MH-304	JUNCTION	4532.06	6.25	0.0		
31	MH-300	JUNCTION	4530.39	7.31	0.0		
32	MH-303	JUNCTION	4530.73	5.19	0.0		
33	EX-S	JUNCTION	4530.25	7.25	0.0		
34	INLET-OS-W	JUNCTION	4533.40	4.73	0.0	Yes	
35	INLET-101	JUNCTION	4535.29	2.87	0.0	Yes	
36	INLET-102	JUNCTION	4535.44	2.72	0.0	Yes	
37	INLET-202	JUNCTION	4534.35	3.00	0.0	Yes	
38	INLET-201	JUNCTION	4534.14	3.06	0.0	Yes	
39	OS-E2	JUNCTION	4539.99	6.00	0.0	Yes	
40	104	JUNCTION	4541.16	6.00	0.0	Yes	
41	OS-E1-US	JUNCTION	4543.01	6.00	0.0	Yes	
42	OS-E2-DS	JUNCTION	4541.02	6.00	0.0		
43	OS-E1-DS	JUNCTION	4542.38	6.00	0.0		
44	FES-POND200	OUTFALL	4533.98	1.00	0.0		
45	POND100-FES	OUTFALL	4534.89	1.50	0.0		
46	FES-COUPDITCH	OUTFALL	4530.09	1.50	0.0		

47
 48 *****

49 Link Summary
 50

Name	From Node	To Node	Type	Length	%Slope	Roughness
301-300	MH-301	MH-300	CONDUIT	675.6	0.4001	0.0130
POND100-301	POND 100-OUTLET	MH-301	CONDUIT	52.3	0.5005	0.0130
102-101	INLET-102	INLET-101	CONDUIT	30.0	0.5000	0.0130
101-POND100FES	INLET-101	POND100-FES	CONDUIT	78.7	0.5097	0.0130
OS-E2-302	OS-E2	MH-302	CONDUIT	47.2	3.1154	0.0130
302-301	MH-302	MH-301	CONDUIT	577.6	0.8355	0.0130
OS-E1-US-DS	OS-E1-US	OS-E1-DS	CONDUIT	75.9	0.8363	0.0130
POND200-306	POND 200-OUTLET	MH-306	CONDUIT	49.2	0.5019	0.0130
OS-W-304	MH-306	MH-304	CONDUIT	279.1	0.3999	0.0130
304-305	MH-304	MH-303	CONDUIT	330.3	0.4003	0.0130
202-201	INLET-202	INLET-201	CONDUIT	55.1	0.3994	0.0130
201-OUT200	INLET-201	FES-POND200	CONDUIT	27.1	0.5600	0.0130
EX-S-COUPDITCH	EX-S	FES-COUPDITCH	CONDUIT	42.8	0.3766	0.0130
OS-W-306	INLET-OS-W	MH-306	CONDUIT	7.0	3.1925	0.0130
OS-E2-US-DS	104	OS-E2-DS	CONDUIT	41.0	0.3292	0.0130
305-300	MH-303	MH-300	CONDUIT	35.2	0.4004	0.0130
300-EX-S	MH-300	EX-S	CONDUIT	400.0	0.0335	0.0150
DITCH-N	OS-E1-DS	104	CONDUIT	400.0	0.3045	0.0150
DITCH-S	OS-E2-DS	OS-E2	CONDUIT	400.0	0.2578	0.0150

Cross Section Summary

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
301-300	CIRCULAR	1.00	0.79	0.25	1.00	1	2.25
POND100-301	CIRCULAR	1.00	0.79	0.25	1.00	1	2.52
102-101	CIRCULAR	1.00	0.79	0.25	1.00	1	2.52
101-POND100FES	CIRCULAR	1.50	1.77	0.38	1.50	1	7.50
OS-E2-302	CIRCULAR	1.00	0.79	0.25	1.00	1	6.29
302-301	CIRCULAR	1.00	0.79	0.25	1.00	1	3.26
OS-E1-US-DS	CIRCULAR	1.00	0.79	0.25	1.00	1	3.26
POND200-306	CIRCULAR	1.50	1.77	0.38	1.50	1	7.44
OS-W-304	CIRCULAR	1.50	1.77	0.38	1.50	1	6.64
304-305	CIRCULAR	1.50	1.77	0.38	1.50	1	6.65
202-201	CIRCULAR	1.00	0.79	0.25	1.00	1	2.25
201-OUT200	CIRCULAR	1.00	0.79	0.25	1.00	1	2.67
EX-S-COUPDITCH	CIRCULAR	1.50	1.77	0.38	1.50	1	6.45
OS-W-306	CIRCULAR	1.50	1.77	0.38	1.50	1	18.77
OS-E2-US-DS	CIRCULAR	1.00	0.79	0.25	1.00	1	2.04
305-300	CIRCULAR	1.50	1.77	0.38	1.50	1	6.65
300-EX-S	CIRCULAR	1.50	1.77	0.38	1.50	1	1.67
DITCH-N	TRIANGULAR	2.00	10.00	0.93	10.00	1	52.03
DITCH-S	TRIANGULAR	2.00	10.00	0.93	10.00	1	47.87

101
 102
 103 *****
 104 NOTE: The summary statistics displayed in this report are
 105 based on results found at every computational time step,
 106 not just on results from each reporting time step.
 107 *****

108
 109 *****
 110 Analysis Options
 111 *****
 112 Flow Units CFS
 113 Process Models:
 114 Rainfall/Runoff NO
 115 RDII NO
 116 Snowmelt NO
 117 Groundwater NO
 118 Flow Routing YES
 119 Ponding Allowed YES
 120 Water Quality NO
 121 Flow Routing Method DYNWAVE
 122 Surcharge Method EXTRAN
 123 Starting Date 12/02/2020 00:00:00
 124 Ending Date 12/02/2020 02:00:00
 125 Antecedent Dry Days 0.0
 126 Report Time Step 00:05:00
 127 Routing Time Step 30.00 sec
 128 Variable Time Step YES
 129 Maximum Trials 8
 130 Number of Threads 1
 131 Head Tolerance 0.005000 ft

132
 133 *****
 134 Control Actions Taken
 135 *****
 136 *****

137
 138

139 *****	Volume	Volume
140 Flow Routing Continuity	acre-feet	10 ⁶ gal
141 *****	-----	-----
142 Dry Weather Inflow	0.000	0.000
143 Wet Weather Inflow	0.000	0.000
144 Groundwater Inflow	0.000	0.000
145 RDII Inflow	0.000	0.000
146 External Inflow	2.094	0.682
147 External Outflow	2.025	0.660
148 Flooding Loss	0.000	0.000
149 Evaporation Loss	0.000	0.000
150 Exfiltration Loss	0.000	0.000

151 Initial Stored Volume 0.000 0.000
 152 Final Stored Volume 0.065 0.021
 153 Continuity Error (%) 0.193

156 *****
 157 Highest Continuity Errors
 158 *****

159 Node MH-301 (3.51%)
 160 Node OS-E1-DS (2.29%)
 161 Node 104 (2.19%)
 162 Node MH-303 (2.13%)
 163 Node OS-E2-DS (2.11%)

166 *****
 167 Time-Step Critical Elements
 168 *****

169 Link OS-W-306 (99.68%)

172 *****
 173 Highest Flow Instability Indexes
 174 *****

175 All links are stable.

178 *****
 179 Routing Time Step Summary
 180 *****

181 Minimum Time Step : 0.30 sec
 182 Average Time Step : 1.03 sec
 183 Maximum Time Step : 2.67 sec
 184 Percent in Steady State : 0.00
 185 Average Iterations per Step : 2.05
 186 Percent Not Converging : 0.62

189 *****
 190 Node Depth Summary
 191 *****

192 -----

194	195	196	197	198	199	200	201	202
Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet		
POND 100-OUTLET	JUNCTION	3.13	5.51	4538.90	0 00:00	3.45		
POND 200-OUTLET	JUNCTION	0.56	0.62	4534.04	0 00:00	0.56		
MH-302	JUNCTION	0.35	0.36	4538.69	0 01:34	0.36		

201	MH-301	JUNCTION	2.99	5.62	4538.92	0	00:15	3.34
202	MH-306	JUNCTION	0.63	0.69	4533.86	0	00:01	0.66
203	MH-304	JUNCTION	0.76	0.80	4532.86	0	02:00	0.80
204	MH-300	JUNCTION	2.08	3.29	4533.68	0	00:15	2.22
205	MH-303	JUNCTION	1.78	2.95	4533.68	0	00:15	1.92
206	EX-S	JUNCTION	1.09	1.17	4531.42	0	02:00	1.17
207	INLET-OS-W	JUNCTION	0.41	0.47	4533.87	0	00:01	0.45
208	INLET-101	JUNCTION	0.93	0.96	4536.25	0	00:00	0.93
209	INLET-102	JUNCTION	1.05	1.26	4536.70	0	00:00	1.05
210	INLET-202	JUNCTION	1.31	2.20	4536.56	0	00:00	1.31
211	INLET-201	JUNCTION	1.24	1.82	4535.95	0	00:00	1.24
212	OS-E2	JUNCTION	0.28	0.28	4540.28	0	01:54	0.28
213	104	JUNCTION	0.44	0.45	4541.61	0	01:55	0.45
214	OS-E1-US	JUNCTION	0.23	0.29	4543.30	0	00:00	0.23
215	OS-E2-DS	JUNCTION	0.42	0.44	4541.46	0	01:34	0.44
216	OS-E1-DS	JUNCTION	0.31	0.31	4542.69	0	00:54	0.31
217	FES-POND200	OUTFALL	0.78	0.78	4534.77	0	00:00	0.78
218	POND100-FES	OUTFALL	0.78	0.79	4535.68	0	00:00	0.78
219	FES-COUPDITCH	OUTFALL	0.82	0.87	4530.96	0	01:59	0.87

220
221
222 *****
223 Node Inflow Summary
224 *****

		Maximum	Maximum	Time of Max		Lateral	Total	Flow
		Lateral	Total	Occurrence		Inflow	Inflow	Balance
		Inflow	Inflow	days hr:min		Volume	Volume	Error
Node	Type	CFS	CFS			10^6 gal	10^6 gal	Percent
232	POND 100-OUTLET	1.77	1.77	0	00:00	0.0953	0.0953	0.182
233	POND 200-OUTLET	1.56	1.56	0	00:00	0.084	0.084	0.128
234	MH-302	0.00	0.92	0	01:34	0	0.0472	1.297
235	MH-301	0.00	2.69	0	00:15	0	0.142	3.639
236	MH-306	0.00	2.79	0	00:00	0	0.131	0.624
237	MH-304	0.00	2.54	0	00:02	0	0.13	1.701
238	MH-300	0.00	5.13	0	02:00	0	0.262	2.008
239	MH-303	0.00	2.57	0	00:05	0	0.128	2.176
240	EX-S	0.00	5.13	0	01:59	0	0.257	0.980
241	INLET-OS-W	0.88	0.88	0	00:00	0.0474	0.0474	0.079
242	INLET-101	1.83	4.36	0	00:00	0.0986	0.225	0.192
243	INLET-102	2.35	2.35	0	00:00	0.127	0.127	0.081
244	INLET-202	2.05	2.05	0	00:00	0.11	0.11	0.156
245	INLET-201	1.31	3.37	0	00:00	0.0705	0.181	0.141
246	OS-E2	0.26	0.92	0	01:49	0.014	0.0476	0.824
247	104	0.29	0.66	0	00:53	0.0156	0.0351	2.244
248	OS-E1-US	0.37	0.37	0	00:00	0.0199	0.0199	0.179
249	OS-E2-DS	0.00	0.66	0	01:54	0	0.0343	2.156
250	OS-E1-DS	0.00	0.41	0	00:00	0	0.0199	2.345

251	FES-POND200	OUTFALL	0.00	3.37	0 00:00	0	0.181	0.000
252	POND100-FES	OUTFALL	0.00	4.28	0 00:00	0	0.225	0.000
253	FES-COUPDITCH	OUTFALL	0.00	5.13	0 01:59	0	0.255	0.000

254
255

256 *****

257 Node Surcharge Summary

258 *****

259
260 Surcharging occurs when water rises above the top of the highest conduit.

261 -----

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
266	POND 100-OUTLET	1.77	4.343	0.000
267	MH-301	1.75	4.420	1.973
268	MH-300	1.80	1.584	4.015
269	MH-303	1.78	1.451	2.243
270	INLET-102	1.99	0.261	1.460
271	INLET-202	1.99	1.201	0.802
272	INLET-201	1.99	0.820	1.240

273
274

275 *****

276 Node Flooding Summary

277 *****

278
279 Flooding refers to all water that overflows a node, whether it ponds or not.

280 -----

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Poned Depth Feet	
286	POND 100-OUTLET	0.01	1.16	0 00:00	0.000	0.000

287
288

289 *****

290 Outfall Loading Summary

291 *****

292 -----

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal	
298	FES-POND200	99.99	3.35	3.37	0.181
299	POND100-FES	99.99	4.17	4.28	0.225
300	FES-COUPDITCH	97.66	4.84	5.13	0.255

301 -----
 302 System 99.21 12.36 5.13 0.660
 303
 304

305 *****
 306 Link Flow Summary
 307 *****

308 -----
 309 -----

310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332
Link	Type	Maximum Flow CFS	Time of Max Occurrence days hr:min	Maximum Veloc ft/sec	Max/ Full Flow	Max/ Full Depth																
301-300	CONDUIT	2.72	0 00:15	3.46	1.21	1.00																
POND100-301	CONDUIT	2.08	0 00:00	5.42	0.82	1.00																
102-101	CONDUIT	2.53	0 00:00	3.78	1.00	0.98																
101-POND100FES	CONDUIT	4.28	0 00:00	4.03	0.57	0.58																
OS-E2-302	CONDUIT	0.92	0 01:34	5.34	0.15	0.27																
302-301	CONDUIT	0.92	0 01:32	2.03	0.28	0.68																
OS-E1-US-DS	CONDUIT	0.41	0 00:00	3.92	0.13	0.27																
POND200-306	CONDUIT	1.91	0 00:00	4.58	0.26	0.42																
OS-W-304	CONDUIT	2.54	0 00:02	4.41	0.38	0.48																
304-305	CONDUIT	2.57	0 00:05	3.64	0.39	0.77																
202-201	CONDUIT	2.06	0 00:00	2.63	0.92	1.00																
201-OUT200	CONDUIT	3.37	0 00:00	4.55	1.26	0.89																
EX-S-COUPDITCH	CONDUIT	5.13	0 01:59	4.00	0.80	0.68																
OS-W-306	CONDUIT	1.12	0 00:00	5.40	0.06	0.39																
OS-E2-US-DS	CONDUIT	0.66	0 01:54	2.29	0.32	0.44																
305-300	CONDUIT	2.44	0 02:00	2.68	0.37	1.00																
300-EX-S	CONDUIT	5.13	0 01:59	3.09	3.08	0.89																
DITCH-N	CONDUIT	0.37	0 00:53	1.25	0.01	0.19																
DITCH-S	CONDUIT	0.66	0 01:49	2.04	0.01	0.18																

333
 334
 335 *****
 336 Flow Classification Summary
 337 *****

338 -----
 339 -----

340	341	342	343	344	345	346	347	348	349	350
Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
301-300	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.04	0.00
POND100-301	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.00	0.00
102-101	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
101-POND100FES	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
OS-E2-302	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
302-301	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.98	0.00
OS-E1-US-DS	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.95	0.00

351	POND200-306	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
352	OS-W-304	1.00	0.00	0.00	0.00	0.98	0.02	0.00	0.00	0.82	0.00
353	304-305	1.00	0.00	0.00	0.00	0.98	0.02	0.00	0.00	0.08	0.00
354	202-201	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
355	201-OUT200	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
356	EX-S-COUPDITCH	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
357	OS-W-306	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
358	OS-E2-US-DS	1.00	0.00	0.00	0.00	0.98	0.02	0.00	0.00	0.00	0.00
359	305-300	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.00	0.00
360	300-EX-S	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
361	DITCH-N	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
362	DITCH-S	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00

363

364

365

366

Conduit Surcharge Summary

367

368

369

370

371

372

373

374

375

376

377

378

379

380

381

382

383

384

385

386

387

```

-----
Conduit          ----- Hours Full -----      Hours      Hours
                   Both Ends  Upstream  Dnstream  Above Full  Capacity
                   -----
301-300          1.78      1.78      1.89      1.74      1.74
POND100-301     1.77      1.77      1.78      0.01      0.01
102-101         0.01      1.99      0.01      0.01      0.01
302-301         0.01      0.01      1.75      0.01      0.01
304-305         0.01      0.01      1.78      0.01      0.01
202-201         1.99      1.99      1.99      0.01      1.99
201-OUT200      0.01      1.99      0.01      1.99      0.01
305-300         1.78      1.78      1.80      0.01      0.01
300-EX-S        0.01      1.85      0.01      1.91      0.01

```

Analysis begun on: Thu Dec 3 11:06:25 2020

Analysis ended on: Thu Dec 3 11:06:25 2020

Total elapsed time: < 1 sec

Appendix E – Checklists

Table 302
Stormwater Management Manual
Drainage Report Checklist

- Instructions:**
1. Applicant to identify with a "check-mark" if information is provided with report. If applicant believes information is not required, indicate with "n/a" and attach separate sheet with explanation
 2. The reviewer will determine if information labeled "n/a" is required and whether information must be submitted.
 3. Those items noted with an "asterisk" are not typically required for conceptual/preliminary report. Applicant shall confirm this with local jurisdiction.
 4. Submit three (3) copies of report and include copy of check list bound with report.

TITLE PAGE

- A. Type of report (Conceptual/Preliminary or Final Drainage Report).
- B. Project Name.
- C. Preparer name, firm, address, number, and date.
- D. Professional Engineer's seal of preparer.
- E. Certifications (see SWMM Section 303.1)

I. INTRODUCTION

- A.
- 1.
- 2.
- B.
- 1.
- 2.
- 3.
- C.
- 1.
- 2.
- 3.
- 4.
- 5.
- D.
- 1.
- 2.

- A. Background
 1. Identify report preparer and purpose.
 2. Identify date of letter with previous County comments.
- B. Project Location
 1. Identify Township, Range, and Section.
 2. Identify adjacent street and subdivision names.
 3. Reference to General Location Map.
- C. Property Description
 1. Identify area in acres of entire contiguous ownership.
 2. Describe existing ground cover, vegetation, soils, topography and slopes.
 3. Describe existing drainage facilities, such as channels, detention areas, or structures.
 4. Describe existing irrigation facilities, such as ditches, head-gates, or diversions.
 5. Identify proposed types of land use and encumbrances.
- D. Previous Investigations
 1. Identify drainage master plans that include the project area, including floodplain studies.
 2. Identify drainage reports for adjacent development.

II. DRAINAGE SYSTEM DESCRIPTION

- A.
- 1.
- 2.
- 3.
- B.
- 1.
- C.

- A. Existing Drainage Conditions
 1. Describe existing topography and provide map with contours extending a minimum of 100 feet beyond property limits.
 2. Identify major drainageway or outfall drainageway and describe map showing location of proposed development within the drainageways.
 3. Identify pre-developed drainage patterns and describe map showing pre-developed sub-basins and concentrated discharge locations. Provide calculations of pre-developed peak flows entering and leaving the site.
- B. Master Drainage Plan
 1. Describe location of the project relative to a previously prepared master drainage plan, including drainage plans prepared for adjacent development.
- C. Offsite Tributary Area

X
X
X
X
X*
X*
Y
X*
X*
Y*
NA*
NA*

1. Identify all offsite drainage basins that are tributary to the project.
 2. Identify assumptions regarding existing and future land use and effects of offsite detention on peak flows.
- D. Proposed Drainage System Description
1. Identify how offsite stormwater is collected and conveyed through the site and ultimately to the receiving water(s).
 2. Identify sub-basins and describe, in general terms, how onsite stormwater is collected and conveyed through the site for each location where stormwater is discharged from the site.
 3. Describe detention volumes, release rates and pool elevations.
 4. Identify the difference in elevation between pond invert and the groundwater table.
 5. Describe how stormwater is discharged from the site, including both concentrated and dispersed discharges and rates.
 6. Describe stormwater quality facilities.
 7. Describe maintenance access aspects of design.
 8. Describe easements and tracts for drainage purposes, including limitation on use.
- E. Drainage Facility Maintenance
1. Identify responsible parties for maintenance of each drainage and water quality facility.
 2. Identify general maintenance activities and schedules.

III. **DRAINAGE ANALYSIS AND DESIGN CRITERIA**

X
X

X
Y

X
X
X

NA*
NA*

- A. Regulations
1. Identify that analysis and design was prepared in accordance with the provisions of the Manual.
 2. Identify other regulations or criteria which have been used to prepare analysis and design.
- B. Development Criteria
1. Identify drainage constraints placed on the project, such as by a major drainage study, floodplain study or other drainage reports relevant to the project.
 2. Identify drainage constraints placed on the project, such as from major street alignments, utilities, existing structures, and other developments.
- C. Hydrologic Criteria
 (If Manual was followed without deviation, then a statement to that effect is all that is required. Otherwise provide the following information where the criteria used deviates from the Manual.)
1. Identify developed storm runoff peak flows and volumes and how they were determined, including rainfall intensity or design storm.
 2. Identify which storm events were used for minor and major flood analysis and design.
 3. Identify how and why any other deviations from the Manual occurred.
- D. Hydraulic Criteria
 (If Manual was followed without deviation, then a statement to that effect is all that is required. Otherwise provide the following information where the criteria used deviates from the Manual.)
1. Identify type(s) of streets within and adjacent to development and source for allowable street capacity.
 2. Identify which type(s) of storm inlets were analyzed or designed and source for allowable capacity.
 3. Identify which type of storm sewers which were analyzed or designed and

NA *
NA *
NA *
X
X
X

- Manning's n-values used.
- 4. Identify which method was used to determine detention volume requirements and how allowable release rates were determined.
- 5. Identify how the capacity of open channels and culverts were determined.
- 6. Identify any special analysis or design requirements not contained with the Manual.
- 7. Identify how and why any other deviations from the Manual occurred.
- E. Variance from Criteria
 - 1. Identify any provisions of the Manual for which a variance is requested.
 - 2. Identify pre-existing conditions which cause the variance request.

***IV. POST CONSTRUCTION STORMWATER MANAGEMENT. See Manual Section 1600 for requirements.**

Note: This section of the Final Drainage Report identifies additional information required by Mesa County's, City of Grand Junction's, and Town of Palisade's, Permit for Stormwater Discharges Associated with Municipal Separate Storm Sewer Systems (MS4s), permit No. COR-090000. The Final Drainage Plan and the Construction SWMP (see SWMM Section 1500) meets the requirements of the MS4s Permit. In general, this section identifies permanent BMP practices to control the discharge of pollutants after construction is complete.

NA *
| *
| *
| *

- *A. Stormwater Quality Control Measures
 - 1. Describe the post-construction BMPs to control discharge of pollutants from the project site.
 - 2. If compensating detention is provided, discuss practices to address water quality from area not tributary to detention area.
 - 3. If underground detention is proposed, discuss how water quality facilities will be provided on the surface.
 - 4. If proprietary BMPs are proposed, provide the justification and sizing requirements (see SWMM Section 1603.3).

X
V.

- *B. Calculations
 - 1. Provide methods and calculations for WQCV, sediment storage, and water quality outlet structure.

CONCLUSIONS

X
X
X

- A. Compliance with Manual
Compliance with Manual and other approved documents, such as drainage plans and floodplain studies.
- B. Design Effectiveness
Effectiveness of drainage design to control impacts of storm runoff.
- C. Areas in Flood Hazard Zone
Meet requirements of Floodplain Regulations: Mesa County Land Development Code, Section 7.13; City of Grand Junction Zoning and Development Code, Section 7.1.
- D. Variances from Manual
Applicant shall identify any requested variances and provide basis for approving variance. If no variances are requested, applicant shall state that none are requested.

NA
VII.

REFERENCES

Provide a reference list of all criteria, master plans, drainage reports, and technical information used.

X

TABLES

Include copy of all tables prepared for report.

X

FIGURES

X

- A. General Location Map (See Section 303.2a)

III. HYDRAULIC AND HYDROLOGIC INFORMATION

NA
NA
NA
X
X
X
X
NA
NA
NA
NA

- A. Routing and accumulative runoff peaks at upstream and downstream ends of the site and at various critical points onsite for initial and major storms. Inflow and outflow from each subbasin shall be shown for both initial and major storms.
- B. Street cross sections showing 100-year flood levels.
- C. Major and minor channels and floodplains.
- D. Detention pond data:
 - 1. Release rates for 10- and 100-year storm events.
 - 2. Required and provided volumes for 10- and 100-year storm events.
 - 3. Design depths for 10- and 100-year storm events.
 - 4. Water quality capture volume and pool elevation.
- E. Channel data:
 - 1. Water surface profiles.
 - 2. Representative 100-year flow velocity and Froude number.
- F. Storm sewer data:
 - 1. Profile of water surface for design flow rate.
 - 2. Peak flows for design flow, 2-year and 100-year storm events.

IV. STANDARD NOTES

X
X
X
X
X

- A. No building, structure, or fill will be placed in the detention areas and no changes or alterations affecting the hydraulic characteristics of the detention areas will be made without the approval of the County.
- B. Maintenance and operation of the detention and water quality areas is the responsibility of property owner. If owner fails in this responsibility, the County has the right to enter the property, maintain the detention areas, and be reimbursed for costs incurred.
- C. Detention pond volumes, all drainage appurtenances, and basin boundaries shall be verified. As-built drawings shall be prepared by a registered professional engineer prior to issuance of certificate of occupancy for any structure within the development.
- D. Permission to reproduce these plans is hereby given to Mesa County for County purposes associated with plan review, approval, permitting, inspection and construction of work.

V. PROFESSIONAL ENGINEER'S SEAL AND SIGNATURE

VI. OTHER

- A. Horizontal and vertical control information and ties to existing and proposed features.

ACKNOWLEDGEMENTS

Drainage Plan checklist was prepared by: SSM

Appendix F – Drainage Maps

