Winsome Filing No 1
17480 Meridian Road North
Colorado Springs, Colorado 80924

Final Drainage Report

JANUARY 22, 2020

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VERTEX Project: 49388
PCD File No.

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Add "PCD File No. SF203"

VERTEX

Engineer's Certification

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 applicable 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.

COLORADO LICENSED
LANCE PATRICK VANDEMARK
01/23/2020
43911
PROFESSIONAL ENGINEER

Lance VanDemark, P.E.
Registered Professional Engineer
State of Colorado No. 43911

Owner Certification

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

Joe DesJardin
Director of Projects
Winsome , LLC

1/23/2020
Date

El Paso County

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

Jennifer Irvine, P.E.
County Engineer / ECM Administrator

Date

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1.0 GENERAL LOCATION AND DESCRIPTION

The following report provides detailed drainage information for existing and proposed conditions for the Winsome Fining No 1 project. Filing No 1 is a portion of the overall development studied last year for Preliminary Plan approval. The intent of this report is to show the routing of minor and major storms through the proposed site in accordance with El Paso County Standards. For this site, a minor flow is defined as the 5-year frequency storm and a major flow as the 100-year frequency storm. The information given in this report is intended to provide a detailed analysis of on-site drainage areas and receiving facilities. This development will consist of large-lot single family residential lots, access roads, and the required infrastructure to serve them.

GENERAL LOCATION

The site is located at 17480 Meridian Road North or, more generally, at the northwest corner of Hodgen Road and Meridian Road North in unincorporated El Paso County, latitude 39°04’38” N and longitude 104°36’47” W. The subject property is undeveloped and situated in Section 24, Township 11 South, Range 65 West of the 6th P.M., County of El Paso, State of Colorado.

The site is bounded to the south by Hodgen Road, to the east by Meridian Road North, and to the north and west by several parcels zoned primarily as Agricultural and Residential use with some Forest Land. On the east side of Median Road is Forest Green Subdivision, a low-density single-family development. On the south side of Hodgen Road is Bison Meadows Subdivision which is also a low-density single family residential subdivision. The remainder of properties surrounding the site have not yet been formally platted. The site has not been included in any previous drainage study. West Kiowa Creek flows approximately through the center of the property from the southwest corner to the northeast corner, upstream to the west and southwest of the property lie 3 Kiowa Creek Watershed Reservoirs notated as 1-N-10, 1-P-10, and 1-P-20. There are no irrigation ditches on the property.

DESCRIPTION OF PROPERTY

The existing site contains 767 acres of agricultural grazing land and dry farm land. Ground cover consists mainly of native grasses, shrubs, and several stands of evergreen trees along its northern and southern boundary. Existing wetlands are present along West Kiowa Creek and its tributaries, wetland boundaries are located roughly 50 feet to either side of the thalweg of West Kiowa Creek and the drainageway way to the south of the creek on the property. There are no existing irrigation canals or ditches on the project site nor are there any major geologic features. The property generally slopes in a northeasterly direction with slopes ranging between 1-16%. Soils consist of Alamosa loam, Brussett loam, Cruckton sandy loam, Elbeth sandy loam, Holderness loam, Kettle gravelly loamy sands, Peyton sandy loam, Peyton-Pring complex, Pring course sandy loam, Tomah-Crowford loamy sands and Tomah-Crowfoot complex. Most of the site has soils classified in Hydrologic Soil Group B; however, the property also contains a small mixture of soils from Hydrologic Soils Groups C and D located in the areas in and adjacent to West Kiowa Creek and its tributaries. A soils map prepared by Natural Resources Conservation Service is included in the Appendix.

The development of this property will consist of 143 2.5 to 10-acre single family residential lots and the requisite public roads and stormwater infrastructure to serve them. Filing 1 of this project is covered in this drainage report and consists of 47 of the total lots with the rest of the site remaining in existing condition. Anticipated construction activities include earthwork and paving associated with the public road development, as well as the installation of culverts and stormwater detention ponds to convey and treat stormwater on the site. As previously discussed, West Kiowa Creek bisects the property, flowing from southwest to northeast. In addition, a major tributary of West Kiowa Creek flows north from a point halfway along the southern property boundary and intersects West Kiowa Creek in the middle of the property. The primary access for the site will be from 3 points along Hodgen Road and 1 entry point along Meridian Road. Filing 1 of the project will construct the first 2 entries off Hodgen. The shaded area in the exhibit below denotes the Filing 1 area.

2.0 DRAINAGE BASINS AND SUB-BASINS

MAJOR BASIN DESCRIPTION

The site resides within the West Kiowa Creek Drainage Basin (KIKI0200) which is located near the northern boundary of El Paso County, approximately 14.5 miles east of downtown Monument, CO. This watershed begins approximately 5 miles southwest of the Winsome property and continues another 10 miles to the northeast where it outfalls into Kiowa Creek which eventually discharges into the South Platte River near Fort Morgan, CO.

DRAINAGE STUDIES, OUTFALL SYSTEM PLANS, & SITE CONSTRAINTS

There are no major drainage studies (DBPS or MDDP) for this area on record and no base flood elevations for this reach of West Kiowa Creek that have been established. In conjunction with the previous Preliminary Plan, a floodplain study has been performed on the section of West Kiowa

Creek located within the property. A Conditional Letter of Map Revision (CLOMR) has been submitted to FEMA to establish the floodplain boundary on-site. A plan showing the new proposed 100-year floodplain line is included in the appendix along with supporting documentation. The site is shown on FEMA flood map 08041C0350G with an effective date of 12/7/2018 which indicates that the site is in Zone X – an area outside of the 0.2% annual chance of flood (see the accompanying exhibits in the Appendix). The areas immediately adjacent to West Kiowa Creek are designated as Zone A, which is a 100-year Flood Hazard Area in which no base flood elevations have been determined. There are no known irrigation facilities located on the property at the current time.

EXISTING SUB-BASIN DESCRIPTION

Historically, the runoff from the property flows into West Kiowa Creek, which bisects the site flowing from the southwest corner of the property to the northeast corner. There are 10 on-site sub-basins and 6 off-site sub-basin that contribute flows to West Kiowa Creek. The 10 on-site sub-basins correspond to the largest defined natural drainage channels that occur on site, while the 6 off-site basins are defined by the entire West Kiowa Creek watershed that is upstream from the subject property.

As previously discussed, the site is currently undeveloped, containing mainly native grasses and shrubs, with limited forested areas along the northern and southern boundary of the site. The existing topography of the site slopes generally in a northerly direction with grades varying from 1-16%. There are no existing irrigation canals or ditches on the project site nor are there any major geologic features. The existing site can be described as 12 sub-basins as follows:

Sub-Basin A is the 915.4-acre watershed of the western tributary to West Kiowa Creek. This sub-basin contains the West Kiowa Creek 1-N-10 Reservoir which is located about a quarter-mile upstream of the property to the west. The sub-basin generates peak runoff of 87.1cfs in the 5-

year event and peak runoff of 585.6cfs in the 100-year event. Stormwater generated within the basin flows east from Southwood Drive to the subject property and discharges into West Kiowa Creek immediately to the east of the western property boundary.

Consisting of the entire West Kiowa Creek watershed that is south of Hodgen Road, Sub-Basin Ba encompasses 3836.7 acres and generates peak runoff of 271.5cfs in the 5-year event and peak runoff of 1448.6cfs in the 100-year event. This sub-basin contains 2 Kiowa Creek Watershed Reservoirs noted as 1-P-10 and 1-P-20 located upstream of the property to the southwest. The largest of these reservoirs is evaluated later in the report for risk hazard. Sub-Basin Ba begins approximately 5 miles to the southwest of the Winsome property near Black Forest, CO. Stormwater generated within the basin flows from southwest to northeast passing under a bridge on Hogden Road into sub-basin Bb.

Stormwater generated within the 100.6-acre sub-basin Bb has a peak runoff of 19.2cfs in the 5-year event and peak runoff of 127.7cfs in the 100-year event. Sub-Basin Bb is located at the southwest corner of the property and consists of the land immediately tributary to West Kiowa Creek on the north side of Hodgen Road. Flows from this sub-basin travel to the northeast discharging into the Creek.

Sub-Basin Ca consists of an off-site area located near the southwest corner of the property. This sub-basin has an area of 162.7-acres and generates peak runoff of 20.7cfs in the 5-year event and peak runoff of 127.8cfs in the 100-year event. This sub-basin discharges into a 30” CMP culvert under Hodgen Road flowing into sub-basin Cb.

Sub-Basin Cb located in the southwest corner of the property. This sub-basin has an area of 70-acres and generates peak runoff of 9.9cfs in the 5-year event and peak runoff of 88.1cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that discharges into sub-basin H.

Sub-Basin Da is the 161.3-acre watershed of the southern tributary to West Kiowa Creek. The sub-basin generates peak runoff of 20.6cfs in the 5-year event and peak runoff of 127.3cfs in the 100-year event. Stormwater generated within the basin flows north from Pole Pine Point to the subject property and discharges into a 72” CMP culvert under Hodgen Road into sub-basin Dc.

Sub-Basin Db is the 49.9-acre watershed of the southern tributary to West Kiowa Creek. The sub-basin generates peak runoff of 5.7cfs in the 5-year event and peak runoff of 34.1cfs in the 100-year event. Stormwater generated within the basin flows north from Pole Pine Point to the subject property and discharges into a 30” CMP culvert under Hodgen Road into sub-basin Dc.

Sub-Basin Dc is the 249.7-acre watershed of the southern tributary to West Kiowa Creek. This sub-basin contains a significant fraction of the southern half of the Winsome property. The sub-basin generates peak runoff of 28.1cfs in the 5-year event and peak runoff of 275.7cfs in the 100-year event. Stormwater generated within the basin flows north discharges into West Kiowa Creek immediately near the center of the project site.

Sub-Basin Ea consists of an off-site area located near the southeast corner of the property. This sub-basin has an area of 37.9-acres and generates peak runoff of 5.4cfs in the 5-year event and peak runoff of 34.8cfs in the 100-year event. This sub-basin discharges into a 30” RCP culvert under Hodgen Road flowing into sub-basin Eb.

Sub-Basin Eb located in the southeast corner of the property and consists of an on-site watershed that discharges into West Kiowa Creek at the eastern property line. This sub-basin has an area of 74.6-acres and generates peak runoff of 4.0cfs in the 5-year event and peak runoff of 85.8cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of Hodgen Road on the eastern side of the site.

Sub-Basin F located in the southeast corner of the property and consists of an on-site watershed that discharges into West Kiowa Creek to the east of the property. This sub-basin has an area of 44.5-acres and generates peak runoff of 6.6cfs in the 5-year event and peak runoff of 56.6cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of Hodgen Road on the eastern side of the site.

Sub-Basin G located on the western side of the property and consists of an on-site watershed of a minor natural drainage channel that flows from west to east and discharges into West Kiowa Creek near the west of the property. This sub-basin has an area of 107.6 acres and generates peak runoff of 45.3cfs in the 5-year event and peak runoff of 199.0cfs in the 100-year event.

Sub-Basin H located in the northern side corner of the property and consists of an on-site watershed that discharges into West Kiowa Creek on the north side of the property. This sub-basin has an area of 121.8 acres and generates peak runoff of 34.8cfs in the 5-year event and peak runoff of 197.2cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of West Kiowa Creek on the western side of the site.

Sub-Basin I located in the northeast corner of the property and consists of an on-site watershed that discharges into West Kiowa Creek to the east of the property. This sub-basin has an area of 37.5-acres and generates peak runoff of 26.4cfs in the 5-year event and peak runoff of 88.4cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of West Kiowa Creek on the eastern side of the site.

Sub-Basin J located in the northeast corner of the property and consists of an on-site watershed that discharges to the north of the property in existing natural drainage channels. This sub-basin has an area of 10.1-acres and generates peak runoff of 3.4cfs in the 5-year event and peak runoff of 19.9cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of Hodgen Road on the eastern side of the site.

Sub-Basin K located in the northeast corner of the property and consists of an on-site watershed that discharges to the north of the property in existing natural drainage channels. This sub-basin has an area of 17.8-acres and generates peak runoff of 12.9cfs in the 5-year event and peak runoff of 45.1cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of Hodgen Road on the eastern side of the site.

Flow rate numbers were generated using NRCS Curve Number Methodology with HEC-HMS modeling software. Colorado Springs Stormwater Manual criteria was used for identifying curve numbers of the type B, C, and D NRCS Hydrologic Soil Groups as they applied to the various sub-basins. A summary of the results of calculations for the existing conditions can be found in the Appendix.

PROPOSED SUB-BASIN DESCRIPTION

In the proposed condition, stormwater runoff will generally flow from southwest to northeast as it does in the existing condition. The main difference between the existing and proposed conditions is the flow paths of West Kiowa Creek and the various tributary drainageways will intersect the proposed public roads that access the residential lots. All existing drainage patterns will be maintained throughout the site to the extent possible. To calculate the design flows for each of the proposed culverts that will convey runoff across the proposed roads, the existing basins were subdivided to create design points at each of the proposed crossing locations. As a result, Filing 1 has 16 on-site sub-basins and 6 off-site sub-basins in the proposed condition.

In accordance with the above-mentioned drainage patterns, the proposed project will be divided into 22 sub-basins that are described as follows:

Sub-Basin A is a 915.4 sub-basin to the west and northwest of West Kiowa Creek, at the west side of the property. The sub-basin consists of agricultural land and native grasslands and contains 1-N-10 Reservoir. The curve number for Sub-Basin A is 61.8. The basin will generate 87.1cfs and 585.6cfc in the minor and major storms, respectively. Stormwater from Sub-Basin A will be conveyed by natural drainageways and then collect into West Kiowa Creek, and flow northeast. In a future submittal, portions of Sub-Basin A will consist of residential lots. For the purposes of Filing 1, the existing conditions of Sub-Basin A were analyzed as it will not be disturbed.

Provide WQCV for Clover Hitch Ct. Sizing to account for the tributary basin going into the pond.

Recommendation. Breakup Basin B4 to additional sub-basin.
The ECM provides an exclusion from WQ for 2.5 ac or larger single-family lots with total imperviousness less than 10 percent (Section I.7.1.B.5). Therefore, sub-basins that only consists of open space and lots would meet this exclusion. The sizing for the other sub-basin with the roadway would be a small tributary basin.

Sub-Basin B1 consists of the West Kiowa Creek watershed to the south of Hodgen Road. This sub-basin has an area of 3836.70 acres. The curve number for Sub-Basin B1 is 60.34. The basin will generate runoff of 271.5cfs and 1448.6cfs in the minor and major storms, respectively. Flows from this sub-basin will pass under Hodgen Road and then conveyed by a natural drainage channel through Sub-Basin B3 via West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin B2 consists of 4 large residential lots at the southwest corner of the project. This sub-basin has an area of 13.10 acres. The curve number for Sub-Basin B2 is 64.00. The basin will generate runoff of 3.3cfs and 19.9cfs in the minor and major storms, respectively. Flows from this basin will travel across the lots from south to north where they will be intercepted by a culvert in Clove Hitch Ct. From the culvert flows will be conveyed by a natural drainage channel through Sub-Basin B4 to West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin B3 is an off-site sub-basin to the west of the site near the southwest corner of the property. This sub-basin has an area of 54.90 acres. The curve number for Sub-Basin B3 is 65.10. The basin will generate runoff of 6.7cfs and 57.9cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed by a natural drainage channel through Sub-Basin B4 to West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin B4 consists of 6 large residential lots and West Kiowa Creek at the southwest corner of the property. This sub-basin has an area of 41.48 acres. The curve number for Sub-Basin B4 is 68.50. The basin will generate runoff of 8.8cfs and 53.1cfs in the minor and major storms, respectively. Flows from this basin will flow north to northeast and will be conveyed by a natural drainage channel through Sub-Basin B4 to West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin C1 is an off-site sub-basin to the south of Hodgen Road. This sub-basin has an area of 162.70 acres. The curve number for Sub-Basin C1 is 60.00. The basin will generate runoff of 20.7cfs and 127.8cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed north by a natural drainage channel to Hodgen Road or through an existing 30" CMP culvert that will convey flows under Hodgen Road into Sub-Basin C2.

Sub-Basin C2 consists of 7 large residential lots along the southern boundary of the property. This sub-basin has an area of 22.40 acres. The curve number for Sub-Basin C2 is 64.00. The basin will generate runoff of 3.1cfs and 23.7cfs in the minor and major storms, respectively. Stormwater from this basin will flow north across the lots to a culvert under Mosey Trail. The culvert flows will be conveyed across Sub-Basin C3 and ultimately will discharge into West Kiowa Creek.

Sub-Basin C3 consists of 5 large residential lots in southern half of the property, just south of Winding Way Circle. This sub-basin has an area of 16.10 acres. The curve number for Sub-Basin C3 is 64.00. The basin will generate runoff of 3.7cfs and 22.1cfs in the minor and major storms, respectively. Runoff from this basin will flow to the northwest across the lots to a culvert under Winsome Way. From the culvert runoff will convey across Sub-Basin B4 and will be discharged into West Kiowa Creek.

Revise. Identify this draining into WQ Pond C prior to discharging into West Kiowa Creek. Typical comment for other basins draining into a WQ Facility.

Sub-Basin C4 consists of only two residential lots and a portion of West Kiowa Creek north of the southern loop of Alamar Way. This sub-basin has an area of 23.80 acres. The curve number for

Sub-Basin C4 is 65.00. The basin will generate runoff of 1.8cfs and 22.9cfs in the minor and major storms, respectively. Stormwater from this sub-basin will flow north across the residential lots to West Kiowa Creek.

Sub-Basin D1.1 is an off-site sub-basin to the south of Hodgen Road consisting of agricultural land and large residential lots. This sub-basin has an area of 161.30 acres. The curve number for Sub-Basin D1.1 is 60.00. The basin will generate runoff of 20.6cfs and 127.3cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed north by a natural drainage channel to an existing 72" CMP culvert that will convey flows under Hodgen Road into Sub-Basin D2.

Sub-Basin D1.2 is an off-site sub-basin to the south of Hodgen Road consisting of agricultural land and large residential lots. This sub-basin has an area of 49.90 acres. The curve number for Sub-Basin D1.2 is 60.00. The basin will generate runoff of 5.7cfs and 34.1cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed north by a natural drainage channel to a 30" CMP culvert that will convey flows under Hodgen Road into Sub-Basin D3.

Sub-Basin D2 consists of 17 large residential lots and the southern tributary to West Kiowa Creek. This sub-basin has an area of 68.70 acres. The curve number for Sub-Basin D2 is 64.75. The basin will generate runoff of 11.7cfs and 81.2cfs in the minor and major storms, respectively. A culvert will convey flows across Alamar Way into Sub-Basin D5.

Sub-Basin D3.4.6 consists of 29 large residential lots and has an area of 167.00 acres. Sub-Basin D3.4.6 is located at the center of Winsome Way, Alamar Way, Bison Meadows Court, and Hodgen Road. The curve number for Sub-Basin D3.4.6 is 66.4. The basin will generate runoff for 5.9cfs and 175.3cfs in the minor and major storms, respectively. Stormwater from this sub-basin will flow north through a culvert, natural channels, and across residential lots to the 7.1 ac-ft

No portion of filing 1 are included in these basins.

Simplify the narrative for these basin by stating (in your own words) no portion of filing 1 is located within sub-basins Ea, Eb, F, ... See the approved Preliminary Drainage Report for Winsome Subdivision, dated ___ prepared by ___ for narrative description and preliminary analysis. A final drainage report will be prepared with future development within these basins.

stormwater detention pond, Pond 3, which will discharge to West Kiowa Creek. Flows in the creek pass under Alamar Way through a double box culvert.

Sub-Basin D5 consists of a portion of the southern tributary to West Kiowa Creek immediately to the north of the southern loop of Alamar Way. This sub-basin has an area of 12.80 acres. The curve number for Sub-Basin D5 is 67.20. The basin will generate runoff of 0.8cfs and 17.5cfs in the minor and major storms, respectively. Stormwater from this sub-basin generally flows south to north along the southern tributary streambed.

Sub-Basin Ea off-site sub-basin is located south of the southeast corner of the property. This sub-basin has an area of 37.9 acres. The curve number for Sub-Basin Ea is 60.00. The basin will generate runoff of 5.4cfs and 34.8cfs in the minor and major storms, respectively. Stormwater from this sub-basin will flow north across the residential lots to a 30" RCP culvert under Hodgen Road and will flow north through Sub-Basin Eb.

Sub-Basin Eb is located on the east side of the property and has an area of 74.6 acres. Sub-Basin Eb consists of native grasslands and agricultural land and has a curve number for Sub-Basin Eb of 67.2. The basin will generate runoff of 4.0cfs and 85.8cfs in the minor and major storms, respectively. Stormwater from Sub-Basin Eb flows north over the native grasslands and through natural drainageways. In a future submittal, Sub-Basin Eb will consist of a commercial lot and several residential lots. For the purposes of Filing 1, the existing conditions of Sub-Basin Eb were analyzed as it will not be disturbed.

Sub-Basin F is located on the east side of the property and has an area of 44.5 acres. Sub-Basin F consists of native grasslands and agricultural land and has a curve number for Sub-Basin F of 69.0. The basin will generate runoff of 6.6cfs and 56.6cfs in the minor and major storms, respectively. Stormwater from this basin flows across the existing drainage channel through the center of the sub-basin and is conveyed north. In a future submittal, Sub-Basin F will consist of

Remove. See comment on page 14

large residential lots. For the purposes of Filing 1, the existing conditions of Sub-Basin F were analyzed as it will not be disturbed.

Sub-Basin G is located on the west boundary of the property and has an area of 107.6 acres. Sub-Basin G consists of native grasslands and has a curve number of 74.5. The basin will generate runoff of 45.3cfs and 199.0cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows east to a natural drainage channel into West Kiowa Creek. The stormwater is then conveyed northeast through West Kiowa Creek. In a future submittal, portions of Sub-Basin G will consist of large residential lots. For the purposes of Filing 1, the existing conditions of Sub-Basin G were analyzed as it will not be disturbed.

Sub-Basin H is located at the northern boundary of the property and has an area of 121.8 acres. Sub-Basin H consists of native grasslands and has a curve number of 71.8. The basin will generate runoff of 34.8cfs and 197.2cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows east through the grasslands to a natural drainage channel into West Kiowa Creek. The stormwater is then conveyed northeast through West Kiowa Creek. In a future submittal, the majority of Sub-Basin H will consist of residential lots. For the purposes of Filing 1, the existing conditions of Sub-Basin H were analyzed as it will not be disturbed.

Sub-Basin I is located at the northern, most easterly, boundary of the property and has an area of 37.5 acres. Sub-Basin I consists of native grasslands and has a curve number of 79.0. The basin will generate runoff of 26.4cfs and 88.4cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows east through the grasslands to a natural drainage channel that conveys the runoff east off the property. In a future submittal, portions of Sub-Basin I will consist of large residential lots. For the purposes of Filing 1, the existing conditions of Sub-Basin I were analyzed as it will not be disturbed.

Sub-Basin J is located at the northern, most westerly, boundary of the property and has an area of 10.1 acres. The curve number for Sub-Basin J would appear to be lower than the historic use at 68.5 versus 69.5. This could result from cleanup of leaves, pine needles, and other debris exposing more ground and allowing more direct contact with water. Conservatively however, using the larger of the two curve numbers, the basin will generate runoff of 3.4cfs and 19.9cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows north across the lots from the property to the north boundary of the project as it did in the existing condition. Flows going offsite will be at or below historic levels.

Sub-Basin K is located at the northern, most central, boundary of the property and has an area of 17.8 acres. The curve number for Sub-Basin K1 would appear to be lower than the historic use at 72 versus 76. This could result from cleanup of leaves, pine needles, and other debris exposing more ground and allowing more direct contact with water. Conservatively however, using the larger of the two curve numbers, the basin will generate runoff of 12.9cfs and 45.1cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows north across the lots from the property to the north boundary of the project as it did in the existing condition. Flows flowing offsite will be at or below historic levels.

3.0 DRAINAGE DESIGN CRITERIA

REGULATIONS

The hydrologic calculations in this report comply with the El Paso County Drainage Criteria Manuals. There are no previous drainage studies that cover this property.

HYDROLOGICAL CRITERIA

Since this project contains both sub-basins over 100 acres and sub-basins less than 100 acres, times of concentration and peak runoff values were calculated for the 5-year and 100-year storm

events using the NRCS Curve Number Method as required by the City of Colorado Springs/El Paso County Drainage Criteria Manuals. The model utilizes the NRCS Type II 24-hr rainfall distribution, the cumulative depth for the 5-year storm is 2.7 inches and cumulative depth of the 100-year storm is 4.6 inches. Per the Drainage Criteria Manual, both Frontal Storms and Thunder Storms were evaluated to determine the higher design flow. The comparative analysis of these storms show that the Frontal Storm produces significantly higher flow rates, so this storm type was used for drainage design. The table below outlines the rain gage data used for the comparison.

Frontal Storm Rainfall Depths			
	1 H	24 H	
5 Year	1.5	2.7	
100 Year	2.52	4.6	
Thunder Storm 2H Rainfall Depths			
Minutes	Fraction of 1 H	5Y	100Y
5	0.01	0.02	0.04
10	0.05	0.07	0.12
15	0.08	0.12	0.20
20	0.12	0.18	0.30
25	0.18	0.27	0.45
30	0.26	0.39	0.65
35	0.42	0.63	1.06
40	0.71	1.07	1.79
45	0.82	1.24	2.08
50	0.89	1.34	2.25
55	0.94	1.40	2.36
60	0.97	1.46	2.45
65	1.00	1.51	2.53
70	1.02	1.53	2.57
75	1.03	1.55	2.60
80	1.04	1.56	2.62
85	1.05	1.58	2.65
90	1.06	1.59	2.68
95	1.07	1.61	2.70
100	1.08	1.62	2.73
105	1.09	1.64	2.75
110	1.10	1.65	2.77
115	1.11	1.66	2.79
120	1.12	1.68	2.82

The peak outfall results for each storm type were reviewed and the frontal storm was identified to have over a 200% greater peak.

NRCS TR-55 CURVE NUMBER SELECTION

Basin runoff curve numbers were generated using the runoff curve tables and methods presented in the Colorado Springs/El Paso County Stormwater Criteria Manual.

With curve values for a developed condition only listed up to a 2-acre lot size, some conservative interpolation was necessary. Taking into account that the curve numbers are not linear as the lot sizes increase, the following table was extrapolated for this study.

LOT SIZE	IMPERVIOUS %	SOIL GROUP A	SOIL GROUP B	SOIL GROUP C	SOIL GROUP D
2 ½ ACRE	11%	NA	64	76	81
5 ACRE	7%	NA	60	72	77

Impervious areas were referenced from the county Engineering Criteria Manual (Appendix L Table 3-1) in the table shown below.

Table 3-1
Typical Values of Percent Impervious

Type of Development	Percent Impervious
Commercial	95%
Industrial	85%
Multi-Family	65%
Single Family - 0.1377 acre lots (6,000 SF)	53%
Single-Family – 0.20 acre lots	43%
Single-Family – 0.25 acre lots	40%
Single-Family – 0.33 acre lots	30%
Single-Family – 0.5 acre lots	25%
Single-Family – 1.0 acre lots	20%
Single-Family – 2.5 acre lots	11%
Single-Family – 5 acre lots	7%

HYDRAULIC CRITERIA

Routing of stormwater runoff and modelling of drainageways on the site, was done using the NRCS Curve Number Method as required by the City of Colorado Springs. However, ultimate culvert and full spectrum detention pond sizing is be based on Rational Method peak flows and will utilize Urban Drainage UD-Culvert & UD-Detention calculations.

Time of Concentration

Assumptions were made for channelized flows through basins to calculate Time of Concentration values. To recognize that larger basins produce more runoff, we structured the hydrology model with 2 channelized flow profiles for basin over and under 100 acres. The table below outlines these assumptions:

	Shape	Side Slopes	Depth	Wetted Perimeter	Cross Sectional Area
< 100 Acre Basin Channels	Triangular	4:1	4’	32.98’	64 sqft
> 100 Acre Basin Channels	Triangular	4:1	3’	24.74’	36 sqft

Conveyance Flow Paths

For conveyance flow paths between basins and the main channel where basins converge, 3 flow profiles were used. Triangular profiles were used for a majority of the conveyances, larger branching tributaries were trapezoidal with an 8’ bottom, and the main channel was modeled as trapezoidal with a 20’ bottom. A full HEC-RAS section analysis was completed that modeled the shape of the main floodplain drainage way. The 20’ bottom is a conservative average.

Provide a section regarding Kiowa Creek. The Preliminary identified prudent line; however this criteria has been removed with the recent update. Hydraulic analysis of the channel is required to identify sections that may require additional stabilization. Provide a narrative on the findings and recommendations.

4.0 D

GENERAL CONCEPT

This project is a low density residential development with lots varying between 2.5 acres and 10 acres in size. Adjoining properties and drainage facilities downstream from the site will not be affected. In order to maintain historic runoff levels for this site, a series of 6 full spectrum detention ponds are being proposed that will capture and control the flows from roads and residential lots. The runoff from these areas will be treated before releasing it into West Kiowa Creek or on to the downstream properties at the historic discharge points. The 6 ponds are sized to over-detain stormwater making up for other basins that are not captured.

As this is a phased project, detention ponds will be installed to maintain flow rates below historic levels at each phase of the project. To achieve this, some ponds will be built and put on line that are outside of the boundary area for a given phase.

SPECIFIC DETAILS

In the existing condition, the subject property is undeveloped land consisting mostly of grassland with a few forested areas near the northern and southern boundaries. Runoff from the site is collected by natural swales and channels that convey flows to West Kiowa Creek, which carries water from the site. The proposed development does not aim to change these natural drainage patterns, but rather to preserve them to the extent possible. With this philosophy in mind, culverts were added to the design to convey water under proposed roads as it flows through the site. The Urban Drainage BMP Decision Tree was used to evaluate various options for water quality and detention as shown below:

	Y	N	Y	N	Y	N	Y	N	Y	N
Step 1—Runoff Reduction Practices										
Grass Swale	●	●	●	●	●	●	●	●	●	●
Grass Buffer	●	●	●	●	●	●	●	●	●	●
Constructed Wetland Channel[2]	●[2]	●[2]	●[2]	●[2]						
Permeable Pavement—Full Infiltration[5]			●[6]				●[6]		●	
Permeable Pavement—No or Partial Infiltration[5]				●[6]				●[6]		●
Green Roof	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3]	●[3]
Step 2—Provide WQCV with Slow Release										
Permeable Pavement — Full Infiltration[5]			●[6]				●[6]		●	
Permeable Pavement – No or Partial Infiltration[5]				●[6]				●[6]		●
Bioretention—Full Infiltration[5]			●[6]				●[6]		●	
Bioretention—No or Partial Infiltration[5]				●[6]				●[6]		●
Extended Dry Detention Basin	●		●		●		●			
Constructed Wetland Basin[2]	●	●	●	●						
Retention Pond	●	●	●	●						
Sand Filter Extended Detention--Full Infiltration[5]			●				●		●	
Sand Filter Extended Detention--No or Partial Infiltration[5]				●				●		●
Green Roof	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3,6]	●[3]	●[3]
Regional Water Quality Treatment	●[4]	●[4]	●[4]	●[4]	●[4]	●[4]	●[4]	●[4]	●[4]	●[4]

Notes: [1] "Tributary impervious area" refers to the impervious area draining to the BMP, **not** the total area of the project site.
[2] For a successful wetland channel or basin, a water source (groundwater or baseflow) will be required.
[3] In the Front Range of Colorado, irrigation, at least periodically in dry times, will be required to sustain a green roof.
[4] If a regional facility will be used to provide the WQCV, some degree of onsite treatment/MDCIA will still likely be required.
[5] No Infiltration = underdrain and liner, Partial Infiltration = underdrain and no liner, Full Infiltration = no underdrain and no liner.
[6] Consider this BMP for a portion of your site. It's best suited for impervious tributary areas of approximately one acre or less.

Figure 2-2. BMP Decision Tree for Conventional Development Sites

Street Classification	Use of Streets for Initial and Major Storms		Cross Flow In Streets For Initial and Major Storms	
	Initial Storm	Major Storm	Initial Storm	Major Storm
Type A (Local with Roadside Ditch)	Flow must not encroach upon street shoulder area.	Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. The depth of flow shall not exceed 6 inches at the shoulder.	Requires culvert. Flow shall not encroach upon street shoulder.	Requires culvert, depth of flow shall not exceed 6 inches at the street shoulder.

stormwater for this project and were used accordingly.

Revise. The criteria notes depth of flow shall not exceed 6 inches at the edge of the road shoulder.
This translate to 2" over the centerline.
Update design calculations.

Results of the hydrologic model show that in the existing condition 100-year storm event, 2469.9cfs leaves the site at the north [illegible] and in the proposed condition 2320.7cfs leaves the site. This development will not adversely impact the drainageways and related facilities downstream from the development.

ROAD CROSSING CULVERTS

A total of five (5) road crossing culverts are proposed and sized to accommodate 100% of the 5-year storm, and have a maximum of 4" road overtopping in the 100Y storm. A summary of the culverts is shown in the table below with additional details in the appendix. The calculated overtopping amount in the last column is conservative by not accounting for head pressure.

	Reach Model	5Y Peak (CFS)	100Y Peak (CFS)	Proposed Culvert Size (IN)	Capacity (CFS)	4" Overtopping (CFS)	Calculated 100Y Overtopping (IN)
Clove Hitch	Basin B2	3.3	19.9	18	13.3	42.4	2.04
Mosey Trail 1	¼ Culv C2	5.9	37.4	24	24.5	31.8	2.88
Mosey Trail 2	¾ Culv C2	17.6	112.3	42	109.7	29.5	1.68
Winsome Way	Culv C3	26.1	166.2	42	149.6	34.7	3.00
Alamar Way	Culv D2	31.2	203.7	60	184.6	25.6	3.60

DETENTION AND WATER QUALITY POND SUMMARY

A summary is shown in the table below and full details are included in the appendix. A total of 3 ponds are proposed, two providing only water quality and 1 providing over detention. This

combination of ponds work together to provide water quality for all stormwater that flows from the roads, and achieves a lower proposed flow at the main outfall relative to historic levels. Ownership and maintenance of the ponds will be through an established metro district. An overview of the pond characteristics is shown in the table below:

	Proposed Volume	Q100 Flow Entering Pond (Developed)	Q100 Flow Exiting Pond (Developed)	Q100 Flow Ratio (Developed vs Historic)
Pond C	0.54 ac-ft	na	na	na
Pond D	1.44 ac-ft	na	na	na
Pond 3	7.3 ac-ft	220.6cfs	120.6cfs	0.8

Identify the design storm going through the overflow grate and the range of design storm going over the spillway. Per the worksheet it appears 10yr and above goes through the spillway.

Similar comment for WQ Pond D.

Water Quality Pond C

Water Quality Pond C is located at a low point near the intersection of Winsome Way and Alamar Way within Filing 1. This pond provides water quality only. Water flows to the pond via a roadside ditch and culvert, entering the pond via a rip rap protected rundown and forebay. The forebay is sized to effectively dissipate the energy of water entering the pond. A trickle channel then conveys water to a concrete lined micropool and outlet structure. The outlet structure provides water quality via an orifice plate allowing the pond to drain over an extended period of time. Water exits the outlet structure through a proposed 12" concrete pipe, and over a reinforced spillway. The spillway is sized to convey the full 100Y flow in less than 1' of flow depth. A full 1' of freeboard is proposed at the spillway, giving a full 2' of freeboard around the rest of the pond. A 10' wide access road is proposed around the top of the pond for servicing requirements.

Water Quality Pond D

Water Quality Pond D is located at a low point along Alamar Way within Filing 1. This pond provides water quality only. Water flows to the pond via a roadside ditch and culvert, entering the pond via a rip rap protected rundown and forebay. The forebay is sized to effectively dissipate

the energy of water entering the pond. A trickle channel then conveys water to a concrete lined micropool and outlet structure. The outlet structure provides water quality via an orifice plate allowing the pond to drain over an extended period of time. Water exits the outlet structure through a proposed 12" concrete pipe, and over a reinforced spillway. The spillway is sized to convey the full 100Y flow in less than 1' of flow depth. A full 1' of freeboard is proposed at the spillway, giving a full 2' of freeboard around the rest of the pond. A 10' wide access road is proposed around the top of the pond for servicing requirements.

Detention Pond 3

Pond 3 is located to the north and outside of Filing 1. This pond provides water quality and over-detention for the project. The pond brings proposed flow at the main outfall down below historic levels relative to the impact of Filing 1. Water flows into Pond 3 through natural channels entering the pond via a rip rap protected rundown. A combination of trickle channels convey the water to a concrete lined micropool and outlet structure providing full spectrum characteristics. The outlet structure provides water quality via an orifice plate allowing the pond to drain over an extended period of time. Water exits the outlet structure through a proposed 12" concrete pipe. An emergency spillway is proposed that will convey the full 100Y flow in less than 1' of flow depth. A full 1' of freeboard is proposed at the spillway, giving a full 2' of freeboard around the rest of the pond. A 10' wide access road is proposed around the top of the pond for servicing requirements.

CONSTRUCTION PHASING

Due to the size and scope of this project, the development has been broken into phases that will be built one at a time. This drainage report covers Filing 1 only.

RISK ASSESSMENT

The site has been further evaluated for future flooding risk with respect to three documented reservoirs upstream from the project. The reservoirs are listed as 1-N-10, 1-P-10, and 1-P-20 in the Kiowa Creek Watershed. The reservoirs were installed as part of jurisdictional flood control and are documented by the state. The Colorado State Dam Safety Engineering office has been contacted. With input criteria from John Hunyadi who oversees jurisdictional dams in this area, the largest of the 3 dams in question has been modeled and results have been provided back to the state. A breaching "sunny day" flow rate of 9500cfs is the largest of the 3 dams and results in a small portion of (two lots) of the project. Easements have been added so that no building will occur in these areas and the current low risk level associated with the dams will remain unchanged. An exhibit of the floodplain area associated with the dam failure, and an approval letter from the Colorado Dam Safety Engineering Office is included in the appendix.

DRAINAGE BASIN FEE

Currently, there are no drainage and bridge fees for Winsome Filing No 1. The West Kiowa Creek Drainage Basin is not part of the El Paso County Drainage Basin Fee Program.

CONCLUSIONS

This report has been prepared in accordance with El Paso County stormwater criteria. It outlines the routing of the 5-Year and 100-year storm events through the project's drainage system. The proposed drainage facilities were designed to convey and treat stormwater flows in accordance with the requirements presented by El Paso County and the Colorado Springs Drainage Criteria Manual. These proposed improvements provide adequate protection to this site without adverse impacts on adjoining upstream and downstream properties.

Consideration has been given to the Four-Step Process outlined in the El Paso County Engineering Criteria Manual for BMP selection as noted below:

Step 1: Employ Runoff Reduction Practices

This project is a low density residential development with lots varying between 2.5 acres and 5 acres in size. The development is designed to have a minimal impact and maintain the rural nature of the existing area. Relative to the size of the site, a small amount of paving is proposed as residential roadways. Roadside ditches and swales will be placed to slow down the velocity and effectively reduce runoff peaks. Full Spectrum Detention Basins will be used to capture stormwater and maintain flows off the site at below historic levels.

Provide analysis of the natural swales.

Step 2: Stabilize Drainageways

Stabilizing the flow paths with in the development will be addressed by roadside ditch designs, flow controls, and swales. Roadside ditch slopes will be designed to control flow rates, and check dams will be used in areas of steeper slopes to slow storm runoff. Low sloping swales are proposed to direct water from adjacent basins to the full spectrum detention ponds. The swales will be graded to reduce the velocity of the water before it enters the ponds. By controlling stormwater along the flow paths we anticipate minimal erosion.

Step 3: Provide Water Quality Capture Volumes (WQCV)

This filing proposes 1 full spectrum detention basin and 2 water quality only ponds to capture stormwater runoff. These ponds have all been sized using UD-Detention and will provide full spectrum detention. Water quality measures are being used for all stormwater that contacts roadways.

Step 4: Consider Need for Industrial and Commercial BMP's

NA

5.0 REFERENCES

1. Urban Storm Drainage Criteria Manuals (Volumes 1, 2, and 3) Urban Drainage & Flood Control District.

2. El Paso County Drainage Criteria Manual, Volumes 1 & 2, Stormwater Quality Policies, Procedures and Best Management Practices (BMPs), Dates May 2014 & June 2019.

3. Federal Emergency Management Agency, Flood Insurance Rate Map Index 08041C0350G, dated December 7, 2018.

4. Natural Resources Conservation Service, Web Soil Survey, dated October 10, 2017.

5. Entech Engineering Geotechnical Report, Dated October 2, 2018.

1.0 VICINITY MAP

VICINITY MAP

VICINITY MAP			
WINSOME SUBDIVISION FILING 1 17480 MERIDIAN ROAD ELBERT, COLORADO	File No.: Date: 01/21/20 Drawn: JCP Checked: LPV Job No.: 49388	FIGURE 1	VERTEX ®

Z:\Shared\Projects\49000-49999\49300-49399\49388.McCune Ranch\06-Engineering\Vertex Drawings\Exhibits\49388_EXH_VinMap.dwg
Tuesday, January 21, 2020 2:05:49 PM
Copyright: 2018 THE VERTEX COMPANIES, INC.

2.0 HYDROLOGIC SOILS MAP

Soil Map—El Paso County Area, Colorado

Map Scale: 1:6,260 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

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: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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
1	Alamosa loam, 1 to 3 percent slopes	28.7	15.6%
26	Elbeth sandy loam, 8 to 15 percent slopes	35.5	19.3%
36	Holderness loam, 8 to 15 percent slopes	21.4	11.6%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	84.7	46.1%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	13.5	7.4%
Totals for Area of Interest		**183.9**	**100.0%**

3.1 MODEL SCHEMATICS

EXISTING CONDITION
MODEL SCHEMATIC

FILING 1 CONDITION
MODEL SCHEMATIC

Add a Section in the narrative explaining and providing a summary of the results for Filing 1 HECHMS analysis.

3.2 FRONTAL STORM RAIN GAGE DATA

Frontal Storm Rain Gage

Time	5Y Values	100Y Values	Time	5Y Values	100Y Values
0:00	0	0	12:00	1.7901	3.0498
0:06	0.00273	0.00465	12:06	1.84129	3.13702
0:12	0.00545	0.00929	12:12	1.88633	3.21374
0:18	0.00824	0.01403	12:18	1.92521	3.27998
0:24	0.01102	0.01877	12:24	1.95793	3.33574
0:30	0.01385	0.0236	12:30	1.9845	3.381
0:36	0.01669	0.02843	12:36	2.00729	3.41982
0:42	0.01958	0.03335	12:42	2.02867	3.45626
0:48	0.02246	0.03827	12:48	2.04865	3.4903
0:54	0.02541	0.04329	12:54	2.06723	3.52194
1:00	0.02835	0.0483	13:00	2.0844	3.5512
1:06	0.03135	0.05341	13:06	2.10049	3.57862
1:12	0.03434	0.05851	13:12	2.11583	3.60474
1:18	0.0374	0.06371	13:18	2.13041	3.62958
1:24	0.04045	0.06891	13:24	2.14423	3.65314
1:30	0.04355	0.0742	13:30	2.1573	3.6754
1:36	0.04666	0.07949	13:36	2.16972	3.69656
1:42	0.04982	0.08487	13:42	2.1816	3.7168
1:48	0.05297	0.09025	13:48	2.19294	3.73612
1:54	0.05619	0.09573	13:54	2.20374	3.75452
2:00	0.0594	0.1012	14:00	2.214	3.772
2:06	0.06267	0.10677	14:06	2.22391	3.78888
2:12	0.06593	0.11233	14:12	2.2336	3.8054
2:18	0.06926	0.11799	14:18	2.24313	3.82163
2:24	0.07258	0.12365	14:24	2.25245	3.8375
2:30	0.07595	0.1294	14:30	2.2616	3.8531
2:36	0.07933	0.13515	14:36	2.27054	3.86832
2:42	0.08276	0.14099	14:42	2.27931	3.88327
2:48	0.08618	0.14683	14:48	2.28787	3.89786
2:54	0.08967	0.15277	14:54	2.29627	3.91216
3:00	0.09315	0.1587	15:00	2.30445	3.9261
3:06	0.09669	0.16473	15:06	2.31247	3.93976
3:12	0.10022	0.17075	15:12	2.32027	3.95306
3:18	0.10381	0.17687	15:18	2.32791	3.96607
3:24	0.10741	0.18299	15:24	2.33534	3.97872
3:30	0.11105	0.1892	15:30	2.3426	3.9911
3:36	0.1147	0.19541	15:36	2.34965	4.0031
3:42	0.1184	0.20171	15:42	2.35653	4.01483
3:48	0.12209	0.20801	15:48	2.3632	4.0262
3:54	0.12585	0.21441	15:54	2.36971	4.03728
4:00	0.1296	0.2208	16:00	2.376	4.048
4:06	0.13341	0.22729	16:06	2.38218	4.05853
4:12	0.13727	0.23386	16:12	2.38828	4.06893
4:18	0.14118	0.24053	16:18	2.39433	4.07923
4:24	0.14515	0.2473	16:24	2.4003	4.0894
4:30	0.14918	0.25415	16:30	2.40621	4.09947
4:36	0.15325	0.2611	16:36	2.41205	4.10941
4:42	0.15738	0.26813	16:42	2.41782	4.11925
4:48	0.16157	0.27526	16:48	2.42352	4.12896
4:54	0.16581	0.28249	16:54	2.42916	4.13857
5:00	0.1701	0.2898	17:00	2.43473	4.14805
5:06	0.17445	0.29721	17:06	2.44023	4.15743
5:12	0.17885	0.3047	17:12	2.44566	4.16668
5:18	0.1833	0.31229	17:18	2.45103	4.17583
5:24	0.18781	0.31998	17:24	2.45632	4.18485
5:30	0.19238	0.32775	17:30	2.46156	4.19377
5:36	0.19699	0.33562	17:36	2.46672	4.20256
5:42	0.20166	0.34357	17:42	2.47182	4.21125
5:48	0.20639	0.35162	17:48	2.47685	4.21981
5:54	0.21117	0.35977	17:54	2.48181	4.22827
6:00	0.216	0.368	18:00	2.4867	4.2366
6:06	0.22089	0.37633	18:06	2.49153	4.24483
6:12	0.22583	0.38474	18:12	2.49629	4.25293
6:18	0.23082	0.39325	18:18	2.50098	4.26093
6:24	0.23587	0.40186	18:24	2.5056	4.2688
6:30	0.24098	0.41055	18:30	2.51016	4.27657
6:36	0.24613	0.41934	18:36	2.51465	4.28421
6:42	0.25134	0.42821	18:42	2.51907	4.29175
6:48	0.25661	0.43718	18:48	2.52342	4.29916
6:54	0.26193	0.44625	18:54	2.52771	4.30647
7:00	0.2673	0.4554	19:00	2.53192	4.31365
7:06	0.27273	0.46465	19:06	2.53608	4.32073
7:12	0.27821	0.47398	19:12	2.54016	4.32768
7:18	0.28374	0.48341	19:18	2.54418	4.33453
7:24	0.28933	0.49294	19:24	2.54812	4.34125
7:30	0.29498	0.50255	19:30	2.55201	4.34787
7:36	0.30067	0.51226	19:36	2.55582	4.35436
7:42	0.30642	0.52205	19:42	2.55957	4.36075
7:48	0.31223	0.53194	19:48	2.56325	4.36701
7:54	0.31809	0.54193	19:54	2.56686	4.37317
8:00	0.324	0.552	20:00	2.5704	4.3792
8:06	0.33008	0.56235	20:06	2.57391	4.38518
8:12	0.33642	0.57316	20:12	2.57739	4.39111
8:18	0.34304	0.58443	20:18	2.58088	4.39705
8:24	0.34992	0.59616	20:24	2.58433	4.40294
8:30	0.35708	0.60835	20:30	2.58779	4.40882
8:36	0.3645	0.621	20:36	2.59122	4.41467
8:42	0.3722	0.63411	20:42	2.59465	4.42051
8:48	0.38016	0.64768	20:48	2.59805	4.4263
8:54	0.3884	0.66171	20:54	2.60145	4.4321
9:00	0.3969	0.6762	21:00	2.60483	4.43785
9:06	0.40554	0.69092	21:06	2.6082	4.4436
9:12	0.41418	0.70564	21:12	2.61155	4.4493
9:18	0.42282	0.72036	21:18	2.6149	4.45501
9:24	0.43146	0.73508	21:24	2.61822	4.46067
9:30	0.4401	0.7498	21:30	2.62154	4.46632
9:36	0.44896	0.76489	21:36	2.62483	4.47194
9:42	0.45824	0.78071	21:42	2.62813	4.47755
9:48	0.46796	0.79727	21:48	2.63139	4.48311
9:54	0.47812	0.81457	21:54	2.63466	4.48868
10:00	0.4887	0.8326	22:00	2.6379	4.4942
10:06	0.49982	0.85155	22:06	2.64114	4.49972
10:12	0.5116	0.87161	22:12	2.64435	4.50519
10:18	0.52402	0.89277	22:18	2.64757	4.51067
10:24	0.53708	0.91503	22:24	2.65075	4.5161
10:30	0.5508	0.9384	22:30	2.65394	4.52152
10:36	0.56538	0.96324	22:36	2.6571	4.52691
10:42	0.58104	0.98992	22:42	2.66026	4.53229
10:48	0.59778	1.01844	22:48	2.66339	4.53762
10:54	0.6156	1.0488	22:54	2.66652	4.54296
11:00	0.6345	1.081	23:00	2.66963	4.54825
11:06	0.65524	1.11633	23:06	2.67273	4.55354
11:12	0.67856	1.15607	23:12	2.67581	4.55878
11:18	0.70448	1.20023	23:18	2.67889	4.56403
11:24	0.733	1.24881	23:24	2.68194	4.56923
11:30	0.7641	1.3018	23:30	2.68499	4.57442
11:36	0.82847	1.41146	23:36	2.68801	4.57958
11:42	0.95677	1.63006	23:42	2.69104	4.58473
11:48	1.16313	1.98163	23:48	2.69403	4.58983
11:54	1.53322	2.61216	23:54	2.69703	4.59494
			24:00:00	2.7	4.6

3.3 TIME OF CONCENTRATION CALCULATIONS

Project Description

File Name	WinsomeSubdivisionExistingCondition (24) - Copy.SPF
Description	
	McCune Ranch Basins

Project Options

Flow Units	CFS
Elevation Type	Depth
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Mar 09, 2018	00:00:00
End Analysis On	Mar 10, 2018	00:00:00
Start Reporting On	Mar 09, 2018	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	16
Nodes	17
Junctions	12
Outfalls	1
Flow Diversions	4
Inlets	0
Storage Nodes	0
Links	18
Channels	14
Pipes	4
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	TS-01	Cumulative	inches	Colorado	El Paso	100	4.60	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	A	915.40	61.83	4.60	1.19	1086.58	565.84	0 00:53:00
2	Ba	3836.70	60.34	4.60	1.10	4201.19	1443.11	0 01:29:33
3	Bb	100.60	69.79	4.60	1.73	173.94	122.13	0 00:40:00
4	Ca	162.70	60.00	4.60	1.07	174.74	113.04	0 00:37:12
5	Cb	70.00	68.70	4.60	1.65	115.50	84.46	0 00:37:25
6	Da	161.30	60.00	4.60	1.07	173.24	112.52	0 00:36:59
7	Db	49.90	60.00	4.60	1.07	53.59	30.63	0 00:44:12
8	Dc	249.70	67.70	4.60	1.58	394.28	267.69	0 00:40:56
9	Ea	37.90	60.00	4.60	1.07	40.70	30.18	0 00:30:30
10	Eb	74.60	67.20	4.60	1.54	115.18	81.57	0 00:38:15
11	F	44.50	69.00	4.60	1.67	74.40	54.18	0 00:37:43
12	G	107.60	74.50	4.60	2.09	224.78	181.44	0 00:33:55
13	H	121.80	71.76	4.60	1.88	228.50	182.91	0 00:33:39
14	I	37.50	79.00	4.60	2.46	92.29	78.32	0 00:31:48
15	J	10.10	69.50	4.60	1.71	17.25	17.21	0 00:22:55
16	K	17.80	76.00	4.60	2.21	39.34	39.26	0 00:24:06

Subbasin Hydrology

Subbasin : A

Input Data

Area (ac) 915.40
Weighted Curve Number 61.83
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	823.86	B	60.00
Pasture, grassland, or range, Fair	9.15	D	84.00
Pasture, grassland, or range, Fair	64.08	C	79.00
Pasture, grassland, or range, Fair	9.15	B	69.00
5 Acre Lots, 7% Impervious	9.15	D	77.00
Composite Area & Weighted CN	915.39		61.83

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	10.62	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	10494	0.00	0.00
Channel Slope (%) :	2	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	8.20	0.00	0.00
Computed Flow Time (min) :	21.34	0.00	0.00

Total TOC (min) 53.01

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.19
Peak Runoff (cfs) 565.84
Weighted Curve Number 61.83
Time of Concentration (days hh:mm:ss) 0 00:53:01

Subbasin : A

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Ba

Input Data

Area (ac) 3836.70
Weighted Curve Number 60.34
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	3759.97	B	60.00
5 Acre Lots, 7% Impervious	76.73	D	77.00
Composite Area & Weighted CN	3836.70		60.34

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.40	0.00	0.00
Computed Flow Time (min) :	11.90	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	23284	0.00	0.00
Channel Slope (%) :	1.4	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	6.86	0.00	0.00
Computed Flow Time (min) :	56.59	0.00	0.00

Total TOC (min) 89.56

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.10
Peak Runoff (cfs) 1443.11
Weighted Curve Number 60.34
Time of Concentration (days hh:mm:ss) 0 01:29:34

Subbasin : Ba

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Bb

Input Data

Area (ac) 100.60
Weighted Curve Number 69.79
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	90.54	B	69.00
Pasture, grassland, or range, Fair	5.03	D	84.00
Composite Area & Weighted CN	95.57		69.79

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.48	0.00	0.00
Computed Flow Time (min) :	11.26	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	4140	0.00	0.00
Channel Slope (%) :	2.4	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	8.98	0.00	0.00
Computed Flow Time (min) :	7.69	0.00	0.00

Total TOC (min) 40.00

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.73
Peak Runoff (cfs) 122.13
Weighted Curve Number 69.79
Time of Concentration (days hh:mm:ss) 0 00:40:00

Subbasin : Bb

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Ca

Input Data

Area (ac) 162.70
Weighted Curve Number 60.00
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	162.70	B	60.00
Composite Area & Weighted CN	162.70		60.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.42	0.00	0.00
Computed Flow Time (min) :	11.74	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	3099	0.00	0.00
Channel Slope (%) :	4.1	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	11.73	0.00	0.00
Computed Flow Time (min) :	4.40	0.00	0.00

Total TOC (min) 37.20

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.07
Peak Runoff (cfs) 113.04
Weighted Curve Number 60.00
Time of Concentration (days hh:mm:ss) 0 00:37:12

Subbasin : Ca

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Cb

Input Data

Area (ac) 70.00
Weighted Curve Number 68.70
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	10.50	B	65.00
Pasture, grassland, or range, Fair	2.10	C	79.00
Pasture, grassland, or range, Fair	57.40	B	69.00
Composite Area & Weighted CN	70.00		68.70

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.6	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.33	0.00	0.00
Computed Flow Time (min) :	12.53	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	2084	0.00	0.00
Channel Slope (%) :	3.6	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.08	0.00	0.00
Computed Flow Time (min) :	3.83	0.00	0.00

Total TOC (min) 37.42

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.65
Peak Runoff (cfs) 84.46
Weighted Curve Number 68.70
Time of Concentration (days hh:mm:ss) 0 00:37:25

Subbasin : Cb

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Da

Input Data

Area (ac) 161.30
Weighted Curve Number 60.00
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	161.30	B	60.00
Composite Area & Weighted CN	161.30		60.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5.7	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.19	0.00	0.00
Computed Flow Time (min) :	14.01	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1601	0.00	0.00
Channel Slope (%) :	5.7	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	13.84	0.00	0.00
Computed Flow Time (min) :	1.93	0.00	0.00

Total TOC (min) 36.99

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.07
Peak Runoff (cfs) 112.52
Weighted Curve Number 60.00
Time of Concentration (days hh:mm:ss) 0 00:36:59

Subbasin : Da

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Db

Input Data

Area (ac) 49.90
Weighted Curve Number 60.00
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	49.90	B	60.00
Composite Area & Weighted CN	49.90		60.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.48	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	0.79	0.00	0.00
Computed Flow Time (min) :	21.10	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	922	0.00	0.00
Channel Slope (%) :	2.48	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.53	0.00	0.00
Computed Flow Time (min) :	2.04	0.00	0.00

Total TOC (min) 44.20

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.07
Peak Runoff (cfs) 30.63
Weighted Curve Number 60.00
Time of Concentration (days hh:mm:ss) 0 00:44:12

Subbasin : Db

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Dc

Input Data

Area (ac) 249.70
Weighted Curve Number 67.70
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	83.80	B	65.00
Pasture, grassland, or range, Fair	4.19	D	84.00
Pasture, grassland, or range, Fair	121.51	B	69.00
Composite Area & Weighted CN	209.50		67.70

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.21	0.00	0.00
Computed Flow Time (min) :	13.77	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	3678	0.00	0.00
Channel Slope (%) :	3	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	10.04	0.00	0.00
Computed Flow Time (min) :	6.11	0.00	0.00

Total TOC (min) 40.94

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.58
Peak Runoff (cfs) 267.69
Weighted Curve Number 67.70
Time of Concentration (days hh:mm:ss) 0 00:40:56

Subbasin : Dc

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Ea

Input Data

Area (ac) 37.90
Weighted Curve Number 60.00
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	37.90	B	60.00
Composite Area & Weighted CN	37.90		60.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	4.9	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.11	0.00	0.00
Computed Flow Time (min) :	7.51	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1227	0.00	0.00
Channel Slope (%) :	4.9	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.59	0.00	0.00
Computed Flow Time (min) :	1.93	0.00	0.00

Total TOC (min) 30.50

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.07
Peak Runoff (cfs) 30.18
Weighted Curve Number 60.00
Time of Concentration (days hh:mm:ss) 0 00:30:30

Subbasin : Ea

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Eb

Input Data

Area (ac) 74.60
Weighted Curve Number 67.20
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	91.84	B	69.00
5 Acre Lots, 7% Impervious	22.96	B	60.00
Composite Area & Weighted CN	114.80		67.20

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	12.25	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	2766	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	4.94	0.00	0.00

Total TOC (min) 38.26

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.54
Peak Runoff (cfs) 81.57
Weighted Curve Number 67.20
Time of Concentration (days hh:mm:ss) 0 00:38:16

Subbasin : Eb

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : F

Input Data

Area (ac) 44.50
Weighted Curve Number 69.00
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	44.50	B	69.00
Composite Area & Weighted CN	44.50		69.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.25	0.00	0.00
Computed Flow Time (min) :	13.33	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1707	0.00	0.00
Channel Slope (%) :	3.2	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.56	0.00	0.00
Computed Flow Time (min) :	3.32	0.00	0.00

Total TOC (min) 37.72

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.67
Peak Runoff (cfs) 54.18
Weighted Curve Number 69.00
Time of Concentration (days hh:mm:ss) 0 00:37:43

Subbasin : F

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : G

Input Data

Area (ac) 107.60
Weighted Curve Number 74.50
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	59.18	C	79.00
Pasture, grassland, or range, Fair	48.42	B	69.00
Composite Area & Weighted CN	107.60		74.50

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.7	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	10.96	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1441	0.00	0.00
Channel Slope (%) :	4.7	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	12.56	0.00	0.00
Computed Flow Time (min) :	1.91	0.00	0.00

Total TOC (min) 33.93

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 2.09
Peak Runoff (cfs) 181.44
Weighted Curve Number 74.50
Time of Concentration (days hh:mm:ss) 0 00:33:56

Subbasin : G

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : H

Input Data

Area (ac) 121.80
Weighted Curve Number 71.76
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	54.81	C	79.00
Woods, Fair	31.67	B	60.00
Pasture, grassland, or range, Fair	30.45	B	69.00
Pasture, grassland, or range, Fair	4.87	D	84.00
Composite Area & Weighted CN	121.80		71.76

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.43	0.00	0.00
Computed Flow Time (min) :	11.66	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	676	0.00	0.00
Channel Slope (%) :	4.2	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	11.88	0.00	0.00
Computed Flow Time (min) :	0.95	0.00	0.00

Total TOC (min) 33.66

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.88
Peak Runoff (cfs) 182.91
Weighted Curve Number 71.76
Time of Concentration (days hh:mm:ss) 0 00:33:40

Subbasin : H

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : I

Input Data

Area (ac) 37.50
Weighted Curve Number 79.00
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	37.50	C	79.00
Composite Area & Weighted CN	37.50		79.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.58	0.00	0.00
Computed Flow Time (min) :	10.55	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	134	0.00	0.00
Channel Slope (%) :	5.1	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.80	0.00	0.00
Computed Flow Time (min) :	0.21	0.00	0.00

Total TOC (min) 31.81

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 2.46
Peak Runoff (cfs) 78.32
Weighted Curve Number 79.00
Time of Concentration (days hh:mm:ss) 0 00:31:49

Subbasin : I

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : J

Input Data

Area (ac) 10.10
Weighted Curve Number 69.50
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Fair	5.05	B	60.00
Woods, Fair	5.05	D	79.00
Composite Area & Weighted CN	10.10		69.50

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	8.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	2.08	0.00	0.00
Computed Flow Time (min) :	1.60	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	228	0.00	0.00
Channel Slope (%) :	8.8	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	14.19	0.00	0.00
Computed Flow Time (min) :	0.27	0.00	0.00

Total TOC (min) 22.93

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.71
Peak Runoff (cfs) 17.21
Weighted Curve Number 69.50
Time of Concentration (days hh:mm:ss) 0 00:22:56

Subbasin : J

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : K

Input Data

Area (ac) 17.80
Weighted Curve Number 76.00
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	17.80	C	76.00
Composite Area & Weighted CN	17.80		76.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	3.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.38	0.00	0.00
Computed Flow Time (min) :	2.42	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	354	0.00	0.00
Channel Slope (%) :	3.9	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.45	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00

Total TOC (min) 24.10

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 2.21
Peak Runoff (cfs) 39.26
Weighted Curve Number 76.00
Time of Concentration (days hh:mm:ss) 0 00:24:06

Subbasin : K

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Project Description

File Name ..... Filing 1 - 2019.11.19.SPF

Project Options

Flow Units ..... CFS
Elevation Type ..... Depth
Hydrology Method ..... SCS TR-55
Time of Concentration (TOC) Method ..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Enable Overflow Ponding at Nodes ..... YES
Skip Steady State Analysis Time Periods ..... NO

Analysis Options

Start Analysis On ..... Sep 14, 2018 00:00:00
End Analysis On ..... Sep 15, 2018 00:00:00
Start Reporting On ..... Sep 14, 2018 00:00:00
Antecedent Dry Days ..... 0 days
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss
Reporting Time Step ..... 0 00:05:00 days hh:mm:ss
Routing Time Step ..... 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	22
Nodes	66
Junctions	55
Outfalls	1
Flow Diversions	4
Inlets	0
Storage Nodes	6
Links	67
Channels	39
Pipes	22
Pumps	0
Orifices	6
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-1	Time Series	TS-01	Cumulative	inches	Colorado	El Paso	100	4.60	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	A	915.40	60.36	4.60	1.10	1003.28	506.27	0 00:53:00
2	B1	3836.70	60.34	4.60	1.10	4201.19	1443.11	0 01:29:33
3	B2	13.10	64.00	4.60	1.33	17.38	15.92	0 00:24:27
4	B3	54.90	65.10	4.60	1.40	76.86	52.19	0 00:39:21
5	B4	41.48	68.50	4.60	1.64	67.86	47.71	0 00:39:30
6	C1	162.70	60.00	4.60	1.07	174.74	113.04	0 00:37:12
7	C2	22.40	64.00	4.60	1.33	29.72	22.55	0 00:32:36
8	C3	16.10	64.00	4.60	1.33	21.36	17.80	0 00:28:22
9	C4	23.80	65.00	4.60	1.39	33.15	21.79	0 00:41:07
10	D1.1	161.30	60.00	4.60	1.07	173.24	112.52	0 00:36:59
11	D1.2	49.90	60.00	4.60	1.07	53.59	30.63	0 00:44:12
12	D2	68.70	64.75	4.60	1.38	94.60	69.43	0 00:34:49
13	D3.4.6	167.00	66.35	4.60	1.49	248.00	170.47	0 00:39:22
14	D5	12.80	67.20	4.60	1.54	19.76	16.27	0 00:30:31
15	Ea	37.90	60.00	4.60	1.07	40.70	30.18	0 00:30:30
16	Eb	74.60	66.23	4.60	1.48	110.18	77.30	0 00:38:15
17	F	44.50	69.00	4.60	1.67	74.40	54.18	0 00:37:43
18	G	107.60	74.50	4.60	2.09	224.78	181.44	0 00:33:55
19	H	121.80	71.76	4.60	1.88	228.50	182.91	0 00:33:39
20	I	37.50	79.00	4.60	2.46	92.29	78.32	0 00:31:48
21	J	10.10	69.50	4.60	1.71	17.25	17.21	0 00:22:55
22	K	17.80	76.00	4.60	2.21	39.34	39.26	0 00:24:06

Subbasin Hydrology

Subbasin : A

Input Data

Area (ac) 915.40
Weighted Curve Number 60.36
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	839.92	B	60.00
Pasture, grassland, or range, Fair	8.66	D	84.00
5 Acre Lots, 7% Impervious	8.66	C	72.00
Composite Area & Weighted CN	857.24		60.36

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	10.62	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	10494	0.00	0.00
Channel Slope (%) :	2	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	8.20	0.00	0.00
Computed Flow Time (min) :	21.34	0.00	0.00

Total TOC (min) 53.01

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.10
Peak Runoff (cfs) 506.27
Weighted Curve Number 60.36
Time of Concentration (days hh:mm:ss) 0 00:53:01

Subbasin : A

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B1

Input Data

Area (ac) 3836.70
Weighted Curve Number 60.34
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	3759.97	B	60.00
5 Acre Lots, 7% Impervious	76.73	D	77.00
Composite Area & Weighted CN	3836.70		60.34

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.40	0.00	0.00
Computed Flow Time (min) :	11.90	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	23284	0.00	0.00
Channel Slope (%) :	1.4	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	6.86	0.00	0.00
Computed Flow Time (min) :	56.59	0.00	0.00

Total TOC (min) 89.56

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.10
Peak Runoff (cfs) 1443.11
Weighted Curve Number 60.34
Time of Concentration (days hh:mm:ss) 0 01:29:34

Subbasin : B1

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B2

Input Data

Area (ac) 13.10
Weighted Curve Number 64.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	13.10	B	64.00
Composite Area & Weighted CN	13.10		64.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	5.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.60	0.00	0.00
Computed Flow Time (min) :	3.13	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	177	0.00	0.00
Channel Slope (%) :	5.2	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.91	0.00	0.00
Computed Flow Time (min) :	0.27	0.00	0.00

Total TOC (min) 24.45

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.33
Peak Runoff (cfs) 15.92
Weighted Curve Number 64.00
Time of Concentration (days hh:mm:ss) 0 00:24:27

Subbasin : B2

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B3

Input Data

Area (ac) 54.90
Weighted Curve Number 65.10
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	38.43	B	60.00
5 Acre Lots, 7% Impervious	16.47	D	77.00
Composite Area & Weighted CN	54.90		65.10

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.27	0.00	0.00
Computed Flow Time (min) :	13.12	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	2693	0.00	0.00
Channel Slope (%) :	3.3	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.69	0.00	0.00
Computed Flow Time (min) :	5.17	0.00	0.00

Total TOC (min) 39.35

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.40
Peak Runoff (cfs) 52.19
Weighted Curve Number 65.10
Time of Concentration (days hh:mm:ss) 0 00:39:21

Subbasin : B3

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B4

Input Data

Area (ac) 41.48
Weighted Curve Number 68.50
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	22.81	B	64.00
Pasture, grassland, or range, Fair	12.44	B	69.00
Pasture, grassland, or range, Fair	6.22	D	84.00
Composite Area & Weighted CN	41.47		68.50

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.06	0.00	0.00
Computed Flow Time (min) :	15.72	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1188	0.00	0.00
Channel Slope (%) :	2.3	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.25	0.00	0.00
Computed Flow Time (min) :	2.73	0.00	0.00

Total TOC (min) 39.51

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.64
Peak Runoff (cfs) 47.71
Weighted Curve Number 68.50
Time of Concentration (days hh:mm:ss) 0 00:39:31

Subbasin : B4

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : C1

Input Data

Area (ac) 162.70
Weighted Curve Number 60.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	162.70	B	60.00
Composite Area & Weighted CN	162.70		60.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.42	0.00	0.00
Computed Flow Time (min) :	11.74	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	3099	0.00	0.00
Channel Slope (%) :	4.1	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	11.73	0.00	0.00
Computed Flow Time (min) :	4.40	0.00	0.00

Total TOC (min) 37.20

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.07
Peak Runoff (cfs) 113.04
Weighted Curve Number 60.00
Time of Concentration (days hh:mm:ss) 0 00:37:12

Subbasin : C1

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : C2

Input Data

Area (ac) 22.40
Weighted Curve Number 64.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	22.40	B	64.00
Composite Area & Weighted CN	22.40		64.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	5.31	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	401	0.00	0.00
Channel Slope (%) :	.05	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	1.07	0.00	0.00
Computed Flow Time (min) :	6.25	0.00	0.00

Total TOC (min) 32.61

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.33
Peak Runoff (cfs) 22.55
Weighted Curve Number 64.00
Time of Concentration (days hh:mm:ss) 0 00:32:37

Subbasin : C2

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : C3

Input Data

Area (ac) 16.10
Weighted Curve Number 64.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	16.10	B	64.00
Composite Area & Weighted CN	16.10		64.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	6.13	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	666	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	1.19	0.00	0.00

Total TOC (min) 28.38

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.33
Peak Runoff (cfs) 17.80
Weighted Curve Number 64.00
Time of Concentration (days hh:mm:ss) 0 00:28:23

Subbasin : C3

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : C4

Input Data

Area (ac) 23.80
Weighted Curve Number 65.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	11.90	B	60.00
Pasture, grassland, or range, Fair	1.19	C	79.00
Pasture, grassland, or range, Fair	10.71	B	69.00
Composite Area & Weighted CN	23.80		65.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	1.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.96	0.00	0.00
Computed Flow Time (min) :	17.36	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1074	0.00	0.00
Channel Slope (%) :	1.9	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	6.59	0.00	0.00
Computed Flow Time (min) :	2.71	0.00	0.00

Total TOC (min) 41.13

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.39
Peak Runoff (cfs) 21.79
Weighted Curve Number 65.00
Time of Concentration (days hh:mm:ss) 0 00:41:08

Subbasin : C4

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : D1.1

Input Data

Area (ac) 161.30
Weighted Curve Number 60.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	161.30	B	60.00
Composite Area & Weighted CN	161.30		60.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5.7	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.19	0.00	0.00
Computed Flow Time (min) :	14.01	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1601	0.00	0.00
Channel Slope (%) :	5.7	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	13.84	0.00	0.00
Computed Flow Time (min) :	1.93	0.00	0.00

Total TOC (min) 36.99

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.07
Peak Runoff (cfs) 112.52
Weighted Curve Number 60.00
Time of Concentration (days hh:mm:ss) 0 00:36:59

Subbasin : D1.1

Subbasin : D1.2

Input Data

Area (ac) 49.90
Weighted Curve Number 60.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	49.90	B	60.00
Composite Area & Weighted CN	49.90		60.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.48	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	0.79	0.00	0.00
Computed Flow Time (min) :	21.10	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	922	0.00	0.00
Channel Slope (%) :	2.48	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.53	0.00	0.00
Computed Flow Time (min) :	2.04	0.00	0.00

Total TOC (min) 44.20

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.07
Peak Runoff (cfs) 30.63
Weighted Curve Number 60.00
Time of Concentration (days hh:mm:ss) 0 00:44:12

Subbasin : D1.2

Subbasin : D2

Input Data

Area (ac) 68.70
Weighted Curve Number 64.75
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	10.31	B	69.00
2.5 Acre Lots, 11% Impervious	58.40	B	64.00
Composite Area & Weighted CN	68.71		64.75

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	12.25	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	848	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	1.52	0.00	0.00

Total TOC (min) 34.83

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.38
Peak Runoff (cfs) 69.43
Weighted Curve Number 64.75
Time of Concentration (days hh:mm:ss) 0 00:34:50

Subbasin : D2

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : D3.4.6

Input Data

Area (ac) 167.00
Weighted Curve Number 66.35
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	21.61	B	64.00
Woods & grass combination, Fair	83.80	B	65.00
Pasture, grassland, or range, Fair	61.59	B	69.00
Composite Area & Weighted CN	167.00		66.35

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.06	0.00	0.00
Computed Flow Time (min) :	15.72	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1128	0.00	0.00
Channel Slope (%) :	2.3	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.25	0.00	0.00
Computed Flow Time (min) :	2.59	0.00	0.00

Total TOC (min) 39.37

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.49
Peak Runoff (cfs) 170.47
Weighted Curve Number 66.35
Time of Concentration (days hh:mm:ss) 0 00:39:22

Subbasin : D3.4.6

Subbasin : D5

Input Data

Area (ac) 12.80
Weighted Curve Number 67.20
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	2.56	B	60.00
Pasture, grassland, or range, Fair	10.24	B	69.00
Composite Area & Weighted CN	12.80		67.20

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	2.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.01	0.00	0.00
Computed Flow Time (min) :	8.25	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	506	0.00	0.00
Channel Slope (%) :	2.1	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	6.93	0.00	0.00
Computed Flow Time (min) :	1.22	0.00	0.00

Total TOC (min) 30.53

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.54
Peak Runoff (cfs) 16.27
Weighted Curve Number 67.20
Time of Concentration (days hh:mm:ss) 0 00:30:32

Subbasin : D5

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Ea

Input Data

Area (ac) 37.90
Weighted Curve Number 60.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	37.90	B	60.00
Composite Area & Weighted CN	37.90		60.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	4.9	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.11	0.00	0.00
Computed Flow Time (min) :	7.51	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1227	0.00	0.00
Channel Slope (%) :	4.9	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.59	0.00	0.00
Computed Flow Time (min) :	1.93	0.00	0.00

Total TOC (min) 30.50

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.07
Peak Runoff (cfs) 30.18
Weighted Curve Number 60.00
Time of Concentration (days hh:mm:ss) 0 00:30:30

Subbasin : Ea

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : Eb

Input Data

Area (ac) 74.60
Weighted Curve Number 66.23
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	22.96	B	60.00
Pasture, grassland, or range, Fair	51.64	B	69.00
Composite Area & Weighted CN	74.60		66.23

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	12.25	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	2766	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	4.94	0.00	0.00

Total TOC (min) 38.26

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.48
Peak Runoff (cfs) 77.30
Weighted Curve Number 66.23
Time of Concentration (days hh:mm:ss) 0 00:38:16

Subbasin : Eb

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : F

Input Data

Area (ac) 44.50
Weighted Curve Number 69.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	44.50	B	69.00
Composite Area & Weighted CN	44.50		69.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.25	0.00	0.00
Computed Flow Time (min) :	13.33	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1707	0.00	0.00
Channel Slope (%) :	3.2	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.56	0.00	0.00
Computed Flow Time (min) :	3.32	0.00	0.00

Total TOC (min) 37.72

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.67
Peak Runoff (cfs) 54.18
Weighted Curve Number 69.00
Time of Concentration (days hh:mm:ss) 0 00:37:43

Subbasin : F

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : G

Input Data

Area (ac) 107.60
Weighted Curve Number 74.50
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	59.18	C	79.00
Pasture, grassland, or range, Fair	48.42	B	69.00
Composite Area & Weighted CN	107.60		74.50

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.7	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	10.96	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1441	0.00	0.00
Channel Slope (%) :	4.7	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	12.56	0.00	0.00
Computed Flow Time (min) :	1.91	0.00	0.00

Total TOC (min) 33.93

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 2.09
Peak Runoff (cfs) 181.44
Weighted Curve Number 74.50
Time of Concentration (days hh:mm:ss) 0 00:33:56

Subbasin : G

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : H

Input Data

Area (ac) 121.80
Weighted Curve Number 71.76
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	54.81	C	79.00
Woods, Fair	31.67	B	60.00
Pasture, grassland, or range, Fair	30.45	B	69.00
Pasture, grassland, or range, Fair	4.87	D	84.00
Composite Area & Weighted CN	121.80		71.76

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.43	0.00	0.00
Computed Flow Time (min) :	11.66	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	676	0.00	0.00
Channel Slope (%) :	4.2	0.00	0.00
Cross Section Area (ft^2) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	11.88	0.00	0.00
Computed Flow Time (min) :	0.95	0.00	0.00

Total TOC (min) 33.66

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.88
Peak Runoff (cfs) 182.91
Weighted Curve Number 71.76
Time of Concentration (days hh:mm:ss) 0 00:33:40

Subbasin : H

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : I

Input Data

Area (ac) 37.50
Weighted Curve Number 79.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	6.80	C	79.00
Composite Area & Weighted CN	6.80		79.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.58	0.00	0.00
Computed Flow Time (min) :	10.55	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	134	0.00	0.00
Channel Slope (%) :	5.1	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.80	0.00	0.00
Computed Flow Time (min) :	0.21	0.00	0.00

Total TOC (min) 31.81

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 2.46
Peak Runoff (cfs) 78.32
Weighted Curve Number 79.00
Time of Concentration (days hh:mm:ss) 0 00:31:49

Subbasin : I

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : J

Input Data

Area (ac) 10.10
Weighted Curve Number 69.50
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Fair	5.05	B	60.00
Woods, Fair	5.05	D	79.00
Composite Area & Weighted CN	10.10		69.50

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	8.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	2.08	0.00	0.00
Computed Flow Time (min) :	1.60	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	228	0.00	0.00
Channel Slope (%) :	8.8	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	14.19	0.00	0.00
Computed Flow Time (min) :	0.27	0.00	0.00

Total TOC (min) 22.93

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 1.71
Peak Runoff (cfs) 17.21
Weighted Curve Number 69.50
Time of Concentration (days hh:mm:ss) 0 00:22:56

Subbasin : J

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : K

Input Data

Area (ac) 17.80
Weighted Curve Number 76.00
Rain Gage ID ..... Rain Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	17.80	C	76.00
Composite Area & Weighted CN	17.80		76.00

Time of Concentration

Sheet Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

Shallow Concentrated Flow Computations	Flowpath A	Flowpath B	Flowpath C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	3.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.38	0.00	0.00
Computed Flow Time (min) :	2.42	0.00	0.00

Channel Flow Computations	Flowpath A	Flowpath B	Flowpath C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	354	0.00	0.00
Channel Slope (%) :	3.9	0.00	0.00
Cross Section Area (ft^2) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.45	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00

Total TOC (min) 24.10

Subbasin Runoff Results

Total Rainfall (in) 4.60
Total Runoff (in) 2.21
Peak Runoff (cfs) 39.26
Weighted Curve Number 76.00
Time of Concentration (days hh:mm:ss) 0 00:24:06

Subbasin : K

Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)

Runoff Hydrograph
Runoff (cfs)
Time (hrs)

3.4 LAG TIME CALCULATIONS

EC Basin Lag Time

Basin	Area AC	TOC MIN	TOC HR	Lag Time HR	Lag Time MIN
A	915.40	53.01	0.88	0.53	31.81
Ba	3836.70	89.56	1.49	0.90	53.74
Bb	100.60	40.00	0.67	0.40	24.00
Ca	162.70	37.20	0.62	0.37	22.32
Cb	70.00	37.42	0.62	0.37	22.45
Da	161.30	36.99	0.62	0.37	22.19
Db	49.90	44.20	0.74	0.44	26.52
Dc	249.70	40.94	0.68	0.41	24.56
Ea	37.90	30.50	0.51	0.31	18.30
Eb	74.60	38.26	0.64	0.38	22.96
F	44.50	37.72	0.63	0.38	22.63
G	107.60	33.93	0.57	0.34	20.36
H	121.80	33.66	0.56	0.34	20.20
I	37.50	31.81	0.53	0.32	19.09
J	10.10	22.93	0.38	0.23	13.76
K	17.80	24.10	0.40	0.24	14.46
	5998.1				

Filing 1 Basin Lag Time

Basin	Area AC	TOC MIN	TOC HR	Lag Time HR	Lag Time MIN
A	915.40	53.01	0.88	0.53	31.81
B1	3836.70	89.56	1.49	0.90	53.74
B2	13.10	24.45	0.41	0.24	14.67
B3	54.90	39.35	0.66	0.39	23.61
B4	41.48	39.51	0.66	0.40	23.71
C1	162.70	37.20	0.62	0.37	22.32
C2	22.40	32.61	0.54	0.33	19.57
C3	16.10	28.38	0.47	0.28	17.03
C4	23.80	41.13	0.69	0.41	24.68
D1.1	161.30	36.99	0.62	0.37	22.19
D1.2	49.90	44.20	0.74	0.44	26.52
D2	68.70	34.83	0.58	0.35	20.90
D3.4.6	167.00	39.37	0.66	0.39	23.62
D5	12.80	30.53	0.51	0.31	18.32
Ea	37.90	30.50	0.51	0.31	18.30
Eb	74.60	38.26	0.64	0.38	22.96
F	44.50	37.72	0.63	0.38	22.63
G	107.60	33.93	0.57	0.34	20.36
H	121.80	33.66	0.56	0.34	20.20
I	37.50	31.81	0.53	0.32	19.09
J	10.10	22.93	0.38	0.23	13.76
K	17.80	24.10	0.40	0.24	14.46
	5998.08				

3.5 INITIAL ABSTRACTION CALCULATIONS

Existing Condition Initial Abstraction Summary

Basin	Area AC	Curve Number	Initial Abstraction
A	915.40	61.83	0.6173
Ba	3836.67	60.34	0.6573
Bb	100.60	69.79	0.4329
Ca	162.70	60.00	0.6667
Cb	70.00	68.70	0.4556
Da	161.30	60.00	0.6667
Db	49.90	60.00	0.6667
Dc	249.70	67.70	0.4771
Ea	37.90	60.00	0.6667
Eb	74.60	67.20	0.4881
F	44.50	69.00	0.4493
G	107.60	74.50	0.3423
H	121.80	71.76	0.3935
I	37.50	79.00	0.2658
J	10.10	69.50	0.4388
K	17.80	76.00	0.3158
	5998.05		

Ia = 0.1[(1000/CN)-10]

Filing 1 Condition Initial Abstraction Summary

Basin	Area AC	Curve Number	Initial Abstraction
A	915.40	61.83	0.6173
B1	3836.67	60.34	0.6573
B2	13.10	64.00	0.5625
B3	54.90	65.10	0.5361
B4	41.48	68.50	0.4599
C1	162.70	60.00	0.6667
C2	22.40	60.00	0.6667
C3	16.10	64.00	0.5625
C4	23.80	65.00	0.5385
D1.1	161.30	60.00	0.6667
D1.2	49.90	60.00	0.6667
D2	68.70	64.75	0.5444
D3,4,6	167.00	66.35	0.5072
D5	12.80	67.20	0.4881
Ea	37.90	60.00	0.6667
Eb	74.60	67.20	0.4881
F	44.50	69.00	0.4493
G	107.60	74.50	0.3423
H	121.80	71.76	0.3935
I	37.50	79.00	0.2658
J	10.10	69.50	0.4388
K	17.80	76.00	0.3158
	5998.05		

Ia = 0.1[(1000/CN)-10]

3.6 BASIN INPUT DETAILS

EC Basin Inputs

Basin	Initial Storage	Max Storage	Initial Abstraction	Curve Number	Impervious	Lag Time
	%	IN	IN		%	Min
A	5.00	0.035	0.617	61.83	6.55	31.80
Ba	5.00	0.035	0.657	60.34	7.00	53.74
Bb	5.00	0.035	0.433	69.79	2.00	24.00
Ca	5.00	0.035	0.667	60.00	7.00	22.32
Cb	5.00	0.035	0.456	68.70	2.00	22.45
Da	5.00	0.035	0.667	60.00	7.00	22.19
Db	5.00	0.035	0.667	60.00	7.00	26.52
Dc	5.00	0.035	0.477	67.70	2.00	24.56
Ea	5.00	0.035	0.667	60.00	7.00	18.30
Eb	5.00	0.035	0.488	67.20	3.00	22.96
F	5.00	0.035	0.449	69.00	2.00	22.63
G	5.00	0.035	0.342	74.50	2.00	20.36
H	5.00	0.035	0.394	71.76	2.00	20.19
I	5.00	0.035	0.266	79.00	2.00	19.08
J	5.00	0.035	0.439	69.50	7.00	13.76
K	5.00	0.035	0.316	76.00	7.00	14.46

Filing 1 Basin Inputs

Basin	Initial Storage	Max Storage	Initial Abstraction	Curve Number	Impervious	Lag Time
	%	IN	IN		%	Min
A	5.00	0.035	0.657	61.83	6.55	31.81
B1	5.00	0.035	0.657	60.34	7.00	53.74
B2	5.00	0.035	0.563	64.00	11.00	14.67
B3	5.00	0.035	0.536	65.10	7.00	23.61
B4	5.00	0.035	0.460	68.50	7.00	23.71
C1	5.00	0.035	0.667	60.00	7.00	22.32
C2	5.00	0.035	0.667	64.00	7.00	19.57
C3	5.00	0.035	0.563	64.00	11.00	17.02
C4	5.00	0.035	0.538	65.00	4.50	24.68
D1.1	5.00	0.035	0.667	60.00	7.00	22.19
D1.2	5.00	0.035	0.667	60.00	7.00	26.52
D2	5.00	0.035	0.544	64.75	9.00	20.89
D3,4,6	5.00	0.035	0.477	66.35	2.00	24.56
D5	5.00	0.035	0.488	67.20	3.00	18.32
Ea	5.00	0.035	0.667	60.00	7.00	18.30
Eb	5.00	0.035	0.488	67.20	3.00	22.96
F	5.00	0.035	0.449	69.00	2.00	22.63
G	5.00	0.035	0.342	74.50	2.00	20.36
H	5.00	0.035	0.394	71.76	2.00	20.19
I	5.00	0.035	0.266	79.00	2.00	19.08
J1	5.00	0.035	0.439	69.50	7.00	13.76
K1	5.00	0.035	0.316	76.00	7.00	14.46

3.7 REACH INPUT DETAILS

EC Reach Inputs

Reach	Length	Slope	Manning's	Shape	Diameter	Bottom Width	Side Slope	Invert
	FT	FT/FT	n		FT	FT	H/V	FT
1	2473.30	0.025	0.04	Trapezoid		20.00	4	7318.5
2	2839.57	0.007	0.04	Trapezoid		20.00	4	7300
3	1717.53	0.012	0.04	Trapezoid		20.00	4	7280
4	1277.36	0.003	0.04	Trapezoid		20.00	4	7280
5	70.66	0.226	0.04	Trapezoid		20.00	4	7260
6	2431.12	0.025	0.04	Triangle			7	7318.5
7	3754.60	0.023	0.04	Triangle			7	7300
8	2431.00	0.025	0.04	Triangle			7	7300
9	5201.60	0.027	0.04	Triangle			7	7276

Filing 1 Reach Inputs

Reach	Length	Slope	Manning's	Shape	Diameter	Bottom Width	Side Slope	Invert
	FT	FT/FT	n		FT	FT	H/V	FT
Reach-B1	2137.84	0.02	0.04	Trapezoid		20.00	4	7334
Reach-B2	1548.66	0.03	0.04	Triangle			7	7318.5
Reach-B3	1801.86	0.01	0.04	Trapezoid		20.00	4	7318.5
Reach-B4-3	155.46	0.12	0.04	Triangle			7	7318.5
Reach-C1	799.51	0.02	0.04	Triangle			7	7363
Reach-C2	861.57	0.02	0.04	Triangle			7	7341
Reach-D1.1	1827.50	0.03	0.04	Trapezoid		8.00	4	7329
Reach-D3	1312.44	0.03	0.04	Triangle			7	7372
Reach-D4	1169.72	0.03	0.04	Triangle			7	7337.5
Reach-D5	1270.02	0.02	0.04	Trapezoid		8.00	4	7300
Reach-Ea	5201.60	0.03	0.04	Triangle			7	7276
Reach-P3	264.79	0.03	0.04	Triangle			7	7280
Reach-1	866.29	0.01	0.04	Trapezoid		20.00	4	7310
Reach-2	1071.31	0.01	0.04	Trapezoid		20.00	4	7300
Reach-3	736.36	0.01	0.04	Trapezoid		20.00	4	7292
Reach-4	1308.67	0.01	0.04	Trapezoid		20.00	4	7280
Reach-5	340.25	0.01	0.04	Trapezoid		20.00	4	7276
EX CULV C1	100.00	0.03	0.03	Circle	2.50			7379
EX CULV D1.1	100.00	0.03	0.03	Circle	6.00			7385
EX CULV D1.2	100.00	0.04	0.03	Circle	2.50			7412
CULV B2	60.00	0.07	0.01	Circle	1.50			7371
CULV C2	60.00	0.05	0.01	Circle	3.00			7360
CULV C3	60	0.0667	0.012	Circle	3			7337
CULV D2	60	0.0167	0.012	Circle	4.5			7328
OUT-1	1089	0.01	0.04	Trapezoid		20	4	7266

Culverts - Filing 1 Condition

Culvert	Basins	Area SQ MILES	Area ACRES	5Y Q CFS	5Y Q Source	Diameter IN	Slope FT/FT	Pipe Type	Mannings n	Q Capacity CFS
Clove Hitch	B2	0.02047	13.10	2.52	UD Rational	18.00	0.0620	RCP	0.012	28.41
Mosey Trail	C1+C2	0.28922	185.10	23.40	HMS Model	24.00	0.0306	RCP	0.012	42.99
Winsome Way	C1+C2+C3	0.31437	201.20	26.10	HMS Model	24.00	0.0120	RCP	0.012	26.92
Alamar Way	D1.1+D2	0.35937	230.00	31.20	HMS Model	30.00	0.0055	RCP	0.012	48.81
Existing 1	C1	0.25422	162.70	20.70	HMS Model	30.00	0.0300	CMP	0.025	37.04
Existing 2	D1.1	0.25203	161.30	20.60	HMS Model	72.00	0.0300	CMP	0.025	382.47

4.1 BASIN AND REACH RUNNOFF SUMMARY

Existing Condition 5 Year Storm

Basin	Area SqMiles	Area Acres	Q CFS	Time of Peak	Volume Inches
A	1.43031	915.40	87.10	26Feb2019, 12:24	0.18
Ba	5.99480	3836.67	271.50	26Feb2019, 12:46	0.19
Bb	0.15719	100.60	19.20	26Feb2019, 12:20	0.14
Ca	0.25422	162.70	20.70	26Feb2019, 12:14	0.19
Cb	0.10938	70.00	9.90	26Feb2019, 12:18	0.11
Da	0.25203	161.30	20.60	26Feb2019, 12:14	0.19
Db	0.07797	49.90	5.70	26Feb2019, 12:18	0.19
Dc	0.39016	249.70	28.10	26Feb2019, 12:20	0.10
Ea	0.05922	37.90	5.40	26Feb2019, 12:10	0.19
Eb	0.11656	74.60	4.00	26Feb2019, 12:14	0.08
F	0.06953	44.50	6.60	26Feb2019, 12:18	0.11
G	0.16813	107.60	45.30	26Feb2019, 12:14	0.24
H	0.19031	121.80	34.80	26Feb2019, 12:16	0.17
I	0.05859	37.50	26.40	26Feb2019, 12:14	0.37
J	0.01578	10.10	3.40	26Feb2019, 12:10	0.25
K	0.02781	17.80	12.90	26Feb2019, 12:08	0.40
		5998.08			
Reach					
1	5.99480	3836.67	271.40	26Feb2019, 12:50	0.19
2	7.94589	5085.37	348.70	26Feb2019, 12:46	0.19
3	9.02449	5775.68	397.40	26Feb2019, 12:40	0.18
4	9.02449	5775.68	397.20	26Feb2019, 12:46	0.18
(Outlet) 5	9.32840	5970.18	408.60	26Feb2019, 12:44	0.18
6	0.25422	162.70	20.20	26Feb2019, 12:22	0.19
7	0.25203	161.30	20.00	26Feb2019, 12:28	0.19
8	0.07797	49.90	5.60	26Feb2019, 12:30	0.19
9	0.05922	37.90	5.00	26Feb2019, 12:36	0.19

Existing Condition 100 Year Storm

Basin	Area SqMiles	Area Acres	Q CFS	Time of Peak	Volume Inches
A	1.43031	915.40	585.60	26Feb2019, 12:26	0.65
Ba	5.99480	3836.67	1448.60	26Feb2019, 12:48	0.63
Bb	0.15719	100.60	127.70	26Feb2019, 12:18	0.86
Ca	0.25422	162.70	127.80	26Feb2019, 12:16	0.63
Cb	0.10938	70.00	88.10	26Feb2019, 12:16	0.79
Da	0.25203	161.30	127.30	26Feb2019, 12:16	0.63
Db	0.07797	49.90	34.10	26Feb2019, 12:20	0.63
Dc	0.39016	249.70	275.70	26Feb2019, 12:18	0.74
Ea	0.05922	37.90	34.80	26Feb2019, 12:12	0.63
Eb	0.11656	74.60	85.80	26Feb2019, 12:16	0.76
F	0.06953	44.50	56.60	26Feb2019, 12:16	0.81
G	0.16813	107.60	199.00	26Feb2019, 12:14	1.42
H	0.19031	121.80	197.20	26Feb2019, 12:14	1.00
I	0.05859	37.50	88.40	26Feb2019, 12:12	2.03
J	0.01578	10.10	19.90	26Feb2019, 12:08	1.03
K	0.02781	17.80	45.10	26Feb2019, 12:08	1.78
		5998.08			
Reach					
1	5.99480	3836.67	1448.40	26Feb2019, 12:50	0.63
2	7.94589	5085.37	1963.80	26Feb2019, 12:42	0.64
3	9.02449	5775.68	2352.40	26Feb2019, 12:36	0.67
4	9.02449	5775.68	2351.40	26Feb2019, 12:38	0.67
(Outlet) 5	9.32840	5970.18	2469.90	26Feb2019, 12:36	0.68
6	0.25422	162.70	127.50	26Feb2019, 12:22	0.62
7	0.25203	161.30	126.30	26Feb2019, 12:26	0.62
8	0.07797	49.90	34.00	26Feb2019, 12:28	0.62
9	0.05922	37.90	34.30	26Feb2019, 12:28	0.62

Filing 1 Condition 5 Year Storm

Basin	Area SqMiles	Area Acres	Q CFS	Time of Peak	Volume Inches
A	1.43031	915.40	87.10	26Feb2019, 12:24	0.18
B1	5.99480	3836.67	271.50	26Feb2019, 12:46	0.19
B2	0.02047	13.10	3.30	26Feb2019, 12:06	0.30
B3	0.08578	54.90	6.70	26Feb2019, 12:16	0.19
B4	0.06481	41.48	8.80	26Feb2019, 12:18	0.24
C1	0.25422	162.70	20.70	26Feb2019, 12:14	0.19
C2	0.03500	22.40	3.10	26Feb2019, 12:12	0.19
C3	0.02516	16.10	3.70	26Feb2019, 12:08	0.30
C4	0.03719	23.80	1.80	26Feb2019, 12:16	0.12
D1.1	0.25203	161.30	20.60	26Feb2019, 12:14	0.19
D1.2	0.07797	49.90	5.70	26Feb2019, 12:18	0.19
D2	0.10734	68.70	11.70	26Feb2019, 12:12	0.24
D3,4,6	0.26094	167.00	5.90	26Feb2019, 12:16	0.05
D5	0.02000	12.80	0.80	26Feb2019, 12:10	0.08
Ea	0.05922	37.90	5.40	26Feb2019, 12:10	0.19
Eb	0.11656	74.60	4.00	26Feb2019, 12:14	0.08
F	0.06953	44.50	6.60	26Feb2019, 12:18	0.11
G	0.16813	107.60	45.30	26Feb2019, 12:14	0.24
H	0.19031	121.80	34.80	26Feb2019, 12:16	0.17
I	0.05859	37.50	26.40	26Feb2019, 12:14	0.37
J	0.01578	10.10	3.40	26Feb2019, 12:10	0.25
K	0.02781	17.80	12.90	26Feb2019, 12:08	0.40
		5998.05			
Reach					
OUT-1	9.32836	5970.15	384.10	26Feb2019, 12:44	0.18
EX CULV C1	0.25422	162.70	20.70	26Feb2019, 12:14	0.19
EX CULV D1.1	0.25203	161.30	20.60	26Feb2019, 12:14	0.19
EX CULV D1.2	0.07797	49.90	5.70	26Feb2019, 12:18	0.19
CULV B2	0.02047	13.10	3.30	26Feb2019, 12:06	0.30
CULV C2	0.28922	185.10	23.40	26Feb2019, 12:16	0.19
CULV C3	0.31438	201.20	26.10	26Feb2019, 12:18	0.20
CULV D2	0.35937	230.00	31.20	26Feb2019, 12:18	0.21
Reach-B1	5.99480	3836.67	271.30	26Feb2019, 12:50	0.19
Reach-B2	0.02047	13.10	3.20	26Feb2019, 12:14	0.30
Reach-B3	6.08058	3891.57	273.40	26Feb2019, 12:54	0.19
Reach-B4-3	0.31438	201.20	26.10	26Feb2019, 12:18	0.20
Reach-C1	0.25422	162.70	20.60	26Feb2019, 12:18	0.19
Reach-C2	0.28922	185.10	23.40	26Feb2019, 12:20	0.19
Reach-D1.1	0.25203	161.30	20.60	26Feb2019, 12:20	0.19
Reach-D3	0.07797	49.90	5.70	26Feb2019, 12:24	0.19

Filing 1 Condition 100 Year Storm

Basin	Area SqMiles	Area Acres	Q CFS	Time of Peak	Volume Inches
A	1.43031	915.40	585.6	26Feb2019, 12:26	0.65
B1	5.99480	3836.67	1448.6	26Feb2019, 12:48	0.63
B2	0.02047	13.10	19.9	26Feb2019, 12:08	0.94
B3	0.08578	54.90	57.9	26Feb2019, 12:18	0.81
B4	0.06481	41.48	53.1	26Feb2019, 12:18	0.98
C1	0.25422	162.70	127.8	26Feb2019, 12:16	0.63
C2	0.03500	22.40	23.7	26Feb2019, 12:14	0.72
C3	0.02516	16.10	22.1	26Feb2019, 12:10	0.94
C4	0.03719	23.80	22.9	26Feb2019, 12:18	0.71
D1.1	0.25203	161.30	127.3	26Feb2019, 12:16	0.63
D1.2	0.07797	49.90	34.1	26Feb2019, 12:20	0.63
D2	0.10734	68.70	81.2	26Feb2019, 12:14	0.88
D3,4,6	0.26094	167.00	175.3	26Feb2019, 12:18	0.69
D5	0.02000	12.80	17.5	26Feb2019, 12:12	0.76
Ea	0.05922	37.90	34.8	26Feb2019, 12:12	0.63
Eb	0.11656	74.60	85.8	26Feb2019, 12:16	0.76
F	0.06953	44.50	56.6	26Feb2019, 12:16	0.81
G	0.16813	107.60	199.0	26Feb2019, 12:14	1.42
H	0.19031	121.80	197.2	26Feb2019, 12:14	1.00
I	0.05859	37.50	88.4	26Feb2019, 12:12	2.03
J	0.01578	10.10	19.9	26Feb2019, 12:08	1.03
K	0.02781	17.80	45.1	26Feb2019, 12:08	1.78
		5998.05			
Reach					
OUT-1	9.32836	5970.15	2320.70	26Feb2019, 12:38	0.68
EX CULV C1	0.25422	162.70	127.70	26Feb2019, 12:16	0.63
EX CULV D1.1	0.25203	161.30	127.20	26Feb2019, 12:16	0.63
EX CULV D1.2	0.07797	49.90	34.00	26Feb2019, 12:20	0.63
CULV B2	0.02047	13.10	19.90	26Feb2019, 12:08	0.94
CULV C2	0.28922	185.10	149.70	26Feb2019, 12:18	0.64
CULV C3	0.31438	201.20	166.20	26Feb2019, 12:18	0.66
CULV D2	0.35937	230.00	203.70	26Feb2019, 12:18	0.70
Reach-B1	5.99480	3836.67	1448.50	26Feb2019, 12:50	0.63
Reach-B2	0.02047	13.10	19.80	26Feb2019, 12:14	0.93
Reach-B3	6.08058	3891.57	1460.90	26Feb2019, 12:52	0.64
Reach-B4-3	0.31438	201.20	165.90	26Feb2019, 12:18	0.66
Reach-C1	0.25422	162.70	127.70	26Feb2019, 12:18	0.63
Reach-C2	0.28922	185.10	149.70	26Feb2019, 12:20	0.64
Reach-D1.1	0.25203	161.30	126.70	26Feb2019, 12:20	0.62
Reach-D3	0.07797	49.90	33.90	26Feb2019, 12:24	0.62

Reach-D4	0.33891	216.90	11.10	26Feb2019, 12:24	0.09
Reach-D5	0.35937	230.00	31.10	26Feb2019, 12:22	0.21
Reach-Ea	0.05922	37.90	5.00	26Feb2019, 12:36	0.19
Reach-P3	0.33891	216.90	10.70	26Feb2019, 12:30	0.09
Reach-1	7.91055	5062.75	334.70	26Feb2019, 12:46	0.19
Reach-2	8.11586	5194.15	342.70	26Feb2019, 12:46	0.19
Reach-3	8.68555	5558.75	365.00	26Feb2019, 12:44	0.19
Reach-4	8.68555	5558.75	364.90	26Feb2019, 12:46	0.19
Reach-5	9.02446	5775.65	372.70	26Feb2019, 12:46	0.19
STORAGE P3	0.33891	216.90	10.70	26Feb2019, 12:28	0.09

Reach-D4	0.33891	216.90	205.30	26Feb2019, 12:20	0.67
Reach-D5	0.35937	230.00	203.10	26Feb2019, 12:20	0.70
Reach-Ea	0.05922	37.90	34.30	26Feb2019, 12:28	0.62
Reach-P3	0.33891	216.90	114.00	26Feb2019, 12:38	0.67
Reach-1	7.91055	5062.75	1872.10	26Feb2019, 12:42	0.64
Reach-2	8.11586	5194.15	1941.00	26Feb2019, 12:42	0.66
Reach-3	8.68555	5558.75	2101.10	26Feb2019, 12:38	0.67
Reach-4	8.68555	5558.75	2100.70	26Feb2019, 12:40	0.67
Reach-5	9.02446	5775.65	2213.80	26Feb2019, 12:40	0.67
STORAGE P3	0.33891	216.90	114.10	26Feb2019, 12:38	0.67

5.1 UD CULVERT CALCULATIONS

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: **Winsome Subdivision - Filing 1**
Pipe ID: **Clove Hitch**

This is a flow capacity software not a culvert calculation software.

Revise.

The following are some free softwares for culvert calculation:

FHWA HY-8
FHWA Hydraulic Toolbox

The two referenced software would also provide overtopping analysis.

Design Information (Input)			
Pipe Invert Slope	So =	0.0090	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	**Q =**	**9.99**	cfs

Full-flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	9.99	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.26	radians
Flow area	An =	1.55	sq ft
Top width	Tn =	1.15	ft
Wetted perimeter	Pn =	3.40	ft
Flow depth	Yn =	1.23	ft
Flow velocity	Vn =	6.45	fps
Discharge	Qn =	9.99	cfs
Percent Full Flow	Flow =	100.0%	of full flow
Normal Depth Froude Number	Fr_n =	0.98	subcritical

Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.25	radians
Critical flow area	Ac =	1.54	sq ft
Critical top width	Tc =	1.17	ft
Critical flow depth	Yc =	1.22	ft
Critical flow velocity	Vc =	6.50	fps
Critical Depth Froude Number	Fr_c =	1.00	

Determination of Culvert Headwater and Outlet Protection

Project: WINSONE
Basin ID: CLOVE HITCH

Soil Type:
Choose One:
- (●) Sandy
- ( ) Non-Sandy

Design Information (Input):

Design Discharge	Q =	19.9	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Grooved End Projection	
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 =	7370	ft
Outlet Elevation **OR** Slope	Elev OUT =	7369.5	ft
Culvert Length	L =	55	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	7	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.60	ft
Flow Area at Max Channel Velocity	A_t =	2.84	ft^2
Culvert Cross Sectional Area Available	A =	1.77	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.00	
Sum of All Losses Coefficients	k_s =	2.20	ft
Culvert Normal Depth	Y_n =	0.28	ft
Culvert Critical Depth	Y_c =	1.47	ft
Tailwater Depth for Design	d =	1.48	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	1.85	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	7.22	$ft^{0.5}/s$
Froude Number	Fr =	-	**Pressure flow!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	5.12	ft
Outlet Control Headwater	HW_O =	5.31	
Design Headwater Elevation	**HW =**	**7,375.31**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**3.54**	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	9	in
Nominal Riprap Size	d_{50} =	9	in
UDFCD Riprap Type	**Type =**	**L**	
Length of Protection	**L_p =**	**8**	**ft**
Width of Protection	**T =**	**6**	**ft**

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: **Winsome Subdivision - Filing 1**
Pipe ID: **Mosey Trail 1**

Design Information (Input)			
Pipe Invert Slope	So =	0.0117	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	**Q =**	**24.54**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	24.54	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.26	radians
Flow area	An =	2.76	sq ft
Top width	Tn =	1.54	ft
Wetted perimeter	Pn =	4.53	ft
Flow depth	Yn =	1.64	ft
Flow velocity	Vn =	8.90	fps
Discharge	Qn =	24.54	cfs
Percent Full Flow	Flow =	100.0%	of full flow
Normal Depth Froude Number	Fr_n =	1.17	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.42	radians
Critical flow area	Ac =	2.91	sq ft
Critical top width	Tc =	1.32	ft
Critical flow depth	Yc =	1.75	ft
Critical flow velocity	Vc =	8.42	fps
Critical Depth Froude Number	Fr_c =	1.00	

Determination of Culvert Headwater and Outlet Protection

Project: WINSOME
Basin ID: MOSEY TRAIL 1

Soil Type:
Choose One:
- (●) Sandy
- ( ) Non-Sandy

Design Information (Input):

Design Discharge	Q =	37.4	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		Grooved End Projection	
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 =	7364	ft
Outlet Elevation **OR** Slope	Elev OUT =	7363.3	ft
Culvert Length	L =	60	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	7	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.80	ft
Flow Area at Max Channel Velocity	A_t =	5.34	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.74	
Sum of All Losses Coefficients	k_s =	1.94	ft
Culvert Normal Depth	Y_n =	0.97	ft
Culvert Critical Depth	Y_c =	1.94	ft
Tailwater Depth for Design	d =	1.97	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	1.85	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	6.61	$ft^{0.5}/s$
Froude Number	Fr =	-	**Pressure flow!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	5.89	ft
Outlet Control Headwater	HW_O =	5.54	
Design Headwater Elevation	**HW =**	**7,369.89**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**2.94**	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	11	in
Nominal Riprap Size	d_{50} =	12	in
UDFCD Riprap Type	**Type =**	**M**	
Length of Protection	**L_p =**	**10**	**ft**
Width of Protection	**T =**	**8**	**ft**

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: **Winsome Subdivision - Filing 1**
Pipe ID: **Mosey Trail 2**

Design Information (Input)			
Pipe Invert Slope	So =	0.0058	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	42.00	inches
Design discharge	**Q =**	**76.83**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	9.62	sq ft
Full-flow wetted perimeter	Pf =	11.00	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	76.83	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.26	radians
Flow area	An =	8.44	sq ft
Top width	Tn =	2.69	ft
Wetted perimeter	Pn =	7.93	ft
Flow depth	Yn =	2.87	ft
Flow velocity	Vn =	9.10	fps
Discharge	Qn =	76.83	cfs
Percent Full Flow	Flow =	100.0%	of full flow
Normal Depth Froude Number	Fr_n =	0.91	subcritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.17	radians
Critical flow area	Ac =	8.09	sq ft
Critical top width	Tc =	2.88	ft
Critical flow depth	Yc =	2.74	ft
Critical flow velocity	Vc =	9.50	fps
Critical Depth Froude Number	Fr_c =	1.00	

Determination of Culvert Headwater and Outlet Protection

Project: WINSOME
Basin ID: MOSEY TRAIL 2

Soil Type:
Choose One:
- (●) Sandy
- ( ) Non-Sandy

Design Information (Input):

Design Discharge	Q =	112.3	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	42	inches
Inlet Edge Type (Choose from pull-down list)	Square End Projection		
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 =	7362	ft
Outlet Elevation **OR** Slope	Elev OUT =	7361.7	ft
Culvert Length	L =	55	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	7	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	1.40	ft
Flow Area at Max Channel Velocity	A_t =	16.04	ft^2
Culvert Cross Sectional Area Available	A =	9.62	ft^2
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.32	
Sum of All Losses Coefficients	k_s =	1.82	ft
Culvert Normal Depth	Y_n =	1.73	ft
Culvert Critical Depth	Y_c =	3.19	ft
Tailwater Depth for Design	d =	3.34	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	2.50	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	4.90	$ft^{0.5}/s$
Froude Number	Fr =	-	**Pressure flow!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	7.81	ft
Outlet Control Headwater	HW_O =	6.90	
Design Headwater Elevation	**HW =**	**7,369.81**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**2.23**	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	14	in
Nominal Riprap Size	d_{50} =	18	in
UDFCD Riprap Type	**Type =**	**H**	
Length of Protection	**L_p =**	**20**	**ft**
Width of Protection	**T =**	**12**	**ft**

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: **Winsome Subdivision - Filing 1**
Pipe ID: **Winsome Way**

Design Information (Input)			
Pipe Invert Slope	So =	0.0220	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	42.00	inches
Design discharge	**Q =**	**149.63**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	9.62	sq ft
Full-flow wetted perimeter	Pf =	11.00	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	149.63	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.26	radians
Flow area	An =	8.44	sq ft
Top width	Tn =	2.69	ft
Wetted perimeter	Pn =	7.93	ft
Flow depth	Yn =	2.87	ft
Flow velocity	Vn =	17.73	fps
Discharge	Qn =	149.63	cfs
Percent Full Flow	Flow =	100.0%	of full flow
Normal Depth Froude Number	Fr_n =	1.76	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.78	radians
Critical flow area	Ac =	9.53	sq ft
Critical top width	Tc =	1.24	ft
Critical flow depth	Yc =	3.39	ft
Critical flow velocity	Vc =	15.71	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: **Winsome Subdivision - Filing 1**
Pipe ID: **Alamar Way**

Design Information (Input)			
Pipe Invert Slope	So =	0.0050	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	60.00	inches
Design discharge	**Q =**	**184.60**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	19.63	sq ft
Full-flow wetted perimeter	Pf =	15.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	184.66	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.26	radians
Flow area	An =	17.22	sq ft
Top width	Tn =	3.85	ft
Wetted perimeter	Pn =	11.32	ft
Flow depth	Yn =	4.10	ft
Flow velocity	Vn =	10.72	fps
Discharge	Qn =	184.60	cfs
Percent Full Flow	Flow =	100.0%	of full flow
Normal Depth Froude Number	Fr_n =	0.89	subcritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.16	radians
Critical flow area	Ac =	16.39	sq ft
Critical top width	Tc =	4.16	ft
Critical flow depth	Yc =	3.89	ft
Critical flow velocity	Vc =	11.27	fps
Critical Depth Froude Number	Fr_c =	1.00	

5.2 ROAD OVERTOPPING CALCULATIONS

CLOVE HITCH OVERTOPPING

The open channel flow calculator

Select Channel Type: Triangle

Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 02 ft/ft	Water depth(y): 33 ft	Bottom W(b) 0 ft
Flow velocity 4.8628 ft/s	LeftSlope (Z1): 83.33 to 1 (H:	RightSlope (Z2): 76.91 to 1 (H:V
Flow discharge 42.4287 ft^3/s	Input n value 013 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 52.88 ft	Flow area 8.73 ft^2	Top width(T) 52.88 ft
Specific energy 0.7 ft	Froude number 2.11	Flow status Supercritical flow
Critical depth 0.45 ft	Critical slope 0.004 ft/ft	Velocity head 0.37 ft

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MOSEY 1 OVERTOPPING

The open channel flow calculator

Select Channel Type: Triangle

Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 02 ft/ft	Water depth(y): 33 ft	Bottom W(b) 0 ft
Flow velocity 4.8626 ft/s	LeftSlope (Z1): 50 to 1 (H:	RightSlope (Z2): 69.93 to 1 (H:V
Flow discharge 31.7539 ft^3/s	Input n value 013 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 39.58 ft	Flow area 6.53 ft^2	Top width(T) 39.58 ft
Specific energy 0.7 ft	Froude number 2.11	Flow status Supercritical flow
Critical depth 0.45 ft	Critical slope 0.004 ft/ft	Velocity head 0.37 ft

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MOSEY 2 OVERTOPPING

The open channel flow calculator

Select Channel Type: Triangle

Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 02 ft/ft	Water depth(y): 33 ft	Bottom W(b) 0 ft
Flow velocity 4.8619 ft/s	LeftSlope (Z1): 97.08 to 1 (H:	RightSlope (Z2): 14.22 to 1 (H:V
Flow discharge 29.4647 ft^3/s	Input n value 013 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 36.74 ft	Flow area 6.06 ft^2	Top width(T) 36.73 ft
Specific energy 0.7 ft	Froude number 2.11	Flow status Supercritical flow
Critical depth 0.45 ft	Critical slope 0.004 ft/ft	Velocity head 0.37 ft

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WINSOME OVERTOPPING

The open channel flow calculator

Select Channel Type: Triangle

Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 02 ft/ft	Water depth(y): 33 ft	Bottom W(b) 0 ft
Flow velocity 4.8626 ft/s	LeftSlope (Z1): 31.05 to 1 (H:	RightSlope (Z2): 100 to 1 (H:V
Flow discharge 34.6978 ft^3/s	Input n value 013 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 43.25 ft	Flow area 7.14 ft^2	Top width(T) 43.25 ft
Specific energy 0.7 ft	Froude number 2.11	Flow status Supercritical flow
Critical depth 0.45 ft	Critical slope 0.004 ft/ft	Velocity head 0.37 ft

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ALAMAR OVERTOPPING

The open channel flow calculator

Select Channel Type: Triangle

Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 02 ft/ft	Water depth(y): 33 ft	Bottom W(b) 0 ft
Flow velocity 4.8622 ft/s	LeftSlope (Z1): 69.93 to 1 (H:	RightSlope (Z2): 26.88 to 1 (H:V
Flow discharge 25.6303 ft^3/s	Input n value 013 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 31.96 ft	Flow area 5.27 ft^2	Top width(T) 31.95 ft
Specific energy 0.7 ft	Froude number 2.11	Flow status Supercritical flow
Critical depth 0.45 ft	Critical slope 0.004 ft/ft	Velocity head 0.37 ft

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6.1 POND INPUT SUMMARY

VERTEX®

DETENTION POND WORKSHEET

CALCULATED BY: JP
CHECKED BY:

PROJECT: Winsome Subdivision
MAJOR BASIN: West Kiowa Creek

JOB NO: **48157**
LOCATION: **Monument, CO**

				IMPERVIOUS FACTOR						SOIL				WATERSHED				CALCULATIONS		
LOCATION	**DESIGN POINT**	**BASIN**	**AREA (Acres)**	**5 ACRE LOT (7%)**	**2.5 ACRE LOT (11%)**	**OPEN SPACE (2%)**	**COMMERCIAL (85%)**	**TOTAL % CHECK**	**WEIGHTED IMPERVIOUSNESS**	**SOIL GROUP A %**	**SOIL GROUP B %**	**SOIL GROUP C/D %**	**TOTAL % CHECK**	**WATERSHED LENGTH**	**WATERSHED HIGH POINT**	**WATERSHED LOW POINT**	**WATERSHED SLOPE**	**100-YEAR REQUIRED VOLUME (AC-FT)**	**PROPOSED VOLUME (AC-FT)**	**PEAK OUTFLOW VS PREDEVELOPED FLOW RATIO**
POND 3	P3	D1.2	49.9	100%	0%	0%	0%	100%	7%	0.0%	100.0%	0.0%	100%							
		D3	41.2	0%	10%	90%	0%	100%	3%	0.0%	100.0%	0.0%	100%							
		D4	34.3	0%	100%	0%	0%	100%	11%	0.0%	100.0%	0.0%	100%							
		D6	41.8	80%	0%	20%	0%	100%	6%	0.0%	90.0%	10.0%	100%							
			167.2						6.6%	0.0%	97.5%	2.5%	100%	6,480	7,480	7,292	0.029	5.1	6.9	0.74
WQ POND 1	WQ1	C1	162.7	0%	0%	100%	0%	100%	2%	0%	100%	0%	100%							
		C2	22.4	0%	100%	0%	0%	100%	11%	0%	100%	0%	100%							
		C3	16.1	0%	100%	0%	0%	100%	11%	0%	100%	0%	100%							
			201.2						3.7%	0.0%	100.0%	0.0%	100%	6,193	7,500	7,339	0.026	NA	NA	NA
WQ POND 2	WQ2	D1.1	161.3	100%	0%	0%	0%	100%	7%	0%	100%	0%	100%							
		D2	68.7	0%	85%	15%	0%	100%	10%	0%	100%	0%	100%							
			230.0						7.8%	0.0%	100.0%	0.0%	100%	4,370	7,477	7,327	0.034	NA	NA	NA

6.2 UD DETENTION CALCULATIONS

Update name to match the map and narrative. "Water Quality Pond D"

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Winsome Filing 1 - Water Quality Pond

Basin ID: Basin D1.1+D2

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	230.00	acres
Watershed Length =	4,370	ft
Watershed Slope =	0.034	ft/ft
Watershed Imperviousness =	7.80%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	1.036	acre-feet
Excess Urban Runoff Volume (EURV) =	1.653	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.109	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.760	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	4.555	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	13.300	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	18.740	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	25.843	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	1.028	acre-feet
Approximate 5-yr Detention Volume =	1.647	acre-feet
Approximate 10-yr Detention Volume =	3.840	acre-feet
Approximate 25-yr Detention Volume =	5.569	acre-feet
Approximate 50-yr Detention Volume =	5.778	acre-feet
Approximate 100-yr Detention Volume =	7.570	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	1.036	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	1.036	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Total detention volume is less than 100-year volume.

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	9,300	0.213		
Spillway Invert	--	4.00	--	--	--	22,100	0.507	62,800	1.442
Freeboard	--	6.00	--	--	--	29,100	0.668	114,000	2.617

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Update name to match the map and narrative. "Water Quality Pond D"

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome Filing 1 - Water Quality Pond

Basin ID: Basin D1.1+D2

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.15	1.036	Orifice Plate
Zone 2			
Zone 3			
		1.036	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.15	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.00	inches
Orifice Plate: Orifice Area per Row =	6.00	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.167E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00	3.00				
Orifice Area (sq. inches)	6.00	6.00	6.00	6.00				

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.15		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00		feet
Overflow Weir Slope =	0.00		H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00		feet
Overflow Grate Open Area % =	85%		%, grate open area/total area
Debris Clogging % =	50%		%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =	3.15		feet
Over Flow Weir Slope Length =	4.00		feet
Grate Open Area / 100-yr Orifice Area =	17.32		should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	13.60		ft^2
Overflow Grate Open Area w/ Debris =	6.80		ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	0.00		ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =	0.79		ft^2
Outlet Orifice Centroid =	0.50		feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	144.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.98	feet
Stage at Top of Freeboard =	5.98	feet
Basin Area at Top of Freeboard =	0.67	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	1.036	1.653	1.109	1.760	4.555	13.300	18.740	25.843	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.034	1.651	1.107	1.758	4.550	13.283	18.714	25.808	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.23	0.74	1.03	1.37	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	3.1	5.4	52.7	170.8	236.0	316.2	0.0
Peak Inflow Q (cfs) =	18.8	29.8	20.1	31.7	80.9	229.0	318.3	431.8	#N/A
Peak Outflow Q (cfs) =	0.8	6.7	0.9	6.8	69.9	246.5	373.4	476.4	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.3	1.3	1.4	1.6	1.5	#N/A
Structure Controlling Flow =	Plate	Outlet Plate 1	Plate	Outlet Plate 1	Spillway	Spillway	Spillway	Spillway	#N/A
Max Velocity through Grate 1 (fps) =	N/A	0.41	N/A	0.4	0.4	0.5	0.5	0.5	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	37	39	37	29	16	12	8	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**42**	43	43	42	38	30	26	22	#N/A
Maximum Ponding Depth (ft) =	2.93	3.63	3.08	3.78	4.27	4.67	4.88	5.04	#N/A
Area at Maximum Ponding Depth (acres) =	0.43	0.48	0.44	0.49	0.53	0.56	0.58	0.59	#N/A
Maximum Volume Stored (acre-ft) =	0.937	1.259	1.002	1.327	1.582	1.794	1.919	2.007	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.55 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:04:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:09:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:13:39	0.82	1.29	0.88	1.37	3.33	7.91	9.90	11.58	#N/A
1.098	0:18:12	2.23	3.51	2.38	3.73	9.29	24.04	31.52	38.71	#N/A
	0:22:45	5.72	9.02	6.11	9.58	23.84	61.81	81.26	101.06	#N/A
	0:27:18	15.71	24.75	16.78	26.31	65.36	168.63	221.18	274.01	#N/A
	0:31:51	18.77	29.80	20.07	31.71	80.87	228.95	314.18	408.82	#N/A
	0:36:24	17.94	28.52	19.18	30.35	77.92	227.55	318.28	431.85	#N/A
	0:40:57	16.33	25.96	17.46	27.62	71.02	209.76	295.90	404.33	#N/A
	0:45:30	14.62	23.29	15.64	24.79	63.98	189.40	267.78	366.39	#N/A
	0:50:03	12.66	20.22	13.55	21.53	56.01	167.16	237.63	328.55	#N/A
	0:54:36	11.01	17.57	11.79	18.70	48.92	146.48	208.93	292.09	#N/A
	0:59:09	9.99	15.93	10.68	16.96	44.13	130.84	185.71	260.13	#N/A
	1:03:42	8.28	13.27	8.86	14.13	37.02	111.65	159.78	225.18	#N/A
	1:08:15	6.79	10.92	7.27	11.64	30.69	93.00	133.82	190.87	#N/A
	1:12:48	5.27	8.54	5.65	9.11	24.35	75.05	109.23	158.47	#N/A
	1:17:21	3.96	6.48	4.25	6.93	18.84	58.79	86.53	128.76	#N/A
	1:21:54	2.87	4.75	3.09	5.08	14.09	44.74	66.98	103.00	#N/A
	1:26:27	2.21	3.62	2.37	3.86	10.55	33.04	50.24	80.09	#N/A
	1:31:00	1.81	2.95	1.94	3.15	8.47	26.04	38.76	60.79	#N/A
	1:35:33	1.53	2.49	1.65	2.66	7.13	21.74	31.97	48.48	#N/A
	1:40:06	1.34	2.18	1.44	2.33	6.20	18.75	27.38	40.85	#N/A
	1:44:39	1.21	1.96	1.30	2.09	5.54	16.67	24.21	35.67	#N/A
	1:49:12	1.11	1.80	1.19	1.92	5.07	15.18	21.94	31.99	#N/A
	1:53:45	0.82	1.32	0.88	1.41	3.79	11.83	17.44	25.99	#N/A
	1:58:18	0.60	0.97	0.64	1.03	2.74	8.52	12.63	19.17	#N/A
	2:02:51	0.44	0.71	0.47	0.76	2.03	6.32	9.32	13.94	#N/A
	2:07:24	0.32	0.53	0.35	0.56	1.51	4.69	6.93	10.39	#N/A
	2:11:57	0.23	0.38	0.25	0.41	1.11	3.48	5.15	7.82	#N/A
	2:16:30	0.17	0.27	0.18	0.29	0.80	2.52	3.77	5.83	#N/A
	2:21:03	0.12	0.20	0.13	0.21	0.58	1.82	2.73	4.30	#N/A
	2:25:36	0.08	0.13	0.09	0.14	0.40	1.31	2.00	3.20	#N/A
	2:30:09	0.05	0.08	0.05	0.09	0.26	0.87	1.37	2.31	#N/A
	2:34:42	0.02	0.04	0.03	0.05	0.15	0.53	0.87	1.57	#N/A
	2:39:15	0.01	0.02	0.01	0.02	0.07	0.27	0.48	0.97	#N/A
	2:43:48	0.00	0.00	0.00	0.00	0.02	0.09	0.20	0.52	#N/A
	2:48:21	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.20	#N/A
	2:52:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	#N/A
	2:57:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:02:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:06:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:11:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:15:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:20:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:24:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:29:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:33:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:38:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:42:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:47:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:52:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:56:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:01:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:05:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:10:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:14:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:19:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:23:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:28:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:33:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:37:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:42:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:46:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:51:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:55:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:00:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:04:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:09:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:13:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:18:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:23:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:27:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Winsome Filing 1

Basin ID: Pond 3

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	167.20	acres		
Watershed Length =	6,480	ft		
Watershed Slope =	0.029	ft/ft		
Watershed Imperviousness =	6.60%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	97.5%	percent		
Percentage Hydrologic Soil Groups C/D =	2.5%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.649	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.000	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.664	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.091	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.075	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	9.462	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	13.432	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	18.613	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.615	acre-feet		
Approximate 5-yr Detention Volume =	1.022	acre-feet		
Approximate 10-yr Detention Volume =	2.542	acre-feet		
Approximate 25-yr Detention Volume =	3.747	acre-feet		
Approximate 50-yr Detention Volume =	3.861	acre-feet		
Approximate 100-yr Detention Volume =	5.110	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.649	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.352	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.109	acre-feet
Total Detention Basin Volume =	5.110	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	40,000	0.918		
	--	2.00	--	--	--	48,000	1.102	87,520	2.009
	--	4.00	--	--	--	58,000	1.331	194,000	4.454
Spillway Invert	--	6.00	--	--	--	68,000	1.561	320,000	7.346
Freeboard	--	8.00	--	--	--	78,000	1.791	466,000	10.698

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome Filing 1

Basin ID: Pond 3

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.69	0.649	Orifice Plate
Zone 2 (EURV)	1.04	0.352	Circular Orifice
Zone 3 (100-year)	4.49	4.109	Weir&Pipe (Circular)
		5.110	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	0.69	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	2.80	inches
Orifice Plate: Orifice Area per Row =	9.75	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	6.771E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.23	0.46					
Orifice Area (sq. inches)	9.75	9.75	9.75					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.69	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	1.04	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	34.00	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	6.31	N/A	ft^2
Vertical Orifice Centroid =	1.42	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	8.00	N/A	feet
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.00	N/A	feet
Over Flow Weir Slope Length =	8.25	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.46	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	56.07	N/A	ft^2
Overflow Grate Open Area w/ Debris =	28.04	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	48.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected	
Outlet Orifice Area =	12.57	N/A	ft^2
Outlet Orifice Centroid =	2.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	74.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.96	feet
Stage at Top of Freeboard =	7.96	feet
Basin Area at Top of Freeboard =	1.79	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.649	1.000	0.664	1.091	3.075	9.462	13.432	18.613	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.648	1.000	0.664	1.091	3.075	9.452	13.425	18.605	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.14	0.48	0.67	0.91	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.4	2.7	23.1	80.3	111.2	151.6	0.0
Peak Inflow Q (cfs) =	8.2	12.7	8.4	13.8	38.3	114.9	161.2	220.6	#N/A
Peak Outflow Q (cfs) =	0.6	1.1	0.6	1.3	11.4	69.4	96.1	120.6	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.5	0.9	0.9	0.8	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.6	0.8	1.0	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	39	41	39	41	35	21	17	13	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**43**	46	43	46	45	36	32	27	#N/A
Maximum Ponding Depth (ft) =	0.60	0.89	0.61	0.96	2.07	3.56	4.52	5.97	#N/A
Area at Maximum Ponding Depth (acres) =	0.97	1.00	0.97	1.01	1.11	1.28	1.39	1.56	#N/A
Maximum Volume Stored (acre-ft) =	0.558	0.854	0.577	0.924	2.087	3.879	5.162	7.299	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
6.53 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:06:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:13:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:19:35	0.37	0.55	0.37	0.60	1.62	4.27	5.55	6.88	#N/A
0.766	0:26:07	0.98	1.50	1.01	1.63	4.47	12.51	16.90	21.89	#N/A
	0:32:39	2.53	3.86	2.58	4.20	11.47	32.13	43.47	56.41	#N/A
	0:39:11	6.94	10.59	7.10	11.53	31.46	87.84	118.58	153.55	#N/A
	0:45:43	8.24	12.65	8.43	13.79	38.34	114.87	161.18	217.90	#N/A
	0:52:14	7.86	12.09	8.05	13.18	36.78	112.71	160.25	220.61	#N/A
	0:58:46	7.16	11.01	7.33	12.00	33.47	103.45	147.74	205.02	#N/A
	1:05:18	6.39	9.85	6.55	10.74	30.12	93.34	133.41	185.51	#N/A
	1:11:50	5.52	8.53	5.65	9.31	26.28	82.16	117.75	164.59	#N/A
	1:18:22	4.81	7.42	4.93	8.10	22.90	71.94	103.19	144.68	#N/A
	1:24:53	4.36	6.73	4.46	7.34	20.71	64.49	92.16	128.61	#N/A
	1:31:25	3.60	5.57	3.68	6.09	17.32	54.68	78.65	110.63	#N/A
	1:37:57	2.94	4.57	3.01	4.99	14.32	45.49	65.52	92.63	#N/A
	1:44:29	2.26	3.54	2.32	3.88	11.30	36.51	52.89	75.57	#N/A
	1:51:01	1.68	2.66	1.73	2.92	8.68	28.49	41.43	59.82	#N/A
	1:57:32	1.22	1.93	1.25	2.12	6.45	21.57	31.54	46.27	#N/A
	2:04:04	0.95	1.48	0.97	1.63	4.86	15.96	23.30	34.68	#N/A
	2:10:36	0.78	1.22	0.80	1.33	3.93	12.66	18.35	26.78	#N/A
	2:17:08	0.66	1.03	0.68	1.13	3.31	10.61	15.32	22.10	#N/A
	2:23:40	0.58	0.90	0.59	0.99	2.88	9.18	13.21	18.94	#N/A
	2:30:11	0.52	0.81	0.53	0.89	2.58	8.18	11.74	16.75	#N/A
	2:36:43	0.48	0.75	0.49	0.82	2.37	7.46	10.70	15.18	#N/A
	2:43:15	0.35	0.55	0.36	0.60	1.76	5.72	8.34	12.06	#N/A
	2:49:47	0.26	0.40	0.27	0.44	1.27	4.12	6.01	8.73	#N/A
	2:56:19	0.19	0.30	0.19	0.32	0.94	3.06	4.46	6.44	#N/A
	3:02:50	0.14	0.22	0.14	0.24	0.70	2.27	3.31	4.79	#N/A
	3:09:22	0.10	0.16	0.10	0.17	0.51	1.68	2.45	3.56	#N/A
	3:15:54	0.07	0.11	0.07	0.12	0.36	1.21	1.78	2.61	#N/A
	3:22:26	0.05	0.08	0.05	0.09	0.26	0.88	1.28	1.89	#N/A
	3:28:58	0.03	0.05	0.03	0.06	0.18	0.62	0.92	1.38	#N/A
	3:35:29	0.02	0.03	0.02	0.04	0.12	0.41	0.62	0.95	#N/A
	3:42:01	0.01	0.02	0.01	0.02	0.07	0.25	0.37	0.60	#N/A
	3:48:33	0.00	0.01	0.00	0.01	0.03	0.12	0.19	0.33	#N/A
	3:55:05	0.00	0.00	0.00	0.00	0.01	0.04	0.07	0.14	#N/A
	4:01:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	#N/A
	4:08:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:14:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:21:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:27:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:34:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:40:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:47:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:53:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:00:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:06:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:13:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:19:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:26:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:33:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:39:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:46:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:52:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:59:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:05:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:12:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:18:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:25:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:31:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:38:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:44:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:51:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:57:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:04:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:10:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:17:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:24:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:30:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:37:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:43:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:50:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Update name to match the map and narrative. "Water Quality Pond C"

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Winsome Filing 1 - WQ Pond

Basin ID: Basin C1+C2+C3

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	201.20	acres
Watershed Length =	6,193	ft
Watershed Slope =	0.026	ft/ft
Watershed Imperviousness =	3.70%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.457	acre-feet
Excess Urban Runoff Volume (EURV) =	0.646	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.403	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.679	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.816	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	10.596	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	15.391	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	21.651	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.372	acre-feet
Approximate 5-yr Detention Volume =	0.634	acre-feet
Approximate 10-yr Detention Volume =	2.298	acre-feet
Approximate 25-yr Detention Volume =	3.569	acre-feet
Approximate 50-yr Detention Volume =	3.566	acre-feet
Approximate 100-yr Detention Volume =	4.814	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.457	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.457	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Total detention volume is less than 100-year volume.

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	3,100	0.071		
Spillway Invert	--	4.00	--	--	--	8,700	0.200	23,600	0.542
Freeboard	--	6.00	--	--	--	12,100	0.278	44,400	1.019

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Update name to match the map and narrative. "Water Quality Pond C"

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome Filing 1 - WQ Pond

Basin ID: C1+C2+C3

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.57	0.457	Orifice Plate
Zone 2			
Zone 3			
		0.457	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.57	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.00	inches
Orifice Plate: Orifice Area per Row =	2.25	sq. inches (diameter = 1-11/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.563E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.19	2.38					
Orifice Area (sq. inches)	2.25	2.25	2.25					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.56		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00		feet
Overflow Weir Slope =	0.00		H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00		feet
Overflow Grate Open Area % =	85%		%, grate open area/total area
Debris Clogging % =	50%		%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =	3.56		feet
Over Flow Weir Slope Length =	4.00		feet
Grate Open Area / 100-yr Orifice Area =	17.32		should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	13.60		ft^2
Overflow Grate Open Area w/ Debris =	6.80		ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	0.00		ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =	0.79		ft^2
Outlet Orifice Centroid =	0.50		feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	91.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.97	feet
Stage at Top of Freeboard =	5.97	feet
Basin Area at Top of Freeboard =	0.28	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.457	0.646	0.403	0.679	2.816	10.596	15.391	21.651	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.457	0.646	0.402	0.678	2.813	10.589	15.381	21.628	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.15	0.52	0.72	0.98	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.9	3.2	30.1	104.5	144.9	197.0	0.0
Peak Inflow Q (cfs) =	6.2	8.8	5.5	9.2	37.6	137.3	196.6	272.6	#N/A
Peak Outflow Q (cfs) =	0.3	3.2	0.3	3.7	49.8	155.4	200.6	289.9	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	1.7	1.5	1.4	1.5	#N/A
Structure Controlling Flow =	Plate	Overflow Grate 1	Plate	Overflow Grate 1	Spillway	Spillway	Spillway	Spillway	#N/A
Max Velocity through Grate 1 (fps) =	N/A	0.22	N/A	0.2	0.5	0.5	0.5	0.6	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	41	41	40	41	28	9	4	2	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**45**	46	44	46	39	25	20	15	#N/A
Maximum Ponding Depth (ft) =	3.29	3.73	3.00	3.74	4.29	4.65	4.78	5.00	#N/A
Area at Maximum Ponding Depth (acres) =	0.18	0.19	0.17	0.19	0.21	0.23	0.23	0.24	#N/A
Maximum Volume Stored (acre-ft) =	0.408	0.487	0.358	0.491	0.599	0.680	0.707	0.759	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
6.10 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:06:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:12:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:18:18	0.28	0.39	0.25	0.41	1.60	4.98	6.55	7.96	#N/A
0.819	0:24:24	0.75	1.05	0.66	1.10	4.39	14.78	20.27	25.87	#N/A
	0:30:30	1.92	2.69	1.70	2.82	11.27	37.97	52.16	67.02	#N/A
	0:36:36	5.29	7.40	4.66	7.76	30.92	103.73	142.17	182.12	#N/A
	0:42:42	6.25	8.79	5.50	9.22	37.60	137.25	196.55	264.32	#N/A
	0:48:48	5.95	8.39	5.24	8.80	36.06	135.21	196.62	272.57	#N/A
	0:54:54	5.42	7.64	4.77	8.01	32.81	124.26	181.63	254.32	#N/A
	1:01:00	4.83	6.82	4.25	7.16	29.51	112.15	164.04	230.29	#N/A
	1:07:06	4.16	5.89	3.66	6.18	25.74	98.81	144.95	205.30	#N/A
	1:13:12	3.63	5.13	3.19	5.38	22.42	86.54	127.05	181.23	#N/A
	1:19:18	3.29	4.65	2.89	4.88	20.28	77.49	113.30	160.54	#N/A
	1:25:24	2.70	3.84	2.37	4.03	16.95	65.84	96.95	138.85	#N/A
	1:31:30	2.20	3.13	1.93	3.29	14.01	54.79	80.81	117.11	#N/A
	1:37:36	1.69	2.41	1.48	2.54	11.04	44.06	65.38	96.43	#N/A
	1:43:42	1.25	1.80	1.09	1.89	8.47	34.43	51.30	77.31	#N/A
	1:49:48	0.91	1.30	0.79	1.37	6.28	26.10	39.16	60.81	#N/A
	1:55:54	0.71	1.01	0.62	1.06	4.74	19.27	28.99	46.32	#N/A
	2:02:00	0.58	0.83	0.51	0.87	3.83	15.27	22.74	35.11	#N/A
	2:08:06	0.49	0.70	0.43	0.74	3.23	12.78	18.94	28.64	#N/A
	2:14:12	0.43	0.62	0.38	0.65	2.82	11.05	16.31	24.40	#N/A
	2:20:18	0.39	0.56	0.34	0.58	2.52	9.84	14.48	21.48	#N/A
	2:26:24	0.36	0.51	0.32	0.54	2.31	8.97	13.18	19.37	#N/A
	2:32:30	0.26	0.38	0.23	0.40	1.71	6.91	10.35	15.56	#N/A
	2:38:36	0.19	0.28	0.17	0.29	1.24	4.98	7.46	11.34	#N/A
	2:44:42	0.14	0.20	0.12	0.21	0.92	3.70	5.53	8.30	#N/A
	2:50:48	0.10	0.15	0.09	0.16	0.68	2.75	4.10	6.19	#N/A
	2:56:54	0.07	0.11	0.07	0.11	0.50	2.03	3.04	4.62	#N/A
	3:03:00	0.05	0.08	0.05	0.08	0.36	1.47	2.21	3.41	#N/A
	3:09:06	0.04	0.05	0.03	0.06	0.26	1.06	1.60	2.49	#N/A
	3:15:12	0.02	0.04	0.02	0.04	0.18	0.76	1.15	1.85	#N/A
	3:21:18	0.01	0.02	0.01	0.02	0.11	0.50	0.77	1.30	#N/A
	3:27:24	0.01	0.01	0.01	0.01	0.06	0.30	0.47	0.85	#N/A
	3:33:30	0.00	0.00	0.00	0.00	0.03	0.15	0.24	0.50	#N/A
	3:39:36	0.00	0.00	0.00	0.00	0.01	0.05	0.09	0.24	#N/A
	3:45:42	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	#N/A
	3:51:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:57:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:04:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:10:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:16:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:22:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:28:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:34:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:40:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:46:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:52:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:58:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:11:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:17:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:23:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:29:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:35:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:41:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:47:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:53:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:59:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:06:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:12:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:18:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:24:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:30:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:36:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:42:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:48:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:54:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:00:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:07:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:13:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:19:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

6.3 FOREBAY CALCULATIONS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**Jason Priddy**
Company:	**Vertex Engineering**
Date:	**January 21, 2020**
Project:	**Winsome Filing 1**
Location:	**Water Quality Pond C**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 3.7 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.037

C) Contributing Watershed Area — Area = 201.200 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 2.52 in

E) Design Concept
(Select EURV when also designing for flood control)

Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)
— V_{DESIGN}= ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$
— $V_{DESIGN\ OTHER}$= ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)
— $V_{DESIGN\ USER}$= 0.457 ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
— $EURV_{DESIGN}$ = ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired)
— $EURV_{DESIGN\ USER}$= ac-f t

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.)
— L : W = 2.5 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred)
— Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:
— Forebay

5. Forebay

A) Minimum Forebay Volume
(V_{FMIN} = 3% of the WQCV)
— V_{FMIN} = 0.014 ac-ft

B) Actual Forebay Volume — V_F = 0.017 ac-ft

C) Forebay Depth
(D_F = 18 inch maximum)
— D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 272.60 cfs

ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)
— Q_F = 5.45 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = in

G) Rectangular Notch Width — Calculated W_N = 14.3 in

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**Jason Priddy**
Company:	**Vertex Engineering**
Date:	**January 21, 2020**
Project:	**Winsome Filing 1**
Location:	**Water Quality Pond D**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 7.8 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.078

C) Contributing Watershed Area — Area = 230.000 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 2.52 in

E) Design Concept
(Select EURV when also designing for flood control)

Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)
— V_{DESIGN}= ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$
— $V_{DESIGN\ OTHER}$= ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)
— $V_{DESIGN\ USER}$= 1.036 ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
— $EURV_{DESIGN}$ = ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired)
— $EURV_{DESIGN\ USER}$= ac-f t

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.)
— L : W = 5.3 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred)
— Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:
— Forebay

5. Forebay

A) Minimum Forebay Volume
(V_{FMIN} = 3% of the WQCV)
— V_{FMIN} = 0.031 ac-ft

B) Actual Forebay Volume — V_F = 0.047 ac-ft

C) Forebay Depth
(D_F = 18 inch maximum)
— D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 431.80 cfs

ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)
— Q_F = 8.64 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = in

G) Rectangular Notch Width — Calculated W_N = 20.5 in

6.4 TRICKLE CHANNEL CALCULATIONS

WQ POND C

The open channel flow calculator

Select Channel Type: Rectangle

Depth from Q

Select unit system: Feet(ft)

Channel slope:	0.005	ft/ft	Water depth(y):	0.46	ft
Flow velocity	3.986541	ft/s	LeftSlope (Z1):	0	to 1 (H:V)
Flow discharge	5.45	ft^3/s	Input n value	0.013	or select n clean,uncoated castiron:0.014
Calculate!			Status:	Calculation finished	
Wetted perimeter	3.91	ft	Flow area	1.37	ft^2
Specific energy	0.7	ft	Froude number	1.04	
Critical depth	0.47	ft	Critical slope	0.0045	ft/ft

Bottom W(b)	3	ft
RightSlope (Z2):	0	to 1 (H:V)
Reset		
Top width(T)	3	ft
Flow status	Supercritical flow	
Velocity head	0.25	ft

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WQ POND D

The open channel flow calculator

Select Channel Type: Rectangle

Depth from Q

Select unit system: Feet(ft)

Channel slope:	0.005	ft/ft	Water depth(y):	0.5	ft
Flow velocity	4.321729	ft/s	LeftSlope (Z1):	0	to 1 (H:V)
Flow discharge	8.64	ft^3/s	Input n value	0.013	or select n clean,uncoated castiron:0.014
Calculate!			Status:	Calculation finished	
Wetted perimeter	5	ft	Flow area	2	ft^2
Specific energy	0.79	ft	Froude number	1.08	
Critical depth	0.53	ft	Critical slope	0.0041	ft/ft

Bottom W(b)	4	ft
RightSlope (Z2):	0	to 1 (H:V)
Reset		
Top width(T)	4	ft
Flow status	Supercritical flow	
Velocity head	0.29	ft

POND 3

The open channel flow calculator

Select Channel Type: Rectangle

Depth from Q

Select unit system: Feet(ft)

Channel slope:	0.005	ft/ft	Water depth(y):	0.46	ft
Flow velocity	3.870968	ft/s	LeftSlope (Z1):	0	to 1 (H:V)
Flow discharge	4.41	ft^3/s	Input n value	0.013	or select n clean,uncoated castiron:0.014
Calculate!			Status:	Calculation finished	
Wetted perimeter	3.41	ft	Flow area	1.14	ft^2
Specific energy	0.69	ft	Froude number	1.01	
Critical depth	0.46	ft	Critical slope	0.0048	ft/ft

Bottom W(b)	2.5	ft
RightSlope (Z2):	0	to 1 (H:V)
Reset		
Top width(T)	2.5	ft
Flow status	Supercritical flow	
Velocity head	0.23	ft

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7.1 DAM FAILURE FLOODPLAIN EXHIBIT

DAM RISK ASSESSMENT

WINSOME SUBDIVISION

A PARCEL OF PROPERTY LOCATED IN SECTIONS 13 & 24, TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH P.M. AND IN THE WEST HALF OF THE WEST HALF OF SECTION 19, TOWNSHIP 11 SOUTH, RANGE 64 WEST OF THE 6TH P.M., COUNTY OF EL PASO, STATE OF COLORADO

VERTEX®
2420 W. 26th Avenue, Suite 100-D | Denver, CO 80211
Main: 303.623.9116 | VERTEXENG.COM

9500 CFS DAM FAILURE FLOODPLAIN

SITE: 17480 MERIDIAN ROAD
ELBERT, COLORADO 80106

FOR: PT MCCUNE, LLC
1864 WOODMORE DR, SUITE 100
MONUMENT, COLORADO 80132

NO.	REVISIONS
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

DATE: 1/4/19
DRAWN BY: JCP
CHECKED BY: LPV
JOB #: 49388

1

0' 300' 600'

P:\Projects\49000-49999\49300-49399\49388.McCune Ranch\06-Engineering\Vertex Drawings\Exhibits\49388-EXHIBIT-DamFailure.dwg
Wednesday, January 09, 2019 1:51:34 PM
Copyright: 2019 The Vertex Companies, Inc.

7.2 DAM FAILURE FLOODPLAIN SECTIONS

McCune PC Fnl Plan: McCunePC 1/2/2019
.035
.035
0.3
Legend
EG 500-yr
WS 500-yr
Crit 500-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

McCune PC Fnl Plan: McCunePC 1/2/2019
.035
.03
.035
Legend
EG 500-yr
WS 500-yr
Crit 500-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Upper Reach Bridge

McCune PC Fnl Plan: McCunePC 1/2/2019
.035
.03
.035
Legend
EG 500-yr
WS 500-yr
Crit 500-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

McCune PC Fnl Plan: McCunePC 1/2/2019
.035
.03
.035
Legend
EG 500-yr
WS 500-yr
Crit 500-yr
Ground
Bank Sta
Ineff
Elevation (ft)
Station (ft)

McCune PC Fnl Plan: McCunePC 1/2/2019
.035
.03
.035
Legend
EG 500-yr
WS 500-yr
Crit 500-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

McCune PC Fnl Plan: McCunePC 1/2/2019
Lower Reach Bridge
.035
.03
.035
Legend
EG 500-yr
WS 500-yr
Crit 500-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

McCune PC Fnl Plan: McCunePC 1/2/2019
.035
.03
.035
Legend
EG 500-yr
WS 500-yr
Crit 500-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
7310
7305
7300
7295
7290
7285
7280
7275
0
200
400
600
800
1000

McCune PC Fnl Plan: McCunePC 1/2/2019
.035
.03
.035
Legend
EG 500-yr
WS 500-yr
Crit 500-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7315
7310
7305
7300
7295
7290
7285
7280
7275
7270
0
200
400
600
800
1000

7.3 LETTER FROM COLORADO STATE DAM AUTHORITY

COLORADO
Division of Water Resources
Department of Natural Resources

Dam Safety

Mr. Jason Priddy
The Vertex Companies, Inc.
2420 W. 26th Ave., Suite 100-D
Denver, Colorado 80211
jpriddy@vertexeng.com

When replying, please refer to:
Kiowa Crk Wtrshd 1-N-10, DAMID 010318
Kiowa Crk Wtrshd 1-P-10, DAMID 010319
Kiowa Crk Wtrshd 1-P-20, DAMID 010320
Water Division 1, Water District 01

January 22, 2019

SUBJECT: Winsome Subdivision – Planning Associated with Upstream Jurisdictional Dams

Dear Mr. Priddy:

I would like to start by thanking you for reaching out to me as part of your planning efforts for the Winsome Subdivision located in northeastern El Paso County, CO. The subject dams noted above are all currently registered as Low Hazard jurisdictional dams owned by the Kiowa Conservation District and are located just upstream of the planned Winsome Subdivision. Through coordination with this office, you completed hydraulic routing of a conservative peak dam breach discharge of 9,500 cfs through the planned development. This value was developed by this office in adherence to our *2010 Guidelines for Dam Breach Analysis* for the largest reservoir, 1-P-10. All three dams are situated on different drainages and do not cause cascading failure scenarios. There was concern that a failure of any one of the dams could both impact structures within the development and cause a hazard classification increase, requiring subsequent risk mitigation efforts by the dam owner.

This office has reviewed your floodplain analysis routing the peak dam break failure through the planned development. We understand that the modelling indicates the majority of the lots were not impacted at all by the peak breach. Your modelling indicates that corner of two lots (24 and 64) were within the wetted perimeter at depths less than 2 feet. To be conservative, you have chosen to place these portions of the two lots in "no-build" areas. We have reviewed the HEC-RAS model used to develop the hydraulic analysis and have no objections with the model assumptions and the slight alteration to the planned subdivision lot usage.

In conclusion, this office believes that your foresight in planning development at Winsome will retain Low Hazard classifications for the above-referenced dams. In other words, there is no risk posed by the dams to the structures of the planned development and the owner can continue to monitor and operate these in accordance with our requirements for Low Hazard dams.

Please contact me if you have questions or comments regarding the information contained in the report or if you require assistance with any dam-safety related issues.

Sincerely,

John Hunyadi, P.E.
Dam Safety Engineer

ec: Bill McCormick, Chief Dam Safety
Gilbert LaForce, El Paso County, gilbertlaforce@elpasoco.com
Linda Pollick, NRCS, linda.pollick@co.usda.gov
Pam Brewster, Kiowa Conservation District, pam.brewster@co.nacdnet.net

8.0 SITE PHOTOGRAPHS

9.0 DRAINAGE PLANS

CONSTRUCTION DOCUMENTS

WINSOME FILING NO 1

A TRACT OF LAND BEING A PORTION OF SECTION 24, RANGE 11 SOUTH, RANGE 65 WEST, OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO

EXISTING STORMWATER RUNOFF TABLE

BASIN	BASIN AREA (ACRES)	CURVE NUMBER	Q_{100}
A	915.4	61.8	585.6
Ba	3836.7	60.3	1448.6
Bb	100.6	69.8	127.7
Ca	162.7	60.0	127.8
Cb	70.0	68.7	88.1
Da	161.3	60.0	127.3
Db	49.9	60.0	34.1
Dc	249.7	67.7	275.7
Ea	37.9	60.0	34.8
Eb	74.6	67.2	85.8
F	44.5	69.0	56.6
G	107.6	74.5	199.0
H	121.8	71.8	197.2
I	37.5	79.0	88.4
J	10.1	69.5	19.9
K	17.8	76.0	45.1
	5998.1		

LEGEND

- PROPERTY BOUNDARY LINE
- 5540 EXISTING CONTOUR
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN FLOW PATH
- BASIN NAME (A)
- DRAINAGE BASIN SIZE (4.09 ACRES)
- 100-YEAR RUNOFF (4.73)
- CURVE NUMBER (14.05)
- FLOW ARROWS

0' 1500' 3000' 4500'

SCALE: 1" = 1500'

PCD FILE NO ####

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COLORADO LICENSED PATRICK VANDERMAY 01/23/2020 43911 PROFESSIONAL ENGINEER

DRAINAGE PLAN - EXISTING CONDITION - FULL

SITE: 17480 MERIDIAN ROAD
ELBERT, COLORADO 80106

FOR: WINSOME, LLC
1864 WOODMORE DR, SUITE 100
MONUMENT, COLORADO 80132

NO.	REVISIONS
1	SUBMITTAL 1
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DATE: 01.22.20
DRAWN BY: JCP
CHECKED BY: LPV
JOB #: 49388.01

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CONSTRUCTION DOCUMENTS

WINSOME FILING NO 1

A TRACT OF LAND BEING A PORTION OF SECTION 24, RANGE 11 SOUTH, RANGE 65 WEST,
OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO

NOTES:

1. EXISTING FLOODPLAIN AS SHOWN BASED ON FIRM MAP #08041C0350G PANEL 350 REVISED 12/7/2018, GENERATED BY GRAPHICAL OVERLAY.

E1 MAIN OUTFALL E4+E5+E6+E7 Q5=408.6CFS Q100=2469.9CFS

E2 OFFSITE FLOW Q5=3.4CFS Q100=19.9CFS

E3 OFFSITE FLOW Q5=12.9CFS Q100=45.1CFS

E4 + E5 OFFSITE FLOW Q5=26.4CFS Q100=88.4CFS

E6 OFFSITE FLOW Q5=4.0CFS Q100=85.8CFS

E7 OFFSITE FLOW Q5=6.6CFS Q100=56.6CFS

LEGEND

- PROPERTY BOUNDARY LINE
- 5540 EXISTING CONTOUR
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN FLOW PATH
- A — BASIN NAME
- 4.09 ACRES — DRAINAGE BASIN SIZE
- 4.73 | 14.05 — 100-YEAR RUNOFF / CURVE NUMBER
- FLOW ARROWS

0' 400' 800' 1200'

SCALE: 1" = 400'

PCD FILE NO ####

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01/23/2020
43911
PROFESSIONAL ENGINEER

DRAINAGE PLAN - EXISTING CONDITION - SITE

SITE: 17480 MERIDIAN ROAD
ELBERT, COLORADO 80106

FOR: WINSOME, LLC
1864 WOODMORE DR, SUITE 100
MONUMENT, COLORADO 80132

NO.	REVISIONS
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DATE: 01.22.20
DRAWN BY: JCP
CHECKED BY: LPV
JOB #: 49388.01

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CONSTRUCTION DOCUMENTS

WINSOME FILING NO 1

A TRACT OF LAND BEING A PORTION OF SECTION 24, RANGE 11 SOUTH, RANGE 65 WEST,
OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED STORMWATER RUNOFF

BASIN	BASIN AREA (ACRES)	CURVE NUMBER	Q_{100}
A	915.4	61.8	585.6
B1	3836.7	60.3	1448.6
B2	13.1	64.0	19.9
B3	54.9	65.1	57.9
B4	41.5	68.5	53.1
C1	162.7	60.0	127.8
C2	22.4	64.0	23.7
C3	16.1	64.0	22.1
C4	23.8	65.0	22.9
D1.1	161.3	60.0	127.3
D1.2	49.9	60.0	34.1
D2	68.7	64.8	81.2
D3.4.6	167.0	66.4	175.3
D5	12.8	67.2	17.5
Ea	37.9	60.0	34.8
Eb	74.6	67.2	85.8
F	44.5	69.0	56.6
G	107.6	74.5	199.0
H	121.8	71.8	197.2
I	37.5	79.0	88.4
J	10.1	69.5	19.9
K	17.8	76.0	45.1
	5998.1		

DETENTION POND SUMMARY

POND NUMBER	PROPOSED VOLUME	100Y FLOW EXITING POND
3	7.1 AC-FT	126.8 CFS

LEGEND

- PROPERTY BOUNDARY LINE
- 5540 — PROPOSED CONTOUR
- 5540 — EXISTING CONTOUR
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN FLOW PATH

A — BASIN NAME
4.09 ACRES — DRAINAGE BASIN SIZE
4.73 | 14.05 — 100-YEAR RUNOFF; CURVE NUMBER
FLOW ARROWS

0' 1500' 3000' 4500'
SCALE: 1" = 1500'

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LANCE PATRICK VANDERWERF
01/23/2020
43911
PROFESSIONAL ENGINEER

DRAINAGE PLAN - FILING 1 CONDITION - FULL

SITE: 17480 MERIDIAN ROAD
ELBERT, COLORADO 80106

FOR: WINSOME, LLC
1864 WOODMORE DR, SUITE 100
MONUMENT, COLORADO 80132

NO.	REVISIONS
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DATE: 01.22.20
DRAWN BY: JCP
CHECKED BY: LPV
JOB #: 49388.01

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WINSOME FILING NO 1

A TRACT OF LAND BEING A PORTION OF SECTION 24, RANGE 11 SOUTH, RANGE 65 WEST, OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO

NOTES:

1. EXISTING FLOODPLAIN AS SHOWN BASED ON FIRM MAP #08041C0350G PANEL 350 REVISED 12/7/2018, GENERATED BY GRAPHICAL OVERLAY.

1 MAIN OUTFALL+DESIGN POINTS 4, 5, 6, 7 Q5=384.1CFS Q100=2320.7CFS

2 OFFSITE FLOW Q5=3.4CFS Q100=19.9CFS

3 OFFSITE FLOW Q5=12.9CFS Q100=45.1CFS

4 + 5 OFFSITE FLOW Q5=26.4CFS Q100=88.4CFS

6 OFFSITE FLOW Q5=4.0CFS Q100=85.8CFS

7 OFFSITE FLOW Q5=6.6CFS Q100=56.6CFS

P3 OUTFALL Q5=1.4CFS Q100=126.8CFS

Provide a pond summary table on the drainage map:
- Required WQCV, 100yr Storage
- Designed WQCV, 100yr Storage
- 5yr/100yr Qin/Qout

LEGEND

- PROPERTY BOUNDARY LINE
- 5540 EXISTING CONTOUR
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN FLOW PATH
- A — BASIN NAME
- 4.09 ACRES — DRAINAGE BASIN SIZE
- 4.73 | 14.05 — 100-YEAR RUNOFF / CURVE NUMBER
- FLOW ARROWS

0' 200' 400' 600'

SCALE: 1" = 200'

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DRAINAGE PLAN - FILING 1 CONDITION - SITE

SITE: 17480 MERIDIAN ROAD
ELBERT, COLORADO 80106

FOR: WINSOME, LLC
1864 WOODMORE DR, SUITE 100
MONUMENT, COLORADO 80132

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