

**PRELIMINARY DRAINAGE REPORT
FOR
CHAMBERS AND HESS FILING NO. 1**

Job Number: D-1173

January 24, 2020

RICK ENGINEERING COMPANY

ENGINEERING COMPANY

RICK ENGINEERING CO

**PRELIMINARY DRAINAGE REPORT
FOR
CHAMBERS AND HESS FILING NO. 1
PARKER, COLORADO**

Job Number: D-1173

Owner:

FIRST GUARDIAN GROUP, INC.
2025 Gateway Place, Suite 485
San Jose, CA 95110

Applicant/Developer:

REPUBLIC INVESTMENT GROUP
5750 DTC Parkway, Suite 160
Greenwood Village, CO 80111

Engineer:

RICK ENGINEERING COMPANY
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January 24, 2020

Certification

Professional Engineer:

This report for the preliminary design of Chambers and Hess Filing No. 1 was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for the drainage facilities designed by others.

Troy Bales
Registered Professional Engineer
State of Colorado No. 50961



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I. GENERAL LOCATION AND DESCRIPTION

A. Location

The Chambers and Hess Filing No. 1 development is in the Town of Parker, Douglas County, Colorado. More specifically, the development is located in the southeast one-quarter of Section 29, Township 6 South, Range 66 West of the Sixth Principal Meridian.

The subject site is also known as Block 10, Lot 1 of Douglas 234 Filing No. 1. The site is 13.803 acres in area. Chambers and Hess Filing No. 1 is located entirely within the Douglas 234 Filing No. 1 subdivision.

Bordering the Chambers and Hess Filing No. 1 development to the north is South Red Sky Drive, a residential collector street that transitions to a residential local street east of the existing traffic roundabout. To the south, Chambers and Hess Filing No. 1 development is bordered by existing Hess Road, an arterial roadway. South of Hess Road is the Stroh Ranch Development. West of Chambers and Hess Filing No. 1 development is existing Chambers Road, arterial roadway. East of Chambers and Hess Filing No. 1 development is Block 12, Lots 7-23, of Douglas 234 Filing No. 1, 1st Amendment.

Chambers and Hess Filing No. 1 is within the Cherry Creek watershed. Cherry Creek is located about 1.75 miles east of Chambers and Hess Filing No. 1.

A National Resources Conservation Service (NRCS) soils map is in the Appendix. Four distinct soil types are encountered within Chamber and Hess Filing No. 1. Newlin-Satanta (NsE) complex, Hydrologic Soil Group B, described as gravelly sandy clay loam. Kutch clay loam (KuE), Hydrologic Soil Group D, described as clay loam. Manzanola clay loam (Ma), Hydrologic Soil Group C, described as clay loam. Renohill-Buick (RmE) complex, Hydrologic Soil Group D, described as clay loam.

In the existing condition, Chambers and Hess Filing No. 1 is vacant ground composed of native grasses and only a few trees. The site generally slopes from west to east with grades varying between 1% and 28%. Along the western boundary, the land slopes to the west to Chambers Road. Along the southern boundary, land slopes to the south to Hess Road.

Chambers and Hess Filing No. 1 is proposed to be developed for commercial/retail development.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

Chambers and Hess Filing No. 1 is located within two major drainage basins, Cherry Creek and Oak Gulch. Oak Gulch is tributary to Cherry Creek.

Chambers and Hess Filing No. 1 is approximately 2 miles upstream of Cherry Creek. The most recent Flood Hazard Area Delineation for Cherry Creek in 2003 by URS did not include Chambers and Hess Filing No. 1 in the report.

Oak Gulch was studied as part of the “Oak Gulch and Lemon Gulch Flood Hazard Area Delineation” (Reference 4). Chambers and Hess Filing No. 1 is part of sub-basin 109.

Chambers and Hess Filing No.1 is in FEMA Zone X, an area of minimal flood hazard. A FEMA LOMR will not be required.

The Chambers and Hess Filing No. 1 site was originally studied as part of the Parker 234 Subdivision Final Drainage Report (Reference 3). The report identified that the site is part of the Cherry Creek watershed and Oak Gulch watershed. The report assigned historic drainage basin C-3 (area tributary to Cherry Creek) and historic drainage basin D-3 (area tributary to Oak Gulch).

B. Site Sub-Basin Description

Referring to the Historic Drainage Map in Appendix C, the basin designations were adopted from the Parker 234 Final Drainage Report to maintain clarity and continuity.

Historic Basins C1, C2, C3 and C4, tributary to Cherry Creek, drain from west to east. Basin C1 drains to an existing area inlet that was constructed as part of the Parker 234 subdivision improvements. The runoff then travels north and east via storm sewer to existing detention Pond “A”. Basin C2 drains from west to east, ultimately through the residential lots on Block 2 of Douglas 234 Filing No. 1, eventually to the existing Red Sky Drive, then to existing pond “A”. Basin C3 drains from west to east through the residential lots on Block 2 of Douglas 234 Filing No. 1, eventually to existing Detention Pond “A”. Detained runoff from Pond “A” is conveyed under Jordan Road to the east, to an unnamed drainage way that ultimately connects to Cherry Creek. Basin C4 drains to the north to Red Sky Drive, then to the east and ultimately captured by existing storm sewer and routed to Pond “A”.

Historic Basins D1 and D2, tributary to Oak Gulch, drain to the west and south to existing South Chambers Road and Hess Road. Runoff from Historic Basins D1 and D2 travels south on Chambers Road, then east on Hess Road, to Pond F (Reference 5). Runoff from Pond F is conveyed south, under Hess Road to Oak Gulch.

There is no offsite runoff that flows onto Chambers and Hess Filing No. 1.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

Chambers and Hess Filing No. 1 is not located within a regulated flood plain, therefore, Chambers and Hess Filing No. 1 is in compliance with the Town of Parker’s floodplain ordinance.

B. Discussion of compliance with the Town’s Stream Preservation Standards

Chambers and Hess Filing No. 1 is not located within the Town of Parker Stream Preservation Area. Nonetheless, Chambers and Filing No. 1 will implement BMP measures to ensure that no adverse impact to water quality due to land disturbances. There are no Minor or Major Modifications requested. There are no planned improvements that would be eligible for Mile High Flood District’s maintenance eligibility.

C. Development Criteria and Constraints

Chambers and Hess Filing No. 1 will comply with the drainage improvements outlined in the Final Drainage Report for the Parker 234 Subdivision. The report assigned the area of Chambers and Hess Filing No. 1 as future commercial development, 95% impervious. Chambers and Hess Filing No. 1 is using 75% impervious for the commercial lots, according to Mile High Flood District Table 6-3 (see Appendix) Business: Suburban Area. The proposed impervious is 73%. By reducing the impervious area, there will be no adverse impact to the downstream drainage conveyance elements, including the existing storm sewer and existing detention Pond "A".

D. Hydrology Criteria

The minor storm is the 2 year recurrence interval. The major storm is the 100 year recurrence interval.

The site is 13.80 acres. The Rational Method is the method used to determine runoff rates for the minor and major storm. Rational Method runoff coefficients are based on the NRCS Hydrologic Soil Ratings. The predominant soil type (10 acres), Newlin-Satanta, has Hydrologic Soil Group Rating as Type "B". There are also 5 acres of Type "C/D" rated soils. After consulting the Mile High Flood District about how to calculate Rational Method Runoff Coefficients when there are differing types of soils from a Hydrologic Soil Group Rating standpoint, they recommended to evaluate each basin based on where the basin is located with respect to the Hydrologic Soil Group Rating. The Rational Method Runoff Coefficients were calculated assuming the entire site is Type "C/D" soils for simplicity, yielding a more conservative estimate of developed runoff.

There are no detention facilities proposed for Chambers and Hess Filing No. 1. Existing detention pond "A" will receive developed runoff from Chambers and Hess Filing No. 1, as designated in the Final Drainage Report for the Parker 234 Subdivision.

E. Hydraulic Criteria

Private Drive A is a normal crowned roadway, 26' flowline to flowline. Street capacities for Drive A are calculated using UD-Inlet Version 4.05. The minor storm flow depth is limited to no curb overtopping. Minor storm runoff can spread to the crown of the street. The major storm flow depth cannot exceed 12 inches. Appendix B contains street capacity calculations. UD-Inlet was also utilized to calculate proposed storm sewer inlet capture rates.

Hydraulic grade lines are calculated using Mile High Flood District's UD Sewer software. The hydraulic grade line for the minor storm must be located below the crown of the pipe. The hydraulic grade line for the major storm must be located at least 12" below finished grade as a maximum condition.

F. Variance from Criteria

There are no variances from criteria being sought.

IV. DRAINAGE FACILITY DESIGN

A. General Concept

Chambers and Hess Filing No. 1 eleven proposed commercial lots. The specific developments within the commercial lots are unknown currently. This report will quantify the runoff tributary from each commercial lot in sizing the storm drainage infrastructure. The proposed storm sewer system will provide a stub to each lot so that when the lot is developed, they can utilize the connection to the storm sewer system to convey runoff from each commercial lot. The commercial lots are designated to be a maximum of 75% impervious.

The drive and commercial lots will convey runoff to proposed storm inlets and ultimately to the existing storm sewer stub constructed in Tract B of Parker 234 subdivision. There is no offsite runoff draining on the Chambers and Hess Filing No. 1. Runoff from Chambers and Hess Filing No. 1 is designated to be collected and conveyed by the proposed storm sewer system. Existing Pond "A" will ultimately receive the developed runoff from Chambers and Hess Filing No. 1.

The appendix contains design charts utilized to quantify developed runoff.

B. Specific Details

The site is 13.80 acres and subdivided into 13 sub-basins to quantify developed storm runoff at various design points. Each sub-basin is evaluated for the proposed impervious improvements. Areas within the sub-basins are assigned land uses, Concrete or Asphalt Pavement, Drives and Walks, Landscape or lawns and Commercial areas. The Proposed Impervious calculation in the Appendix summarizes the percent impervious of each sub basin. Times of Concentrations are either calculated or assumed to be the minimum of 5 minutes. Design points are located to calculate runoff to determine if the drive has the capacity to convey runoff. Design points are also located at proposed inlets and manholes to calculate the cumulative effect of runoff as the runoff conveys downstream.

As previously discussed, each commercial lot will capture developed runoff that is conveyed to the storm sewer system constructed by this proposal. The proposed storm system will convey the major storm from each commercial lot to the existing storm sewer connection.

Referring to the proposed drainage map, sump inlets are located at drive low point are proposed at Design Points 9 and 10. The sump inlets are designed to provide 100% capture of the major storm. At no point does runoff ever exceed available street capacities for the minor or major storm.

C. Discussion of Detention Storage Required for Full-Spectrum Detention

As previously discussed, Chambers and Hess Filing No. 1 is not required to have on site detention because the property was included in the tributary area to the existing detention Pond "A", about 1200 feet east of Chambers and Hess Filing No. 1. When Pond "A" was designed, the Chambers and Hess Filing No. 1 property was assigned a percent impervious of 95%. The proposed site impervious for Chambers and Hess Filing No. 1 is 73%. There is no additional drainage area tributary to Pond "A". Therefore, the detention volume requirements for Pond "A"

are not adversely impacted by a developed Chambers and Hess Filing No. 1 property because the pond will receive more pervious drainage area than originally designed.

D. Discussion of Outlet Requirements

The outlet structure for existing Pond “A” will require no further improvements due to the construction of Chambers and Hess Filing No. 1 as discussed in the previous section.

E. Discussion of Storm Sewer Configuration

The proposed storm sewer main is located in Drive A. The storm sewer main will have storm sewer stubs extending in the commercial lots to convey major storm runoff to the existing storm sewer stub in Tract B of Parker 234 Subdivision. The storm sewer main is routed through the site to convey developed runoff to the existing stub. The Final Drainage Report for Parker 234 Subdivision calculated the total developed storm runoff from the Chambers and Hess Filing No. 1 property to be in the minor storm, 34.7 cfs and 88.6 cfs in the major storm. By reducing the amount of impervious area, the total developed storm runoff from Chambers and Hess Filing No. 1 property in the minor and major storm respectively is: 20.4 cfs and 74.5 cfs.

UDSewer was utilized to calculate the Hydraulic Grade Line for the major and minor storm sewer. The major storm model used a tailwater elevation that corresponds to the tailwater elevation of existing manhole SDMH-2 in the Final Drainage Report for Parker 234 Subdivision. The minor storm tailwater elevation was calculated as normal depth pipe flow at Parker 234 SDMH-2. The Hydraulic Grade Line calculations are located in Appendix B.

F. Discussion on Channel Design and Soil Erodibility Within Channel

There are only minor drainage grass lined swales proposed for Chambers and Hess Filing No. 1. The calculations for these minor drainage grass lined swales are in the appendix. The relatively low developed runoff conveyed by these swales yield velocities less than 5 feet per second, resulting in stable grass swales that do not require grade drops or armoring.

G. Stormwater Utility Eligible Facilities

V. ENVIRONMENTAL PROTECTION CRITERIA

A. General

There are no wetlands located in Chambers and Hess Filing No. 1. There are no “Waters of the U.S.” located in Chambers and Hess Filing No. 1.

B. Construction BMP Plan

Construction BMP’s will be implemented in a three phase schedule, initial, interim and final stabilization.

The initial phase will install construction fencing, perimeter construction BMP’s like Silt Fencing and Sediment Control Logs. Vehicle tracking control to reduce the tracking of soils into the surrounding public streets and subdivision. At existing storm drain inlets on Hess Road and Red Sky Drive will have Inlet Protections installed to prevent sediments from entering existing storm drain systems.

The interim phase will have the erosion and sediment controls associated with ongoing construction and grading operations. As grading operations bring the ground to finished grade elevations, trenching for proposed utilities, and rough street cuts prior to paving, BMP's like Check Dams, Diversion Ditches are installed to reduce stormwater runoff to non erosive velocities.

The final phase is where the site is to be stabilized by revegetating disturbed areas, installing erosion control blankets or similar on steeper grades.

C. Permanent BMP Plan

Chambers and Hess Filing No. 1 will utilize a regional Permanent BMP by discharging developed runoff to existing Pond "A". Pond "A" acts as the Water Quality Enhancement BMP for Chambers and Hess Filing No. 1.

VI. CONCLUSIONS

A. Compliance with Standards

The drainage plan for Chambers and Hess Filing No. 1 is compliant with Town of Parker's stormwater ordinances. Chambers and Hess Filing No. 1 is compliant with the Town of Parker's Storm Drainage and Environmental Criteria Manual by utilizing the design methods and requirements outlined in the SDECM.

B. Drainage Concept

The drainage design for Chambers and Hess Filing No. 1 effectively controls developed runoff by constructing storm sewer and storm drain inlets that convey developed runoff to the existing storm sewer stub constructed in anticipation of commercial development. By reducing the impervious area from the original drainage concept ensures that there are no adverse downstream impacts to the existing storm drainage infrastructure within the Parker 234 subdivision.

VII. REFERENCES

1. "Urban Storm Drainage Criteria Manual Volumes 1, 2 and 3". Urban Drainage and Flood Control District, 2016.
2. "Storm Drainage and Environmental Criteria Manual". Town of Parker, Colorado. February 2014.
3. "Final Drainage Report for the Parker 234 Subdivision Parker Colorado". CVL Consultants of Colorado, Inc. 2003.
4. "Oak Gulch and Lemon Gulch Flood Hazard Area Delineation". CH2M Hill. 2000.
5. "Addendum #2 to the Final Drainage Report for Douglas 234 Parker Colorado". CVL Consultants of Colorado, Inc. 2004.

Appendix A

Hydrologic Computations

National Flood Hazard Layer FIRMette



39°29'52.64"N



Legend

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

- | | | |
|------------------------------------|--|---|
| SPECIAL FLOOD HAZARD AREAS | | Without Base Flood Elevation (BFE)
Zone A, V, A99 |
| | | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | | Area with Reduced Flood Risk due to Levee. See Notes. Zone X |
| | | Area with Flood Risk due to Levee Zone D |
| OTHER AREAS | | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | | Effective LOMRs |
| GENERAL STRUCTURES | | Area of Undetermined Flood Hazard Zone D |
| | | Channel, Culvert, or Storm Sewer |
| | | Levee, Dike, or Floodwall |
| OTHER FEATURES | | 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation |
| | | 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation |
| | | Coastal Transect |
| | | Base Flood Elevation Line (BFE) |
| | | Limit of Study |
| MAP PANELS | | Jurisdiction Boundary |
| | | Coastal Transect Baseline |
| | | Profile Baseline |
| | | Hydrographic Feature |
| | | Digital Data Available |
| | | No Digital Data Available |
| | | Unmapped |



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

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

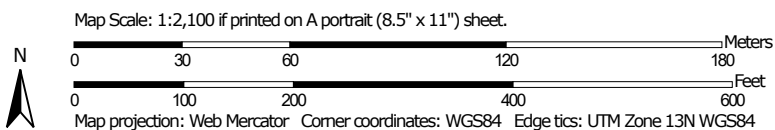
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **11/25/2019 at 3:59:17 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Hydrologic Soil Group—Castle Rock Area, Colorado




Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines


 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points






 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

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 1:20,000.

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: Castle Rock Area, Colorado
 Survey Area Data: Version 12, 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: Jun 10, 2014—Aug 21, 2014

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
KuE	Kutch clay loam, 8 to 20 percent slopes	D	0.6	3.8%
Ma	Manzanola clay loam	C	3.5	23.1%
NsE	Newlin-Satanta complex, 5 to 20 percent slopes	B	9.9	64.6%
RmE	Renohill-Buick complex, 5 to 25 percent slopes	D	1.3	8.5%
Totals for Area of Interest			15.3	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.276}$	$C_A = 0.87i^{1.232}$	$C_A = 0.84i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B = 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$	$C_{C/D} = 0.32i+0.588$

Where:

i = % imperviousness (expressed as a decimal)

C_A = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

C_B = Runoff coefficient for NRCS HSG B soils

$C_{C/D}$ = Runoff coefficient for NRCS HSG C and D soils.

The values for various catchment imperviousness and storm return periods are presented graphically in Figures 6-1 through 6-3, and are tabulated in Table 6-5. These coefficients were developed for the Denver region to work in conjunction with the time of concentration recommendations in Section 2.4. Use of these coefficients and this procedure outside of the semi-arid climate found in the Denver region may not be valid. The UD-Rational Excel workbook performs all the needed calculations to find the runoff coefficient given the soil type and imperviousness and the reader may want to take advantage of this macro-enabled Excel workbook that is available for download from the UDFCD’s website www.udfcd.org.

See Examples 7.1 and 7.2 that illustrate the Rational Method.

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only):	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

PROJECT: CHAMBERS AND HESS FILING NO. 1
 SUBJECT: HISTORIC IMPERVIOUSNESS

JOB #: D01173
 DATE: 12/13/2019
 BY: BHE

Basin Name	Square Footage	Acres	Native Ground (sf)	Native Ground (Acres)	Gravel (sf)	Gravel (Acres)	Roofs (sf)	Roofs (Acres)	Soil Type "C/D" Composite Runoff Factors			
									C ₂	C ₅	C ₁₀₀	I %
C1	417,552	9.59	417,552	9.59	0	0.00	0	0.00	0.01	0.05	0.49	2.0
C2	28,133	0.65	28,133	0.65	0	0.00	0	0.00	0.01	0.05	0.49	2.0
C3	8,776	0.20	8,776	0.20	0	0.00	0	0.00	0.01	0.05	0.49	2.0
C4	2,644	0.06	2,644	0.06	0	0.00	0	0.00	0.01	0.05	0.49	2.0
D1	75,297	1.73	75,297	1.73	0	0.00	0	0.00	0.01	0.05	0.49	2.0
D2	68,188	1.57	68,188	1.57	0	0.00	0	0.00	0.01	0.05	0.49	2.0

Land Use	Imp., I %
Native Ground	2%
Gravel	40%
Roofs	90%

PROJECT: CHAMBERS AND HESS FILING NO. 1
 SUBJECT: TIME OF CONCENTRATION

JOB #: D01173
 DATE: 12/13/2019
 BY: BHE

TIME OF CONCENTRATION

			TIME (Ti) [Max. 300']					TRAVEL TIME (Tt)							Tc CHECK		FINAL	Time to	Remarks
Basin No.	Area (acres)	5Yr. co-eff.	Elevations		Dist. (ft)	Slope (%)	Ti (min)	Elevations		Dist. (ft)	Slope (%)	*	Vel. (fps)	Tt (min)	Tc		Tc (min)	Peak** Flow	
			Upstream	Downstream				Upstream	Downstream						Tc	(min)			
C1	9.59	0.05	6085.1	6074.0	196	5.7	14.9	6074.0	6054.0	408	4.9	3	1.8	3.7	18.6	29.0	18.6	29.0	NON URBANIZED
C2	0.65	0.05																5.0	ASSUME MIN TC
C3	0.20	0.05	6070.0	6064.0	143	4.2	14.1	6064.0	6059.0	172	2.9	3	1.2	2.3	16.4	27.5	16.4	27.5	NON URBANIZED
C4	0.06	0.05																5.0	ASSUME MIN TC
D1	1.73	0.05	6085.4	6084.0	76	1.8	13.6	6084.0	6082.0	64	3.1	3	1.3	0.8	14.4	26.3	14.4	26.3	NON URBANIZED
D2	1.57	0.05	6086.0	6083.1	84	3.5	11.5	6083.1	6054.7	512	5.5	3	2.0	4.4	15.8	29.6	15.8	29.6	NON URBANIZED

* Type of Land Surface for Overland Travel Time

VELOCITY COEFFICIENTS

- | | | |
|--|---|-----|
| 1 = Heavy Meadow | 1 | 2.5 |
| 2 = Tillage / Field | 2 | 5 |
| 3 = Short pasture & lawns | 3 | 7 |
| 4 = Nearly bare ground | 4 | 10 |
| 5 = Grassed waterway | 5 | 15 |
| 6 = Paved areas and shallow paved swales | 6 | 20 |

**STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

CALCULATED BY: **BHE**
DATE: **12/13/19**
CHECKED BY:

P1= **0.99**

JOB NO: **D01173**
PROJECT: **CHAMBERS AND HESS FILING NO. 1**
DESIGN STORM: **2 Year**

BASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(CA) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	
C1	1	C1	9.59	0.01	29.0	0.10	1.59	0.2													
C2			0.65	0.01	5.0	0.01	3.36	0.0													
C3			0.20	0.01	27.5	0.00	1.64	0.0													
C4			0.06	0.01	5.0	0.00	3.36	0.0													
D1			1.73	0.01	26.3	0.02	1.68	0.0													
D2			1.57	0.01	29.6	0.02	1.57	0.0													

**STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

CALCULATED BY: **BHE**
DATE: **12/13/19**
CHECKED BY:

P1= **2.60**

JOB NO: **D01173**
PROJECT: **CHAMBERS AND HESS FILING NO. 1**
DESIGN STORM: **100 YEAR**

BASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(CA) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	
C1	1	C1	9.59	0.49	29.0	4.72	4.16	19.6													
C2			0.65	0.49	5.0	0.32	8.82	2.8													
C3			0.20	0.49	27.5	0.10	4.29	0.4													
C4			0.06	0.49	5.0	0.03	8.82	0.3													
D1			1.73	0.49	26.3	0.85	4.40	3.7													
D2			1.57	0.49	29.6	0.77	4.11	3.2													

PROJECT: CHAMBERS AND HESS FILING NO. 1
 SUBJECT: Proposed Impervious

JOB #: D01173
 DATE: 1/24/2020
 BY: BHE

Basin Name	Square Footage	Acres	Lawns/ Native Area (sf)	Lawns/ Native Area (Acres)	Asphalt/ Concrete (sf)	Asphalt/ Concrete (Acres)	Drives and Walks (sf)	Drives and Walks (Acres)	Suburban Commercial (sf)	Suburban Commercial (Acres)	Soil Type "C/D" Composite Runoff Factors			
											C ₂	C ₅	C ₁₀₀	I %
A1	40,782	0.94	0	0.00	0	0.00	0	0.00	40,782	0.94	0.60	0.65	0.79	75.0
A2	43,166	0.99	0	0.00	0	0.00	0	0.00	43,166	0.99	0.60	0.65	0.79	75.0
A3	41,151	0.94	0	0.00	0	0.00	0	0.00	41,151	0.94	0.60	0.65	0.79	75.0
A4	42,254	0.97	0	0.00	0	0.00	0	0.00	42,254	0.97	0.60	0.65	0.79	75.0
A5	35,369	0.81	0	0.00	0	0.00	0	0.00	35,369	0.81	0.60	0.65	0.79	75.0
A6	73,051	1.68	0	0.00	0	0.00	0	0.00	73,051	1.68	0.60	0.65	0.79	75.0
A7	39,158	0.90	0	0.00	0	0.00	0	0.00	39,158	0.90	0.60	0.65	0.79	75.0
A8	35,765	0.82	0	0.00	0	0.00	0	0.00	35,765	0.82	0.60	0.65	0.79	75.0
A9	34,498	0.79	13,386	0.31	15,574	0.36	5,538	0.13	0	0.00	0.47	0.53	0.73	60.4
A10	36,273	0.83	14,964	0.34	15,602	0.36	5,707	0.13	0	0.00	0.45	0.51	0.72	58.0
A11	38,337	0.88	0	0.00	0	0.00	0	0.00	38,337	0.88	0.60	0.65	0.79	75.0
A12	60,464	1.39	0	0.00	0	0.00	0	0.00	60,464	1.39	0.60	0.65	0.79	75.0
A13	80,321	1.84	0	0.00	0	0.00	0	0.00	80,321	1.84	0.60	0.65	0.79	75.0
HESS1	56,658	1.30	12,553	0.29	39,461	0.91	4,644	0.11	0	0.00	0.62	0.67	0.80	77.5
HESS2	2,683	0.06	363	0.01	2,014	0.05	306	0.01	0	0.00	0.70	0.74	0.83	85.6
Totals:	600,588	13.79	28,350	0.65	31,176	0.72	11,245	0.26	529,817	12.16	0.58	0.63	0.78	73.1

Land Use	Imp., I %
Lawns/Native Area	2%
Asphalt/Concrete	100%
Drives and Walks	90%
Suburban Commercial	75%

PROJECT: CHAMBERS AND HESS FILING NO. 1
 SUBJECT: TIME OF CONCENTRATION

JOB #: D01173
 DATE: 1/24/2020
 BY: BHE

TIME OF CONCENTRATION

			TIME (Ti) [Max. 300']					TRAVEL TIME (Tt)							Tc CHECK		FINAL Tc	Time to Peak**	Remarks
Basin No.	Area (acres)	5Yr. co-eff.	Elevations		Dist. (ft)	Slope (%)	Ti (min)	Elevations		Dist. (ft)	Slope (%)	*	Vel. (fps)	Tt (min)	Tc		Tc (min)	Peak** Flow	
			Upstream	Downstream				Upstream	Downstream						Tc	(min)			
A1	0.94	0.65																5.0	Assume Min Tc
A2	0.99	0.65																5.0	Assume Min Tc
A3	0.94	0.65																5.0	Assume Min Tc
A4	0.97	0.65																5.0	Assume Min Tc
A5	0.81	0.65																5.0	Assume Min Tc
A6	1.68	0.65																5.0	Assume Min Tc
A7	0.90	0.65																5.0	Assume Min Tc
A8	0.82	0.65																5.0	Assume Min Tc
A9	0.79	0.53	6077.4	6076.9	19	2.9	3.1	6076.9	6053.2	1076	2.2	6	2.9	6.3	9.4	22.7	9.4	9.4	
A10	0.83	0.51	6077.4	6076.8	20	2.9	3.4	6076.8	6053.1	1101	2.2	6	2.9	6.4	9.8	23.4	9.8	9.8	
A11	0.88	0.65																5.0	Assume Min Tc
A12	1.39	0.65																5.0	Assume Min Tc
A13	1.84	0.65																5.0	Assume Min Tc
HESS1	1.30	0.67	6074.1	6072.7	67	2.1	5.0	6072.7	6055.2	644	2.7	6	3.2	3.4	8.4	16.1	8.4	8.4	Assume Min Tc
HESS2	0.06	0.74																5.0	Assume Min Tc

* Type of Land Surface for Overland Travel Time

VELOCITY COEFFICIENTS

- 1 = Heavy Meadow
- 2 = Tillage / Field
- 3 = Short pasture & lawns
- 4 = Nearly bare ground
- 5 = Grassed waterway
- 6 = Paved areas and shallow paved swales

- 1 2.5
- 2 5
- 3 7
- 4 10
- 5 15
- 6 20

**STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

CALCULATED BY: **BHE**
DATE: **1/24/20**
CHECKED BY:

P1= **0.99**

JOB NO: **D01173**
PROJECT: **CHAMBERS AND HESS FILING NO. 1**
DESIGN STORM: **2 Year**

BASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(CA) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	
A1	1	A1	0.94	0.60	5.0	0.56	3.36	1.9							1.9	2.8	18	194	8.0	0.4	INL-11 TO SDMH-09
A2			0.99	0.60	5.0	0.60	3.36	2.0							2.0	2.0	18	44	7.5	0.1	INL-10 TO SDMH-09
	2	A1+A2							5.4	1.16	3.29	3.8			3.8	2.0	18	144	7.1	0.3	SDMH-09 TO SDMH-08
A3			0.94	0.60	5.0	0.57	3.36	1.9							1.9	3.7	18	44	7.2	0.1	INL-09 TO SDMH-08
	3	A1-A3							5.7	1.73	3.23	5.6			5.6	2.0	24	99	7.7	0.2	SDMH-08 TO SDMH-07
A4			0.97	0.60	5.0	0.58	3.36	2.0							2.0	3.7	18	44	7.3	0.1	INL-08 TO SDMH-07
	4	A1-A4							6.0	2.31	3.20	7.4			7.4	2.0	24	205	8.3	0.4	SDMH-07 TO SDMH-03
A5			0.81	0.60	5.0	0.49	3.36	1.6							1.6	8.0	18	47	9.0	0.1	INL-07 TO SDMH-03
	5	A1-A5							6.4	2.80	3.13	8.8			8.8	5.8	24	160	12.8	0.2	SDMH-03 TO SDMH-01
A6	6	A6	1.68	0.60	5.0	1.01	3.36	3.4							3.4	2.0	18	154	6.8	0.4	INL-13 TO INL-12
A7	7	A6-A7	0.90	0.60	5.0	0.54	3.36	1.8	5.4	1.55	3.29	5.1			5.1	2.0	24	158	7.5	0.4	INL-12 TO INL-05
A8	8	A6-A8	0.82	0.60	5.0	0.49	3.36	1.7	5.7	2.04	3.24	6.6			6.6	2.0	24	29	8.1	0.1	INL-05 TO INL-04
HESS2	9		0.06	0.70	5.0	0.04	3.36	0.1													
A9	9	A9+HESS2	0.79	0.47	9.4	0.37	2.74	1.0	9.4	0.42	2.74	1.1									INL-04 DESIGN Q
	9	A6-A9+HESS2							9.4	2.46	2.74	6.7			6.7	28.9	24	11	8.1	0.0	DP9: RUNOFF LEAVING INL-04
A10	10	A10	0.83	0.45	9.8	0.38	2.70	1.0							1.0	13.6	18	21	9.4	0.0	INL-044 TO SDMH-02
	11	A6-A10+HESS2							9.8	2.83	2.70	7.6			7.6	0.5	30	245	4.9	0.8	SDMH-02 TO SDMH-01
	12	A1-A10+HESS2							10.6	5.63	2.61	14.7			14.7	0.5	36	248	5.9	0.7	SDMH-01 TO INL-02
A11	13	A1-A11+HESS2	0.88	0.60	5.0	0.53	3.36	1.8	11.3	6.16	2.54	15.7			15.7	0.5	36	88	6.0	0.2	INL-02 TO INL-01
A12	14	A12	1.39	0.60	5.0	0.83	3.36	2.8							2.8	5.8	18	179	7.5	0.4	INL-06 TO INL-01
A13	15	A13	1.84	0.60	5.0	1.11	3.36	3.7													
	16	A1-A13+HESS2							11.6	8.10	2.52	20.4									TOTAL RUNOFF INTO EXISTING DOUGLAS 234 STORM SYSTEM
HESS1	17	HESS1	1.30	0.62	8.4	0.81	2.87	2.3													

**STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

CALCULATED BY: BHE
DATE: 1/24/20
CHECKED BY:

P1= 2.60

JOB NO: D01173
PROJECT: CHAMBERS AND HESS FILING NO. 1
DESIGN STORM: 100 YEAR

BASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(CA) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	
A1	1	A1	0.94	0.79	5.0	0.74	8.82	6.5							6.5	2.8	18	194	11.4	0.3	INL-11 TO SDMH-09
A2			0.99	0.79	5.0	0.78	8.82	6.9							6.9	2.0	18	44	10.7	0.1	INL-10 TO SDMH-09
	2	A1+A2							5.3	1.53	8.69	13.3			13.3	2.0	18	144	9.5	0.3	SDMH-09 TO SDMH-08
A3			0.94	0.79	5.0	0.75	8.82	6.6							6.6	3.7	18	44	10.2	0.1	INL-09 TO SDMH-08
	3	A1-A3							5.5	2.27	8.58	19.5			19.5	2.0	24	99	10.7	0.2	SDMH-08 TO SDMH-07
A4			0.97	0.79	5.0	0.77	8.82	6.8							6.8	3.7	18	44	10.3	0.1	INL-08 TO SDMH-07
	4	A1-A4							5.7	3.04	8.51	25.9			25.9	2.0	24	205	11.4	0.3	SDMH-07 TO SDMH-03
A5			0.81	0.79	5.0	0.64	8.82	5.7							5.7	8.0	18	47	13.0	0.1	INL-07 TO SDMH-03
	5	A1-A5							6.0	3.68	8.39	30.9			30.9	5.8	24	160	18.0	0.1	SDMH-03 TO SDMH-01
A6	6	A6	1.68	0.79	5.0	1.33	8.82	11.7							11.7	2.0	18	154	9.3	0.3	INL-13 TO INL-12
A7	7	A6-A7	0.90	0.79	5.0	0.71	8.82	6.3	5.3	2.04	8.69	17.7			17.7	2.0	24	158	10.5	0.3	INL-12 TO INL-05
A8	8	A6-A8	0.82	0.79	5.0	0.65	8.82	5.7	5.5	2.69	8.58	23.1			23.1	2.0	24	29	11.1	0.0	INL-05 TO INL-04
HESS1	17	HESS1	1.30	0.80	8.4	1.04	7.52	7.8	8.4	0.84	7.52	6.3									CAPTURED BY INLET S(113) BYPASSED INLET S(113) TO INLET A4
HESS2			0.06	0.83	5.0	0.05	8.82	0.5													
A9	9	A9+HESS1+HESS2	0.79	0.73	9.4	0.58	7.21	4.2	9.4	0.84	7.21	6.0									INL-04 INLET DESIGN
		A6-A9+HESS1+HESS2							9.4	3.52	7.21	25.4			25.4	28.9	24	11	30.0	0.0	DP9: RUNOFF LEAVING INL-04
A10	10	A10	0.83	0.72	9.8	0.60	7.10	4.3							4.3	13.6	18	21	14.5	0.0	INL-044 TO SDMH-02
	11	A6-A10							9.8	4.13	7.09	29.3			29.3	0.5	30	245	6.9	0.6	SDMH-02 TO SDMH-01
	12	A1-A10							10.4	7.81	6.93	54.1			54.1	0.5	36	248	7.4	0.6	SDMH-01 TO INL-02
A11	13	A1-A11	0.88	0.79	5.0	0.70	8.82	6.1	10.9	8.51	6.78	57.7			57.7	0.5	36	88	7.9	0.2	INL-02 TO INL-01
A12	14	A12	1.39	0.79	5.0	1.10	8.82	9.7							9.7	5.8	18	179	13.4	0.2	INL-06 TO INL-01
A13	15	A13	1.84	0.79	5.0	1.46	8.82	12.9													
	16	A1-A13							11.1	11.06	6.74	74.5									TOTAL RUNOFF INTO EXISTING DOUGLAS 234 STORM SYSTEM

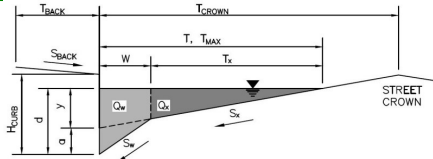
Appendix B

Hydraulic Computations

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **CHAMBERS AND HESS**
 Inlet ID: **DRIVE A STREET CAPACITY**



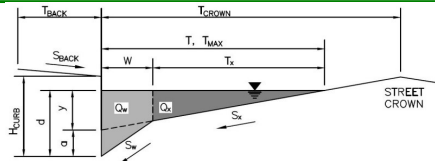
THE DRIVE A STREET CAPACITIES ARE SUMMARIZED IN A RATING CURVE AT VARIOUS STREET LONGITUDINAL SLOPES

Gutter Geometry (Enter data in the blue cells)									
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 5.0$ ft								
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft								
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$								
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches								
Distance from Curb Face to Street Crown	$T_{CROWN} = 13.0$ ft								
Gutter Width	$W = 2.00$ ft								
Street Transverse Slope	$S_X = 0.020$ ft/ft								
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_W = 0.083$ ft/ft								
Street Longitudinal Slope - Enter 0 for sump condition	$S_0 = 0.005$ ft/ft								
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$								
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> <td></td> </tr> <tr> <td>T_{MAX}</td> <td style="text-align: center;">13.0</td> <td style="text-align: center;">13.0</td> <td>ft</td> </tr> </table>		Minor Storm	Major Storm		T_{MAX}	13.0	13.0	ft
	Minor Storm	Major Storm							
T_{MAX}	13.0	13.0	ft						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> <td></td> </tr> <tr> <td>d_{MAX}</td> <td style="text-align: center;">6.0</td> <td style="text-align: center;">12.0</td> <td>inches</td> </tr> </table>		Minor Storm	Major Storm		d_{MAX}	6.0	12.0	inches
	Minor Storm	Major Storm							
d_{MAX}	6.0	12.0	inches						
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input checked="" type="checkbox"/> check = yes								
Maximum Capacity for 1/2 Street based On Allowable Spread									
Water Depth without Gutter Depression (Eq. ST-2)	$y = 3.12$ inches								
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c = 2.0$ inches								
Gutter Depression ($d_c - (W * S_x * 12)$)	$a = 1.51$ inches								
Water Depth at Gutter Flowline	$d = 4.63$ inches								
Allowable Spread for Discharge outside the Gutter Section W (T - W)	$T_X = 11.0$ ft								
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_0 = 0.456$								
Discharge outside the Gutter Section W, carried in Section T_X	$Q_X = 2.2$ cfs								
Discharge within the Gutter Section W ($Q_T - Q_X$)	$Q_W = 1.8$ cfs								
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs								
Maximum Flow Based On Allowable Spread	$Q_T = 4.0$ cfs								
Flow Velocity within the Gutter Section	$V = 3.0$ fps								
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V*d = 1.2$								
Maximum Capacity for 1/2 Street based on Allowable Depth									
Theoretical Water Spread	$T_{TH} = 18.7$ ft								
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{XTH} = 16.7$ ft								
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_0 = 0.318$								
Theoretical Discharge outside the Gutter Section W, carried in Section T_{XTH}	$Q_{XTH} = 6.6$ cfs								
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	$Q_X = 6.3$ cfs								
Discharge within the Gutter Section W ($Q_d - Q_X$)	$Q_W = 3.1$ cfs								
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs								
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q = 9.4$ cfs								
Average Flow Velocity Within the Gutter Section	$V = 3.7$ fps								
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V*d = 1.9$								
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	$R = 1.00$								
Max Flow Based on Allowable Depth (Safety Factor Applied)	$Q_d = 9.4$ cfs								
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d = 6.00$ inches								
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} = 1.37$ inches								
MINOR STORM Allowable Capacity is based on Spread Criterion									
MAJOR STORM Allowable Capacity is based on Depth Criterion									
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'									
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'									

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **CHAMBERS AND HESS**
 Inlet ID: **DRIVE A STREET CAPACITY**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} = 5.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.020$

Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 13.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_Y = 0.010$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	13.0	13.0	ft
d_{MAX}	6.0	12.0	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Water Depth without Gutter Depression (Eq. ST-2)
 Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")
 Gutter Depression ($d_c - (W * S_x * 12)$)
 Water Depth at Gutter Flowline
 Allowable Spread for Discharge outside the Gutter Section W (T - W)
 Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
 Discharge outside the Gutter Section W, carried in Section T_x
 Discharge within the Gutter Section W ($Q_T - Q_x$)
 Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)

	Minor Storm	Major Storm	
y	3.12	3.12	inches
d_c	2.0	2.0	inches
a	1.51	1.51	inches
d	4.63	4.63	inches
T_x	11.0	11.0	ft
E_o	0.456	0.456	
Q_x	3.1	3.1	cfs
Q_W	2.6	2.6	cfs
Q_{BACK}	0.0	0.0	cfs
Q_T	5.7	5.7	cfs
V	4.3	4.3	fps
$V*d$	1.6	1.6	

Maximum Flow Based On Allowable Spread

Flow Velocity within the Gutter Section
 $V*d$ Product: Flow Velocity times Gutter Flowline Depth

Maximum Capacity for 1/2 Street based on Allowable Depth

Theoretical Water Spread
 Theoretical Spread for Discharge outside the Gutter Section W (T - W)
 Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
 Theoretical Discharge outside the Gutter Section W, carried in Section T_{XTH}
 Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})
 Discharge within the Gutter Section W ($Q_d - Q_x$)
 Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)
 Total Discharge for Major & Minor Storm (Pre-Safety Factor)
 Average Flow Velocity Within the Gutter Section
 $V*d$ Product: Flow Velocity Times Gutter Flowline Depth
 Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm

	Minor Storm	Major Storm	
T_{TH}	18.7	43.7	ft
T_{XTH}	16.7	41.7	ft
E_o	0.318	0.130	
Q_{XTH}	9.4	107.8	cfs
Q_x	8.9	60.2	cfs
Q_W	4.4	16.2	cfs
Q_{BACK}	0.0	9.9	cfs
Q	13.2	86.3	cfs
V	5.2	8.8	fps
$V*d$	2.6	8.8	
R	1.00	1.00	
Q_d	13.2	86.3	cfs
d	6.00	12.00	inches
d_{CROWN}	1.37	7.37	inches

Max Flow Based on Allowable Depth (Safety Factor Applied)

Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)
 Resultant Flow Depth at Street Crown (Safety Factor Applied)

	Minor Storm	Major Storm	
Q_{allow}	5.7	86.3	cfs

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

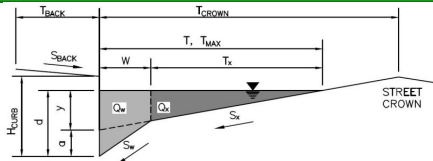
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID:

**CHAMBERS AND HESS
DRIVE A STREET CAPACITY**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} = 5.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.020$

Height of Curb at Gutter Flow Line
Distance from Curb Face to Street Crown
Gutter Width
Street Transverse Slope
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
Street Longitudinal Slope - Enter 0 for sump condition
Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 13.0$ ft
 $W = 2.00$ ft
 $S_x = 0.020$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_o = 0.020$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	13.0	13.0	ft
d_{MAX}	6.0	12.0	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Water Depth without Gutter Depression (Eq. ST-2)
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")
Gutter Depression ($d_c - (W * S_x * 12)$)
Water Depth at Gutter Flowline
Allowable Spread for Discharge outside the Gutter Section W (T - W)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
Discharge outside the Gutter Section W, carried in Section T_x
Discharge within the Gutter Section W ($Q_T - Q_x$)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)

	Minor Storm	Major Storm	
y	3.12	3.12	inches
d_c	2.0	2.0	inches
a	1.51	1.51	inches
d	4.63	4.63	inches
T_x	11.0	11.0	ft
E_o	0.456	0.456	
Q_x	4.4	4.4	cfs
Q_w	3.7	3.7	cfs
Q_{BACK}	0.0	0.0	cfs
Q_T	8.0	8.0	cfs
V	6.0	6.0	fps
$V*d$	2.3	2.3	

Maximum Flow Based On Allowable Spread

Flow Velocity within the Gutter Section
 $V*d$ Product: Flow Velocity times Gutter Flowline Depth

Maximum Capacity for 1/2 Street based on Allowable Depth

Theoretical Water Spread
Theoretical Spread for Discharge outside the Gutter Section W (T - W)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
Theoretical Discharge outside the Gutter Section W, carried in Section T_{XTH}
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})
Discharge within the Gutter Section W ($Q_d - Q_x$)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)
Total Discharge for Major & Minor Storm (Pre-Safety Factor)
Average Flow Velocity Within the Gutter Section
 $V*d$ Product: Flow Velocity Times Gutter Flowline Depth
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm

	Minor Storm	Major Storm	
T_{TH}	18.7	43.7	ft
T_{XTH}	16.7	41.7	ft
E_o	0.318	0.130	
Q_{XTH}	13.3	152.5	cfs
Q_x	12.5	85.1	cfs
Q_w	6.2	22.9	cfs
Q_{BACK}	0.0	14.0	cfs
Q	18.7	122.0	cfs
V	7.4	12.5	fps
$V*d$	3.7	12.5	
R	1.00	0.83	
Q_d	18.7	101.8	cfs
d	6.00	11.13	inches
d_{CROWN}	1.37	6.50	inches

Max Flow Based on Allowable Depth (Safety Factor Applied)

Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)
Resultant Flow Depth at Street Crown (Safety Factor Applied)

	Minor Storm	Major Storm	
Q_{allow}	8.0	101.8	cfs

MINOR STORM Allowable Capacity is based on Spread Criterion

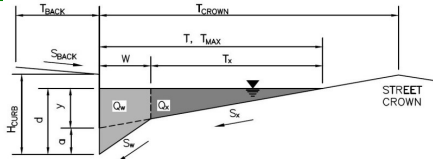
MAJOR STORM Allowable Capacity is based on Depth Criterion

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **CHAMBERS AND HESS**
 Inlet ID: **DRIVE A STREET CAPACITY**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} = 5.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.020$

Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 13.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_0 = 0.030$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	13.0	13.0	ft
d_{MAX}	6.0	12.0	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Water Depth without Gutter Depression (Eq. ST-2)
 Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")
 Gutter Depression ($d_c - (W * S_x * 12)$)
 Water Depth at Gutter Flowline
 Allowable Spread for Discharge outside the Gutter Section W (T - W)
 Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
 Discharge outside the Gutter Section W, carried in Section T_x
 Discharge within the Gutter Section W ($Q_T - Q_x$)
 Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)

	Minor Storm	Major Storm	
y	3.12	3.12	inches
d_c	2.0	2.0	inches
a	1.51	1.51	inches
d	4.63	4.63	inches
T_x	11.0	11.0	ft
E_0	0.456	0.456	
Q_x	5.3	5.3	cfs
Q_W	4.5	4.5	cfs
Q_{BACK}	0.0	0.0	cfs
Q_T	9.8	9.8	cfs
V	7.4	7.4	fps
$V*d$	2.9	2.9	

Maximum Flow Based On Allowable Spread

Flow Velocity within the Gutter Section
 $V*d$ Product: Flow Velocity times Gutter Flowline Depth

Maximum Capacity for 1/2 Street based on Allowable Depth

Theoretical Water Spread
 Theoretical Spread for Discharge outside the Gutter Section W (T - W)
 Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
 Theoretical Discharge outside the Gutter Section W, carried in Section T_{XTH}
 Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})
 Discharge within the Gutter Section W ($Q_d - Q_x$)
 Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)
 Total Discharge for Major & Minor Storm (Pre-Safety Factor)
 Average Flow Velocity Within the Gutter Section
 $V*d$ Product: Flow Velocity Times Gutter Flowline Depth
 Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm

	Minor Storm	Major Storm	
T_{TH}	18.7	43.7	ft
T_{XTH}	16.7	41.7	ft
E_0	0.318	0.130	
Q_{XTH}	16.3	186.8	cfs
Q_x	15.4	104.2	cfs
Q_W	7.6	28.0	cfs
Q_{BACK}	0.0	17.1	cfs
Q	22.9	149.4	cfs
V	9.1	15.3	fps
$V*d$	4.5	15.3	
R	0.74	0.60	
Q_d	17.1	90.1	cfs
d	5.46	9.77	inches
d_{CROWN}	0.83	5.14	inches

Max Flow Based on Allowable Depth (Safety Factor Applied)

Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)
 Resultant Flow Depth at Street Crown (Safety Factor Applied)

	Minor Storm	Major Storm	
Q_{allow}	9.8	90.1	cfs

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

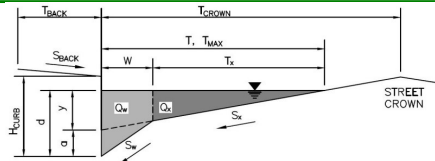
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID:

**CHAMBERS AND HESS
DRIVE A STREET CAPACITY**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

T_{BACK} = 5.0 ft
 S_{BACK} = 0.020 ft/ft
 n_{BACK} = 0.020

Height of Curb at Gutter Flow Line
Distance from Curb Face to Street Crown
Gutter Width
Street Transverse Slope
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
Street Longitudinal Slope - Enter 0 for sump condition
Manning's Roughness for Street Section (typically between 0.012 and 0.020)

H_{CURB} = 6.00 inches
 T_{CROWN} = 13.0 ft
 W = 2.00 ft
 S_x = 0.020 ft/ft
 S_w = 0.083 ft/ft
 S_0 = 0.040 ft/ft
 n_{STREET} = 0.016

Max. Allowable Spread for Minor & Major Storm
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	13.0	13.0	ft
d_{MAX}	6.0	12.0	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Water Depth without Gutter Depression (Eq. ST-2)
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")
Gutter Depression ($d_c - (W * S_x * 12)$)
Water Depth at Gutter Flowline
Allowable Spread for Discharge outside the Gutter Section W (T - W)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
Discharge outside the Gutter Section W, carried in Section T_x
Discharge within the Gutter Section W ($Q_T - Q_x$)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)

	Minor Storm	Major Storm	
y	3.12	3.12	inches
d_c	2.0	2.0	inches
a	1.51	1.51	inches
d	4.63	4.63	inches
T_x	11.0	11.0	ft
E_0	0.456	0.456	
Q_x	6.2	6.2	cfs
Q_w	5.2	5.2	cfs
Q_{BACK}	0.0	0.0	cfs
Q_T	11.3	11.3	cfs
V	8.5	8.5	fps
$V*d$	3.3	3.3	

Maximum Flow Based On Allowable Spread

Flow Velocity within the Gutter Section
 $V*d$ Product: Flow Velocity times Gutter Flowline Depth

Maximum Capacity for 1/2 Street based on Allowable Depth

Theoretical Water Spread
Theoretical Spread for Discharge outside the Gutter Section W (T - W)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
Theoretical Discharge outside the Gutter Section W, carried in Section T_{XTH}
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})
Discharge within the Gutter Section W ($Q_d - Q_x$)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)
Total Discharge for Major & Minor Storm (Pre-Safety Factor)
Average Flow Velocity Within the Gutter Section
 $V*d$ Product: Flow Velocity Times Gutter Flowline Depth
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm

	Minor Storm	Major Storm	
T_{TH}	18.7	43.7	ft
T_{XTH}	16.7	41.7	ft
E_0	0.318	0.130	
Q_{XTH}	18.8	215.7	cfs
Q_x	17.7	120.4	cfs
Q_w	8.8	32.4	cfs
Q_{BACK}	0.0	19.8	cfs
Q	26.5	172.5	cfs
V	10.5	17.6	fps
$V*d$	5.2	17.6	
R	0.59	0.48	
Q_d	15.7	82.7	cfs
d	5.09	8.95	inches
d_{CROWN}	0.46	4.32	inches

Max Flow Based on Allowable Depth (Safety Factor Applied)

Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)
Resultant Flow Depth at Street Crown (Safety Factor Applied)

	Minor Storm	Major Storm	
Q_{allow}	11.3	82.7	cfs

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

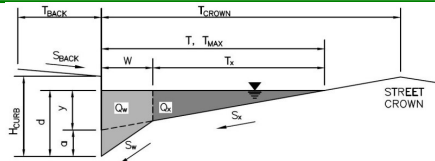
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID:

**CHAMBERS AND HESS
DRIVE A STREET CAPACITY**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

T_{BACK} =	5.0	ft
S_{BACK} =	0.020	ft/ft
n_{BACK} =	0.020	

Height of Curb at Gutter Flow Line
Distance from Curb Face to Street Crown
Gutter Width
Street Transverse Slope
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
Street Longitudinal Slope - Enter 0 for sump condition
Manning's Roughness for Street Section (typically between 0.012 and 0.020)

H_{CURB} =	6.00	inches
T_{CROWN} =	13.0	ft
W =	2.00	ft
S_x =	0.020	ft/ft
S_w =	0.083	ft/ft
S_0 =	0.050	ft/ft
n_{STREET} =	0.016	

Max. Allowable Spread for Minor & Major Storm
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
T_{MAX} =	13.0	13.0	ft
d_{MAX} =	6.0	12.0	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Water Depth without Gutter Depression (Eq. ST-2)
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")
Gutter Depression ($d_c - (W * S_x * 12)$)
Water Depth at Gutter Flowline
Allowable Spread for Discharge outside the Gutter Section W (T - W)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
Discharge outside the Gutter Section W, carried in Section T_x
Discharge within the Gutter Section W ($Q_T - Q_x$)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)

	Minor Storm	Major Storm	
y =	3.12	3.12	inches
d_c =	2.0	2.0	inches
a =	1.51	1.51	inches
d =	4.63	4.63	inches
T_x =	11.0	11.0	ft
E_0 =	0.456	0.456	
Q_x =	6.9	6.9	cfs
Q_w =	5.8	5.8	cfs
Q_{BACK} =	0.0	0.0	cfs
Q_T =	12.7	12.7	cfs
V =	9.5	9.5	fps
$V*d$ =	3.7	3.7	

Maximum Flow Based On Allowable Spread

Flow Velocity within the Gutter Section
 $V*d$ Product: Flow Velocity times Gutter Flowline Depth

Maximum Capacity for 1/2 Street based on Allowable Depth

Theoretical Water Spread
Theoretical Spread for Discharge outside the Gutter Section W (T - W)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
Theoretical Discharge outside the Gutter Section W, carried in Section T_{XTH}
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})
Discharge within the Gutter Section W ($Q_d - Q_x$)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)
Total Discharge for Major & Minor Storm (Pre-Safety Factor)
Average Flow Velocity Within the Gutter Section
 $V*d$ Product: Flow Velocity Times Gutter Flowline Depth
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm

	Minor Storm	Major Storm	
T_{TH} =	18.7	43.7	ft
T_{XTH} =	16.7	41.7	ft
E_0 =	0.318	0.130	
Q_{XTH} =	21.0	241.2	cfs
Q_x =	19.8	134.6	cfs
Q_w =	9.8	36.2	cfs
Q_{BACK} =	0.0	22.1	cfs
Q =	29.6	192.9	cfs
V =	11.7	19.7	fps
$V*d$ =	5.9	19.7	
R =	0.49	0.40	
Q_d =	14.6	77.3	cfs
d =	4.83	8.38	inches
d_{CROWN} =	0.20	3.75	inches

Max Flow Based on Allowable Depth (Safety Factor Applied)

Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)
Resultant Flow Depth at Street Crown (Safety Factor Applied)

	Minor Storm	Major Storm	
Q_{allow} =	12.7	77.3	cfs

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

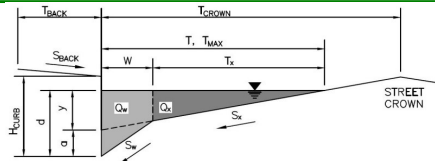
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID:

CHAMBERS AND HESS
DRIVE A AND ALLEY A STREET CAPACITY



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

T_{BACK} =	5.0	ft
S_{BACK} =	0.020	ft/ft
n_{BACK} =	0.020	

Height of Curb at Gutter Flow Line
Distance from Curb Face to Street Crown
Gutter Width
Street Transverse Slope
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
Street Longitudinal Slope - Enter 0 for sump condition
Manning's Roughness for Street Section (typically between 0.012 and 0.020)

H_{CURB} =	6.00	inches
T_{CROWN} =	14.0	ft
W =	2.00	ft
S_x =	0.020	ft/ft
S_w =	0.083	ft/ft
S_0 =	0.060	ft/ft
n_{STREET} =	0.016	

Max. Allowable Spread for Minor & Major Storm
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
T_{MAX} =	14.0	14.0	ft
d_{MAX} =	6.0	12.0	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Water Depth without Gutter Depression (Eq. ST-2)
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")
Gutter Depression ($d_c - (W * S_x * 12)$)
Water Depth at Gutter Flowline
Allowable Spread for Discharge outside the Gutter Section W (T - W)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
Discharge outside the Gutter Section W, carried in Section T_x
Discharge within the Gutter Section W ($Q_T - Q_x$)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)

	Minor Storm	Major Storm	
y =	3.36	3.36	inches
d_c =	2.0	2.0	inches
a =	1.51	1.51	inches
d =	4.87	4.87	inches
T_x =	12.0	12.0	ft
E_0 =	0.425	0.425	
Q_x =	9.5	9.5	cfs
Q_w =	7.0	7.0	cfs
Q_{BACK} =	0.0	0.0	cfs
Q_T =	16.6	16.6	cfs
V =	10.9	10.9	fps
$V*d$ =	4.4	4.4	

Maximum Flow Based On Allowable Spread

Flow Velocity within the Gutter Section
 $V*d$ Product: Flow Velocity times Gutter Flowline Depth

Maximum Capacity for 1/2 Street based on Allowable Depth

Theoretical Water Spread
Theoretical Spread for Discharge outside the Gutter Section W (T - W)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
Theoretical Discharge outside the Gutter Section W, carried in Section T_{XTH}
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})
Discharge within the Gutter Section W ($Q_d - Q_x$)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)
Total Discharge for Major & Minor Storm (Pre-Safety Factor)
Average Flow Velocity Within the Gutter Section
 $V*d$ Product: Flow Velocity Times Gutter Flowline Depth
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm

	Minor Storm	Major Storm	
T_{TH} =	18.7	43.7	ft
T_{XTH} =	16.7	41.7	ft
E_0 =	0.318	0.130	
Q_{XTH} =	23.0	264.2	cfs
Q_x =	22.2	157.3	cfs
Q_w =	10.7	39.6	cfs
Q_{BACK} =	0.0	24.2	cfs
Q =	33.0	221.2	cfs
V =	12.9	21.6	fps
$V*d$ =	6.4	21.6	
R =	0.43	0.35	
Q_d =	14.1	76.6	cfs
d =	4.65	7.98	inches
d_{CROWN} =	0.00	3.11	inches

Max Flow Based on Allowable Depth (Safety Factor Applied)

Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)
Resultant Flow Depth at Street Crown (Safety Factor Applied)

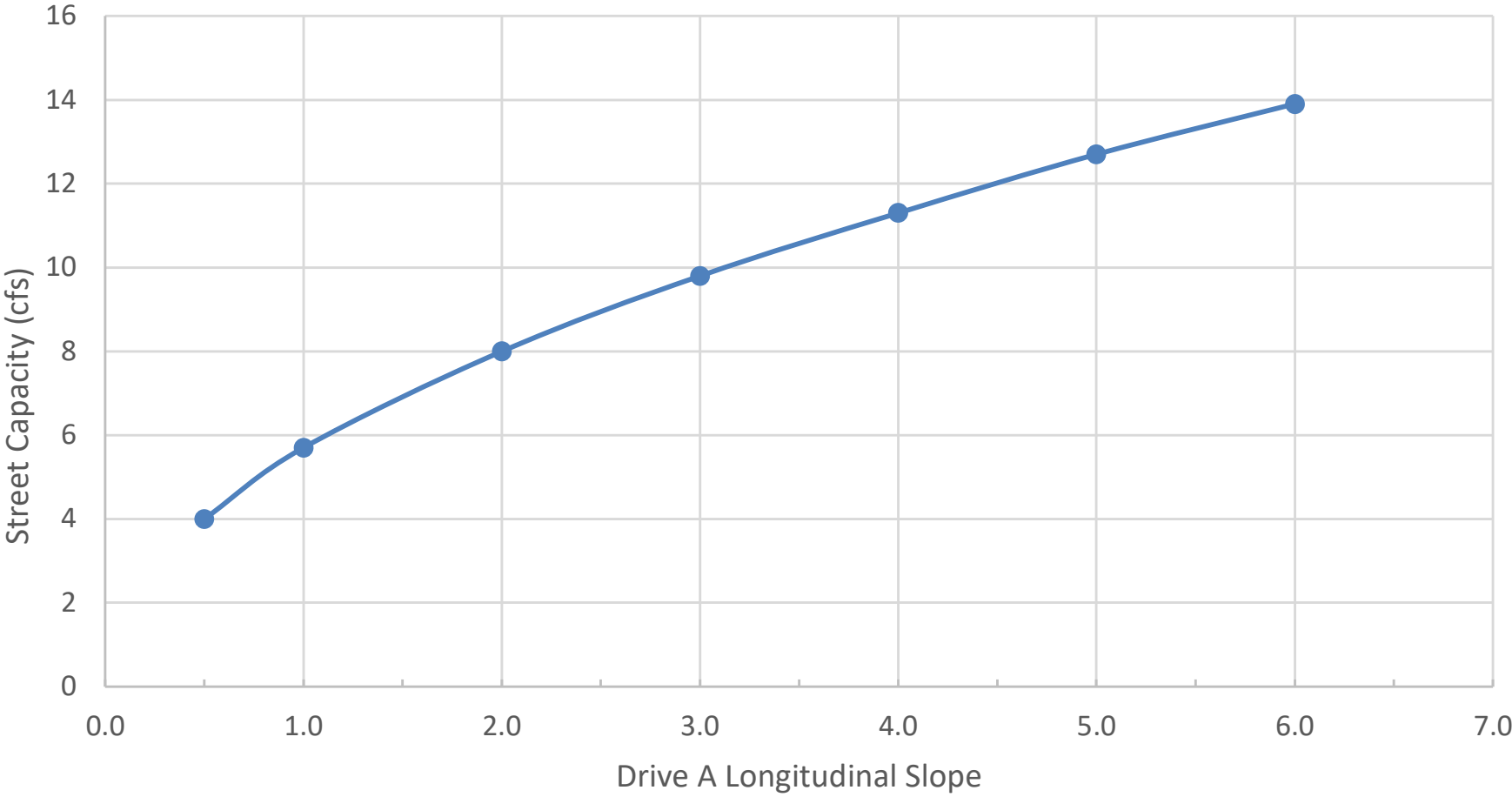
	Minor Storm	Major Storm	
Q_{allow} =	14.1	76.6	cfs

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Drive A Minor Storm Street Capacity



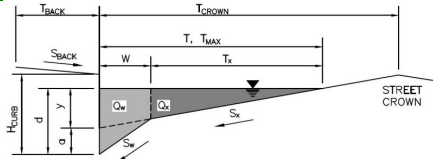
SEE THE PREVIOUS PAGES FOR THE STREET CAPACITY CALCULATIONS AT VARIOUS LONGITUDINAL SLOPES

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID:

**CHAMBERS AND HESS
INLET 04 (DP 9)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 5.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.020$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 13.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_D = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	13.0	13.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

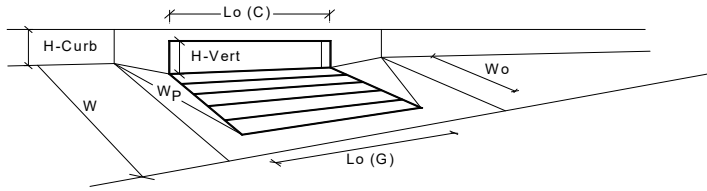
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



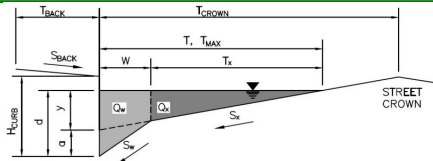
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)			
Water Depth at Flowline (outside of local depression)			
Grate Information	MINOR	MAJOR	
Length of a Unit Grate	L _g (G) =	N/A	feet
Width of a Unit Grate	W _g =	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A _{ratio} =	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C _f (G) =	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C _w (G) =	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C _o (G) =	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	L _c (C) =	5.00	feet
Height of Vertical Curb Opening in Inches	H _{vert} =	6.00	inches
Height of Curb Orifice Throat in Inches	H _{throat} =	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W _p =	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C _f (C) =	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C _w (C) =	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C _o (C) =	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	d _{grate} =	N/A	ft
Depth for Curb Opening Weir Equation	d _{curb} =	0.22	ft
Combination Inlet Performance Reduction Factor for Long Inlets	RF _{combination} =	0.59	
Curb Opening Performance Reduction Factor for Long Inlets	RF _{curb} =	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF _{grate} =	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	Q _a =	2.9	cfs
	Q _{PEAK REQUIRED} =	1.1	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID:

CHAMBERS AND HESS
INLET 044 (DP 10)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 5.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.020$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 13.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_D = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	13.0	13.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

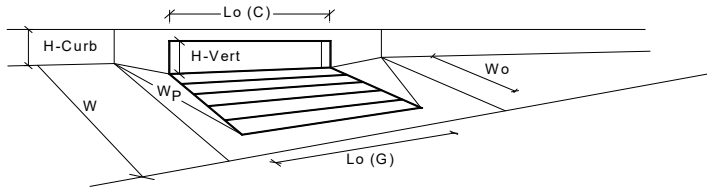
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)			
Water Depth at Flowline (outside of local depression)			
Grate Information			
Length of a Unit Grate			
Width of a Unit Grate			
Area Opening Ratio for a Grate (typical values 0.15-0.90)			
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)			
Grate Weir Coefficient (typical value 2.15 - 3.60)			
Grate Orifice Coefficient (typical value 0.60 - 0.80)			
Curb Opening Information			
Length of a Unit Curb Opening			
Height of Vertical Curb Opening in Inches			
Height of Curb Orifice Throat in Inches			
Angle of Throat (see USDCM Figure ST-5)			
Side Width for Depression Pan (typically the gutter width of 2 feet)			
Clogging Factor for a Single Curb Opening (typical value 0.10)			
Curb Opening Weir Coefficient (typical value 2.3-3.7)			
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)			
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth			
Depth for Curb Opening Weir Equation			
Combination Inlet Performance Reduction Factor for Long Inlets			
Curb Opening Performance Reduction Factor for Long Inlets			
Grated Inlet Performance Reduction Factor for Long Inlets			
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)			
	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a_{local} =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	4.6	6.0	inches
	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
L_o (G) =	N/A	N/A	feet
W_o =	N/A	N/A	feet
A_{ratio} =	N/A	N/A	
C_f (G) =	N/A	N/A	
C_w (G) =	N/A	N/A	
C_o (G) =	N/A	N/A	
	MINOR	MAJOR	
L_o (C) =	5.00	5.00	feet
H_{vert} =	6.00	6.00	inches
H_{throat} =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W_p =	2.00	2.00	feet
C_f (C) =	0.10	0.10	
C_w (C) =	3.60	3.60	
C_o (C) =	0.67	0.67	
	MINOR	MAJOR	
d_{grate} =	N/A	N/A	ft
d_{curb} =	0.22	0.33	ft
RF _{Combination} =	0.59	0.77	
RF _{Curb} =	1.00	1.00	
RF _{Grate} =	N/A	N/A	
	MINOR	MAJOR	
Q_a =	2.9	5.4	cfs
Q _{PEAK REQUIRED} =	1.0	4.3	cfs

PROJECT: CHAMBERS AND HESS FILING NO. 1
SUBJECT: INLET DESIGNS

JOB #: D01173
DATE: 1/24/2020
BY: BHE

Determine Head Required to capture the runoff

Commercial Lot 1
Design Q= 6.5 cfs
CDOT Type 13
Area= 1.12 ft²
Perimeter= 4.73 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 1.48

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.60

Larger h Controls: 1.48 ft of Head required to capture 100% of runoff

Commercial Lot 2
Design Q= 6.9 cfs
CDOT Type 13
Area= 1.12 ft²
Perimeter= 4.73 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 1.66

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.62

Larger h Controls: 1.66 ft of Head required to capture 100% of runoff

Commercial Lot 3
Design Q= 6.6 cfs
CDOT Type 13
Area= 1.12 ft²
Perimeter= 4.73 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 1.51

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.60

Larger h Controls: 1.51 ft of Head required to capture 100% of runoff

Commercial Lot 4
Design Q= 6.8 cfs
CDOT Type 13
Area= 1.12 ft²
Perimeter= 4.73 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 1.59

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.61

Larger h Controls: 1.59 ft of Head required to capture 100% of runoff

PROJECT: CHAMBERS AND HESS FILING NO. 1
SUBJECT: INLET DESIGNS

JOB #: D01173
DATE: 1/24/2020
BY: BHE

Commercial Lot 5
Design Q= 11.7 cfs
CDOT Type C
Area= 4.09 ft²
Perimeter= 6.84 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.35

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.69

Larger h Controls: 0.69 ft of Head required to capture 100% of runoff

Commercial Lot 6
Design Q= 6.3 cfs
CDOT Type 13
Area= 1.12 ft²
Perimeter= 4.73 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 1.36

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.58

Larger h Controls: 1.36 ft of Head required to capture 100% of runoff

Commercial Lot 7
Design Q= 5.7 cfs
CDOT Type 13
Area= 1.12 ft²
Perimeter= 4.73 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 1.14

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.55

Larger h Controls: 1.14 ft of Head required to capture 100% of runoff

Commercial Lot 8
Design Q= 6.1 cfs
CDOT Type D
Area= 6.79 ft²
Perimeter= 9.09 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.04

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.37

Larger h Controls: 0.37 ft of Head required to capture 100% of runoff

PROJECT: CHAMBERS AND HESS FILING NO. 1
SUBJECT: INLET DESIGNS

JOB #: D01173
DATE: 1/24/2020
BY: BHE

Commercial Lot 9
Design Q= 5.7 cfs
CDOT Type 13
Area= 1.12 ft²
Perimeter= 4.73 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 1.11

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.54

Larger h Controls: 1.11 ft of Head required to capture 100% of runoff

Commercial Lot 10
Design Q= 12.9 cfs
CDOT Type D
Area= 6.79 ft²
Perimeter= 9.09 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.16

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.61

Larger h Controls: 0.61 ft of Head required to capture 100% of runoff

Commercial Lot 11
Design Q= 9.7 cfs
CDOT Type C
Area= 4.09 ft²
Perimeter= 6.84 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.24

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.61

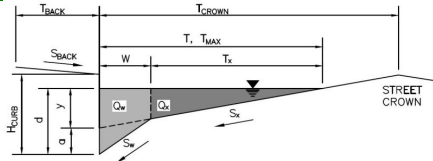
Larger h Controls: 0.61 ft of Head required to capture 100% of runoff

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID:

**CHAMBERS AND HESS
INLET S(113) HESS ROAD**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} = 10.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.020$

Height of Curb at Gutter Flow Line
Distance from Curb Face to Street Crown
Gutter Width
Street Transverse Slope
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
Street Longitudinal Slope - Enter 0 for sump condition
Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 62.0$ ft
 $W = 2.00$ ft
 $S_x = 0.021$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_D = 0.030$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
$T_{MAX} =$	62.0	62.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	check = yes

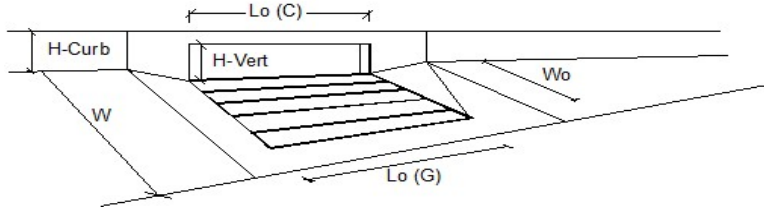
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
$Q_{allow} =$	17.2	141.3	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity*			
Design Discharge for Half of Street (from Sheet Inlet Management)	2.3	7.8	cfs
Water Spread Width	6.3	11.4	ft
Water Depth at Flowline (outside of local depression)	3.1	4.4	inches
Water Depth at Street Crown (or at T _{MAX})	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	0.793	0.508	
Discharge outside the Gutter Section W, carried in Section T _x	0.5	3.8	cfs
Discharge within the Gutter Section W	1.8	4.0	cfs
Discharge Behind the Curb Face	0.0	0.0	cfs
Flow Area within the Gutter Section W	0.35	0.56	sq ft
Velocity within the Gutter Section W	5.2	7.0	fps
Water Depth for Design Condition	6.1	7.4	inches
Grate Analysis (Calculated)			
Total Length of Inlet Grate Opening	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	N/A	N/A	
Under No-Clogging Condition			
Minimum Velocity Where Grate Splash-Over Begins	N/A	N/A	fps
Interception Rate of Frontal Flow	N/A	N/A	
Interception Rate of Side Flow	N/A	N/A	
Interception Capacity	N/A	N/A	cfs
Under Clogging Condition			
Clogging Coefficient for Multiple-unit Grate Inlet	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	N/A	N/A	fps
Interception Rate of Frontal Flow	N/A	N/A	
Interception Rate of Side Flow	N/A	N/A	
Actual Interception Capacity	N/A	N/A	cfs
Carry-Over Flow = Q_c - Q_a (to be applied to curb opening or next d/s inlet)	N/A	N/A	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			
Equivalent Slope S _e (based on grate carry-over)	0.169	0.116	ft/ft
Required Length L _T to Have 100% Interception	7.20	15.96	ft
Under No-Clogging Condition			
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L _T)	7.20	10.00	ft
Interception Capacity	2.3	6.5	cfs
Under Clogging Condition			
Clogging Coefficient	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	0.06	0.06	
Effective (Unclogged) Length	9.37	9.37	ft
Actual Interception Capacity	2.3	6.3	cfs
Carry-Over Flow = Q_b(GRATE) - Q_a	0.0	1.5	cfs
Summary			
Total Inlet Interception Capacity	2.3	6.3	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	1.5	cfs
Capture Percentage = Q _a /Q _c =	100	81	%

P-7	161.00	36 inch	65.75	6,014.39	6,008.53
P-8	54.00	36 inch	47.96	6,008.92	6,006.13
P-11	84.00	36 inch	53.22	6,003.64	6,002.39
P-12	90.00	36 inch	53.13	6,001.66	5,999.07
P-13	28.00	36 inch	62.50	5,999.73	5,998.71
P-20	77.00	36 inch	88.60	6,048.89	6,035.91
P-21	102.00	36 inch	88.34	6,035.19	6,030.38
P-22	29.00	36 inch	87.89	6,031.03	6,028.72
P-23	184.00	18 inch	5.50	6,033.31	6,029.02
P-25	141.00	36 inch	53.37	6,006.83	6,004.38
P-26	22.00	18 inch	5.87	6,008.95	6,008.92
P-27	47.00	18 inch	5.91	6,010.48	6,009.07
P-28	94.00	18 inch	5.95	6,014.07	6,010.30
P-31	226.00	18 inch	3.80	6,025.90	6,021.91
P-32	212.00	18 inch	6.04	6,021.91	6,013.90
P-35	108.00	36 inch	67.21	5,999.04	5,994.01
P-36	119.00	36 inch	67.09	5,993.03	5,986.62

----- Elevations -----				
Label	Discharge	Ground	Upstream HGL	Downstream HGL
SDIN-1	88.60	6,062.42	6,048.89	6,048.89
SDMH-2	87.89	6,037.20	6,031.03	6,031.03
SDIN-3	66.84	6,036.51	6,029.02	6,029.02
SDMH-3	66.72	6,036.20	6,028.17	6,028.17
SDMH-4	66.05	6,030.00	6,019.72	6,018.84
SDMH-5	65.75	6,024.40	6,015.26	6,014.39
SDIN-4	47.96	6,017.37	6,008.92	6,008.92
SDIN-7	53.37	6,015.70	6,006.83	6,006.83
SDMH-9	53.22	6,012.30	6,004.38	6,003.64
SDMH-10	53.13	6,010.00	6,002.39	6,001.66
SDIN-8	62.50	6,008.42	5,999.73	5,999.73
SDIN-9	67.21	6,008.42	5,999.04	5,999.04
SDIN-2	5.50	6,041.41	6,033.31	6,033.31
SDMH-1	88.34	6,040.80	6,035.19	6,035.19
SDMH-8	5.87	6,018.30	6,009.07	6,008.95
SDMH-7	5.91	6,020.00	6,010.68	6,010.48
SDMH-6	5.95	6,023.40	6,014.27	6,014.07
SDIN-5	3.80	6,034.15	6,025.90	6,025.90
SDIN-6	6.04	6,030.16	6,021.91	6,021.91
Outlet	66.96	5,990.00	5,986.62	5,986.62

100 YEAR
TAILWATER
ELEVATION
FOR UDSEWER

----- Elevations -----				
Label	Discharge	Ground	Upstream HGL	Downstream HGL
SDMH-11	67.09	6,006.00	5,994.01	5,993.03

Elapsed: 0 minute(s) 1 second(s)

Program: UDSEWER Math Model Interface 2.1.1.4 Run Date: 1/24/2020 10:38:54 AM	<h2 style="margin: 0;">UDSewer Results Summary</h2> <p>Project Title: CHAMBERS AND HESS MAJOR STORM Project Description: Default system</p>
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System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6031.03 ←

Manhole Input Summary:

Element Name	Ground Elevation (ft)	Given Flow		Sub Basin Information						
		Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1 S(99)	6053.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXISTING PARKER 234	6042.20	74.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-01	6053.31	74.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-02	6054.11	57.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-01	6060.75	54.10	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-02	6053.38	29.30	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-04	6053.10	25.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-05	6053.72	23.10	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-12	6060.21	17.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-13	6063.92	11.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

INL-044	6053.10	4.30	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-03	6064.36	30.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-07	6063.81	5.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-04	6065.36	25.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-05	6066.37	25.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-06	6067.37	25.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-07	6068.37	25.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-08	6066.63	6.80	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-08	6070.33	19.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-09	6073.16	13.30	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-10	6076.12	6.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-11	6075.50	6.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-10	6071.85	6.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-09	6068.62	6.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-06	6059.50	9.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

Manhole Output Summary:

Element Name	Local Contribution					Total Design Flow				Comment
	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	
OUTFALL 1 S(99)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
EXISTING PARKER 234	8.62	0.59	9.21	NaN	NaN	12.00	6.21	NaN	74.50	
INL-01	8.62	0.59	9.21	NaN	NaN	11.50	6.48	NaN	74.50	
INL-02	8.62	0.59	9.21	NaN	NaN	10.50	5.50	NaN	57.70	
SDMH-01	8.62	0.59	9.21	NaN	NaN	10.00	5.41	NaN	54.10	
SDMH-02	8.62	0.59	9.21	NaN	NaN	3.00	9.77	NaN	29.30	
INL-04	8.62	0.59	9.21	NaN	NaN	2.00	12.70	NaN	25.40	
INL-05	8.62	0.59	9.21	NaN	NaN	1.50	15.40	NaN	23.10	
INL-12	8.62	0.59	9.21	NaN	NaN	1.00	17.70	NaN	17.70	
INL-13	8.62	0.59	9.21	NaN	NaN	0.50	23.40	NaN	11.70	
INL-044	8.62	0.59	9.21	NaN	NaN	0.50	8.60	NaN	4.30	
SDMH-03	8.62	0.59	9.21	NaN	NaN	6.50	4.75	NaN	30.90	
INL-07	8.62	0.59	9.21	NaN	NaN	0.50	11.40	NaN	5.70	
SDMH-04	8.62	0.59	9.21	NaN	NaN	5.50	4.71	NaN	25.90	
SDMH-05	8.62	0.59	9.21	NaN	NaN	5.00	5.18	NaN	25.90	
SDMH-06	8.62	0.59	9.21	NaN	NaN	4.50	5.76	NaN	25.90	
SDMH-07	8.62	0.59	9.21	NaN	NaN	4.00	6.48	NaN	25.90	
INL-08	8.62	0.59	9.21	NaN	NaN	0.50	13.60	NaN	6.80	
SDMH-08	8.62	0.59	9.21	NaN	NaN	3.00	6.50	NaN	19.50	
SDMH-09	8.62	0.59	9.21	NaN	NaN	2.00	6.65	NaN	13.30	
SDMH-10	8.62	0.59	9.21	NaN	NaN	1.00	6.50	NaN	6.50	
INL-11	8.62	0.59	9.21	NaN	NaN	0.50	13.00	NaN	6.50	
INL-10	8.62	0.59	9.21	NaN	NaN	0.50	13.80	NaN	6.90	
INL-09	8.62	0.59	9.21	NaN	NaN	0.50	13.20	NaN	6.60	
INL-06	8.62	0.59	9.21	NaN	NaN	0.50	19.40	NaN	9.70	

Sewer Input Summary:

	Elevation	Loss Coefficients	Given Dimensions
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Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
EXISTING PARKER 234	104.00	6027.93	4.3	6032.40	0.013	0.29	0.00	CIRCULAR	36.00 in	36.00 in
INL-01	82.83	6034.04	8.4	6041.00	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
INL-02	87.80	6041.20	0.5	6041.64	0.013	1.00	0.00	CIRCULAR	36.00 in	36.00 in
SDMH-01	247.69	6041.84	1.0	6044.32	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
SDMH-02	245.90	6045.32	0.5	6046.55	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
INL-04	10.80	6048.41	2.0	6048.63	0.013	0.87	0.00	CIRCULAR	24.00 in	24.00 in
INL-05	29.40	6048.83	2.0	6049.42	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
INL-12	157.66	6049.62	2.0	6052.77	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
INL-13	154.30	6053.27	2.0	6056.36	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-044	20.67	6047.05	7.6	6048.63	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
SDMH-03	159.65	6045.32	4.8	6052.91	0.013	1.00	0.00	CIRCULAR	24.00 in	24.00 in
INL-07	46.50	6053.59	8.0	6057.31	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
SDMH-04	51.27	6053.11	2.0	6054.14	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
SDMH-05	51.27	6054.34	2.0	6055.37	0.013	0.09	0.00	CIRCULAR	24.00 in	24.00 in
SDMH-06	51.27	6055.57	2.0	6056.60	0.013	0.09	0.00	CIRCULAR	24.00 in	24.00 in
SDMH-07	51.27	6056.80	2.0	6057.83	0.013	0.09	0.00	CIRCULAR	24.00 in	24.00 in
INL-08	43.50	6058.52	3.7	6060.13	0.013	0.81	0.00	CIRCULAR	18.00 in	18.00 in
SDMH-08	99.50	6058.03	2.0	6060.02	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
SDMH-09	144.35	6060.52	2.0	6063.41	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
SDMH-10	150.42	6063.61	2.0	6066.62	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-11	43.50	6066.83	5.0	6069.00	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
INL-10	43.50	6063.61	4.0	6065.35	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
INL-09	43.50	6060.51	3.7	6062.12	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
INL-06	179.08	6046.13	3.0	6051.50	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

Element Name	Full Flow Capacity		Critical Flow		Normal Flow				Flow (cfs)	Surcharged Length (ft)	Comment
	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition			
EXISTING PARKER 234	138.68	19.62	32.56	11.08	18.78	19.97	3.15	Supercritical Jump	74.50	3.33	Velocity is Too High
INL-01	193.83	27.42	32.56	11.08	15.48	25.62	4.56	Supercritical	74.50	0.00	Velocity is Too High
INL-02	47.29	6.69	36.00	8.16	36.00	8.16	0.00	Pressurized	57.70	87.80	
SDMH-01	66.88	9.46	28.66	8.97	24.56	10.53	1.37	Pressurized	54.10	247.69	
SDMH-02	47.29	6.69	21.03	6.83	20.51	7.05	1.05	Supercritical Jump	29.30	129.83	
INL-04	32.08	10.21	21.26	8.63	16.12	11.32	1.83	Supercritical	25.40	0.00	
INL-05	32.08	10.21	20.51	8.08	15.08	11.11	1.89	Supercritical	23.10	0.00	
INL-12	32.08	10.21	18.19	6.93	12.73	10.46	2.00	Supercritical	17.70	0.00	
INL-13	14.90	8.43	15.62	7.18	12.02	9.33	1.75	Supercritical	11.70	0.00	
INL-044	29.12	16.48	9.54	4.52	4.67	11.80	3.95	Supercritical Jump	4.30	9.18	
SDMH-03	49.46	15.74	22.51	10.10	13.74	16.61	3.02	Supercritical Jump	30.90	77.52	
INL-07	29.79	16.86	11.05	5.01	5.34	13.00	4.05	Supercritical	5.70	0.00	
SDMH-04	32.08	10.21	21.40	8.76	16.35	11.36	1.81	Supercritical	25.90	0.00	
SDMH-05	32.08	10.21	21.40	8.76	16.35	11.36	1.81	Supercritical	25.90	0.00	

SDMH-06	32.08	10.21	21.40	8.76	16.35	11.36	1.81	Supercritical	25.90	0.00	
SDMH-07	32.08	10.21	21.40	8.76	16.35	11.36	1.81	Supercritical	25.90	0.00	
INL-08	20.26	11.46	12.11	5.38	7.18	10.33	2.72	Supercritical Jump	6.80	22.53	
SDMH-08	32.08	10.21	19.05	7.29	13.51	10.71	1.97	Supercritical	19.50	0.00	
SDMH-09	14.90	8.43	16.33	7.89	13.26	9.53	1.63	Supercritical	13.30	0.00	
SDMH-10	14.90	8.43	11.83	5.28	8.32	8.14	1.96	Supercritical Jump	6.50	26.39	
INL-11	23.55	13.33	11.83	5.28	6.46	11.39	3.19	Supercritical	6.50	0.00	
INL-10	21.07	11.92	12.20	5.41	7.09	10.67	2.83	Supercritical Jump	6.90	17.60	
INL-09	20.26	11.46	11.93	5.31	7.07	10.25	2.72	Supercritical	6.60	0.00	
INL-06	18.24	10.32	14.42	6.39	9.33	10.48	2.35	Supercritical	9.70	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

Element Name	Peak Flow (cfs)	Cross Section	Existing		Calculated		Used			Comment
			Rise	Span	Rise	Span	Rise	Span	Area (ft ²)	
EXISTING PARKER 234	74.50	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
INL-01	74.50	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	
INL-02	57.70	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
SDMH-01	54.10	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
SDMH-02	29.30	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
INL-04	25.40	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
INL-05	23.10	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
INL-12	17.70	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
INL-13	11.70	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-044	4.30	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
SDMH-03	30.90	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
INL-07	5.70	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
SDMH-04	25.90	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
SDMH-05	25.90	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
SDMH-06	25.90	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
SDMH-07	25.90	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
INL-08	6.80	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
SDMH-08	19.50	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
SDMH-09	13.30	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
SDMH-10	6.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-11	6.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-10	6.90	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-09	6.60	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-06	9.70	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.

- Sewer sizes should not decrease downstream.
- All hydraulics were calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6031.03

Element Name	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
EXISTING PARKER 234	6027.93	6032.40	0.00	0.00	6031.03	6035.11	6032.75	4.26	6037.02
INL-01	6034.04	6041.00	0.09	0.00	6035.33	6043.71	6045.53	0.09	6045.62
INL-02	6041.20	6041.64	1.03	0.00	6045.62	6046.27	6046.65	0.65	6047.31
SDMH-01	6041.84	6044.32	0.05	0.00	6046.44	6048.06	6047.35	1.62	6048.97
SDMH-02	6045.32	6046.55	0.01	0.00	6048.72	6048.84	6048.99	0.25	6049.24
INL-04	6048.41	6048.63	0.88	0.00	6049.98	6050.40	6051.42	0.14	6051.56
INL-05	6048.83	6049.42	0.04	0.00	6050.44	6051.13	6052.01	0.14	6052.14
INL-12	6049.62	6052.77	0.02	0.00	6051.15	6054.29	6052.38	2.65	6055.03
INL-13	6053.27	6056.36	0.03	0.00	6054.32	6057.66	6055.63	2.83	6058.46
INL-044	6047.05	6048.63	0.09	0.00	6049.24	6049.42	6049.33	0.41	6049.74
SDMH-03	6045.32	6052.91	1.50	0.00	6049.57	6054.79	6051.07	5.30	6056.37
INL-07	6053.59	6057.31	0.16	0.00	6054.95	6058.23	6056.66	1.96	6058.62
SDMH-04	6053.11	6054.14	0.05	0.00	6054.84	6055.92	6056.48	0.63	6057.11
SDMH-05	6054.34	6055.37	0.09	0.00	6056.02	6057.15	6057.71	0.63	6058.34
SDMH-06	6055.57	6056.60	0.09	0.00	6057.25	6058.38	6058.94	0.63	6059.57
SDMH-07	6056.80	6057.83	0.09	0.00	6058.48	6059.61	6060.17	0.63	6060.80
INL-08	6058.52	6060.13	0.19	0.00	6060.76	6061.14	6060.99	0.60	6061.59
SDMH-08	6058.03	6060.02	0.03	0.00	6059.64	6061.61	6060.94	1.50	6062.43
SDMH-09	6060.52	6063.41	0.04	0.00	6061.65	6064.77	6063.04	2.70	6065.74
SDMH-10	6063.61	6066.62	0.01	0.00	6065.54	6067.61	6065.75	2.29	6068.04
INL-11	6066.83	6069.00	0.21	0.00	6067.82	6069.99	6069.38	1.04	6070.42
INL-10	6063.61	6065.35	0.24	0.00	6065.74	6066.37	6065.98	0.85	6066.82
INL-09	6060.51	6062.12	0.22	0.00	6061.82	6063.11	6062.73	0.82	6063.55
INL-06	6046.13	6051.50	0.47	0.00	6046.91	6052.70	6048.61	4.72	6053.34

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_{fi} ^ 2/(2*g)
- Lateral loss = V_{fo} ^ 2/(2*g) - Junction Loss K * V_{fi} ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft

The minimum trench width is 2.00 ft

Element Name	Downstream				Upstream			Volume (cu. yd)	Comment			
	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)					
EXISTING PARKER 234	104.00	4.00	6.00	6.67	48.76	26.22	22.05	17.60	10.63	6.47	1383.95	
INL-01	82.83	4.00	6.00	6.67	14.32	8.99	4.82	22.62	13.14	8.98	346.38	
INL-02	87.80	4.00	6.00	6.67	22.22	12.94	8.78	22.94	13.30	9.14	490.44	

SDMH-01	247.69	4.00	6.00	6.67	22.53	13.10	8.93	30.86	17.26	13.10	1888.38	
SDMH-02	245.90	4.00	6.00	6.67	28.86	16.26	12.10	11.66	7.66	3.50	1315.41	
INL-04	10.80	3.00	4.00	5.50	8.93	5.55	2.72	7.94	5.05	2.22	12.55	
INL-05	29.40	3.00	4.00	5.50	7.54	4.85	2.02	7.60	4.88	2.05	30.31	
INL-12	157.66	3.00	4.00	5.50	7.21	4.69	1.85	13.88	8.02	5.19	257.48	Sewer Too Shallow
INL-13	154.30	2.50	4.00	4.92	13.37	7.48	5.23	14.62	8.10	5.85	337.20	
INL-044	20.67	2.50	4.00	4.92	12.16	6.87	4.62	8.44	5.01	2.76	28.57	
SDMH-03	159.65	3.00	4.00	5.50	29.86	16.01	13.18	21.90	12.03	9.20	1093.48	
INL-07	46.50	2.50	4.00	4.92	21.04	11.31	9.06	12.50	7.04	4.79	146.05	
SDMH-04	51.27	3.00	4.00	5.50	21.49	11.83	9.00	21.44	11.80	8.97	244.41	
SDMH-05	51.27	3.00	4.00	5.50	21.03	11.60	8.77	21.00	11.58	8.75	235.33	
SDMH-06	51.27	3.00	4.00	5.50	20.59	11.38	8.55	20.54	11.35	8.52	226.45	
SDMH-07	51.27	3.00	4.00	5.50	20.13	11.15	8.32	20.08	11.12	8.29	217.57	
INL-08	43.50	2.50	4.00	4.92	19.20	10.39	8.14	12.50	7.04	4.79	121.71	
SDMH-08	99.50	3.00	4.00	5.50	19.68	10.92	8.09	19.62	10.89	8.06	405.56	
SDMH-09	144.35	2.50	4.00	4.92	19.11	10.35	8.10	19.00	10.29	8.04	538.53	
SDMH-10	150.42	2.50	4.00	4.92	18.60	10.09	7.84	18.50	10.04	7.79	534.53	
INL-11	43.50	2.50	4.00	4.92	18.09	9.84	7.59	12.50	7.04	4.79	113.38	
INL-10	43.50	2.50	4.00	4.92	18.60	10.09	7.84	12.50	7.04	4.79	117.15	
INL-09	43.50	2.50	4.00	4.92	19.14	10.36	8.11	12.50	7.04	4.79	121.24	
INL-06	179.08	2.50	4.00	4.92	13.86	7.72	5.47	15.50	8.54	6.29	424.46	

Total earth volume for sewer trenches = 10631 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
 - Four inches for pipes less than 33 inches.
 - Six inches for pipes less than 60 inches.
 - Eight inches for all larger sizes.

Channel Report

MINOR STORM TAIL WATER CALCULATION FOR UD SEWER

Circular

Diameter (ft) = 3.00

Invert Elev (ft) = 6027.92

Slope (%) = 4.30

N-Value = 0.013

Calculations

Compute by: Known Q

Known Q (cfs) = 20.40

Highlighted

Depth (ft) = 0.78

Q (cfs) = 20.40

Area (sqft) = 1.48

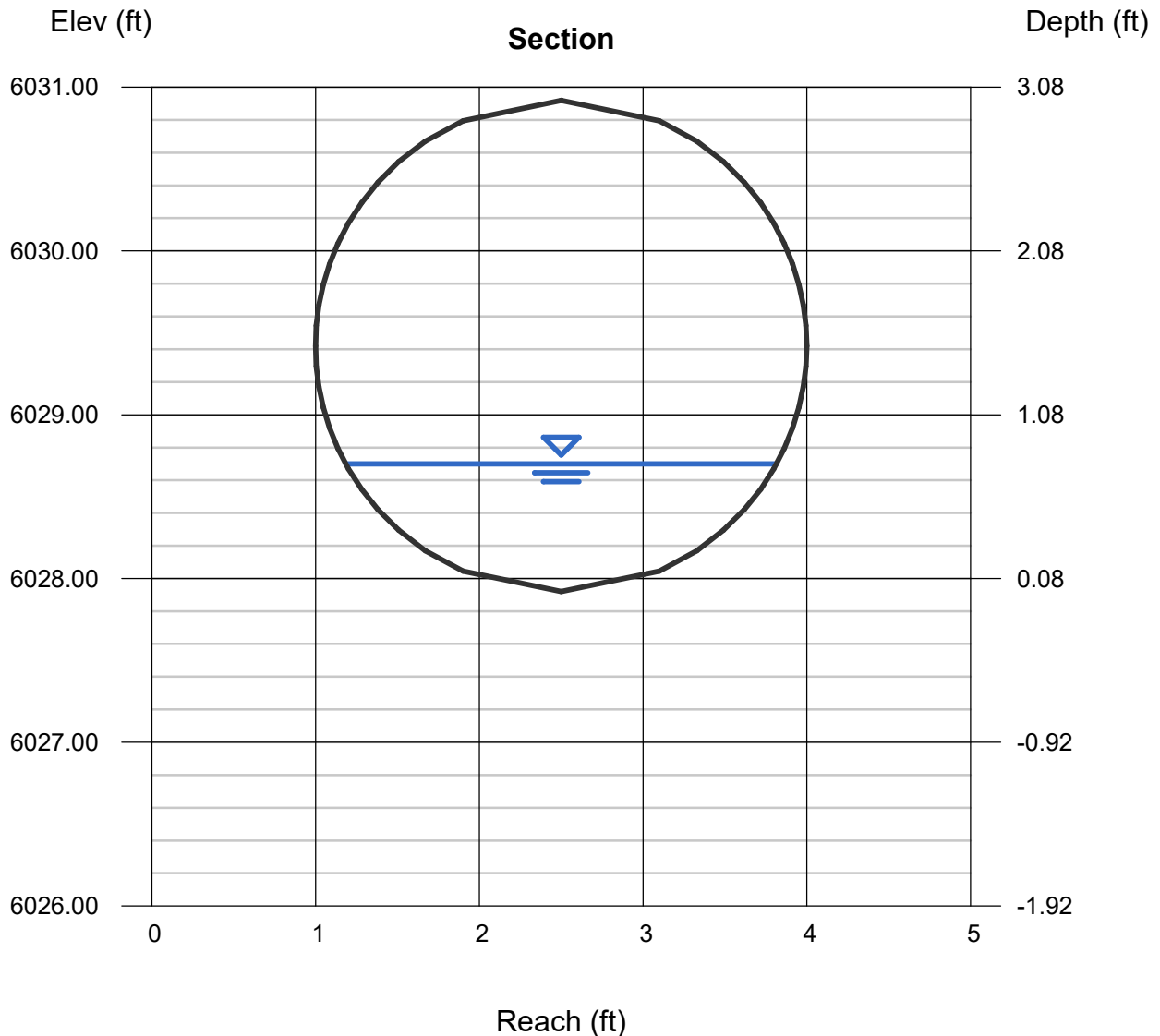
Velocity (ft/s) = 13.81

Wetted Perim (ft) = 3.22

Crit Depth, Yc (ft) = 1.45

Top Width (ft) = 2.64

EGL (ft) = 3.74



Program: UDSEWER Math Model Interface 2.1.1.4 Run Date: 1/24/2020 10:32:05 AM	<h2 style="margin: 0;">UDSewer Results Summary</h2> <p>Project Title: CHAMBERS AND HESS MINOR STORM Project Description: Default system</p>
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System Input Summary

Rainfall Parameters

Rainfall Return Period: 2
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6028.70

Manhole Input Summary:

Element Name	Ground Elevation (ft)	Given Flow		Sub Basin Information						
		Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1 S(99)	6053.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXISTING PARKER 234	6042.20	20.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-01	6053.31	20.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-02	6054.11	15.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-01	6060.75	14.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-02	6053.38	7.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-04	6053.10	6.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-05	6053.72	6.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-12	6060.21	5.10	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-13	6063.92	3.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

INL-044	6053.10	1.00	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-03	6064.36	8.80	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-07	6063.81	1.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-04	6065.36	7.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-05	6066.37	7.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-06	6067.37	7.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-07	6068.37	7.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-08	6066.63	2.00	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-08	6070.33	5.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-09	6073.16	3.80	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-10	6076.12	1.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-11	6075.50	1.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-10	6071.85	2.00	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-09	6068.62	1.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-06	6059.50	2.80	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

Manhole Output Summary:

Element Name	Local Contribution					Total Design Flow				Comment
	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	
OUTFALL 1 S(99)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
EXISTING PARKER 234	8.62	0.59	9.21	NaN	NaN	12.00	1.70	NaN	20.40	
INL-01	8.62	0.59	9.21	NaN	NaN	11.50	1.77	NaN	20.40	
INL-02	8.62	0.59	9.21	NaN	NaN	10.50	1.50	NaN	15.70	
SDMH-01	8.62	0.59	9.21	NaN	NaN	10.00	1.47	NaN	14.70	
SDMH-02	8.62	0.59	9.21	NaN	NaN	3.00	2.53	NaN	7.60	
INL-04	8.62	0.59	9.21	NaN	NaN	2.00	3.35	NaN	6.70	
INL-05	8.62	0.59	9.21	NaN	NaN	1.50	4.40	NaN	6.60	
INL-12	8.62	0.59	9.21	NaN	NaN	1.00	5.10	NaN	5.10	
INL-13	8.62	0.59	9.21	NaN	NaN	0.50	6.80	NaN	3.40	
INL-044	8.62	0.59	9.21	NaN	NaN	0.50	2.00	NaN	1.00	
SDMH-03	8.62	0.59	9.21	NaN	NaN	6.50	1.35	NaN	8.80	
INL-07	8.62	0.59	9.21	NaN	NaN	0.50	3.20	NaN	1.60	
SDMH-04	8.62	0.59	9.21	NaN	NaN	5.50	1.35	NaN	7.40	
SDMH-05	8.62	0.59	9.21	NaN	NaN	5.00	1.48	NaN	7.40	
SDMH-06	8.62	0.59	9.21	NaN	NaN	4.50	1.64	NaN	7.40	
SDMH-07	8.62	0.59	9.21	NaN	NaN	4.00	1.85	NaN	7.40	
INL-08	8.62	0.59	9.21	NaN	NaN	0.50	4.00	NaN	2.00	
SDMH-08	8.62	0.59	9.21	NaN	NaN	3.00	1.87	NaN	5.60	
SDMH-09	8.62	0.59	9.21	NaN	NaN	2.00	1.90	NaN	3.80	
SDMH-10	8.62	0.59	9.21	NaN	NaN	1.00	1.90	NaN	1.90	
INL-11	8.62	0.59	9.21	NaN	NaN	0.50	3.80	NaN	1.90	
INL-10	8.62	0.59	9.21	NaN	NaN	0.50	4.00	NaN	2.00	
INL-09	8.62	0.59	9.21	NaN	NaN	0.50	3.80	NaN	1.90	
INL-06	8.62	0.59	9.21	NaN	NaN	0.50	5.60	NaN	2.80	

Sewer Input Summary:

	Elevation	Loss Coefficients	Given Dimensions
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Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
EXISTING PARKER 234	104.00	6027.93	4.3	6032.40	0.013	0.29	0.00	CIRCULAR	36.00 in	36.00 in
INL-01	82.83	6034.04	8.4	6041.00	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
INL-02	87.80	6041.20	0.5	6041.64	0.013	1.00	0.00	CIRCULAR	36.00 in	36.00 in
SDMH-01	247.69	6041.84	1.0	6044.32	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
SDMH-02	245.90	6045.32	0.5	6046.55	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
INL-04	10.80	6048.41	2.0	6048.63	0.013	0.66	0.00	CIRCULAR	24.00 in	24.00 in
INL-05	29.40	6048.83	2.0	6049.42	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
INL-12	157.66	6049.62	2.0	6052.77	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
INL-13	154.30	6053.27	2.0	6056.36	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-044	20.67	6047.05	7.6	6048.63	0.013	0.76	0.00	CIRCULAR	18.00 in	18.00 in
SDMH-03	159.65	6045.32	4.8	6052.91	0.013	1.00	0.00	CIRCULAR	24.00 in	24.00 in
INL-07	46.50	6053.61	8.0	6057.31	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
SDMH-04	51.27	6053.11	2.0	6054.14	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
SDMH-05	51.27	6054.34	2.0	6055.37	0.013	0.09	0.00	CIRCULAR	24.00 in	24.00 in
SDMH-06	51.27	6055.57	2.0	6056.60	0.013	0.09	0.00	CIRCULAR	24.00 in	24.00 in
SDMH-07	51.27	6056.80	2.0	6057.83	0.013	0.09	0.00	CIRCULAR	24.00 in	24.00 in
INL-08	43.50	6058.52	3.7	6060.13	0.013	0.81	0.00	CIRCULAR	18.00 in	18.00 in
SDMH-08	99.50	6058.03	2.0	6060.02	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
SDMH-09	144.35	6060.52	2.0	6063.41	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
SDMH-10	150.42	6063.61	2.0	6066.62	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-11	43.50	6066.83	5.0	6069.00	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
INL-10	43.50	6063.61	4.0	6065.35	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
INL-09	43.50	6060.51	3.7	6062.12	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
INL-06	179.08	6046.13	3.0	6051.50	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

Element Name	Full Flow Capacity		Critical Flow		Normal Flow				Flow (cfs)	Surcharged Length (ft)	Comment
	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition			
EXISTING PARKER 234	138.68	19.62	17.40	6.03	9.33	14.03	3.33	Supercritical	20.40	0.00	
INL-01	193.83	27.42	17.40	6.03	7.89	17.80	4.62	Supercritical	20.40	0.00	
INL-02	47.29	6.69	15.17	5.55	14.28	6.01	1.12	Supercritical	15.70	0.00	
SDMH-01	66.92	9.47	14.66	5.44	11.46	7.59	1.61	Supercritical	14.70	0.00	
SDMH-02	47.29	6.69	10.42	4.48	9.76	4.91	1.14	Supercritical	7.60	0.00	
INL-04	32.08	10.21	11.01	4.77	7.44	8.07	2.12	Supercritical	6.70	0.00	
INL-05	32.08	10.21	10.92	4.74	7.39	8.04	2.12	Supercritical	6.60	0.00	
INL-12	32.08	10.21	9.55	4.38	6.47	7.47	2.12	Supercritical	5.10	0.00	
INL-13	14.90	8.43	8.44	4.18	5.85	6.83	2.02	Supercritical	3.40	0.00	
INL-044	29.12	16.48	4.47	2.92	2.28	7.68	3.75	Supercritical	1.00	0.00	
SDMH-03	49.46	15.74	12.70	5.22	6.85	11.89	3.27	Supercritical	8.80	0.00	
INL-07	29.71	16.81	5.70	3.33	2.84	8.96	3.91	Supercritical	1.60	0.00	
SDMH-04	32.08	10.21	11.60	4.92	7.84	8.30	2.12	Supercritical	7.40	0.00	
SDMH-05	32.08	10.21	11.60	4.92	7.84	8.30	2.12	Supercritical	7.40	0.00	
SDMH-06	32.08	10.21	11.60	4.92	7.84	8.30	2.12	Supercritical	7.40	0.00	
SDMH-07	32.08	10.21	11.60	4.92	7.84	8.30	2.12	Supercritical	7.40	0.00	
INL-08	20.26	11.46	6.40	3.55	3.82	7.30	2.72	Supercritical	2.00	0.00	
SDMH-08	32.08	10.21	10.03	4.50	6.79	7.67	2.12	Supercritical	5.60	0.00	

SDMH-09	14.90	8.43	8.94	4.34	6.20	7.05	2.02	Supercritical	3.80	0.00	
SDMH-10	14.90	8.43	6.23	3.50	4.34	5.79	2.02	Supercritical	1.90	0.00	
INL-11	23.55	13.33	6.23	3.50	3.46	8.00	3.15	Supercritical	1.90	0.00	
INL-10	21.07	11.92	6.40	3.55	3.75	7.51	2.83	Supercritical	2.00	0.00	
INL-09	20.26	11.46	6.23	3.50	3.72	7.19	2.72	Supercritical	1.90	0.00	
INL-06	18.24	10.32	7.62	3.93	4.77	7.47	2.48	Supercritical	2.80	0.00	

- A Froude number of 0 indicates that pressurized flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

Element Name	Peak Flow (cfs)	Cross Section	Existing		Calculated		Used			Comment
			Rise	Span	Rise	Span	Rise	Span	Area (ft ²)	
EXISTING PARKER 234	20.40	CIRCULAR	36.00 in	36.00 in	18.00 in	18.00 in	36.00 in	36.00 in	7.07	
INL-01	20.40	CIRCULAR	36.00 in	36.00 in	18.00 in	18.00 in	36.00 in	36.00 in	7.07	
INL-02	15.70	CIRCULAR	36.00 in	36.00 in	24.00 in	24.00 in	36.00 in	36.00 in	7.07	
SDMH-01	14.70	CIRCULAR	36.00 in	36.00 in	21.00 in	21.00 in	36.00 in	36.00 in	7.07	
SDMH-02	7.60	CIRCULAR	36.00 in	36.00 in	21.00 in	21.00 in	36.00 in	36.00 in	7.07	
INL-04	6.70	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-05	6.60	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-12	5.10	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-13	3.40	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-044	1.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
SDMH-03	8.80	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-07	1.60	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
SDMH-04	7.40	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
SDMH-05	7.40	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
SDMH-06	7.40	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
SDMH-07	7.40	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-08	2.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
SDMH-08	5.60	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
SDMH-09	3.80	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
SDMH-10	1.90	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-11	1.90	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-10	2.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-09	1.90	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-06	2.80	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics were calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6028.70

Element Name	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
	Downstream (ft)	Upstream (ft)	Bend Loss	Lateral Loss	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss	Upstream (ft)

			(ft)	(ft)				(ft)	
EXISTING PARKER 234	6027.93	6032.40	0.00	0.00	6028.71	6033.85	6031.76	2.65	6034.41
INL-01	6034.04	6041.00	0.01	0.00	6034.70	6042.45	6039.62	3.40	6043.01
INL-02	6041.20	6041.64	0.08	0.00	6042.85	6042.90	6043.09	0.29	6043.38
SDMH-01	6041.84	6044.32	0.00	0.00	6042.91	6045.54	6043.69	2.31	6046.00
SDMH-02	6045.32	6046.55	0.00	0.00	6046.13	6047.42	6046.51	1.22	6047.73
INL-04	6048.41	6048.63	0.05	0.00	6049.14	6049.55	6049.80	0.10	6049.90
INL-05	6048.83	6049.42	0.00	0.00	6049.55	6050.33	6050.45	0.23	6050.68
INL-12	6049.62	6052.77	0.00	0.00	6050.33	6053.57	6051.02	2.84	6053.86
INL-13	6053.27	6056.36	0.00	0.00	6053.76	6057.06	6054.49	2.85	6057.33
INL-044	6047.05	6048.63	0.00	0.00	6047.42	6049.00	6048.16	0.98	6049.14
SDMH-03	6045.32	6052.91	0.12	0.00	6045.89	6053.97	6048.09	6.30	6054.39
INL-07	6053.61	6057.31	0.01	0.00	6053.98	6057.79	6055.09	2.86	6057.96
SDMH-04	6053.11	6054.14	0.00	0.00	6053.97	6055.11	6054.84	0.64	6055.48
SDMH-05	6054.34	6055.37	0.01	0.00	6055.11	6056.34	6056.07	0.64	6056.71
SDMH-06	6055.57	6056.60	0.01	0.00	6056.34	6057.57	6057.30	0.64	6057.94
SDMH-07	6056.80	6057.83	0.01	0.00	6057.57	6058.80	6058.53	0.64	6059.17
INL-08	6058.52	6060.13	0.02	0.00	6058.84	6060.66	6059.67	1.19	6060.86
SDMH-08	6058.03	6060.02	0.00	0.00	6058.80	6060.86	6059.51	1.66	6061.17
SDMH-09	6060.52	6063.41	0.00	0.00	6061.04	6064.16	6061.81	2.64	6064.45
SDMH-10	6063.61	6066.62	0.00	0.00	6064.16	6067.14	6064.49	2.84	6067.33
INL-11	6066.83	6069.00	0.02	0.00	6067.16	6069.52	6068.11	1.60	6069.71
INL-10	6063.61	6065.35	0.02	0.00	6064.17	6065.88	6064.80	1.28	6066.08
INL-09	6060.51	6062.12	0.02	0.00	6060.87	6062.64	6061.62	1.20	6062.83
INL-06	6046.13	6051.50	0.04	0.00	6046.52	6052.14	6047.39	4.98	6052.38

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_{fi} ^ 2/(2*g)
- Lateral loss = V_{fo} ^ 2/(2*g)- Junction Loss K * V_{fi} ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
 The minimum trench width is 2.00 ft

Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Downstream			Upstream			Volume (cu. yd)	Comment
					Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)		
EXISTING PARKER 234	104.00	4.00	6.00	6.67	48.76	26.22	22.05	17.60	10.63	6.47	1383.95	
INL-01	82.83	4.00	6.00	6.67	14.32	8.99	4.82	22.62	13.14	8.98	346.38	
INL-02	87.80	4.00	6.00	6.67	22.22	12.94	8.78	22.94	13.30	9.14	490.44	
SDMH-01	247.69	4.00	6.00	6.67	22.54	13.10	8.94	30.86	17.26	13.10	1888.70	
SDMH-02	245.90	4.00	6.00	6.67	28.86	16.26	12.10	11.66	7.66	3.50	1315.41	
INL-04	10.80	3.00	4.00	5.50	8.93	5.55	2.72	7.94	5.05	2.22	12.55	
INL-05	29.40	3.00	4.00	5.50	7.54	4.85	2.02	7.60	4.88	2.05	30.31	
INL-12	157.66	3.00	4.00	5.50	7.21	4.69	1.85	13.88	8.02	5.19	257.48	Sewer Too Shallow
INL-13	154.30	2.50	4.00	4.92	13.37	7.48	5.23	14.62	8.10	5.85	337.20	
INL-044	20.67	2.50	4.00	4.92	12.16	6.87	4.62	8.44	5.01	2.76	28.57	
SDMH-03	159.65	3.00	4.00	5.50	29.86	16.01	13.18	21.90	12.03	9.20	1093.48	
INL-07	46.50	2.50	4.00	4.92	21.00	11.29	9.04	12.50	7.04	4.79	145.69	
SDMH-04	51.27	3.00	4.00	5.50	21.49	11.83	9.00	21.44	11.80	8.97	244.41	

SDMH-05	51.27	3.00	4.00	5.50	21.03	11.60	8.77	21.00	11.58	8.75	235.33	
SDMH-06	51.27	3.00	4.00	5.50	20.59	11.38	8.55	20.54	11.35	8.52	226.45	
SDMH-07	51.27	3.00	4.00	5.50	20.13	11.15	8.32	20.08	11.12	8.29	217.57	
INL-08	43.50	2.50	4.00	4.92	19.20	10.39	8.14	12.50	7.04	4.79	121.71	
SDMH-08	99.50	3.00	4.00	5.50	19.68	10.92	8.09	19.62	10.89	8.06	405.56	
SDMH-09	144.35	2.50	4.00	4.92	19.11	10.35	8.10	19.00	10.29	8.04	538.53	
SDMH-10	150.42	2.50	4.00	4.92	18.60	10.09	7.84	18.50	10.04	7.79	534.53	
INL-11	43.50	2.50	4.00	4.92	18.09	9.84	7.59	12.50	7.04	4.79	113.38	
INL-10	43.50	2.50	4.00	4.92	18.60	10.09	7.84	12.50	7.04	4.79	117.15	
INL-09	43.50	2.50	4.00	4.92	19.14	10.36	8.11	12.50	7.04	4.79	121.24	
INL-06	179.08	2.50	4.00	4.92	13.86	7.72	5.47	15.50	8.54	6.29	424.46	

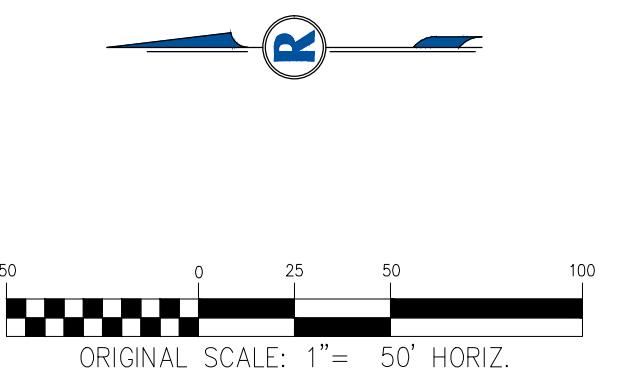
Total earth volume for sewer trenches = 10630 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
 - Four inches for pipes less than 33 inches.
 - Six inches for pipes less than 60 inches.
 - Eight inches for all larger sizes.

Appendix C
Drainage Plan

SOUTH RED SKY DRIVE

DOUGLAS 234 FILING NO. 1
1ST AMENDMENT
BLOCK 2



LEGEND

- BASIN ID
- 2 YR. RUNOFF COEFFICIENT
- 100 YR. RUNOFF COEFFICIENT
- AREA IN ACRES
- DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- FLOW ARROW
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING FENCE
- FLOODPLAIN
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED LOT LINE
- PROPOSED STORM SEWER

BASIN SUMMARY

BASIN	Q5 CFS	Q100 CFS
C1	0.2	19.6
C2	0.0	2.8
C3	0.0	0.4
C4	0.0	0.3
D1	0.0	3.7
D2	0.0	3.2

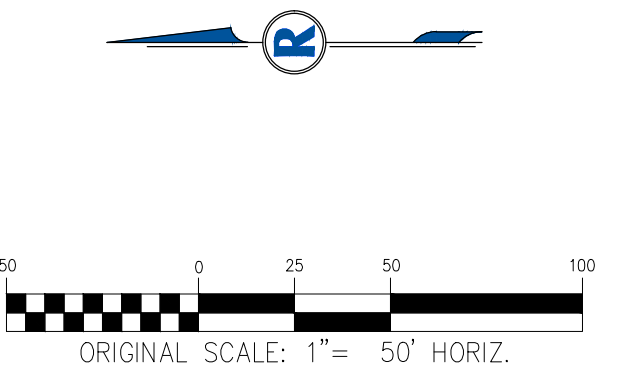
RICK ENGINEERING COMPANY
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DATE: DEC 13, 2019

SHEET 1 OF 2

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LEGEND

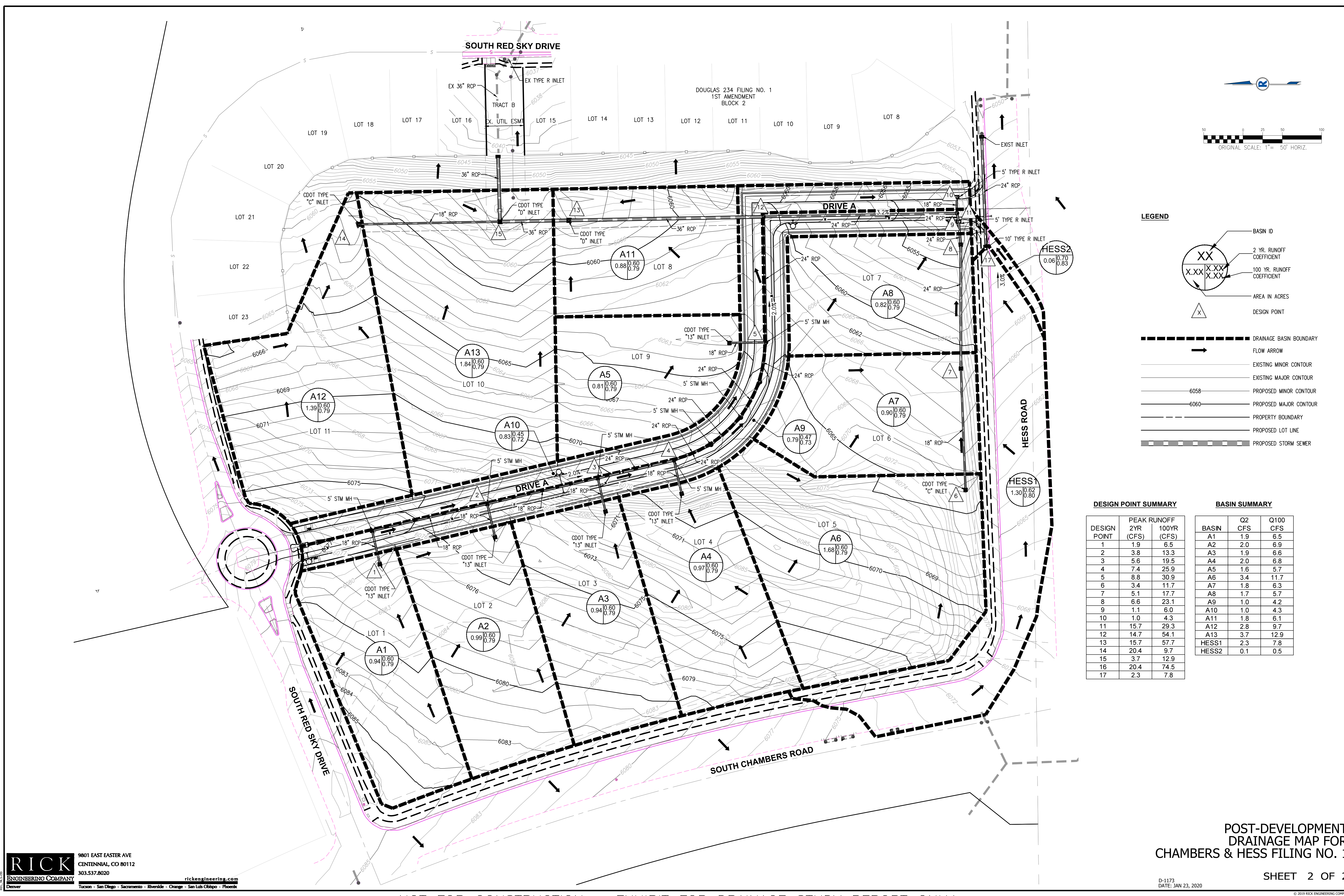
- XX BASIN ID
- X.XX 2 YR. RUNOFF COEFFICIENT
- X.XX 100 YR. RUNOFF COEFFICIENT
- X.XX AREA IN ACRES
- X DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- FLOW ARROW
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED LOT LINE
- PROPOSED STORM SEWER

DESIGN POINT SUMMARY

DESIGN POINT	PEAK RUNOFF 2YR (CFS)	100YR (CFS)
1	1.9	6.5
2	3.8	13.3
3	5.6	19.5
4	7.4	25.9
5	8.8	30.9
6	3.4	11.7
7	5.1	17.7
8	6.6	23.1
9	1.1	6.0
10	1.0	4.3
11	15.7	29.3
12	14.7	54.1
13	15.7	57.7
14	20.4	9.7
15	3.7	12.9
16	20.4	74.5
17	2.3	7.8

BASIN SUMMARY

BASIN	Q2 CFS	Q100 CFS
A1	1.9	6.5
A2	2.0	6.9
A3	1.9	6.6
A4	2.0	6.8
A5	1.6	5.7
A6	3.4	11.7
A7	1.8	6.3
A8	1.7	5.7
A9	1.0	4.2
A10	1.0	4.3
A11	1.8	6.1
A12	2.8	9.7
A13	3.7	12.9
HES1	2.3	7.8
HES2	0.1	0.5



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POST-DEVELOPMENT DRAINAGE MAP FOR CHAMBERS & HESS FILING NO. 1

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