FINAL DRAINAGE REPORT

DOUGLAS 234, FILING NO. 6 LOT 3

MCDONALD'S

Parker, Colorado

Prepared for:

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Project #: 096806010
Prepared: July 1, 2021
Resubmitted: September 21, 2021
Resubmitted: November 22, 2021

DOUGLAS 234, FILING NO. 6
LOT 3
MCDONALD'S

PARKER, COLORADO

DRAINAGE REPORT

NOVEMBER 22, 2021

Prepared by:

Kimley»Horn

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ENGINEER’S STATEMENT

"This report for the drainage design of the Douglas 234 Filing No. 6, Lot 3 McDonald’s Development 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 drainage facilities designed by others.”

____

Jessica McCallum, P.E.

Registered Professional Engineer

State of Colorado No. 59054

GENERAL LOCATION AND DESCRIPTION

The purpose of this report is to outline the drainage plan for the McDonald's Development near the northeast corner of Chambers Road and Hess Road in the Town of Parker, County of Douglas, State of Colorado (herein the "Project").

LOCATION

The Site is located on Lot 3 of the Douglas 234, Filing No. 6 development (the "Site"). More specifically, the Site is located in the southeast corner of Section 29, Township 6 South, Range 66 West of the Sixth Principal Meridian, Town of Parker, County of Douglas, State of Colorado. A vicinity map is provided below for reference.

VICINITY MAP

DESCRIPTION OF PROPERTY

The overall site is approximately 1.204 acres of undeveloped land. The existing topography generally drains from northwest to southeast to Sliceroo Drive. The majority of the site drains into a swale on the east side of the Site to a Type C inlet which then routes flows west to a regional detention pond for water quality and detention. The overall site varies in elevation from a low of approximately 6073 feet to a high of approximately 6083 feet. Respective runoff sheet flows across the property from northwest to southeast at slopes varying from 2% to 3%.

The existing vacant ground cover consists of sparse vegetation of native weeds and grasses. A review of the Natural Resource Conservation Service (NRCS) Web Soil Survey determined that the Site is made up primarily of Manzanola Clay Loam which is consistent with an NRCS Soil Type C. Soil Type C was utilized for calculations included within this report. The NRCS study is found in **Appendix A** of the report.

Groundwater was not encountered. No geologic hazards have been identified within the proposed Project Site.

DESCRIPTION OF PROJECT

The Project is anticipated to consist of a new single-story McDonald's fast-food restaurant with dual drive-thru lanes, drive aisles, parking on the south, east, and west side of the building, landscaping, and associated utility improvements. The proposed building will be oriented from east to west centered in the Site. Drive aisles are proposed to loop around the building to provide internal traffic circulation as well as emergency access throughout the Project. Runoff from the Project will be captured by proposed inlets and storm sewer infrastructure which will route the runoff to the regional detention pond.

Roadway infrastructure proposed within the overall development adjacent to the Project will provide access from the Project to the adjacent right-of-way and access roadways. Project access will be obtained through both South Red Sky Drive and Hess Road.

Water quality and detention for this property and the adjacent rights-of-way are provided off-site within the existing detention pond "A" which is located approximately 1200 feet east of Chambers and Hess Filing No. 1. Therefore, no additional water quality or detention is proposed with this project.

DRAINAGE BASINS AND SUB-BASINS

MAJOR DRAINAGE BASIN DESCRIPTION

This project falls within the limits and is tributary to Cherry Creek outlined in the "*Final Drainage Report for Chambers and Hess Filing No. 1*" prepared by Rick Engineering Company. dated January 25, 2021 (the "*Master Drainage Report*"). The Site falls entirely within Sub-Basin A3 of the Master Drainage Report.

Consistent with the Master Drainage Report, the weighted imperviousness for the project site is equal to or less than 75% (actual is 75.0%) and stormwater from the proposed project site maintains existing drainage patterns towards the existing storm sewer and eventually outfall to the existing detention pond "A". Likewise, the Master Drainage Report provides flows for Sub-Basin A3 for the 5-year and 100-year event of 3.6 cfs and 8.2 cfs, respectively. The proposed Site flows are 2.22 cfs in the 5-year event and 7.03 cfs in the 100-year event.

By scaled map location and graphical review of the Flood Insurance Rate Map (FIRM) Number 08035C0181G, dated March 16, 2016, the Site lies within as area classified as Zone X. Areas classified as Zone X are considered areas of minimal flood hazard, usually depicted by Flood Insurance Rate Maps as areas outside of the 500-year floodplain. The FIRM map is included in **Appendix A**.

The proposed development is ultimately tributary to Cherry Creek. On-Site drainage infrastructure is provided to convey stormwater conveyed to the existing detention pond "A" for water quality treatment and detention and then outfalls to Cherry Creek.

SUB-BASIN DESCRIPTION

The Site has been divided into sub-basins that are tributary to the existing storm sewer system which is conveyed downstream to the existing detention pond "A". Further information regarding the basin characteristics, runoff, coefficients and drainage patterns can be found in **Appendix B.**

Existing Runoff Conditions

The proposed Project lies entirely within the existing sub-basin A3 within the Master Development. This sub-basin was assigned an imperviousness value of 75% with runoff flowing from northwest to southeast to the existing Type C inlet. Flow are ultimately conveyed to the existing detention pond “A” for water quality treatment and detention. The 5-year and 100-year runoff values are 3.6 cfs and 8.2 cfs, respectively. The existing drainage map from the Master Report is provided in **Appendix E.**

Proposed Runoff Conditions

Sub-basin A1 is 0.09 acres consisting of the two access points and landscaping. Runoff from this basin sheets flows into Sliceroo Drive at Design Point A1, following historic drainage patterns east to inlets within the roadway and ultimately outfall to the existing detention pond.

Sub-basin A2 is 0.14 acres consisting of concrete drive aisles, parking, and landscaping. Runoff from this basin will surface flow to a proposed inlet on the northeast side of the basin at Design Point A2 where it will be conveyed via storm sewer to the existing storm sewer system. If the inlet were to plug the runoff would pond until ultimately flowing into Sliceroo Drive, following historic drainage patterns.

Sub-basin A3 is 0.16 acres consisting of concrete drive aisles and landscaping. Runoff from this basin will surface flow to a proposed inlet on the northwest side of the basin at Design Point A3 where it will be conveyed via storm sewer to the existing storm sewer system. If the inlet were to plug the runoff would pond until ultimately flowing into the Sub-basin A2 inlet.

Sub-basin A4 is 0.26 acres consisting of concrete drive aisles and landscaping on the west side of the Site. Runoff from this basin will surface flow to a proposed inlet on the southwest side of the basin at Design Point A4 where it will be conveyed via storm sewer to the existing storm sewer system. If the inlet were to plug the runoff would pond until ultimately flowing into the Sub-basin A5 inlet.

Sub-basin A5 is 0.28 acres consisting of concrete drive aisles, parking, and landscaping on the south side of the Site. Runoff from this basin will surface flow to a proposed inlet on the southeast side of the basin to Design Point A5 where it will be conveyed via storm sewer to the existing storm sewer system. If the inlet were to plug the runoff would pond until ultimately flowing into the existing inlet at Design Point A6.

Sub-basin A6 is 0.15 acres consisting of concrete drive aisles, parking, trash enclosure and landscaping. Runoff from this basin will surface flow to an existing inlet at Design Point A6 on the southeast side of the basin where it will be conveyed to the existing storm sewer system. If the inlet were to plug the runoff would pond until ultimately flowing into Sliceroo Drive, following historic drainage patterns.

Sub-basin R1 is 0.12 acres and consists of the roof area. Runoff from this basin will be routed to one roof drain at Design Point R1 which outfalls into the proposed storm sewer system, out falling into the existing storm sewer system.

DRAINAGE DESIGN CRITERIA

REGULATIONS

The *Town of Parker Storm Drainage and Environmental Criterial Manual* (the “CRITERIA”) and the *Urban Storm Drainage Criteria Manual* (the “MANUAL”) provided by Mile High Flood District (MHFD) were used for the drainage design and preparation of this letter.

There are no proposed deviations from the Town of Parker and MHFD floodplain regulations and ordinance.

COMPLIANCE WITH TOWN'S STREAM PRESERVATION STANDARDS

There are no existing stream buffers within the Project area.

DEVELOPMENT CRITERIA REFERENCE AND CONSTRAINTS

The FIRM panel cited in the Major Drainage Basin Description Section shows no portion of the Site to be located within the 100-year floodplain. The proposed storm facilities are in compliance with the CRITERIA and the MANUAL. Site drainage is not significantly impacted by such constraints as utilities or existing development.

The proposed approach included pipe flow into an existing storm sewer system. Additional detail regarding onsite drainage patterns is provided in the Drainage Facility Design Section.

The proposed Project is in general compliance with the Master Drainage Report.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per Table 2.3 of the CRITERIA. Table 5.1 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERA and MANUAL. Runoff coefficients for the proposed development were determined using Table RO-5 of the MANUAL by calculating weighted impervious values for each specific site basin. No modifications are proposed to any off-site drainage structure.

The rainfall intensity values used for the 5-year event and 100-year event are 1.9 inches/hour and 2.6 inches/hour, respectively.

Hydrologic design criteria utilized to analyze runoff conditions consists of the Rational Method as approved by the Criteria. Also, for sub-basins less than 160 acres in size, the Rational Method can be utilized as approved by the Manual.

Hydrologic calculations are provided in **Appendix B.**

HYDRAULIC CRITERIA

STORM SEWER PIPE HYDRAULICS

StormCAD was utilized to analyze pipe flows and conveyance capacity to the existing swale based upon direct runoff and time of concentration calculations for respective design point tributary areas. StormCAD modeling software allows the designer to analyze the system with respect to system conveyance timing and corresponding hydraulic gradient and capacity calculations.

Storm sewer design and modeling consists of design intervals as outlined by the following design storm events:

- Minor Storm: 5-year Storm Event
- Major Storm: 100-year Storm Event

Compliant with the Town Criteria, the Hydraulic Grade Line (HGL) for the minor event shall be contained within the pipe and for the major event shall be at least 12-inches below the finished grade elevation for the length of the pipe.

The resulting hydraulic analysis has been included in **Appendix C**.

GUTTER CAPACITY, INLET HYDRAULICS AND OUTFALL PROTECTION

Applicable design methods have been utilized to size proposed storm sewer inlets, which includes the use of UD-Inlet, v4.06 MHFD spreadsheets and nomographs.

The gutter capacity, inlet hydraulic and outfall protection analysis will consist of design intervals as outlined by the following design storm events:

- Minor Storm: 5-year Storm Event
- Major Storm: 100-year Storm Event

Analysis of the gutter capacity of internal access drives, curb cuts, riprap dissipation and Inlet Hydraulic Calculations have been included in **Appendix D**.

VARIANCE FROM CRITERIA

At this time, no variances from the Criteria are being requested.

DRAINAGE DESIGN

GENERAL CONCEPT

The Project consists of a proposed McDonald's fast-food restaurant with a dual drive-thru, drive aisles, parking, landscaping, and utility improvements.

Water quality and detention has been provided downstream of the Site within existing detention pond "A"; thus, no additional water quality or detention improvements are proposed with this Project.

FLOODPLAIN DEVELOPMENT PERMIT

This site does not fall within a FEMA floodplain and no floodplain modifications are required for this project therefor a floodplain development permit from the Town of Parker is not required.

ENVIRONMENTAL PROTECTION CRITERIA

GENERAL

No impacts to threatened or endangered species are anticipated as a result of the Project, and the Project is understood to comply with the State and Federal environmental permitting regulations. Additionally, no existing wetlands or Waters of the US are adjacent to the project site or are anticipated to be impacted by the proposed improvements.

CONSTRUCTION BMP PLAN

Construction BMPs will be used throughout the redevelopment of the Site in order to comply with Section 8.2 of the CRITERIA. Construction BMPs implemented onsite include silt fences and construction fence around the perimeter of the Site, vehicle tracking control, and a concrete washout area. The full list of construction BMPs to be implemented will be shown with the Project's Civil Construction Documents.

PERMANENT BMP PLAN

Existing detention pond "A" acts as the Water Quality Enhancement BMP for the Project Site.

CONCLUSIONS

COMPLIANCE WITH STANDARDS

The drainage design presented within this report conforms to the Town of Parker Storm Drainage and Environmental Criteria Manual. The existing detention pond will not be adversely affected by the Project, and the Project meets Mile High Flood District requirements.

DRAINAGE CONCEPT

The drainage design discussed herein effectively controls the storm runoff from the Project by conveying developed runoff to the existing storm sewer system where it is then conveyed to the regional detention facility. The proposed developed imperviousness falls below the assumed imperviousness outlined in the Master Drainage Report resulting in less runoff than assumed to the existing detention pond.

SEDIMENT AND EROSION CONTROL CONCEPT

The Construction BMP plans are designed to prevent erosion within the Site during and after construction. BMPs are in place to prevent erosion during construction including silt fence around the perimeter of the Site, vehicle tracking control, and a concrete washout area.

REFERENCES

Final Drainage Report for Chambers and Hess Filing No. 1, Rick Engineering Company; January 25, 2021.

Town of Parker Storm Drainage and Environmental Criteria Manual, Town of Parker; February 1996, Revised and Adopted February 2014.

Urban Storm Drainage Criteria Manual, Volume 1-3, Urban Drainage and Flood Control District, Denver, CO.; latest editions. (Provided by Mile High Flood Control District)

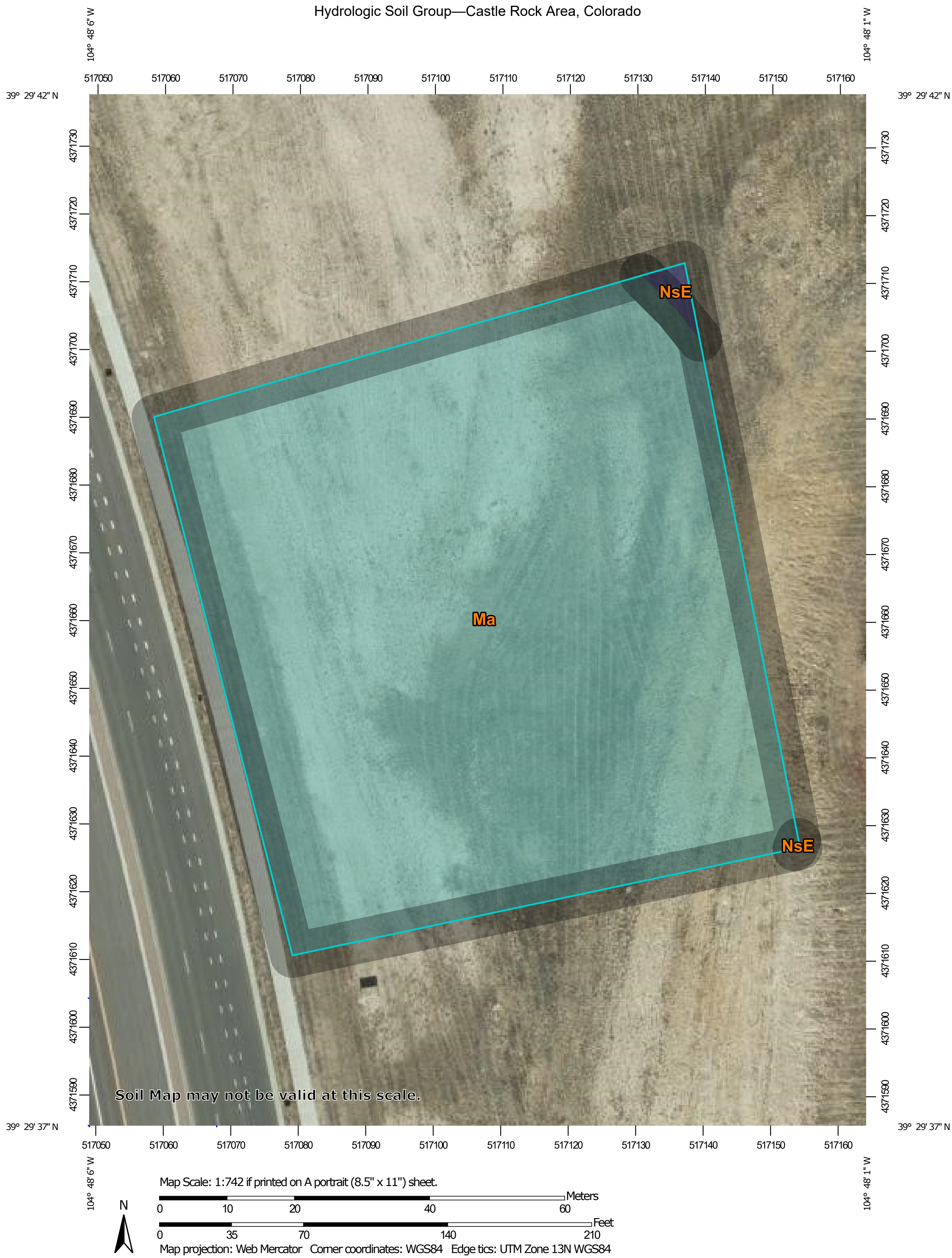
APPENDIX

APPENDIX A – FIRM, SOILS AND DRAINAGE MAPS

FEMA FIRM Map

NRCS Soil Map

Proposed Drainage Maps


104° 48' 6" W
104° 48' 1" W
39° 29' 42" N
39° 29' 37" N
517050
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Soil Map may not be valid at this scale.
Map Scale: 1:742 if printed on A portrait (8.5" x 11") sheet.
Meters
0
10
20
40
60
Feet
0
35
70
140
210
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil 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 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Oct 3, 2018—Dec 4, 2018

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
Ma	Manzanola clay loam	C	1.7	99.5%
NsE	Newlin-Satanta complex, 5 to 20 percent slopes	B	0.0	0.5%
Totals for Area of Interest			**1.7**	**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

National Flood Hazard Layer FIRMette

FEMA

104°48'23"W 39°29'53"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

104°47'46"W 39°29'25"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

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

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

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

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

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

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

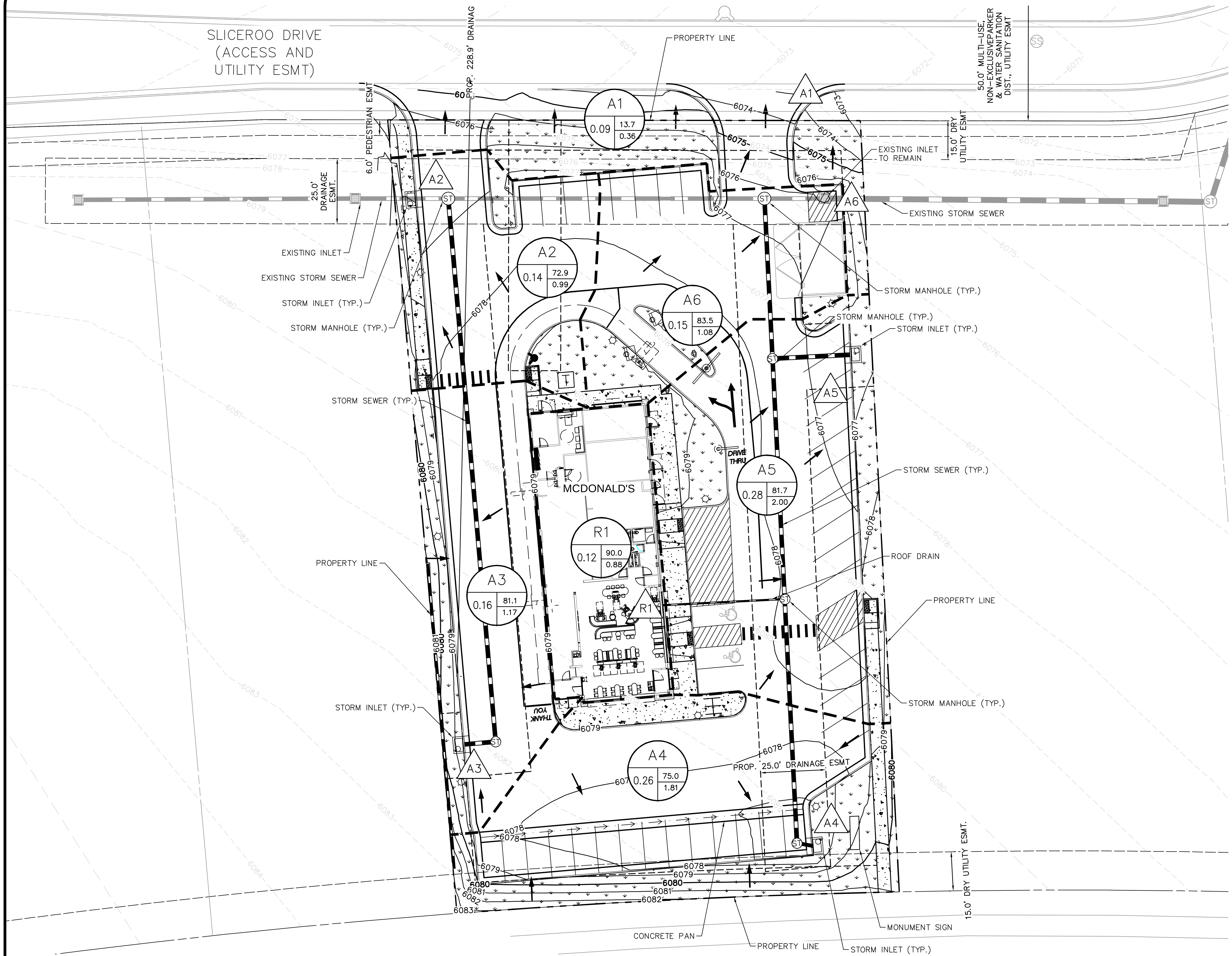
N

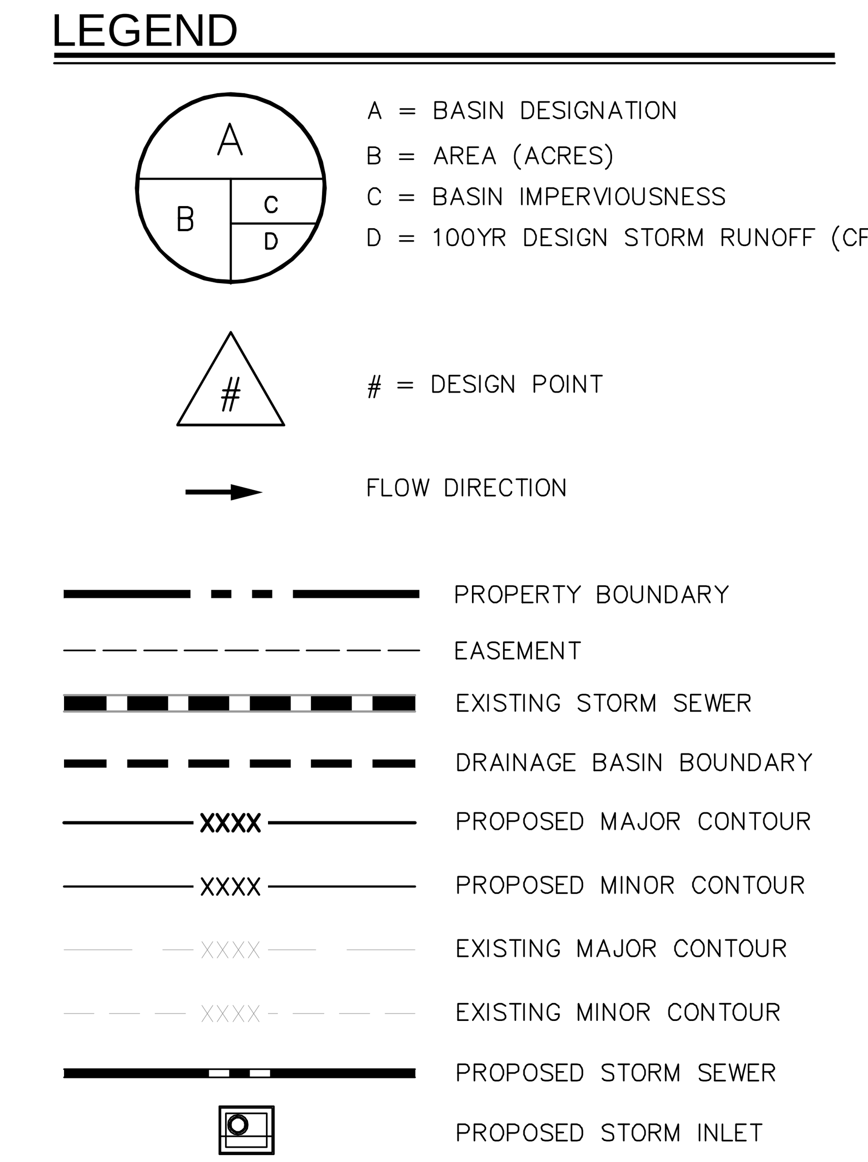
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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 5/19/2021 at 5:50 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.

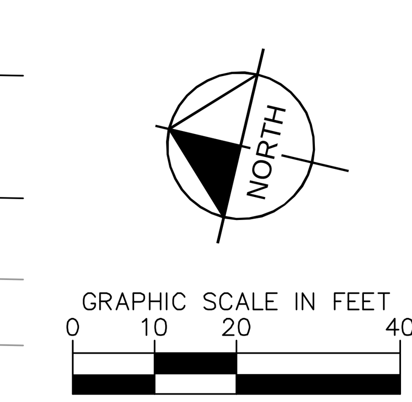
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory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





SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
A1	A1	0.09	0.04	0.36	2.22	7.03
A2	A2	0.14	0.31	0.99	0.31	0.99
A3	A3	0.16	0.39	1.17	0.39	1.17
A4	A4	0.26	0.57	1.81	0.57	1.81
A5	A5	0.28	0.66	2.00	0.66	2.00
A6	A6	0.15	0.36	1.08	0.36	1.08
R1	R1	0.12	0.30	0.88	0.30	0.88



DRAINAGE EXHIBIT – MCDONALD'S CHAMBERS ROAD AND HESS ROAD, PARKER, CO

Kimley»Horn

APPENDIX B – HYDROLOGIC COMPUTATIONS

Sub-Basin Impervious Area Calculations

Sub-Basin Runoff Calculations

The one-hour point rainfall depths for different frequency events are shown in Table 5.1 herein. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where, I = rainfall intensity (in/hr)
P_1 = one-hour point rainfall depth (in)
t_c = time of concentration (min)

	2-yr	5-yr	10-yr	100-yr
P_1 =	0.99	1.39	1.64	2.6

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF				LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS	LANDSCAPE				PAVEMENT AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT				WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS			
					C2	C5	C10	C100			C2	C5	C10	C100			C2	C5	C10	C100		C2	C5	C10	C100
A1	3,986	0.09	0	90%	0.74	0.77	0.80	0.85	3,510	2%	0.01	0.05	0.15	0.49	476	100%	0.83	0.86	0.87	0.89	13.7%	0.11	0.15	0.24	0.54
A2	6,269	0.14	0	90%	0.74	0.77	0.80	0.85	1,736	2%	0.01	0.05	0.15	0.49	4,533	100%	0.83	0.86	0.87	0.89	72.9%	0.60	0.64	0.67	0.78
A3	7,130	0.16	0	90%	0.74	0.77	0.80	0.85	1,372	2%	0.01	0.05	0.15	0.49	5,758	100%	0.83	0.86	0.87	0.89	81.1%	0.67	0.70	0.73	0.81
A4	11,376	0.26	0	90%	0.74	0.77	0.80	0.85	2,900	2%	0.01	0.05	0.15	0.49	8,476	100%	0.83	0.86	0.87	0.89	75.0%	0.62	0.65	0.69	0.79
A5	12,108	0.28	0	90%	0.74	0.77	0.80	0.85	2,258	2%	0.01	0.05	0.15	0.49	9,850	100%	0.83	0.86	0.87	0.89	81.7%	0.68	0.71	0.74	0.82
A6	6,496	0.15	230	90%	0.74	0.77	0.80	0.85	1,070	2%	0.01	0.05	0.15	0.49	5,196	100%	0.83	0.86	0.87	0.89	83.5%	0.69	0.72	0.75	0.82
R1	5,089	0.12	5,089	90%	0.74	0.77	0.80	0.85	0	2%	0.01	0.05	0.15	0.49	0	100%	0.83	0.86	0.87	0.89	90.0%	0.74	0.77	0.80	0.85
TOTAL	52,454	1.20	5,319	90%	0.74	0.77	0.80	0.85	12,846	2%	0.01	0.05	0.15	0.49	34,289	100%	0.83	0.86	0.87	0.89	75.0%	0.62	0.65	0.69	0.79

McDonald's - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
A1	A1	3,986	0.09	0.15	71	6.2%	8.0	117	1.8%	20.00	2.7	0.7	8.7	188	11.0	8.7
A2	A2	6,269	0.14	0.64	13	20.0%	1.1	104	2.4%	20.00	3.1	0.6	5.0	117	10.7	5.0
A3	A3	7,130	0.16	0.70	10	32.8%	0.7	77	3.1%	20.00	3.5	0.4	5.0	87	10.5	5.0
A4	A4	11,376	0.26	0.65	31	5.1%	2.7	110	1.4%	20.00	2.4	0.8	5.0	141	10.8	5.0
A5	A5	12,108	0.28	0.71	10	9.3%	1.1	203	2.0%	20.00	2.8	1.2	5.0	213	11.2	5.0
A6	A6	6,496	0.15	0.72	69	3.2%	3.9	0	1.0%	21.00	2.1	0.0	5.0	69	10.4	5.0
R1	R1	5,089	0.12	0.77	45	1.0%	4.1	100	1.0%	20.00	2.0	0.8	5.0	145	10.8	5.0

McDonald's - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm 5 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
A1	A1	0.09	0.15	8.7	0.01	2.82	0.04	8.7	0.79	2.82	2.22	Total flow of Site
A2	A2	0.14	0.64	5.0	0.09	3.36	0.31					
A3	A3	0.16	0.70	5.0	0.12	3.36	0.39					
A4	A4	0.26	0.65	5.0	0.17	3.36	0.57					
A5	A5	0.28	0.71	5.0	0.20	3.36	0.66					
A6	A6	0.15	0.72	5.0	0.11	3.36	0.36					
R1	R1	0.12	0.77	5.0	0.09	3.36	0.30					

McDonald's - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm 100 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
A1	A1	0.09	0.54	8.7	0.05	7.41	0.36	8.7	0.95	7.41	7.03	Total flow of Site
A2	A2	0.14	0.78	5.0	0.11	8.82	0.99					
A3	A3	0.16	0.81	5.0	0.13	8.82	1.17					
A4	A4	0.26	0.79	5.0	0.21	8.82	1.81					
A5	A5	0.28	0.82	5.0	0.23	8.82	2.00					
A6	A6	0.15	0.82	5.0	0.12	8.82	1.08					
R1	R1	0.12	0.85	5.0	0.10	8.82	0.88					

SUMMARY - PROPOSED RUNOFF TABLE						
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
A1	A1	0.09	0.04	0.36	2.22	7.03
A2	A2	0.14	0.31	0.99	0.31	0.99
A3	A3	0.16	0.39	1.17	0.39	1.17
A4	A4	0.26	0.57	1.81	0.57	1.81
A5	A5	0.28	0.66	2.00	0.66	2.00
A6	A6	0.15	0.36	1.08	0.36	1.08
R1	R1	0.12	0.30	0.88	0.30	0.88

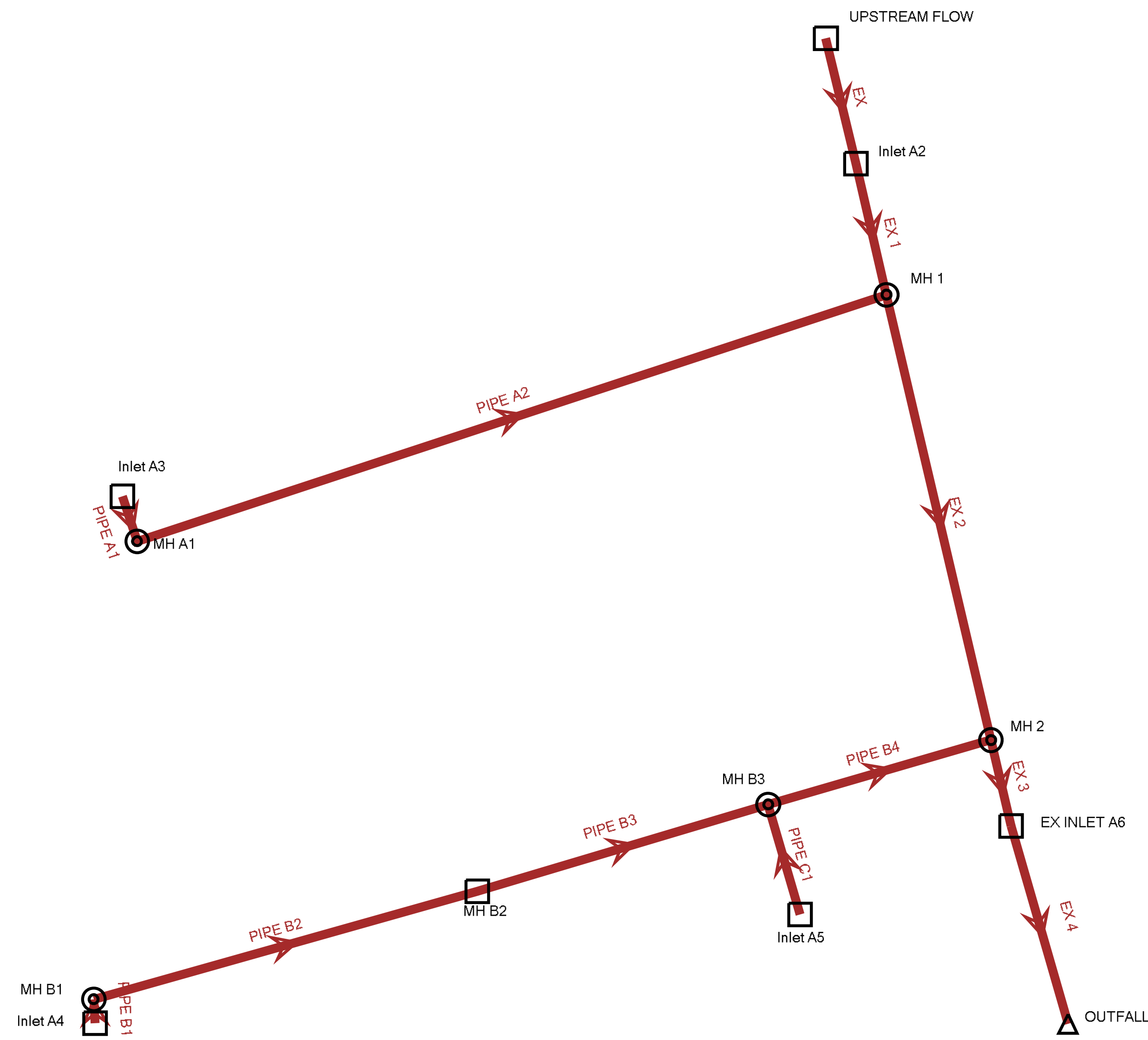
APPENDIX C – HYDRAULIC COMPUTATIONS

StormCAD Map

StormCAD Results Tables

StormCAD Result Profiles (100yr and 5yr)

Scenario: 5-YEAR



FlexTable: Catch Basin Table

Active Scenario: 5-YEAR

Label	Inlet Type	Flow (Additional Subsurface) (cfs)	Capture Efficiency (Calculated) (%)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Manning's n (Inlet)
Inlet A2	Full Capture	0.31	100.0	6,071.21	6,072.07	6,072.07	0.013
Inlet A3	Full Capture	0.39	100.0	6,074.05	6,074.28	6,074.28	0.013
Inlet A4	Full Capture	0.57	100.0	6,072.96	6,073.24	6,073.24	0.013
Inlet A5	Full Capture	0.66	100.0	6,072.29	6,072.59	6,072.59	0.013
EX INLET A6	Full Capture	0.36	100.0	6,068.74	6,069.79	6,069.79	0.013
MH B2	Full Capture	0.30	100.0	6,071.95	6,072.30	6,072.30	0.013
UPSTREAM FLOW	Full Capture	4.70	100.0	6,072.06	6,072.89	6,072.89	0.013

FlexTable: Conduit Table

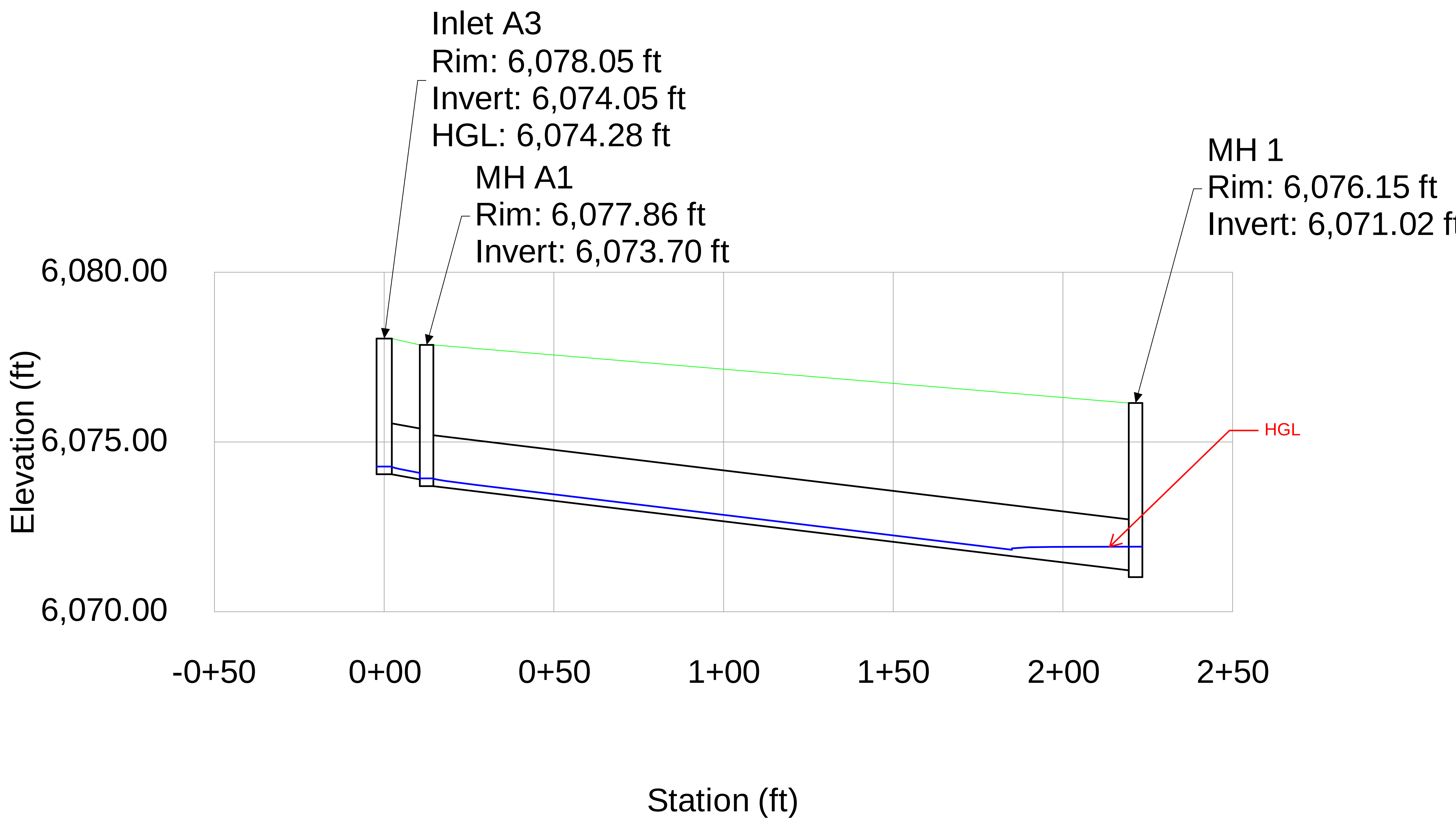
Active Scenario: 5-YEAR

Label	Start Node	Stop Node	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
PIPE A1	Inlet A3	MH A1	0.012	18.0	0.013	0.39	3.01	11.44	3.4	6,074.28	6,074.09
PIPE A2	MH A1	MH 1	0.012	18.0	0.013	0.39	3.01	11.44	3.4	6,073.93	6,071.92
PIPE B4	MH B3	MH 2	0.032	18.0	0.013	1.53	6.42	18.87	8.1	6,071.76	6,070.13
PIPE C1	Inlet A5	MH B3	0.026	18.0	0.013	0.66	4.63	16.91	3.9	6,072.59	6,071.70
PIPE B1	Inlet A4	MH B1	0.005	18.0	0.013	0.57	2.49	7.43	7.7	6,073.24	6,073.21
EX 2	MH 1	MH 2	0.016	18.0	0.013	5.40	7.09	13.19	40.9	6,071.92	6,070.13
EX 1	Inlet A2	MH 1	0.015	18.0	0.013	5.01	6.85	12.92	38.8	6,072.07	6,071.92
EX 3	MH 2	EX INLET A6	0.016	18.0	0.013	6.93	7.56	13.19	52.5	6,070.13	6,069.79
PIPE B2	MH B1	MH B2	0.005	18.0	0.013	0.57	2.55	7.68	7.4	6,073.00	6,072.43
PIPE B3	MH B2	MH B3	0.006	18.0	0.013	0.87	2.95	7.95	10.9	6,072.30	6,071.83
EX 4	EX INLET A6	OUTFALL	0.028	18.0	0.013	7.29	9.45	17.50	41.6	6,069.79	6,067.92
EX	UPSTREAM FLOW	Inlet A2	0.025	18.0	0.013	4.70	8.09	16.61	28.3	6,072.89	6,072.07

Profile Report

Engineering Profile - STORM A (McDonald's Parker_StormCAD.stsw)

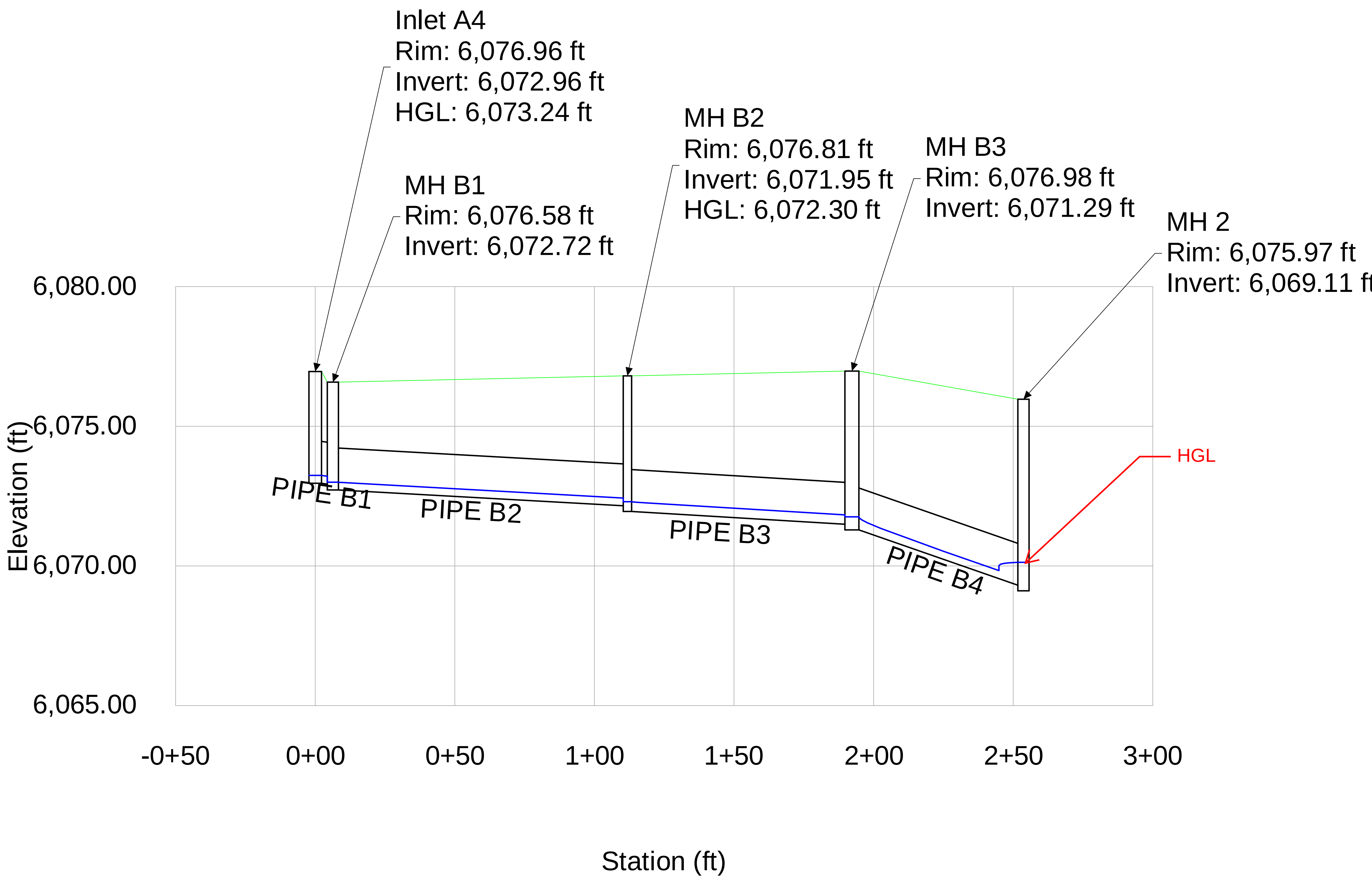
Active Scenario: 5-YEAR



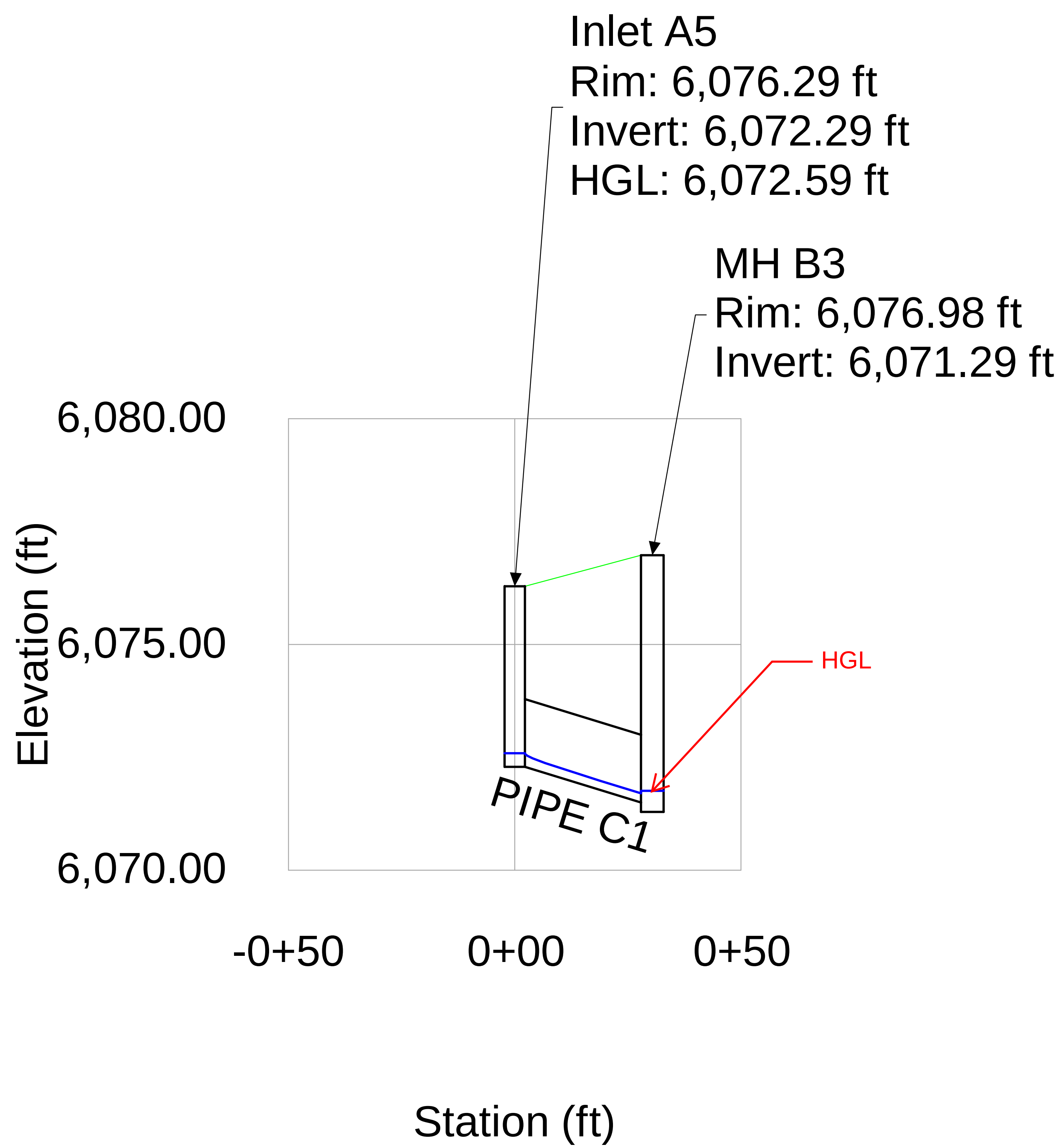
Profile Report

Engineering Profile - STORM B (McDonald's Parker_StormCAD.stsw)

Active Scenario: 5-YEAR



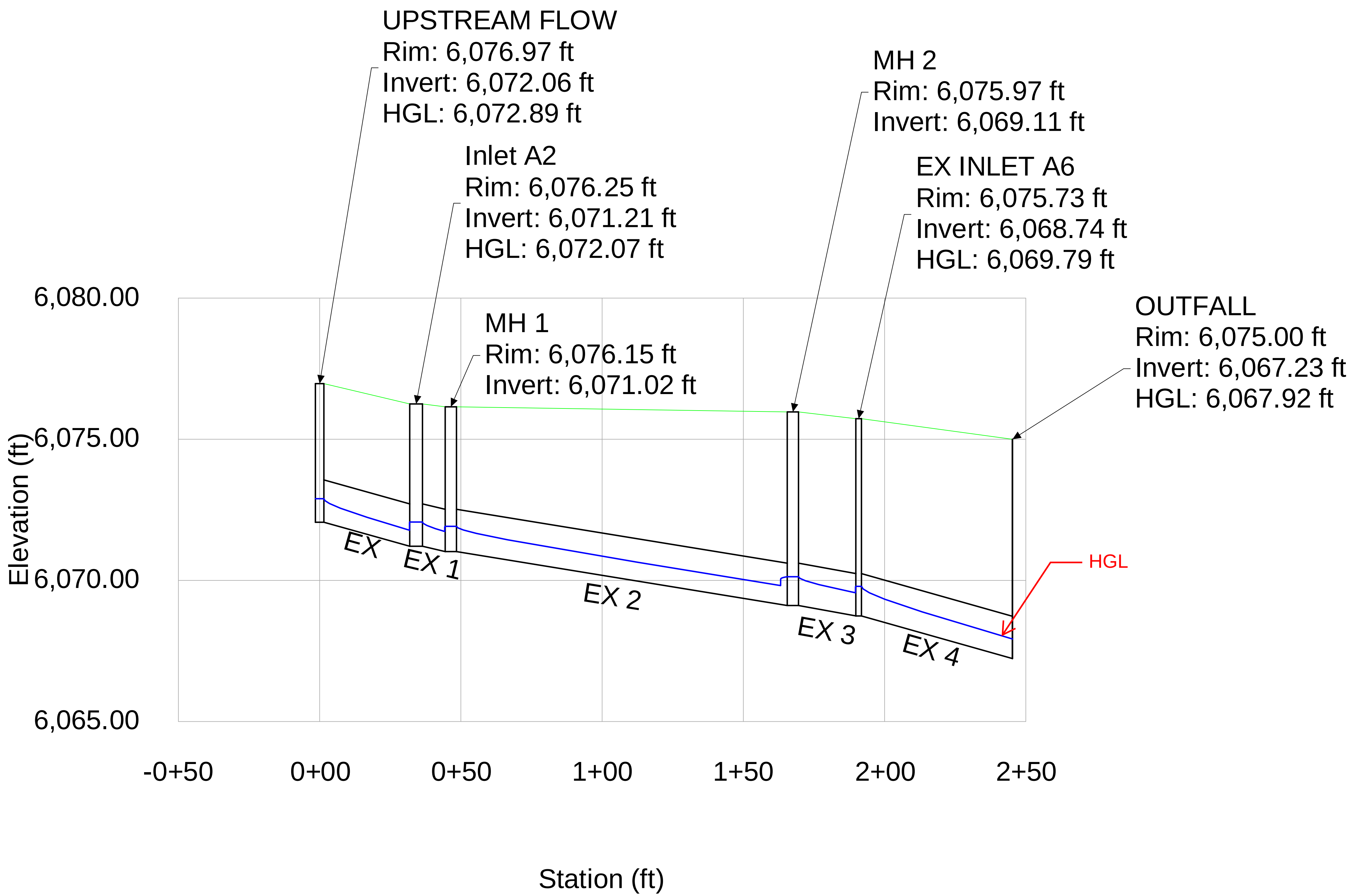
Profile Report
Engineering Profile - STORM C (McDonald's Parker_StormCAD.stsw)
Active Scenario: 5-YEAR



Profile Report

Engineering Profile - EX. STORM LINE (McDonald's Parker_StormCAD.stsw)

Active Scenario: 5-YEAR



FlexTable: Conduit Table

Active Scenario: 100-YEAR

Label	Start Node	Stop Node	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
PIPE A1	Inlet A3	MH A1	0.012	18.0	0.013	1.17	4.17	11.44	10.2	6,074.45	6,074.23
PIPE A2	MH A1	MH 1	0.012	18.0	0.013	1.17	4.17	11.44	10.2	6,074.10	6,072.72
PIPE B4	MH B3	MH 2	0.032	18.0	0.013	4.69	8.86	18.87	24.9	6,072.13	6,070.88
PIPE C1	Inlet A5	MH B3	0.026	18.0	0.013	2.00	6.42	16.91	11.8	6,072.82	6,072.13
PIPE B1	Inlet A4	MH B1	0.005	18.0	0.013	1.81	3.47	7.43	24.4	6,073.47	6,073.44
EX 2	MH 1	MH 2	0.016	18.0	0.013	12.96	7.33	13.19	98.2	6,072.72	6,070.88
EX 1	Inlet A2	MH 1	0.015	18.0	0.013	11.79	6.67	12.92	91.2	6,072.88	6,072.72
EX 3	MH 2	EX INLET A6	0.016	18.0	0.013	17.65	9.99	13.19	133.8	6,070.88	6,070.19
PIPE B2	MH B1	MH B2	0.005	18.0	0.013	1.81	3.55	7.68	23.6	6,073.22	6,072.65
PIPE B3	MH B2	MH B3	0.006	18.0	0.013	2.69	4.06	7.95	33.8	6,072.58	6,072.13
EX 4	EX INLET A6	OUTFALL	0.028	18.0	0.013	18.73	11.10	17.50	107.0	6,070.11	6,068.59
EX	UPSTREAM FLOW	Inlet A2	0.025	18.0	0.013	10.80	10.01	16.61	65.0	6,073.32	6,072.88

FlexTable: Catch Basin Table

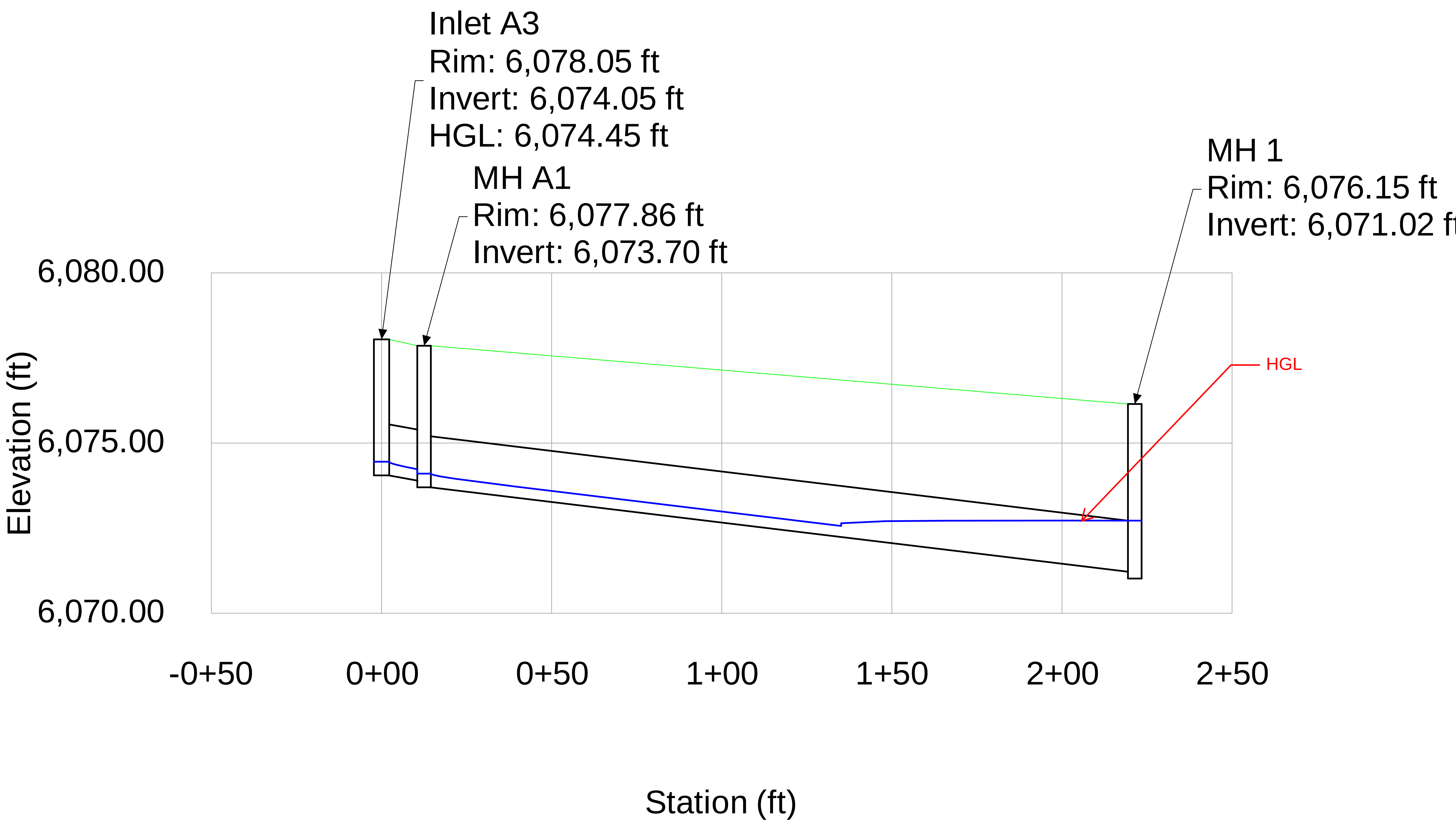
Active Scenario: 100-YEAR

Label	Inlet Type	Flow (Additional Subsurface) (cfs)	Capture Efficiency (Calculated) (%)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Manning's n (Inlet)
Inlet A2	Full Capture	0.99	100.0	6,071.21	6,072.88	6,072.88	0.013
Inlet A3	Full Capture	1.17	100.0	6,074.05	6,074.45	6,074.45	0.013
Inlet A4	Full Capture	1.81	100.0	6,072.96	6,073.47	6,073.47	0.013
Inlet A5	Full Capture	2.00	100.0	6,072.29	6,072.82	6,072.82	0.013
EX INLET A6	Full Capture	1.08	100.0	6,068.74	6,070.11	6,070.11	0.013
MH B2	Full Capture	0.88	100.0	6,071.95	6,072.58	6,072.58	0.013
UPSTREAM FLOW	Full Capture	10.80	100.0	6,072.06	6,073.32	6,073.32	0.013

Profile Report

Engineering Profile - STORM A (McDonald's Parker_StormCAD.stsw)

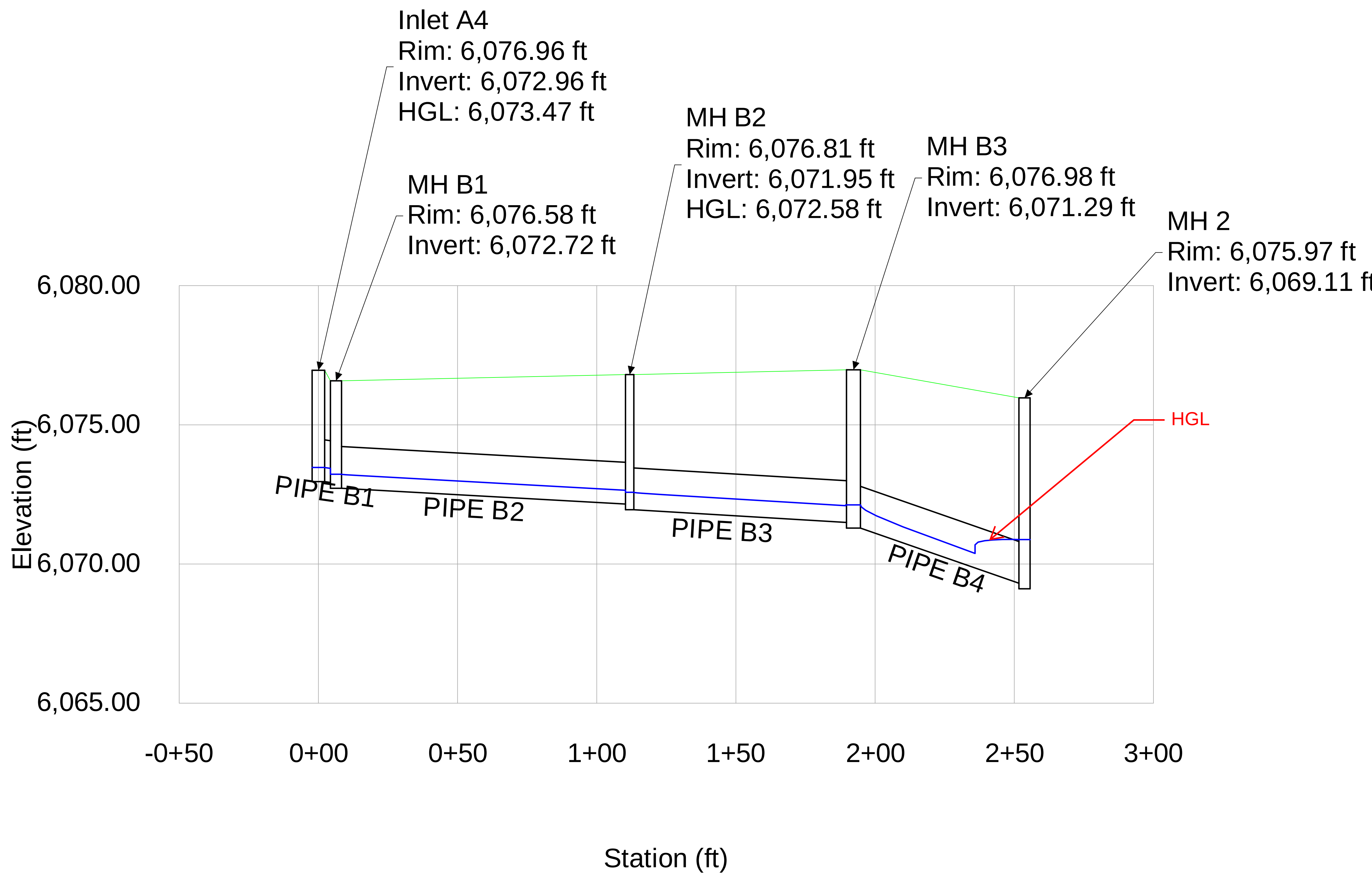
Active Scenario: 100-YEAR



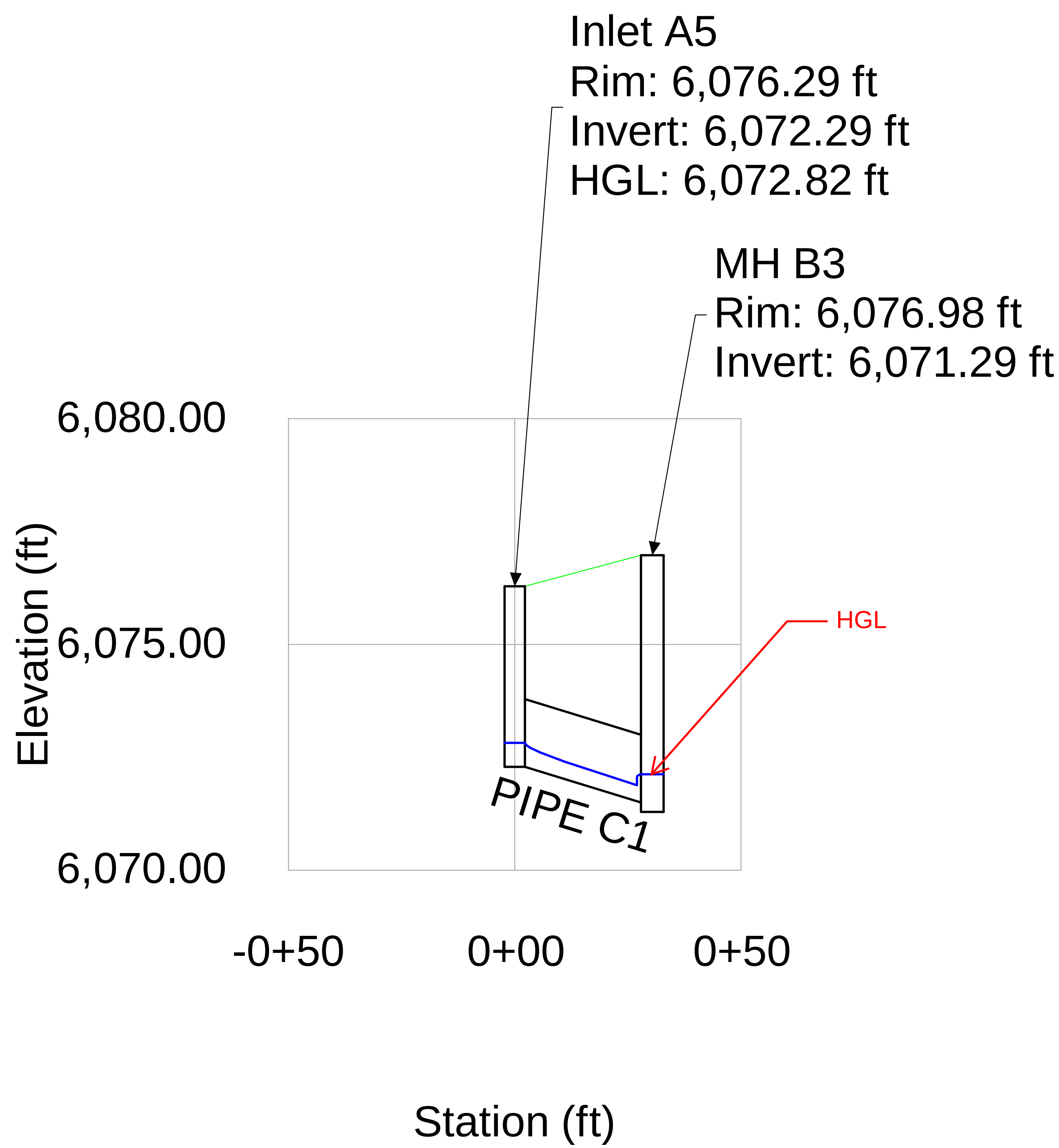
Profile Report

Engineering Profile - STORM B (McDonald's Parker_StormCAD.stsw)

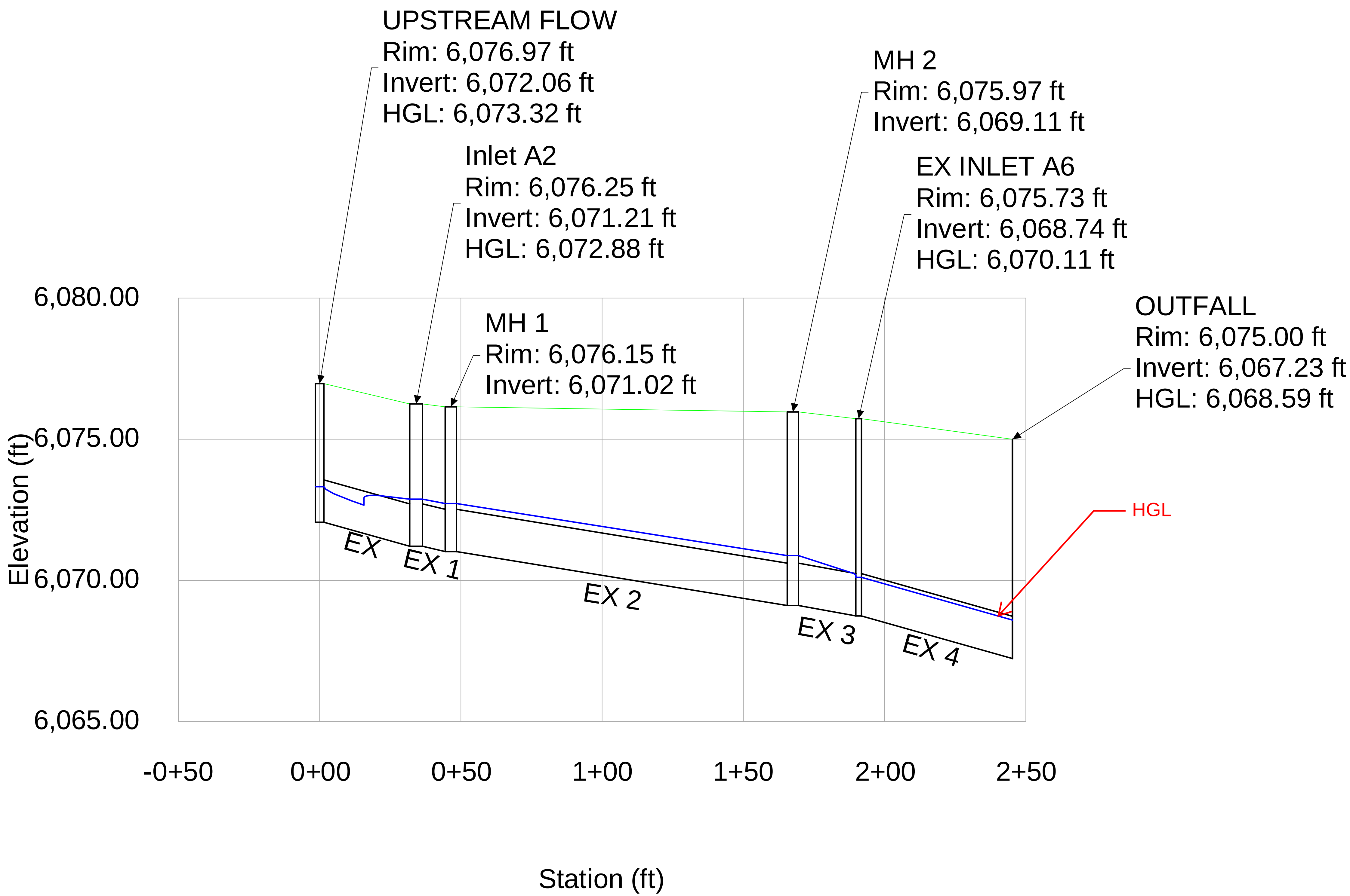
Active Scenario: 100-YEAR



Profile Report
Engineering Profile - STORM C (McDonald's Parker_StormCAD.stsw)
Active Scenario: 100-YEAR



Profile Report
Engineering Profile - EX. STORM LINE (McDonald's Parker_StormCAD.stsw)
Active Scenario: 100-YEAR



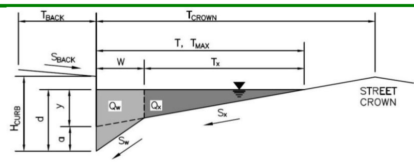
APPENDIX D – INLET COMPUTATIONS

UD-Inlet Sizing

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

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

Project: McDonald's Parker
Inlet ID: Sub-Basin A2 Inlet



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.150	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} =	28.0	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_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

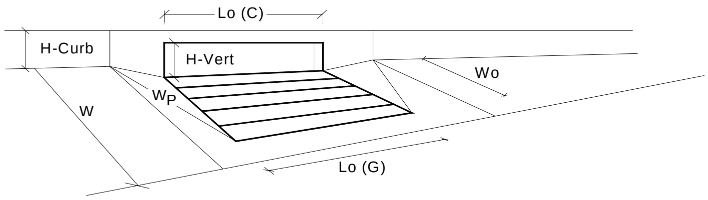
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	28.0	28.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

		Minor Storm	Major Storm	
	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

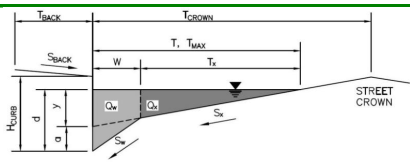


		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	5.4	5.4	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.3	1.0	cfs

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

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

Project: McDonald's Parker
Inlet ID: Sub_Basin A3 Inlet



Gutter Geometry:

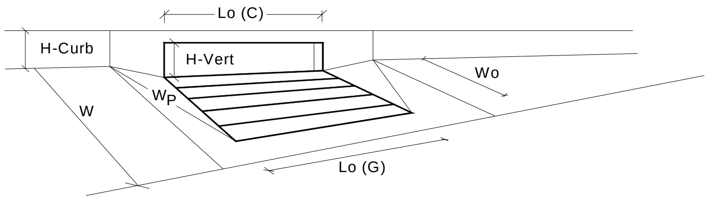
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.330	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.015	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_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)	CDOT Type R Curb Openi		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

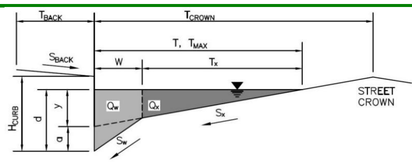
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	5.4	5.4	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.4	1.2	cfs

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

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

Project: McDonald's Parker
Inlet ID: Sub-Basin A4 Inlet



Gutter Geometry:

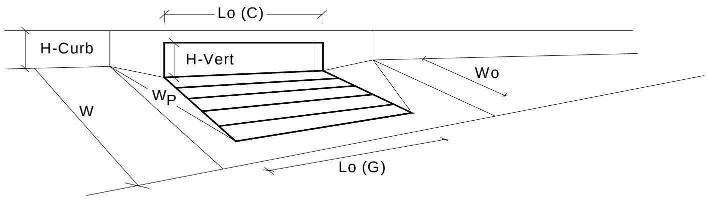
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.330	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	35.0	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_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	35.0	35.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

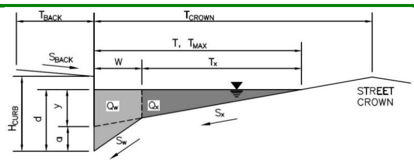


		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	5.4	5.4	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.8	cfs

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

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

Project: McDonald's Parker
Inlet ID: Sub-Basin A5 Inlet



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.050	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} =	28.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.035	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_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

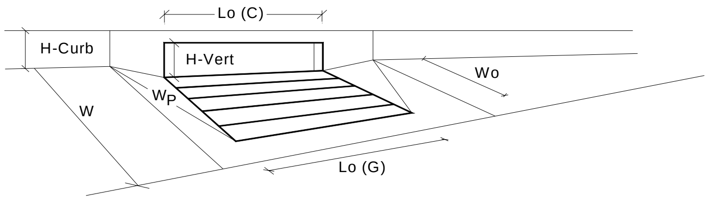
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	28.0	28.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Openi)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

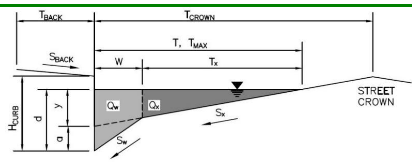
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	5.4	5.4	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.7	2.0	cfs

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

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

Project: McDonald's Parker
Inlet ID: Sub-Basin A6 Inlet



Gutter Geometry:

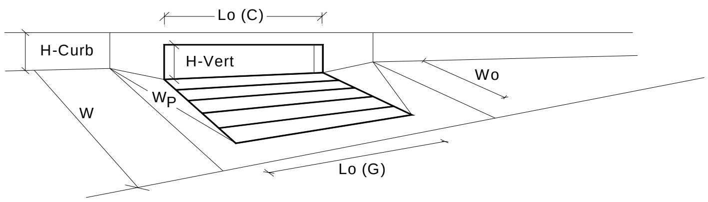
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	3.00	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_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)	CDOT Type C Grate	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type C Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.9	5.9	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	2.92	2.92	feet
Width of a Unit Grate	W_o =	2.92	2.92	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.70	0.70	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	2.41	2.41	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.67	0.67	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.453	0.453	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.92	0.92	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	2.5	2.5	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.4	1.1	cfs

APPENDIX E – REFERENCE REPORT EXCERPTS

Final Drainage Report for Chambers and Hess Filing No. 1

FINAL DRAINAGE REPORT
FOR
CHAMBERS AND HESS FILING NO. 1

Job Number: D-1173

January 25, 2021

RICK ENGINEERING COMPANY

FINAL 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
9801 East Easter Avenue
Centennial, CO 80112
(303) 537-8020

January 25, 2021

Certification

Professional Engineer:

This report for the final 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

COLORADO LICENSED
TROY W. BALES
50961
PROFESSIONAL ENGINEER

TABLE OF CONTENTS

APPENDICES

A. Hydrologic Computations
B. Hydraulic Computations
C. Excerpts from Final Drainage Report for the Douglas 234 Subdivision
D. Drainage Plan

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 Douglas 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 Douglas 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 Douglas 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". The existing conditions match the assumptions of the Final Drainage Report for the Douglas 234 Subdivision.

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 Douglas 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 5 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 Douglas 234 Subdivision.

E. Hydraulic Criteria

Sliceroo Drive is a normal crowned roadway, 26' flowline to flowline. Street capacities for Sliceroo Drive 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 Douglas 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 15 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 in Sliceroo Drive, near Hess Road 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. The appendices contain original design calculations for Pond "A". 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 68%. 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 within the commercial lots and Sliceroo Drive. The storm sewer main will have storm sewer inlets in the commercial lots to convey major storm runoff to the existing storm sewer stub in Tract B of Douglas 234 Subdivision. The storm sewer main is routed through the site to convey developed runoff to the existing stub. The Final Drainage Report for Douglas 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: 28.7 cfs and 70.8 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 Douglas 234 Subdivision. The minor storm tailwater elevation was calculated as normal depth pipe flow at Douglas 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 Criterial 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 Douglas 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 Douglas 234 Subdivision Parker Colorado". CVL Consultants of Colorado, Inc. April 29, 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.

PROJECT: **CHAMBERS AND HESS FILING NO. 1** JOB #: **D01173**
SUBJECT: Proposed Impervious DATE: **1/25/2021**
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)	Surburban Commercial (sf)	Surburban Commercial (Acres)	Soil Type "C/D" Composite Runoff Factors			
											C_2	C_5	C_{100}	I %
A1	39,679	0.91	0	0.00	0	0.00	0	0.00	39,679	0.91	0.60	0.65	0.79	75.0
A2	28,457	0.65	0	0.00	0	0.00	0	0.00	28,457	0.65	0.60	0.65	0.79	75.0
A3	51,364	1.18	0	0.00	0	0.00	0	0.00	51,364	1.18	0.60	0.65	0.79	75.0
A4	38,474	0.88	0	0.00	0	0.00	0	0.00	38,474	0.88	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	75,090	1.72	0	0.00	0	0.00	0	0.00	75,090	1.72	0.60	0.65	0.79	75.0
A7	34,360	0.79	0	0.00	0	0.00	0	0.00	34,360	0.79	0.60	0.65	0.79	75.0
A8	26,401	0.61	0	0.00	0	0.00	0	0.00	26,401	0.61	0.60	0.65	0.79	75.0
A9	41,603	0.96	19,881	0.46	16,022	0.37	5,700	0.13	0	0.00	0.40	0.46	0.70	51.8
A10	36,711	0.84	15,322	0.35	15,602	0.36	5,787	0.13	0	0.00	0.45	0.51	0.72	57.5
A11	31,512	0.72	0	0.00	0	0.00	0	0.00	31,512	0.72	0.60	0.65	0.79	75.0
A12	60,015	1.38	0	0.00	0	0.00	0	0.00	60,015	1.38	0.60	0.65	0.79	75.0
A13	69,307	1.59	0	0.00	0	0.00	0	0.00	69,307	1.59	0.60	0.65	0.79	75.0
A14	17,850	0.41	17,850	0.41	0	0.00	0	0.00	0	0.00	0.01	0.05	0.49	2.0
OS1	14,396	0.33	14,396	0.33	0	0.00	0	0.00	0	0.00	0.01	0.05	0.49	2.0
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
RSD1	11,469	0.26	1,583	0.04	7,920	0.18	1,966	0.05	0	0.00	0.69	0.73	0.83	84.8
Totals:	**600,588**	**13.79**	**67,450**	**1.55**	**31,624**	**0.73**	**11,486**	**0.26**	**490,028**	**11.25**	**0.54**	**0.60**	**0.76**	**68.4**

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

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

CALCULATED BY: BHE
DATE: 1/25/21 **P1=** 1.39
CHECKED BY:

JOB NO: D01173
PROJECT: CHAMBERS AND HESS FILING NO. 1
DESIGN STORM: 5 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)	(C A) (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	0.91	0.65	5.0	0.59	4.71	**2.8**							2.8	1.7	18	102	6.1	0.3	INL-10 TO INL-09
A2	2	A2	0.65	0.65	5.0	0.42	4.71	**2.0**													
	2	A1+A2							5.3	1.02	4.65	**4.7**			4.7	1.4	18	178	6.5	0.5	INL-09 TO INL-08
A3	3	A3	1.18	0.65	5.0	0.77	4.71	**3.6**													
	3	A1-A3							5.7	1.78	4.54	**8.1**			8.1	2.8	24	125	9.5	0.2	INL-08 TO INL-07
A4	4	A4	0.88	0.65	5.0	0.57	4.71	**2.7**													
	4	A1-A4							6.0	2.36	4.49	**10.6**			10.6	1.8	24	228	8.7	0.4	INL-07 TO INL-05
A5			0.81	0.65	5.0	0.53	4.71	**2.5**													
	5	A1-A5							6.4	2.89	4.40	**12.7**			12.7	7.3	24	132	15.2	0.1	INL-05 TO SDMH-01
A6	6	A6	1.72	0.65	5.0	1.12	4.71	**5.3**							5.3	3.0	18	142	8.8	0.3	INL-14 TO INL-13
A7	7	A6-A7	0.79	0.65	5.0	0.51	4.71	**2.4**	5.3	1.63	4.65	**7.6**			7.6	6.3	24	111	12.3	0.2	INL-13 TO INL-12
A8	8	A6-A8	0.61	0.65	5.0	0.39	4.71	**1.9**	5.4	2.03	4.61	**9.4**			9.4	4.6	24	72	11.8	0.1	INL-12 TO INL-11
RSD1			0.26	0.73	5.0	0.19	4.71	**0.9**					2.3	0.9				1096	2.9	6.2	TO INL-11
HESS2	9		0.06	0.74	5.0	0.05	4.71	**0.2**													TO INL-11
A9	9	A9+HESS2+RSD1	0.96	0.46	10.0	0.44	3.76	**1.7**	11.2	0.68	3.59	**2.4**									INL-11 DESIGN Q
	9	A6-A9+HESS2+RSD1							11.2	2.70	3.59	**9.7**			9.7	0.5	24	6	5.3	0.0	DP9: RUNOFF LEAVING INL-11 TO SDMH-02
A10	10	A10	0.84	0.51	9.8	0.43	3.79	**1.6**							1.6	0.5	18	19	3.3	0.1	INL-16 TO SDMH-02
	11	A6-A10+HESS2+RSD1							11.2	3.13	3.59	**11.2**			11.2	0.5	30	290	5.5	0.9	SDMH-02 TO SDMH-01
	12	A1-A10+HESS2+RSD1							12.1	6.02	3.48	**20.9**			20.9	0.5	36	194	6.5	0.5	SDMH-01 TO INL-04
A11	13	A1-A11+HESS2+RSD1	0.72	0.65	5.0	0.47	4.71	**2.2**	12.6	6.49	3.41	**22.1**			22.1	2.7	36	83	12.1	0.1	INL-04 TO INL-02
A12	14	A12	1.38	0.65	5.0	0.90	4.71	**4.2**							4.2	8.8	18	174	11.9	0.2	INL-03 TO INL-02
A13	15	A13	1.59	0.65	5.0	1.03	4.71	**4.9**													
	15	A1-A13+HESS2+RSD1							12.7	8.42	3.40	**28.6**			28.6	4.3	36	33	15.2	0.0	INL-02 TO INL-01

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

CALCULATED BY: BHE
DATE: 1/25/21 **P1=** 2.60
CHECKED BY:

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

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
BASIN	DESIGN POINT	AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(C A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	REMARKS
A1	1	A1	0.91	0.79	5.0	0.72	8.82	**6.4**							6.4	1.7	18	102	7.6	0.2	INL-10 TO INL-09
A2	2		0.65	0.79	5.0	0.52	8.82	**4.6**													
	2	A1+A2							5.2	1.24	8.72	**10.8**			10.8	1.4	18	178	7.9	0.4	INL-09 TO INL-08
A3	3		1.18	0.79	5.0	0.93	8.82	**8.2**													
	3	A1-A3							5.6	2.17	8.55	**18.6**			18.6	2.8	24	125	11.9	0.2	INL-08 TO INL-07
A4	4		0.88	0.79	5.0	0.70	8.82	**6.2**													
	4	A1-A4							5.8	2.87	8.48	**24.3**			24.3	1.8	24	228	11.0	0.3	INL-07 TO INL-05
A5	5		0.81	0.79	5.0	0.64	8.82	**5.7**													
	5	A1-A5							6.1	3.51	8.33	**29.3**			29.3	7.3	24	132	19.0	0.1	INL-05 TO SDMH-01
A6	6	A6	1.72	0.79	5.0	1.36	8.82	**12.0**							12.0	3.0	18	142	11.0	0.2	INL-14 TO INL-13
A7	7	A6-A7	0.79	0.79	5.0	0.62	8.82	**5.5**	5.2	1.99	8.72	**17.3**			17.3	6.3	24	111	15.8	0.1	INL-13 TO INL-12
A8	8	A6-A8	0.61	0.79	5.0	0.48	8.82	**4.2**	5.3	2.47	8.67	**21.4**			21.4	4.6	24	72	14.9	0.1	INL-12 TO INL-11
OS1			0.33	0.49	5.0	0.16	8.82	**1.4**													
HESS1	17	HESS1	1.30	0.80	8.4	1.04	7.52	**7.8**	8.4	1.21	7.52	**9.1**									
									8.4 8.4	0.92 0.29	7.52 7.52	**6.9** **2.2**									CAPTURED BY INLET INL-15 BYPASSED INLET 16 TO INLET A11
RSD1			0.26	0.83	5.0	0.22	8.82	**1.9**					2.3	1.9				1096	2.9	6.2	TO INL-11
HESS2			0.06	0.83	5.0	0.05	8.82	**0.5**													TO INL-11
A9	9	A9+HESS1+HESS2+ RSD1	0.96	0.70	10.0	0.67	7.04	**4.7**	11.2	1.22	6.72	**8.2**									INL-11 INLET DESIGN
		A6-A9+HESS1+ HESS2+RSD1							11.2	3.69	6.72	**24.8**			24.8	0.5	24	6	7.9	0.0	DP9: RUNOFF LEAVING INL-11
A10	10	A10	0.84	0.72	9.8	0.61	7.09	**4.3**							4.3	0.5	18	19	4.4	0.1	INL-10 TO SDMH-02
	11	A6-A10+HESS1+ HESS2+RSD1							11.2	4.30	6.71	**28.9**			28.9	0.5	24	290	9.0	0.5	SDMH-02 TO SDMH-01
	12	A1-A10+HESS1+ HESS2+RSD1							11.8	7.81	6.58	**51.4**			51.4	0.5	36	194	8.3	0.4	SDMH-01 TO INL-04
A11	13	A1-A11+HESS1+ HESS2+RSD1	0.72	0.79	5.0	0.57	8.82	**5.0**	12.2	8.38	6.49	**54.4**			54.4	2.7	36	83	15.3	0.1	INL-04 TO INL-02

Appendix C

Drainage Plan

BASIN SUMMARY

BASIN	Q5 CFS	Q100 CFS
C1	1.1	19.6
C2	0.2	2.8
C3	0.0	0.4
C4	0.0	0.3
D1	0.2	3.7
D2	0.2	3.2

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

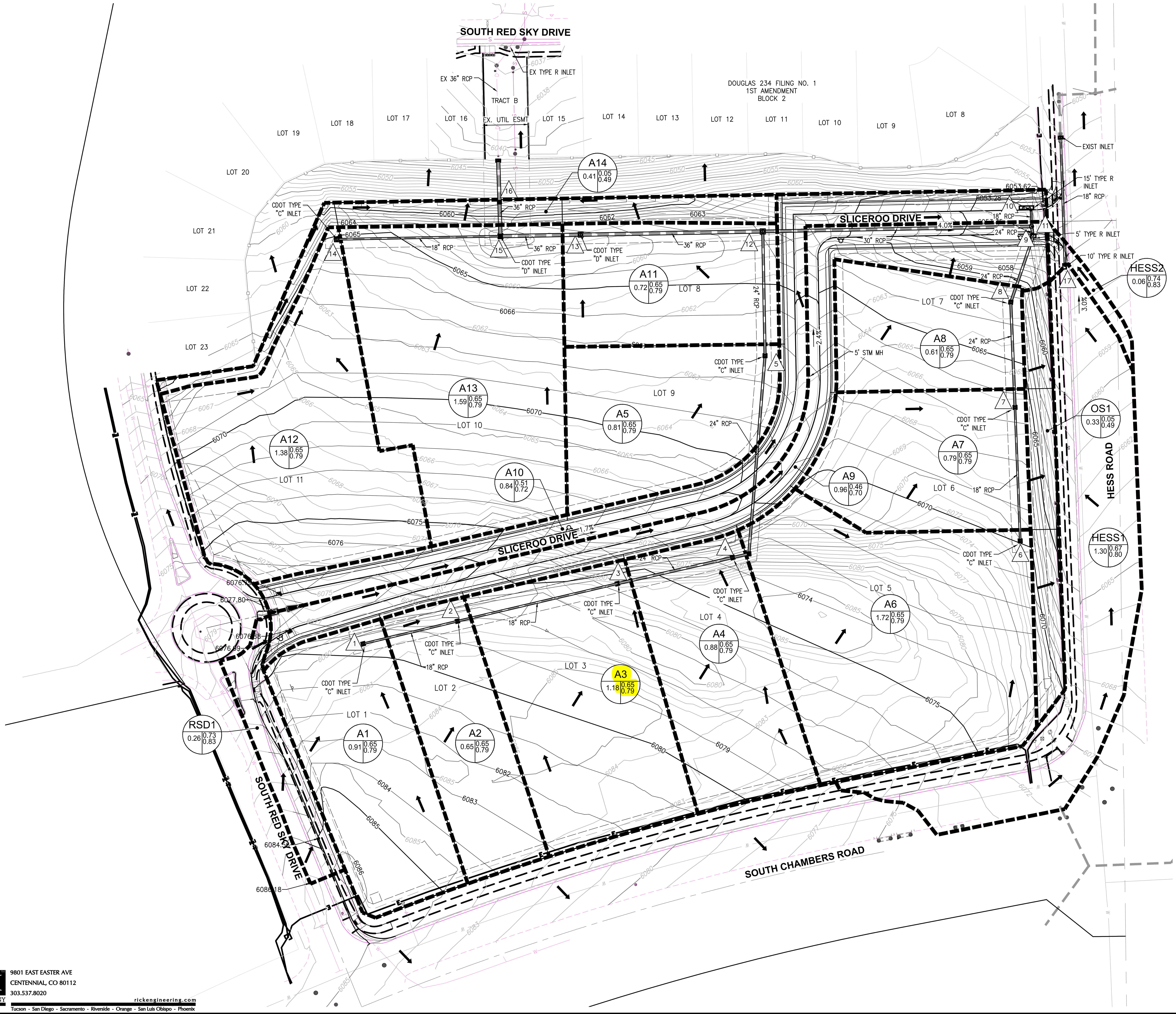
SHEET 1 OF 2

D-1173
DATE: DEC 13, 2019

RICK ENGINEERING COMPANY
Denver
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
rickengineering.com
Tucson - San Diego - Sacramento - Riverside - Orange - San Luis Obispo - Phoenix

C:\RICK\Projects\D_CEN_L\1173_Chambers&Hess\WaterResources\... REC_NCS.ctb

NOT FOR CONSTRUCTION — EXHIBIT FOR DRAINAGE STUDY REPORT ONLY



LEGEND

- BASIN ID
- 5 YR. RUNOFF COEFFICIENT
- 100 YR. RUNOFF COEFFICIENT
- AREA IN ACRES
- DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- FLOW ARROW
- 6058 EXISTING MINOR CONTOUR
- 6060 EXISTING MAJOR CONTOUR
- 6058 PROPOSED MINOR CONTOUR
- 6060 PROPOSED MAJOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED LOT LINE
- PROPOSED STORM SEWER

ORIGINAL SCALE: 1" = 50' HORIZ.

DESIGN POINT SUMMARY

DESIGN POINT	PEAK RUNOFF 5YR (CFS)	PEAK RUNOFF 100YR (CFS)
1	2.8	6.4
2	4.7	10.8
3	8.1	18.6
4	10.6	24.3
5	12.7	29.3
6	5.3	12.0
7	7.6	17.3
8	9.4	21.4
9	2.4	8.2
10	1.6	4.3
11	11.2	28.9
12	20.9	51.4
13	22.1	54.4
14	4.2	9.6
15	28.6	69.5
16	28.7	70.8
17	3.6	9.1

BASIN SUMMARY

BASIN	Q5 CFS	Q100 CFS
A1	2.8	6.4
A2	2.0	4.6
A3	3.6	8.2
A4	2.7	6.2
A5	2.5	5.7
A6	5.3	12.0
A7	2.4	5.5
A8	1.9	4.2
A9	1.7	4.7
A10	1.6	4.3
A11	2.2	5.0
A12	4.2	9.6
A13	4.9	11.1
A14	0.1	1.8
HESS1	3.5	7.8
HESS2	0.2	0.5
RSD1	0.9	1.9
OS1	0.1	1.4

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

RICK ENGINEERING COMPANY
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D-1173
DATE: JANUARY 25, 2021

NOT FOR CONSTRUCTION — EXHIBIT FOR DRAINAGE STUDY REPORT ONLY