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Drainage Conformance Letter

for

Maverik
Convenience Store and Fuel Station

Lincoln and Dransfeldt
Parker, Colorado 80138
TOWN OF PARKER # SP21-133

Prepared for:

Maverik, Inc.
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DCI Job No. 21-122-0001
August 2022

Engineer's Certification:

I hereby affirm that this report and plan for the drainage design for Maverik Convenience Store and Fuel Station was prepared by me, or under my direct supervision, for the owners thereof, in accordance with the provision for the Town of Parker Storm and Enviromental Drainage Design and Technical Criteria Manual, and approved variances and exceptions thereto. I understand that Town of Parker does not and will not assume liability for drainage facilities designed by others.

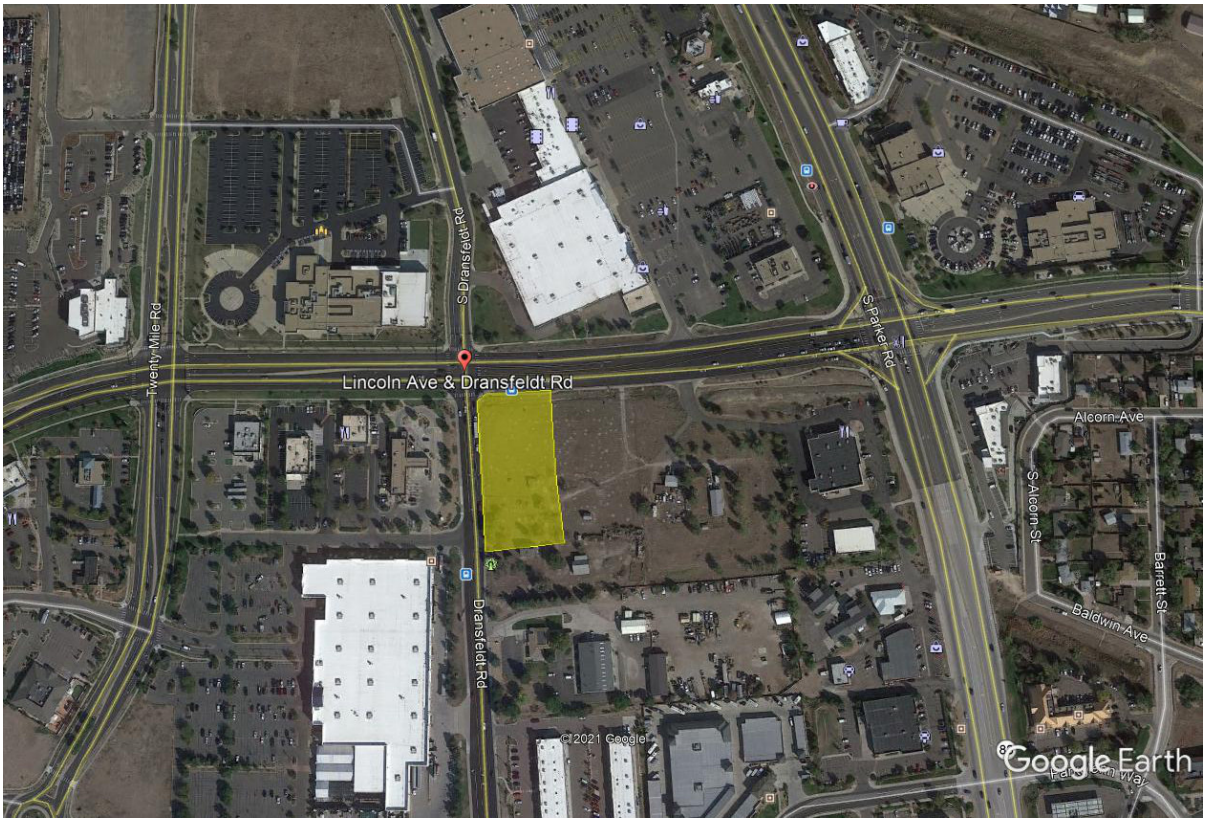
By: Damon A. Smith, PE
Licensed Professional Engineer
State of Colorado
No. 59516

TABLE OF CONTENTS

SECTION II. GENERAL LOCATION AND DESCRIPTION

A: GENERAL LOCATION AND DESCRIPTION

The proposed Maverik Development is located within the Town of Parker, within Douglas County in Colorado. Prior to the submittal of the Site Improvement Permit, the site was approved for annexation into the Town boundaries. The proposed 1.30-acre plot of land is comprised of a single parcel that was created under the Lincoln Professional Park Subdivision Filing. The site is situated on the southeast corner of Lincoln Avenue and Dransfeldt Road and is located on what is currently undeveloped former agricultural land.



The Colorado State Land Board maintains records of the Cadastral Survey of the state for purposes of establishing legal property boundaries in proposed land subdivisions. The proposed property is located on the western edge of the A Parcel of land situated in the

Northwest Quarter of Section 15, Township 6 South, Range 66 West of the Sixth Principal Meridian, County of Douglas, State of Colorado, This Drainage Report accompanies the proposed Site Plan Application, dated July 2021.

The legal description, as identified on the Subdivision Plat by HKS, is as follows:

COMMENCING AT THE NORTHWEST CORNER OF SAID SECTION 15;

THENCE SOUTH 83°44'03" EAST, A DISTANCE OF 846.76 FEET TO A POINT ON THE SOUTH RIGHT-0F-WAY LINE OF LINCOLN AVENUE AND THE POINT OF BEGINNING;

THENCE NORTH 89°29'OO' EAST ALONG SAID SOUTH RIGHT-OF-WAY LINE, A DISTANCE OF 697.77 FEET TO THE N0RTHTWEST CORNER OF LOT 1, PEASLEE SUBDIVISION FILING NO. 1, RECORDED AT RECEPTION N0. 99104313;

THENCE ALONG THE WEST LINE OF SAID LOT 1 THE FOLLOWING TWO (2) COURSES:

1) SOUTH 00°31'00" EAST, A DISTANCE OF 89.84 FEET;

2) S0UTH 11°49'46" EAST, A DISTANCE OF 225.08 FEET TO THE NORTHWEST CORNER OF LOT 1, PEASLEE SUBDIVISION FILING N0. 2, RECORDED AT RECEPTION NO. 2005085666;

THENCE SOUTH 05°51'51" EAST ALONG THE WEST LINE OF SAID LOT 1, A DISTANCE OF 120.83 FEET TO A POINT ON THE NORTH LINE OF LOT 1B, PARKER PROFESSIONAL PARK FIRST AMENDMENT, RECORDED AT RECEPTION NO. 8725509;

THENCE SOUTH 84°07'50" WEST ALONG SAID NORTH LINE, A DISTANCE OF 24.51 FEET TO THE NORTHEAST CORNER OF LOT 1, BLOCK 1 E.T. TECHNOLOGIES INC., RECORDED AT RECEPTION NO. 2002093991;

THENCE ALONG SAID NORTH LINE THE F0LL0WING TW0 (2) COURSES:

1) SOUTH 82°44'13" WEST, A DISTANCE OF 163.50 FEET;

2) SOUTH 84°51'34" WEST, A DISTANCE OF 577.15 FEET TO A POINT ON THE EAST RIGHT-OF-WAY LINE OF DRANSFELDT ROAD DEEDED BY RECEPTION NO. 2002088425 AND A POINT OF NON-TANGENT CURVATURE:

THENCE ALONG SAID EAST RIGHT-OF-WAY LINE THE FOLLOWING SIX (6) COURSES:

1) ALONG THE ARC OF SAID CURVE TO THE RIGHT AN ARC LENGTH OF 25.79 FEET, SAID CURVE HAVING A RADIUS OF 660.00 FEET, A CENTRAL ANGLE 0F 02°14'19" AND A CHORD WHICH BEARS NORTH 02°20'42" WEST A CHORD DISTANCE OF 25.79 FEET;

2) NORTH 01°13'32" WEST, A DISTANCE OF 165.71 FEET TO A POINT OF CURVATURE;

3) AL0NG THE ARC OF SAID CURVE TO THE LEFT AN ARC LENGTH OF 43.04 FEET, SAID CURVE HAVING A RADIUS OF 740.00 FEET, A CENTRAL ANGLE OF 03°19'57", AND A CHORD WHICH BEARS NORTH 02°53'30" WEST A CHORD DISTANCE OF 43.03 FEET;

4) NORTH 04°33'29" WEST, A DISTANCE OF 217.83 FEET TO A POINT OF CURVATURE;

5) ALONG THE ARC OF SAID CURVE TO THE RIGHT AN ARC LENGTH OF 49.23 FEET, SAID CURVE HAVING A RADIUS OF 3O.00 FEET, A CENTRAL ANGLE OF 94°01'51", AND A CHORD WHICH BEARS NORTH 42°27'27" EAST A CHORD DISTANCE OF 43.89 FEET;

6) NORTH 04°33'21" WEST, A DISTANCE OF 15.04 FEET TO THE POINT OF BEGINNING.

SAID PARCEL CONTAINS 346,479 SQUARE FEET OR 7.95 ACRES, MORE 0R LESS

After the approved annexation in 2021, the proposed development is located within the boundaries of the Town of Parker. The site is bordered by Lincoln Avenue on the north and Dransfeldt Road on the west, both which operates under the jurisdiction of the Douglas County Public Works. Interstate 25, a major thorough-fare for the Denver metro area, is located just 8 miles to the west of the site. As a part of this project, the applicant proposes a new driveway connection on Dransfeldt to align with the existing driveway into Lowe's Home Improvement as well as maintaining the existing driveway access onto Lincoln Avenue, that is currently serving the Walgreens pharmacy and a residential parcel.

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

The proposed Maverik Convenience Store consists of a new, approximately 4500SF store with a fuel canopy that contains up to 6 fuel islands. The parcel is zoned general commercial with restaurant uses most common in the surrounding properties. The development includes shared driveways and access aisles with the proposed development at Parcel __ that has not yet been defined. A separate parcel has been created to contain the regional drainage for the overall master development. The design of that regional detention was prepared by HKS and is referenced in this report.

B: DESCRIPTION OF PROPERTY

The proposed development consists of 1.30 acres of previously undeveloped property within a larger planned commercial/retail development. The site is currently vacant land that was originally intended

as agricultural land but has remained unused for many years. Remnants of a former residence will be demolished as part of this proposed development. A site visit by DCI Engineers in June 2021 saw no visible signs of drainage issues or flooding concerns on the property.

An analysis by DCI Engineers indicates a weighted impervious percentage of 79% for the complete build out of the Maverik parcel. Under the criteria of Table 6-3 from Chapter 1 of the UDFCD (Mile High Flood District) Manual, areas within the development were separated into categories. Roofs were assigned an impervious percentage of 90%, sidewalks and asphalt pavements received a 100% percent categorization, and lawn and landscaped areas were assigned a 2% weighted impervious percentage. The resulting calculations can be found in Appendix A. The weighted impervious percentage is below the same weighted percentage for the existing restaurant space, ensuring that the proposed drainage systems do not exceed the regional capacity. A copy of the calculations identifying land uses for the weighted impervious percentage is included in Appendix A.

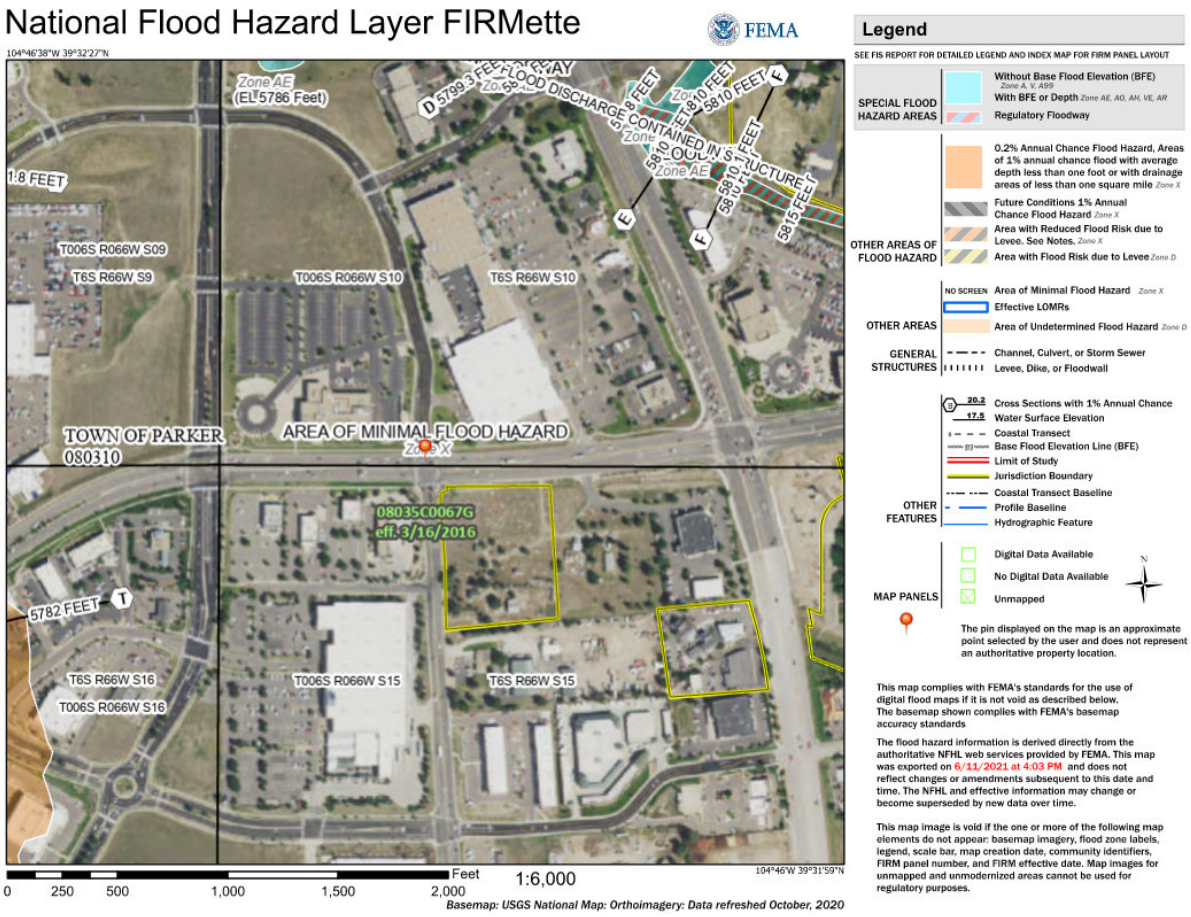
Image 1: Existing Project site facing west along Lincoln

Image 2: Existing site facing north from Dranfeldt

DCI consulted the Natural Resources Conservation Service's (NRCS) Web Soil Survey for a description of local soil types in the area. The soil type across the site is primarily Bresser Sandy Loams loams with slopes in the 1-3% range with a small sample of Sampson Loams. The soils classified as being well-drained and belonging to Hydrologic Group B.

The site lies within the Newlin Gulch basin of the South Platte River (via Cherry Creek). The tributary flows to the northwest through a primarily non-engineered channel (Cherry Creek) as it heads towards its confluence with the South Platte River near downtown Denver.

The proposed Maverik site is located within the area designated as Zone X under FEMA Flood Insurance Rate Map No. 08035C0067G. The map was last modified on March 16, 2016. Zone X indicates that the property is located outside of the are considered to be a special flood hazard zone.



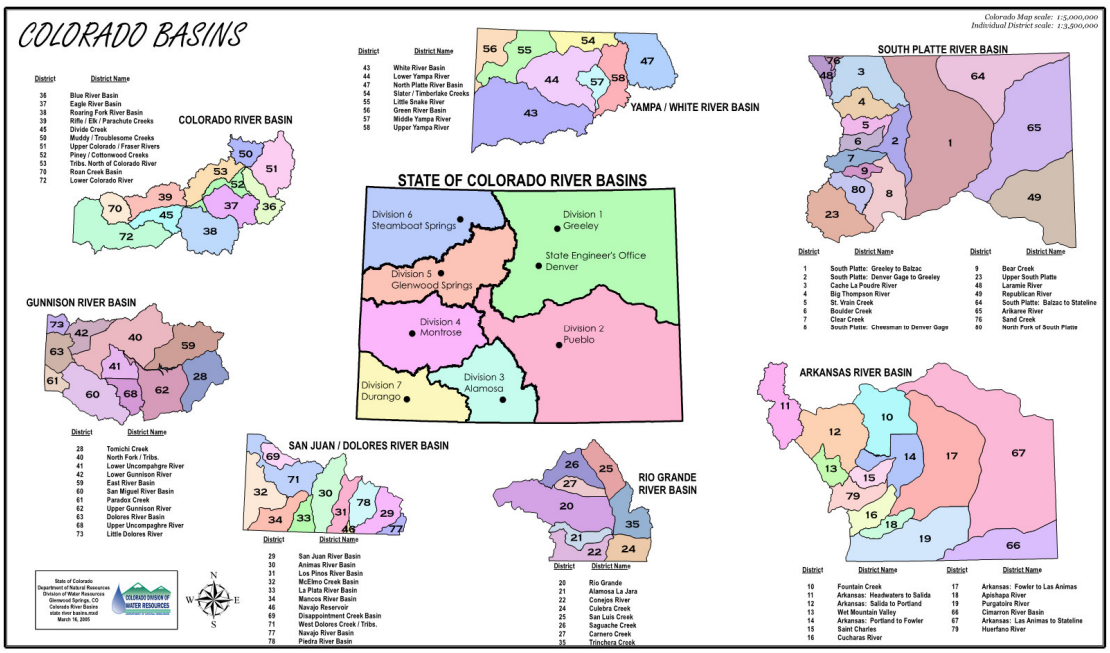
As a part of the proposed development, we do not anticipate any development within a flood plain or any negative effects to the existing floodplain delineations. No additional floodplain permits are required for projects occurring fully outside of the designated floodplain boundaries.

An analysis of the site by DCI Engineers in June of 2021 revealed no signs of current or former irrigation canals or ditches serving the proposed property. There is a drainage swale on the northern boundary of the site that appears to capture runoff from the property and conveys it into the municipal storm drain system at the northwest corner of the proposed development.

SECTION III. DRAINAGE BASINS AND SUB-BASINS

A: MAJOR DRAINAGE BASINS

The State of Colorado is comprised of seven major river basins that are governed by separate divisions within the Colorado Department of Water Resources. The City and County of Denver make up the largest metropolitan city within the South Platte River Basin. The River Basin covers approximately 22,000 square miles in northeastern Colorado and accounts for nearly two-thirds of the state's gross municipal and industrial water demand. Estimates of the total demand for the South Platte River Basin fall between 324,000 and 467,000 acre-feet of water per year.



The South Platte Basin supports a wide range of water needs including municipal, industrial, agricultural as well as important water-dependent ecological and recreational attributes. Coloradoans and tourists regularly enjoy the recreational opportunities provided by the many environmental features of the basin. A South Platte Implementation Plan was developed by HDR in 2015 to identify the unique challenges associated within this river basin.

Within the South Platte River Basin, the site is located within the Newlin Gulch Sub-Basin, a tributary to Cherry Creek. This sub-basin is comprised mostly of a highly urbanized land use with a mix of commercial and residential projects. DCI Engineers analyzed the existing stormwater catchment area using available data from the U.S. Environmental Protection Agency's GeoWaters Viewer. The facility is located within a larger 150-acre catchment that drains into the municipal strom drain system with a discharge into a section of Cherry Creek. Based on Land Use data provided from 2011, this area included approximately 6% High Density Development, 18% Medium Density Development, and 3% Low Density

Development. The remaining land uses include a mix of open space, natural waterways, and grasslands. DCI estimated an approximate roughness coefficient of 0.61 for the overall catchment area. In the fully developed condition, we propose a weighted impervious percentage of approximately 79% (per the land use calculations in Appendix A) which is negligible with respect to the greater 150-acre catchment.

Flows from the existing development flow in the northerly and westerly direction towards the existing underground storm drain system with eventual outlet into the Newlin Gulch catchment of Cherry Creek. The project will utilize regional detention to mitigate any increase in flows and maintain the current drainage patterns through the catchment.

B: MINOR DRAINAGE BASINS

Under the proposed improvement plan, this parcel will consist of a 5,800 SF convenience store with a seven fuel island canopy and surface parking. The site will be mostly paved in asphalt with some buffer landscaped areas around the perimeter to match existing grade. At full build-out, the weighted impervious percentage is 79% for the parcel based on the Mile High Flood District Land Use Criteria (Rational Method calculations using UD-Rational software are included in the appendices).

The proposed site has been designed to drain into an underground storm drain system that connects into the regional pond located just west of the proposed parcel. In general, flows will be conveyed over the surface of the asphalt parking lot and along curb and gutter into a series of Type R inlets at the northeast and southeast corners of the site. In addition the upstream side of the fuel canopies contains a trench drain designed to capture runoff from the parking area before it has the potential to co-mingle with any potential fuel spills underneath the canopies. The intent is to separate “clean” runoff from that which may potentially be contaminated with hydrocarbons. A second trench drain is proposed downstream of the fuel canopies and will be connected to an oil-water separator to ensure the removal of hydrocarbons before discharging into the detention pond downstream.

The existing site was designed as residential/agricultural use with surface drainage leading in the northwesterly direction towards the existing concrete outfall at the corner of Dransfeldt and Lincoln Avenue. As shown in the photos below, the existing site is currently covered in native grasses with the remains of a small one story residence that will be removed as a part of the project. There is no known underground drainage systems or channelized flow through the site.



Douglas County and the Town of Parker maintain various irrigation channels designed to carry flows to different regions within the county limits. At the time of the proposed development, there are no current *irrigation* channels within the proposed limits of the study. Flows from the surrounding Lincoln Avenue right of way are captured in curb inlets and released into a roadside swale that extends along the northern boundary of this site. Flows are conveyed in this swale to a concrete box culvert that runs beneath Dransfeldt as they make their way westwardly to Cherry Creek. The proposed site does not intend to modify the existing roadside swale in any way.

The off-site flow patterns and paths will not be impacted by the proposed development on the property. The roadside swale discussed above will remain in tact for the purpose of draining Lincoln Avenue. Onsite flows will be captured and conveyed into a detention pond before being released at a control rate to the outfall at the Dransfeldt intersection. Similarly, the proposed grades on the site have been designed such that offsite flows will remain within the road-side swale without entering the boundaries of the proposed improvements.

SECTION IV. DRAINAGE DESIGN CRITERIA

A: REGULATIONS

The proposed development was originally part of unincorporated Douglas County, but has since been approved for annexation into the Town of Parker limits. The design of this proposed development is thus subject to the latest stormwater standards of the Town of Parker's Storm Drainage and Environmental Criteria Manual. In accordance with the latest guideline revisions dated February 2014, this project was analyzed for the 5 yr and 100 year recurrence intervals.

The 1.30 acre site is well under the threshold required for the use of the Colorado Urban Hydrograph Procedure and thus the site was analyzed using the modified rational method. The proposed area was broken up into smaller sub-drainage basins to represent localized flow-paths and a rational method analysis was conducted on each individual sub-basin using the procedures developed in the Mile High Flood District manual.

The rational method is based on the direct relationship between rainfall and runoff and can be expressed by the equation

Q = CIA

In which:

Q = the maximum rate of runoff (cubic feet per second [cfs])
C = the runoff coefficient that is the ratio between the runoff volume from an area and the average rainfall depth over a given duration for that area
I = the average intensity of rainfall for a duration equal to the time of concentration (inches/hour) A = basin area (acres)

The runoff coefficients for each sub-watershed were developed using the UD-Rational Spreadsheet produced by the Mile High Flood District (MHFD/UDFCD). A copy of the Spreadsheet is available in the Appendix.

The Town of Parker utilizes the criteria set forth by the Mile High Flood District (Previously the Urban Drainage Flood Control District) with respect to hydrology and stormwater detention. For sub-basins smaller than 5 acres, the rational method is an accepted method for determining pre and post developed hydrology.

This particular property is a part of a larger master planned development that has been designed to capture and treat the runoff from both the Maverik parcel and Parcel 2 (as of yet undetermined). The proposed basin was designed by HKS in 2021 as a full spectrum

detention facility capable of capturing and treating all proposed runoff from both parcels. Full spectrum detention involves the storage of runoff volumes into three separate volumes. Volume one is defined as the Water Quality Control Volume, as described in Section E of this report. In addition, Volume 2 consists of the Excess Urban Runoff Volume (EURV) minus the WQCV. The third and final volume reflects the 100-year runoff volume, exclusive of the EURV. This project has provided the appropriate flow summaries to the master developer for incorporation into the overall pond design, but does not address the design of the pond. A copy of that design has been included in the Appendices for reference.

B: DRAINAGE STUDIES, OUTFALL SYSTEMS PLANS, SITE CONSTRAINTS

The Highland Ranch Community is a master planned community located wholly within the boundaries of Douglas County. As part of the development, the Highlands Ranch Metro District works with the County and the Mile High Flood District to maintain a system of storm drain structure that serve the community.

This particular site lies within a larger planned commercial development that is served by a regional detention system designed to capture, convey, and treat stormwater flows for the retail parcels prior to discharge into the Dad Clark Gulch system. This property is part of a larger 248 acre catchment that contributes flows into the Dad Clark Gulch.

The proposed development associated with the Prost Biergarten does not impact the existing drainage patterns or flows across the parcel, or the larger regional basin. Due to the nature of the improvements (replacing impervious patio space and surface parking with impervious outdoor seating area), the total impervious percentage is reduced by 1% over the entire 1.92 acre parcel area.

C: HYDROLOGY

The proposed development is subject to the latest stormwater standards of the Town of Parker's Storm Drainage and Environmental Criteria Manual. The project's contributing area, totaling 1.30 acres, was analyzed as a series of individual sub-basins, each under the five-acre threshold for the use of the Colorado Urban Hydrograph Procedure. In accordance with the latest guidelines, this project was analyzed for the 5-yr and 100-year recurrence intervals using the Rational Method.

The runoff coefficients for the parcel was developed using the UD-Rational Spreadsheet produced by the MHFD/UDFCD. The spreadsheet analyzes the existing and proposed conditions at the site relative to sub-watershed size, soil types, site slopes, flow paths, and time of concentrations. A copy of the Spreadsheet is available in the Appendix.

The existing parcel is proposed as a one-story convenience store with surface asphalt parking and a single story fuel canopy that acts as additional roof area. The existing parcel contains 77% impervious area, which includes sidewalks/patio space, roof area, and parking. At full build out, the proposed development is anticipated to be approximately 79% impervious (based on a weighted value in accordance with recommended values in UDFCD Table 6-3).

The hydrological analysis for the site was conducted in accordance with the methodology listed in the Town of Parker's Storm Drainage and Environmental Criteria Manual. The project was analyzed for both minor and major storms for commercial projects. A 5 year-1 hour recurrence interval was selected for use as the minor storm event. For purposes of major storm events, the site was analyzed using the rational method for a 100 year-1 hour recurrence interval. The proposed runoff will maintain its existing drainage patterns towards the outfall on the northwest corner of the site, however, it will be conveyed to that point through a series of underground pipes and an extended detention basin to meter the flows prior to discharge.

The basis of storm drainage and hydrologic design for The Town of Parker is found in Chapter 5 of the Storm Drainage and Environmental Criteria Manual. The town in characterized by a single rainfall zone which can be estimated using point rainfall data. Table 5.1 of the Criteria Manual outlines the proposed 1 hour point rainfall for the Town of Parker at various design intervals. The 1-hour duration rainfall depth for various recurrence intervals has historically been used for the calculation of runoff using the Rational or the CUHP method.

TABLE 5.1
ONE-HOUR POINT RAINFALL

Frequency of Design Event (yr)	One-hour Point Rainfall, P_1 (in)
2	0.99
5	1.39
10	1.64
25	1.98
50	2.31
100	2.60

For the purpose of small urban watersheds less than 160 acres in size, a rainfall intensity duration frequncy curve can be used in association with the Rational Method, to determine

rainfall intensity distribution over the period of the 1 hour duration equation RS-1 from the Manual decribes the Intensity with the following equation:

Table 5.3 provides the rainfall intensity-duration values calculated for use with the Rational Method in small watersheds that are 160 acres or less in size, based on the following equation:

$$I = \frac{28.5\ P_1}{(10 + T_c)^{0.786}} \qquad \text{(Equation 5.1)}$$

in which:

I = rainfall intensity (inches per hour)

P_1 = 1-hour point rainfall depth (inches)

T_c = time of concentration (minutes)

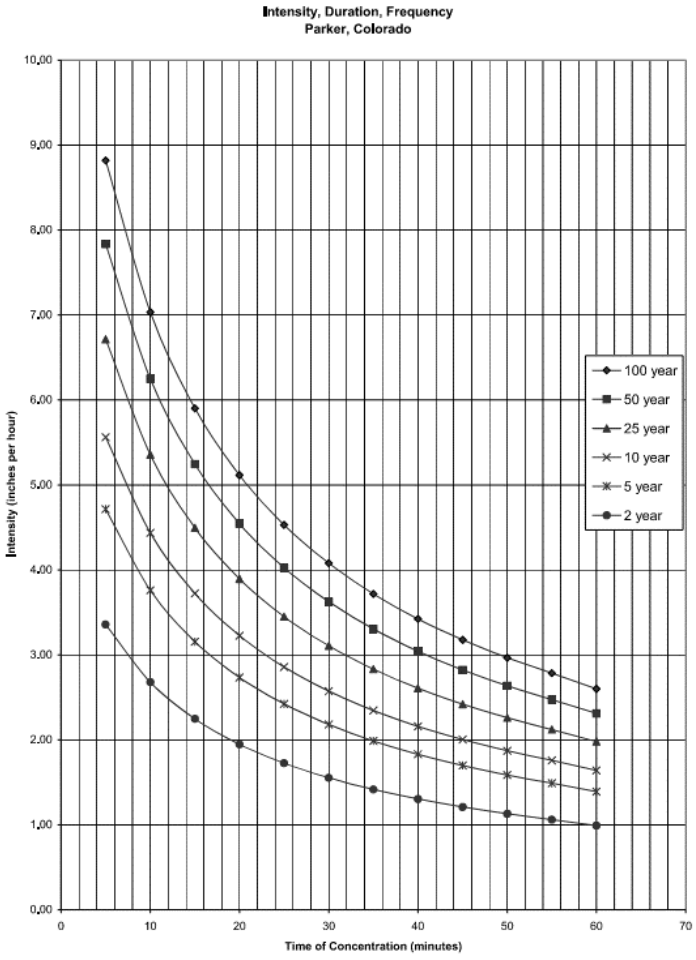


FIGURE 5.1
RAINFALL INTENSITY VERSUS DURATION CURVES FOR PARKER, COLORADO

Both the Town of Parker and Douglas County utilize full spectrum detention to reduce flooding associated with urban development by reducing peak flows across an entire range of storm events up to the 100-year flood event. Full spectrum detention involves the storage of runoff volumes into three separate volumes, depending on the design of the facility. Volume one is defined as the Water Quality Control Volume, as described in Section E of this report. In addition, Volume 2 consists of the Excess Urban Runoff Volume (EURV) minus the

WQCV. The third and final volume reflects the 100-year runoff volume, exclusive of the EURV.

New development and significant redevelopment within the Town of Parker limits are governed by the latest version of the Mile High Flood District Manual and the Town of Parker's Storm Drainage and Environmental Criteria Manual. The drainage system shall account for runoff from both minor and major storm events. The 5-year recurrence interval is utilized as the basis for minor storm events. The design capacity for the development for the major and minor storm events does not include the effects of onsite detention on the peak flows. In all cases, the onsite system has been designed to protect the existing and proposed structures and inhabitants from hazards associated with the 100-year storm event.

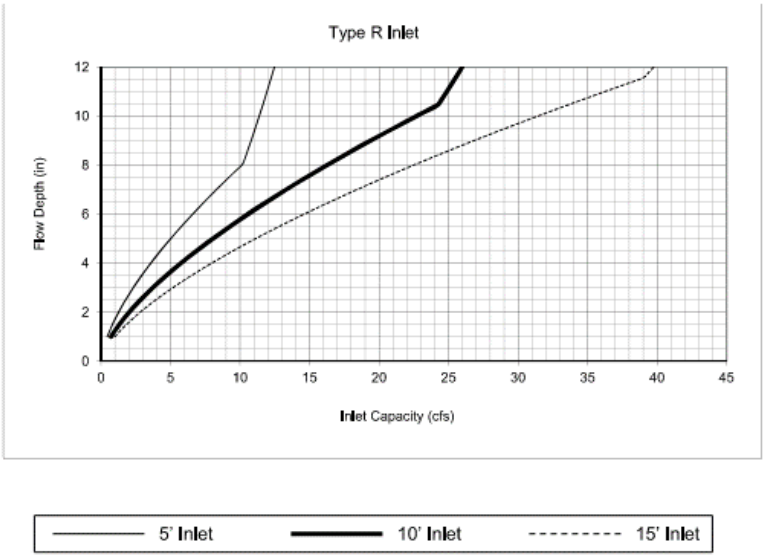
This particular project is being designed as a portion of a greater master planned development with regional detention. The extended detention basin has been sized by HKS according to the flow rates and impervious surfaces presented here. A copy of the master drainage document has been included in the Appendices.

D: HYDRAULICS

Typical design of storm drain systems within the Town of Parker utilize the hydraulic loss method to ensure sufficient capacity in the underground systems. Both inlets and piping are sized to adequately convey the 5 year and 100 year storms with a minimum of 1 foot of freeboard between the maximum Hydraulic Grade Line and the finished surface. Type R inlets were selected based on the Town of Parker's Inlet Capacity Chart for sump conditions, shown below.

INLET CAPACITY CHART SUMP CONDITIONS

CURB OPENING (TYPE R) INLET



This particular project utilizes a combination of overland flow over existing parking lot and underground piping to convey runoff towards the regional detention pond on the west side of the property. Flows travel over parking areas and collect in a series of Type R inlets that collect the runoff into the private underground drainage system, to be maintained by Maverik. Onsite piping was analyzed using the Storm and Sewer Analysis software within AutoDesk Civil 3D. The pipes were calculated at the minor storm (5yr) and major storm (100 yr) events to ensure that the Hydraulic Grade Line was located wholly within the pipe (for the minor storm event) and at least 12" below the finished surface in the major storm event.

E: WATER QUALITY ENHANCEMENT

The project proposes the continuation of the use of the regional detention pond that is proposed to serve the master commercial development. The detention basin was designed according to the Town's standards for water quality treatment and the design can be found in the document prepared by HKS in 2021-2022.

The Town of Parker falls under the purview of the Phase II Non-Standard Municipal Separate Storm Sewer System (MS4) Permit as administered by the Colorado Water Quality Control Division. The permit coverage, under Permit No. COR-070000, requires the management of stormwater runoff from urban development. In accordance with the MS4 permit for the State of Colorado we assume that this development was originally designed per the guidance of the Mile High Flood District's Urban Storm Drainage Criteria Manual.

The Criteria Manual aims to promote a reduction in runoff volume while requiring the treatment of the Water Quality Control Volume prior to the discharge into the municipal storm system.

In addition to the requirements of the Phase II MS4, this project is also subject to the Town's requirements for Grading, Erosion, and Sediment Control as outlined in the County's GESC Manual. A separate GESC Plan has been prepared by DCI Engineers to establish the proposed plan for the protection of the storm drain system from construction sediment loss. Due to the size of the project (over 1 acre), a separate Storm Water Management Plan must be submitted to the Colorado Department of Public Health to comply with the requirements of the NPDES General Construction Permit as well.

SECTION V. STORMWATER MANAGEMENT FACILITY DESIGN

A: STORMWATER CONVEYANCE FACILITIES

The proposed storm drainage for the site has been designed to maintain compliance with the existing drainage patterns on the site. The proposed improvements have been analyzed by DCI with respect to runoff and we have concluded that the effects on the existing drainage system will be negligible due to the controlled discharge from the engineered detention pond to Newlin Gulch.

The existing drainage path for the site consists of overland flow over native grasses to the road-side swale that is located along the northern perimeter of the site. The swale runs east to west and carries runoff from both the proposed site and Lincoln Avenue into a box culvert that runs westwardly under Dransfeldt. A site visit by DCI Engineers on June 14th, 2021 saw little evidence of standing water, though measurable rainfall was recorded on the site the previous day.

At full build out, the proposed project will mimic the existing drainage conditions. Flows will be directed over the surface of the asphalt parking lot towards new Type R curb inlets situated on the east side of the site. Once captured, the flows will be conveyed back towards the proposed detention pond on the parcel west of this one. The runoff will be detained in the extended detention basin where it will collect with other flows from the neighboring parcel. A metered outflow, using a water quality orifice plate will ensure the adequate treatment of runoff with a WQCV drain time of 40 hours.

The site was analyzed using the Rational Method in the pre and post developed condition. A summary of each condition is included in the table below. A copy of the pre and post-developed drainage maps are included in the appendices.

Existing Basin EX-11 consists of 1.30 Acres that are entirely landscaped with native grasses for a weighted impervious percentage of 2% based on the MHFD tables. Drainage from the site travels northeasterly into the road-side swale that borders the development along the northern boundary. The average slope across the site is approximately 1.5% as it travels from north to south and approximately 2% as it flows from east to west. Design Point #1

Proposed Basin A-1 consists of 0.13 acres, or 5,800SF, that represents the full span of the proposed convenience store rooftop (90% Impervious per UDFCD). At this time, the final locations of roof downspouts are unknown, however, we have accounted for the runoff of the roof in a single basin which will yield conservative pipe sizing downstream. Once the downspouts have been determined, the area will be split into sub-basins for the purpose of determining the hydraulic sizes of the downspout connections. Design Point #1.

Proposed Basin B-1 consists of 0.06 acres representing the concrete patio on the north side of the proposed convenience store. The patio is entirely concrete pavement with a land use impervious percentage of 100% per MHFD. The patio is sloped gently at an approximate slope of 1-2% towards the north. The patio sub-basin drains over the surface of the concrete into a series of landscape drains located at the edge of the patio and the slope to the north. From those drains, the runoff is conveyed east to SDMH#1, before the confluence with onsite and offsite flows from the parking lot. Design Point #2.

Proposed Basin B-2 consists of 0.12 acres of asphalt pavement that cover a large portion of the northwest corner of the parking lot. The sub-basin slopes at an approximate slope of 1.5% towards the northeast and has a weighted impervious cover of 100%. Flows in this basin enter at the Type R Inlet CB#1 on the northeast corner of the site before flowing back to the west into SDMH#1. Design Point #3.

Proposed Basin B-3 consists of 0.12 acres of asphalt pavement with a small section of landscaping that is located at the back of the curb along the eastern boundary of the parking lot. Runoff flows over the surface in a northerly direction into the Type R Inlet CB#1 on the northeast corner of the site. The slopes are approximately 1-1.5% and the weighted impervious percentage for the basin is 81.5%. At this Type R inlet, flows combine with the offsite flows coming from the shared driveway (sub-basin OS-2) which are then conveyed westwardly into SDMH #1. Design Point #4.

Proposed Basin B-4 consists of 0.12 acres of asphalt pavement along with a small section of concrete sidewalk that fronts the building entrance. The total weighted impervious percentage for the sub-basin is 100% per Mile High Flood District land use tables and the site generally slopes at approximately 1.5% towards the east. Flows from the basin sheet flow over the asphalt into a section of trench drain that is located on the upstream side of the fuel canopy. From there, runoff is conveyed in underground piping towards the west where it enter the storm drain mainline running from SDMH #1 to SDMH #2. Design Point #5.

Proposed Basin B-5 is similar to the adjacent sub-basin and consists of 0.14 acres of asphalt pavement along with a small section of concrete sidewalk that fronts the building entrance. In addition, this sub-basin includes approximately 200 SF of landscaped area that brings the weighted imperviousness down to 96.8%. Flows from the basin sheet flow over the asphalt into a section of trench drain that is located on the upstream side of the fuel canopy. From there, runoff is conveyed in underground piping towards the west where it enter the storm drain mainline running from SDMH #1 to SDMH #2. Design Point #6.

Proposed Basin B-6 captures a 0.08 acre portion of asphalt parking lot with concrete sidewalk. This sub-basin flows eastwardly at an approximate slope of 1-2% towards the trench drain upstream of the proposed canopy. Flows from this basin sheet flow over the asphalt before entering the underground piping system for the site. The weighted impervious percentage for this basin is 100%. Design Point #7.

Proposed Basin C-1 captures a 0.03 acre portion of the proposed fuel canopy located east of the Maverik store. The canopy design drains into a flat roof system that discharges into a roof downspout with a direct connection to the underground storm drain line. The canopy is 90% impervious per MHFD and has been calculated with an assumed slope of 2% maximum. Design Point #8.

Proposed Basin C-2 captures a 0.05 acre portion of the proposed fuel canopy located east of the Maverik store. Similar to the basin above canopy, the basin drains into a flat roof system that discharges into a roof downspout with a direct connection to the underground storm drain line. The canopy is 90% impervious per MHFD and has been calculated with an assumed slope of 2% maximum. Design Point #9.

Proposed Basin C-3 consists of 0.03 acres of rooftop covering the southern-most portion of the proposed fuel canopy. Similar to the basin above, the basin design drains into a flat roof system that discharges into a roof downspout with a direct connection to the underground storm drain line. The canopy is 90% impervious per MHFD and has been calculated with an assumed slope of 2% maximum. Design Point #10.

Proposed Basin D-1 consists of 0.16 acres of predominantly asphalt pavement, with a small section of landscaping behind the curb. Flows in this basin run over the surface in the easterly direction where they are captured against the curb and flow south into the Type R inlet (CB #2). The total weighted imperviousness for the basin is 75.3%. Once captured in the inlet, the runoff from this basin combines with flows from basins D2 as well as offsite basin OS-3 before flowing in the underground storm drain towards the detention basin to the west. Design Point #11.

Proposed Basin D-2 consists of 0.07 acres of mostly asphalt pavement that wraps around the southeast end of the proposed fuel canopy. Flows in this basin run over the surface in the easterly direction where they combine with the rest of the parking lot drainage as they enter CB#2. The total weighted imperviousness for the basin is 86.9% which reflects a small portion of landscaping on the backside of the Type R inlet which flows back into the parking lot. Once captured in the inlet, the runoff from this basin combines with flows from basins D1 as well as offsite basin OS-3 before flowing in the underground storm drain towards the detention basin to the west. Design Point #12.

Proposed Basin E-1 represents a 0.11 acre landscape buffer section along the western boundary of the proposed site. Due to the proposed finished floor elevation relative to the property line, this narrow 10-12 foot section slopes down at a 3:1 grade to match the existing elevations at the property line. This basin includes a small concrete patio area on the northeast corner of the building, but otherwise is fully landscaped for a weighted impervious percentage of 8.7%. Runoff from this sub-basin flows over the surface of the vegetation towards the detention pond located west of the site. No piped drainage is anticipated for this sub-basin. Design Point #13.

Proposed Basin OS-1 represents a 0.07 acre landscape buffer section along the northern boundary of the proposed site. The sub-basin daylights at the existing road-side swale that conveys flows from Lincoln Avenue, towards the west to the concrete outfall piping under Dransfeldt. The intent of the sub-basin is to retain the existing off-site road drainage while maintaining an adequate landscape buffer to the proposed parking lot. The total weighted imperviousness will remain at 2% (fully vegetated) and will drain over the surface into the existing swale. Peak flows from this drainage basin have been calculated as part of the site flows, though they have not been accounted as draining into the regional detention pond. Design Point #14.

Proposed Basin OS-2 represents a 0.17 acres of asphalt pavement that coincide with the shared access driveway that leads from Lincoln Avenue towards the proposed Maverik site. This sub-basin is located entirely off-site from the proposed parcel, however, the runoff from the driveway flows westwardly along the curb and gutter at an approximate slope of 2% and enters the Type R Inlet at CB#1. The weighted imperviousness has been calculated as 100%, reflective of a fully paved basin. Peak flows from basin OS-2 are not counted as part of the onsite flows, however, the flows do enter the site and have thus been accounted for in the sizing of the pipes and total flows entering the basin. Design Point #15.

Proposed Basin OS-3 represents a 0.11 acres of asphalt pavement that flows from the off-site shared driveway access from Lincoln and flows into the Maverik site at CB#2. The total weighted imperviousness of 100% reflects the paved surface in accordance with Mile High Flood District standards. Slopes in this area are generally mils and average approximately 3% across the basin. Similar to basin OS-2, the peak flows are outside of the Maverik parcel, but

do flow onto the site and have been accounted for in the pipe design as well as the total runoff into the property. Design Point #16.

Proposed Basin OS-4 represents a 0.23 acres of asphalt pavement from the shared access driveway leading from Dransfeldt into the Maverik site. This basin is entirely paved (100% impervious) and is situated entirely outside of the boundary of the Maverik parcel. Flows from this sub-basin travel over the surface of the driveway towards the curb and gutter along the northern side of the drive aisle. From there they flow west at approximately 2% into a Type R Inlet (CB#3) that feeds directly into the regional pond. Note the flows from this area do NOT enter the Maverik parcel, though they have been calculated for the purpose of designing the proposed inlet. Design Point #17.

Table 3: Land Use Summary Table for Post-Developed Conditions

PROPOSED LAND USE CALCULATIONS

Design Point	Tributary Basins	Landscape Area (SF)	Artificial Turf (SF)	Pvmt (SF)	Roof (SF)	Total Contributing Area (Ac)	Landscape (Ac)	Runoff Coeff	Artificial Turf (Ac)	Runoff Coeff	Pavement (Ac)	Runoff Coeff	Roof (Ac)	Runoff Coeff	Weighted Impervious %	Discharges To:
1	A1	0	0	0	5800	0.13	0.00	2.00	0.00	60.00	0.00	100.00	0.13	90.00	90.0	Roof Downspouts to be determined
2	B1	0	0	2657	0	0.06	0.00	2.00	0.00	60.00	0.06	100.00	0.00	90.00	100.0	Concrete Patio to landscape drains
3	B2	0	0	5256	0	0.12	0.00	2.00	0.00	60.00	0.12	100.00	0.00	90.00	100.0	Parking Lot Surface flow to CB#1
4	B3	1029	0	4410	0	0.12	0.02	2.00	0.00	60.00	0.10	100.00	0.00	90.00	81.5	Parking Lot Surface flow to CB#1
5	B4	0	0	5062	0	0.12	0.00	2.00	0.00	60.00	0.12	100.00	0.00	90.00	100.0	Parking Lot Surface flow to Trench Drain 1
6	B5	200	0	5877	0	0.14	0.00	2.00	0.00	60.00	0.13	100.00	0.00	90.00	96.8	Parking Lot Surface flow to Trench Drain 1
7	B6	0	0	3425	0	0.08	0.00	2.00	0.00	60.00	0.08	100.00	0.00	90.00	100.0	Parking Lot Surface flow to Trench Drain 1
8	C1	0	0	0	1408	0.03	0.00	2.00	0.00	60.00	0.00	100.00	0.03	90.00	90.0	Fuel Canopy Roof Drains to Underground Storm
9	C2	0	0	0	2202	0.05	0.00	2.00	0.00	60.00	0.00	100.00	0.05	90.00	90.0	Fuel Canopy Roof Drains to Underground Storm
10	C3	0	0	0	1360	0.03	0.00	1.00	0.00	59.00	0.00	99.00	0.03	89.00	89.0	Fuel Canopy Roof Drains to Underground Storm
11	D1	1734	0	5151	0	0.16	0.04	2.00	0.00	60.00	0.12	100.00	0.00	90.00	75.3	Parking Lot Surface flow to CB#2
12	D2	416	0	2698	0	0.07	0.01	2.00	0.00	60.00	0.06	100.00	0.00	90.00	86.9	Parking Lot Surface flow to CB#2
13	E1	4487	0	328	0	0.11	0.10	2.00	0.00	60.00	0.01	100.00	0.00	90.00	8.7	Overland flow direct to detention pond
14	OS1	3191	0	0	0	0.07	0.07	2.00	0.00	60.00	0.00	100.00	0.00	90.00	2.0	Overland flow direct to road-side swale
15	OS2	0	0	7341	0	0.17	0.00	2.00	0.00	60.00	0.17	100.00	0.00	90.00	100.0	Offsite pavement flow from driveway into site at CB#1
16	OS3	0	0	4813	0	0.11	0.00	2.00	0.00	60.00	0.11	100.00	0.00	90.00	100.0	Offsite pavement flow from driveway into site at CB#2
17	OS4	0	0	10034	0	0.23	0.00	2.00	0.00	60.00	0.23	100.00	0.00	90.00	100.0	Offsite pavement flow into Offsite CB#3

B: STORMWATER STORAGE FACILITIES

Stormwater detention on the property was designed under the original design of the master development, prepared by HKS in 2021. The property was designed to detain flows within an extended detention pond located within Parcel 1 with a connection to the regional system through the box culvert on the northwest corner of the site.

C: WATER QUALITY ENHANCEMENT BMPs

In order to protect the quality of downstream water bodies, the owner shall implement a comprehensive plan for education and outreach to the individual tenants to promote the benefits of enhanced water quality. An operations and maintenance plan has been developed with this Drainage Report and shall outline the goals, procedures, and processes through which the site shall ensure the protection of water quality for downstream users.

D: FLOODPLAIN MODIFICATIONS

The proposed Maverik site is located within the area designated as Zone X under FEMA Flood Insurance Rate Map No. 08035C0067G. The map was last modified on March 16, 2016. Zone X indicates that the property is located outside of the are considered to be a special flood hazard zone. As a result, there is no modifications to existing floodplains being requested, nor is there any proposed work within a regulatory floodway that would require a floodplain development permit.

SECTION E: ADDITIONAL PERMITTING REQUIREMENTS

In addition to permitting through the Town of Parker Land Development Process, projects within the town limits may be subject to additional permit requirements depending on anticipated scope and location.

Section 404 of the Clean Water Act (CWA) establishes a program to regulate the discharge of dredged or fill material into *waters of the United States*, including wetlands. Activities in waters of the United States regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation (e.g., certain farming and forestry activities).

This project is located outside of the established floodplain and there are no signs of established waters of the United States within the project boundaries. DCI analyzed the National Wetland Inventory database provided by the US Fish and Wildlife Service. The nearest emergent wetland is located approximately ½ mile west of the site along the banks of Cherry Creek.

The proposed development is located within the relatively urbanized Newlin Gulch watershed that encompasses a small portion of the Town of Parker. The proposed site is currently situated on one of the few remaining undeveloped parcels within the larger developed portion of the Town infrastructure. We do not anticipate the need for any additional permitting or monitoring as a result of the Endangered Species Act.

SECTION VI: CONCLUSIONS

A: COMPLIANCE WITH STANDARDS

The proposed Drainage Report for Maverik Convenience Store has been designed to comply with the requirements of the Town of Parker Storm Drainage and Environmental Criteria Manual (SDECM) and the Mile High Flood District Manual.

In accordance with the Town of Parker standards, the site was analyzed by DCI Engineers using a Rational Method analysis for the 5year, 1-hour storm event as well as the 100 year-1 hour major storm event. Rainfall intensities were calculated using user defined input from the DCSDDTCM Table 6-1 into the UD-Rational spreadsheet developed by the Mile High Flood District. The proposed improvements increased the overall weighted impervious percentage from the site by 2% compared to the pre-developed condition. The resulting analysis indicates that the overall development will increase the total runoff from the 7.95 acre site in both the minor and major storm events. A summary of the rational method analysis is included in the Appendix.

B: VARIANCES

DCI does not anticipate the need for any variances from Town of Parker standards for this development. The project scope is limited to the replacement of existing impervious area and will result in a total marginal reduction in the overall runoff. Existing flows from the site are conveyed into a regional detention pond that serves as stormwater detention for the larger commercial development, and as a result will not be impacted by the proposed project.

C: DRAINAGE CONCEPT

The overall drainage concept for the proposed project will have an increase in developed flows. The project scope will capture these flows and direct them through a series of storm sewer pipes and structures and direct those developed flows to the master developed detention pond adjacent to this property. The total impervious percentage is anticipated to increase from 2% to 79%.

Drainage on the site in both the existing and proposed conditions flows from east to west across the surface. Water is conveyed in a series of concrete gutters and ribbon gutters to a final discharge point at a curb inlet at the northeast end of the parking lot. Beyond the curb inlet, water is conveyed through storm sewer pipes to an existing storm manhole at the southwest entrance to the drive isle where it combines with flows from adjacent parcels into a detention system designed by HKS.

SECTION XI: REFERENCES

FEMA DFIRM Map No 08035C0028F and 08035C0036F. Federal Emergency Management Agency, September 30, 2005.

Douglas County Storm Drainage Design and Technical Criteria Manual; Douglas County; Revised May 2019.

National Wetlands Inventory Online Mapper; US Fish and Wildlife Service; April 2021

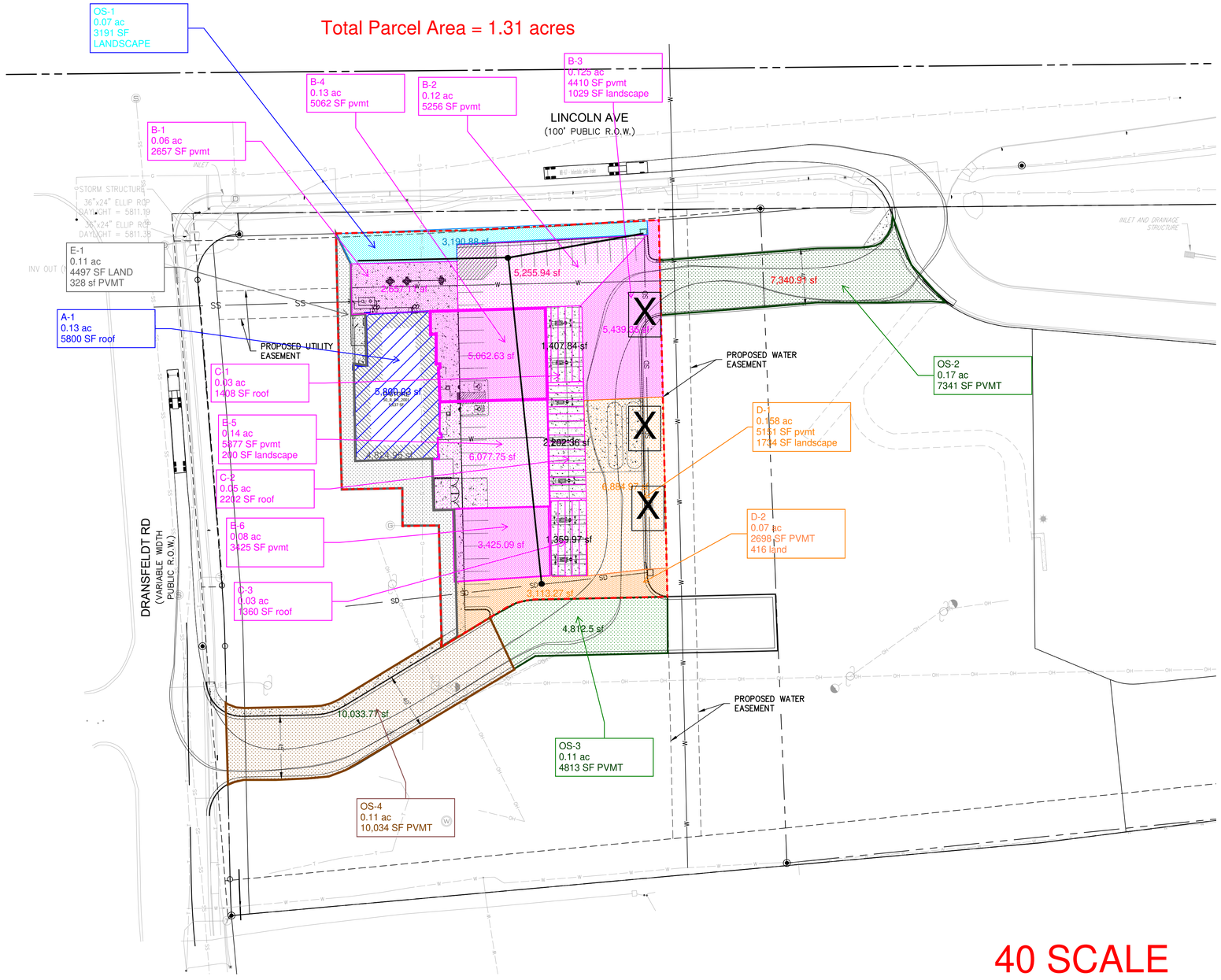
Urban Storm Drainage Criteria Manual-Volumes 1-3; Urban Drainage and Flood Control District (UDFCD); Revised March 2017.

SECTION XII: APPENDICES

Please refer to the attached Appendices for additional information/ reference documents.

A: HYDROLOGIC COMPUTATIONS

Total Parcel Area = 1.31 acres



40 SCALE

OFFSITE FLOWS AWAY FROM THE SITE

OFFSITE FLOWS INTO THE SITE

OFFSITE FLOWS DIRECT TO BASIN DRAINAGE BASIN E

ONSITE SURFACE FLOWS DRAINAGE BASIN A

ONSITE SURFACE FLOWS DRAINAGE BASIN B

ONSITE SURFACE FLOWS DRAINAGE BASIN D

ONSITE CANOPY FLOWS DRAINAGE BASIN C

OFFSITE FLOWS SEPARATE FROM CALCULATIONS (REFERENCE ONLY)

DCI Engineers
1331 17th Street
Suite 605
Denver, Colorado 80202

Maverik Lincoln and Dransfeldt
Maverik Inc.
Lincoln Avenue and Dransfeldt
Parker, CO

EXISTING LAND USE CALCULATIONS

Design Point	Tributary Basins	Landscape Area (SF)	Artificial Turf (SF)	Pvmt (SF)	Roof (SF)	Total Contributing Area (Ac)	Landscape (Ac)	Runoff Coeff	Artificial Turf (Ac)	Runoff Coeff	Pavement (Ac)	Runoff Coeff	Roof (Ac)	Runoff Coeff	Weighted Impervious %	Discharges To:
1	A1	56628	0	0	0	1.30	1.30	2.00	0.00	60.00	0.00	100.00	0.00	90.00	2.0	Overland flow to Outfall at Lincoln and Dransfeldt
	Sum:					1.30										

Total Weighted Impervious Area:

Sum of Area, A:	1.30		
Sum of Landscape Area	1.3	x 2%	0.026
Sum of Pavement:	0.00	x 100%	0
Sum of Artificial Turf	0.00	x60%	0
Sum of Rooftop:	0.00	x 90%	0
Sum / Total Area	1.3		0.020

Washington
Oregon
California
Texas
Alaska
Colorado
Montana
www.dci-engineers.com

DCI Engineers
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Denver, Colorado 80202

Maverik Lincoln and Dransfeldt
Maverik Inc.
Lincoln Avenue and Dransfeldt
Parker, CO

PROPOSED LAND USE CALCULATIONS

Design Point	Tributary Basins	Landscape Area (SF)	Artificial Turf (SF)	Pvmt (SF)	Roof (SF)	Total Contributing Area (Ac)	Landscape (Ac)	Runoff Coeff	Artificial Turf (Ac)	Runoff Coeff	Pavement (Ac)	Runoff Coeff	Roof (Ac)	Runoff Coeff	Weighted Impervious %	Discharges To:
1	A1	0	0	0	5800	0.13	0.00	2.00	0.00	60.00	0.00	100.00	0.13	90.00	90.0	Roof Downspouts to be determined
2	B1	0	0	2657	0	0.06	0.00	2.00	0.00	60.00	0.06	100.00	0.00	90.00	100.0	Concrete Patio to landscape drains
3	B2	0	0	5256	0	0.12	0.00	2.00	0.00	60.00	0.12	100.00	0.00	90.00	100.0	Parking Lot Surface flow to CB#1
4	B3	1029	0	4410	0	0.12	0.02	2.00	0.00	60.00	0.10	100.00	0.00	90.00	81.5	Parking Lot Surface flow to CB#1
5	B4	0	0	5062	0	0.12	0.00	2.00	0.00	60.00	0.12	100.00	0.00	90.00	100.0	Parking Lot Surface flow to Trench Drain 1
6	B5	200	0	5877	0	0.14	0.00	2.00	0.00	60.00	0.13	100.00	0.00	90.00	96.8	Parking Lot Surface flow to Trench Drain 1
7	B6	0	0	3425	0	0.08	0.00	2.00	0.00	60.00	0.08	100.00	0.00	90.00	100.0	Parking Lot Surface flow to Trench Drain 1
8	C1	0	0	0	1408	0.03	0.00	2.00	0.00	60.00	0.00	100.00	0.03	90.00	90.0	Fuel Canopy Roof Drains to Underground Storm
9	C2	0	0	0	2202	0.05	0.00	2.00	0.00	60.00	0.00	100.00	0.05	90.00	90.0	Fuel Canopy Roof Drains to Underground Storm
10	C3	0	0	0	1360	0.03	0.00	1.00	0.00	59.00	0.00	99.00	0.03	89.00	89.0	Fuel Canopy Roof Drains to Underground Storm
11	D1	1734	0	5151	0	0.16	0.04	2.00	0.00	60.00	0.12	100.00	0.00	90.00	75.3	Parking Lot Surface flow to CB#2
12	D2	416	0	2698	0	0.07	0.01	2.00	0.00	60.00	0.06	100.00	0.00	90.00	86.9	Parking Lot Surface flow to CB#2
13	E1	4497	0	328	0	0.11	0.10	2.00	0.00	60.00	0.01	100.00	0.00	90.00	8.7	Overland flow direct to detention pond
14	OS1	3191	0	0	0	0.07	0.07	2.00	0.00	60.00	0.00	100.00	0.00	90.00	2.0	Overland flow direct to road-side swale
15	OS2	0	0	7341	0	0.17	0.00	2.00	0.00	60.00	0.17	100.00	0.00	90.00	100.0	Offsite pavement flow from driveway into site at CB#1
16	OS3	0	0	4813	0	0.11	0.00	2.00	0.00	60.00	0.11	100.00	0.00	90.00	100.0	Offsite pavement flow from driveway into site at CB#2
17	OS4	0	0	10034	0	0.23	0.00	2.00	0.00	60.00	0.23	100.00	0.00	90.00	100.0	Offsite pavement flow into Offsite CB#3
	Sum:					1.81										

Total Weighted Impervious Area:

Sum of Area, A:	1.30		
Sum of Landscape Area	0.3	x 2%	0.005081267
Sum of Pavement:	0.80	x 100%	0.800367309
Sum of Artificial Turf	0.00	x60%	0
Sum of Rooftop:	0.25	x 90%	0.222520661
Sum / Total Area	1.301675849		0.790

Calculation of Peak Runoff using Rational Method

Designer: Manny Nuno, PE
Company: DCI Engineers
Date: 8/26/2022
Project: Maverik Lincoln and Dransfeldt
Location: Parker, CO

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.99	1.39	1.64	1.98	2.31	2.60	3.14
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
EX-1	1.30	B	2.0	0.01	0.01	0.07	0.26	0.34	0.44	0.54	200.00			0.018	23.09	0.00			0.010	20	2.00	0.00	23.09	25.66		1.80	2.53	2.99	3.61	4.21	4.73	5.72	0.02	0.04	0.28	1.23	1.85	2.68	4.04
NW-ADD2	0.08	D									20.00			0.025		125.00			0.010	20	2.00	1.04																	
NW-ADD-3	0.04	D									45.00			0.030		0.00			0.010	20	2.00	0.00																	

Calculation of Peak Runoff using Rational Method

Designer: Manny Nuno, PE
Company: DCI Engineers
Date: 8/26/2022
Project: Maverik Lincoln and Dransfeldt
Location: Parker, CO

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.99	1.39	1.64	1.98	2.31	2.60	3.14

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland (Initial) Flow Time: Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized (Travel) Flow Time: Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)
NW-A1	0.13	B	90.0	0.74	0.76	0.78	0.81	0.83	0.84	0.87	20.00			0.020	2.16	0.00			0.010	20	2.00	0.00
NW-B1	0.06	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	25.00			0.015	1.92	0.00			0.010	20	2.00	0.00
NW-B2	0.12	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	45.00			0.015	2.57	120.00			0.010	20	2.00	1.00
NW-B3	0.12	B	81.5	0.66	0.69	0.71	0.76	0.78	0.80	0.83	56.00			0.015	4.90	100.00			0.010	20	2.00	0.83
NW-B4	0.12	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	75.00			0.015	3.32	0.00			0.010	20	2.00	0.00
NW-B5	0.14	B	96.8	0.80	0.83	0.84	0.86	0.87	0.88	0.89	75.00			0.015	3.73	0.00			0.010	20	2.00	0.00
NW-B6	0.08	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	75.00			0.015	3.32	0.00			0.010	20	2.00	0.00
NW-C1	0.03	B	90.0	0.74	0.76	0.78	0.81	0.83	0.84	0.87	20.00			0.020	2.16	20.00			0.020	20	2.83	0.12
NW-C2	0.05	B	90.0	0.74	0.76	0.78	0.81	0.83	0.84	0.87	20.00			1.020	0.59	20.00			0.020	20	2.83	0.12
NW-C3	0.03	B	89.0	0.73	0.75	0.78	0.81	0.82	0.84	0.86	20.00			2.020	0.48	20.00			0.020	20	2.83	0.12
NW-D1	0.16	B	75.3	0.60	0.63	0.66	0.72	0.75	0.78	0.81	36.00			0.015	4.46	75.00			0.010	20	2.00	0.63
NW-D2	0.07	B	86.9	0.71	0.74	0.76	0.79	0.81	0.83	0.85	20.00			0.015	2.57	0.00			0.060	20	4.90	0.00
NW-E1	0.11	B	8.7	0.05	0.06	0.13	0.30	0.38	0.47	0.57	12.00			0.330	2.05	0.00			0.020	20	2.83	0.00
NW-OS1	0.07	B	2.0	0.01	0.01	0.07	0.26	0.34	0.44	0.54	22.00			0.330	2.91	0.00			0.330	20	11.49	0.00
NW-OS2	0.17	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	36.00			0.025	1.95	150.00			0.025	20	3.16	0.79
NW-OS3	0.11	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	40.00			0.050	1.63	0.00			0.025	20	3.16	0.00
NW-OS4	0.23	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	40.00			0.030	1.93	175.00			0.025	20	3.16	0.92
NW-ADD2	0.08	D									20.00			0.025		125.00			0.010	20	2.00	1.04
NW-ADD-3	0.04	D									45.00			0.030		0.00			0.010	20	2.00	0.00
																				20		
																				20		
																				20		
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																				20		
																				20		
																				20		

Subcatchment Name	Time of Concentration: Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	Rainfall Intensity, I (in/hr) 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Peak Flow, Q (cfs) 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
NW-A1	2.16	10.70	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.33	0.48	0.58	0.73	0.87	0.99	1.23
NW-B1	1.92	9.00	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.17	0.25	0.29	0.36	0.42	0.48	0.59
NW-B2	3.57	9.87	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.34	0.49	0.58	0.71	0.84	0.95	1.16
NW-B3	5.73	12.97	5.73	3.23	4.54	5.36	6.47	7.55	8.50	10.26	0.27	0.39	0.48	0.61	0.74	0.85	1.07
NW-B4	3.32	9.00	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.33	0.47	0.56	0.68	0.81	0.91	1.12
NW-B5	3.73	9.55	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.38	0.54	0.65	0.80	0.95	1.08	1.32
NW-B6	3.32	9.00	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.22	0.32	0.38	0.46	0.55	0.62	0.76
NW-C1	2.27	10.81	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.08	0.12	0.14	0.18	0.21	0.24	0.30
NW-C2	0.71	10.81	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.13	0.18	0.22	0.28	0.33	0.38	0.47
NW-C3	0.60	10.98	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.08	0.11	0.13	0.17	0.20	0.23	0.29
NW-D1	5.08	13.84	5.08	3.34	4.69	5.54	6.69	7.80	8.78	10.60	0.32	0.47	0.58	0.76	0.92	1.08	1.36
NW-D2	2.57	11.23	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.17	0.25	0.30	0.38	0.46	0.52	0.65
NW-E1	2.05	24.53	10.00	2.68	3.76	4.44	5.36	6.25	7.03	8.50	0.01	0.02	0.06	0.18	0.26	0.36	0.53
NW-OS1	2.91	25.66	10.00	2.68	3.76	4.44	5.36	6.25	7.03	8.50	0.00	0.00	0.02	0.10	0.16	0.22	0.34
NW-OS2	2.74	9.69	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.47	0.68	0.81	0.99	1.17	1.32	1.62
NW-OS3	1.63	9.00	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.31	0.45	0.53	0.65	0.77	0.87	1.06
NW-OS4	2.85	9.80	5.00	3.36	4.71	5.56	6.72	7.84	8.82	10.65	0.65	0.93	1.11	1.36	1.60	1.81	2.21
NW-ADD2																	
NW-ADD-3																	

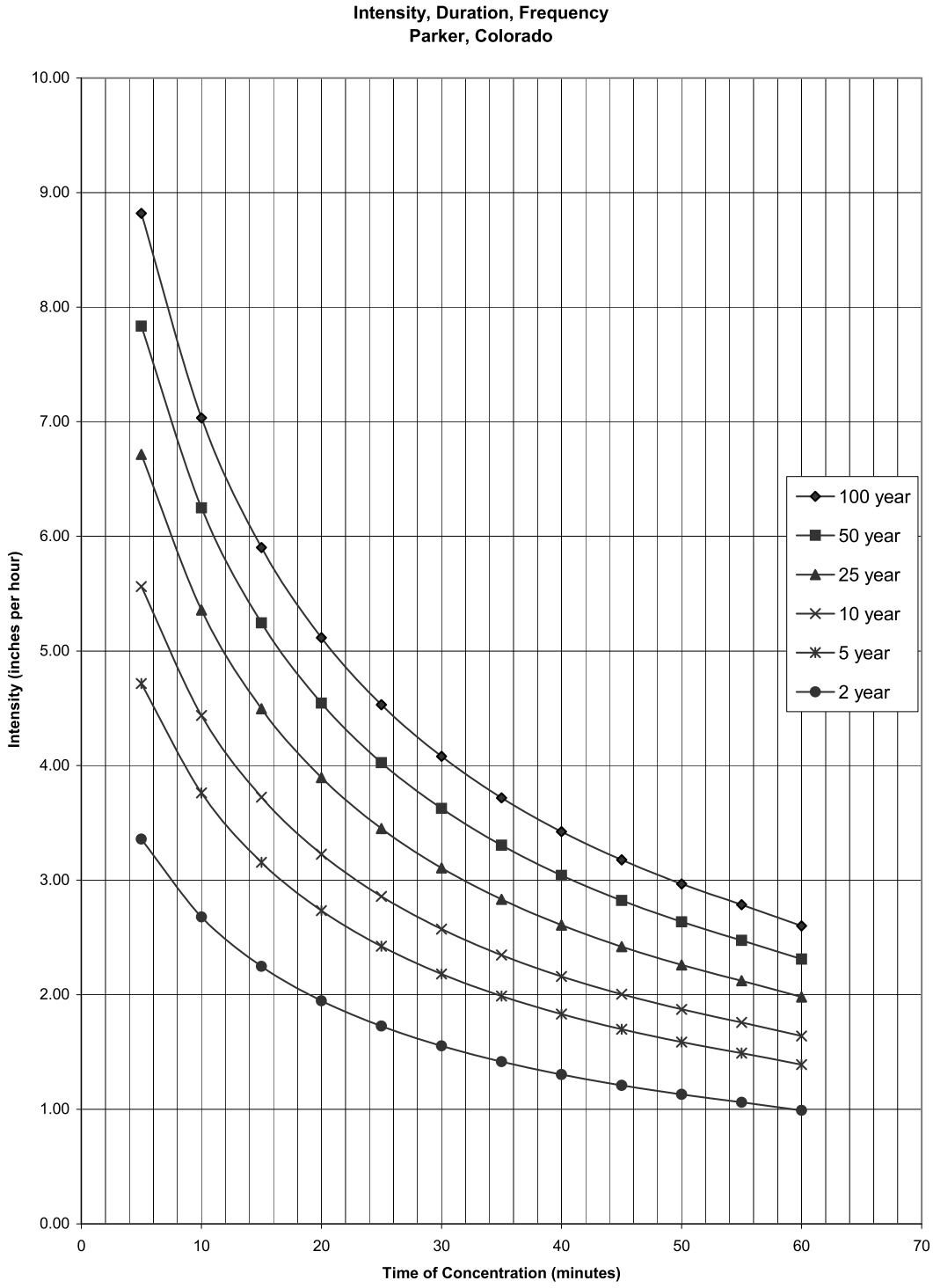

FIGURE 5.1
RAINFALL INTENSITY VERSUS DURATION CURVES FOR PARKER, COLORADO

DCI Engineers
1331 17th Street
Suite 605
Denver, Colorado 80202

Maverik Lincoln and Dransfeldt
Maverik Inc.
Lincoln Avenue and Dransfeldt
Parker, CO

EXISTING CONDITIONS RUNOFF SUMMARY TABLE

Design Point	Tributary Basins	Contributing Area (Ac)	Weighted Impervious %	5 Yr Peak Discharge (CFS)	100 Yr Peak Discharge (CFS)	Discharges To:
1	EX-1	1.30	2.00	0.04	2.68	Roof Downspouts to be determined
TOTAL FOR PARCEL			**2.00%**	**0.04**	**2.68**	

*NOTE: Sheet Links to 2021.06.15 UD-RATIONAL 2.00_Existing.xls for Peak Flows

DCI Engineers
1331 17th Street
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Denver, Colorado 80202

Maverik Lincoln and Dransfeldt
Maverik Inc.
Lincoln Avenue and Dransfeldt
Parker, CO

PROPOSED CONDITIONS RUNOFF SUMMARY TABLE

Design Point	Tributary Basins	Contributing Area (Ac)	Weighted Impervious %	5 Yr Peak Discharge (CFS)	100 Yr Peak Discharge (CFS)	Discharges To:
1	A1	0.13	90.00	0.48	0.99	Roof Downspouts to be determined
2	B1	0.06	100.00	0.25	0.48	Concrete Patio to landscape drains
3	B2	0.12	100.00	0.49	0.95	Parking Lot Surface flow to CB#1
4	B3	0.12	81.46	0.39	0.85	Parking Lot Surface flow to CB#1
5	B4	0.12	100.00	0.47	0.91	Parking Lot Surface flow to Trench Drain 1
6	B5	0.14	96.77	0.54	1.08	Parking Lot Surface flow to Trench Drain 1
7	B6	0.08	100.00	0.32	0.62	Parking Lot Surface flow to Trench Drain 1
8	C1	0.03	90.00	0.12	0.24	Fuel Canopy Roof Drains to Underground Storm
9	C2	0.05	90.00	0.18	0.38	Fuel Canopy Roof Drains to Underground Storm
10	C3	0.03	89.00	0.11	0.23	Fuel Canopy Roof Drains to Underground Storm
11	D1	0.16	75.32	0.47	1.08	Parking Lot Surface flow to CB#2
12	D2	0.07	86.91	0.25	0.52	Parking Lot Surface flow to CB#2
13	E1	0.11	8.66	0.02	0.36	Overland flow direct to detention pond
14	OS1	0.07	2.00	0.00	0.22	Overland flow direct to road-side swale
TOTAL FOR PARCEL			**78.97%**	**4.09**	**8.92**	
15	OS2	0.17	100.00	0.68	1.32	Offsite pavement flow from driveway into site at CB#1
16	OS3	0.11	100.00	0.45	0.87	Offsite pavement flow from driveway into site at CB#2
TOTAL OFFSITE FLOW RUNNING INTO SITE				**1.13**	**2.19**	
17	OS4	0.23	100.00	0.93	1.81	Offsite pavement flow into Offsite CB#3
TOTAL OFFSITE FLOW RUNNING INTO CB #3				**0.93**	**1.81**	

*NOTE: Sheet Links to 2021.06.15 UD-RATIONAL 2.00_Proposed.xls for Peak Flows