Drainage Report for I-25: Mobility Hub (Sky Ridge @ Lone Tree) Project

Final

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

1. INTRODUCTION

The purpose of this I-25 – Mobility Hub (Sky Ridge @ Lone Tree) Project is to provide Northbound (NB) and Southbound (SB) mobility hubs between Lincoln Avenue and Sky Ridge Avenue allowing the Bustang transit service minimal delay for departure and re-entry along the I-25 corridor while improving safety, mobility and operations. The I-25 – Mobility Hub (Sky Ridge @ Lone Tree) Project is hereafter referred to as "project" in this report. The purpose will be achieved by constructing two bus stops and a pedestrian bridge connection across I-25 for access between mobility hubs. The project will include widening of the Lincoln Ave NB Off-Ramp and Lincoln Ave SB On-Ramp with bus stop pull outs on either side as well as sidewalk and trail connections on the west side of the project to connect to the adjacent RTD light rail station at Sky Ridge and north to Lincoln Ave. The project is limited to improvements along I-25 between Lincoln Avenue and Sky Ridge Avenue that includes roadway improvements, traffic signing and striping, roadway lighting, bus platform and sidewalk installation, environmental restoration of areas disturbed by construction, and associated drainage and permanent water quality improvements.

A. LOCATION OF IMPROVEMENTS

The project is located along I-25 between Sky Ridge Ave and Lincoln Ave in the City of Lone Tree within Douglas County, Colorado. The site is in Section 15, Township 6 South, Range 67 West of the 6th Principal Meridian. The project location is shown on a Google Earth image in **Figure 1**. The project is entirely within the Cottonwood Creek watershed, which is a tributary to the Cherry Creek Reservoir.

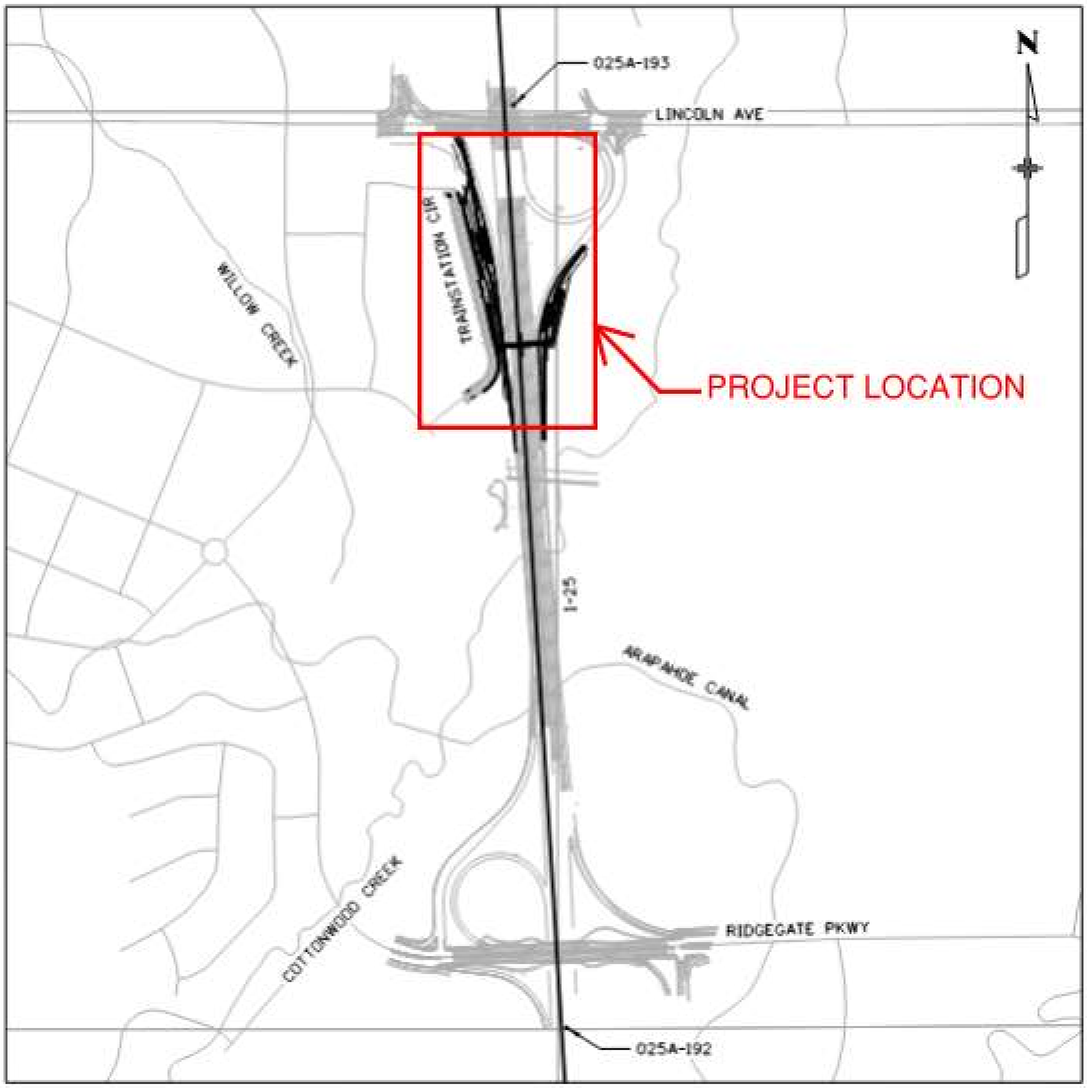

FIGURE 1: PROJECT LOCATION

B. DESCRIPTION OF IMPROVEMENTS

This project will construct transit stops with bus pullouts on the southbound and northbound ramps to Lincoln Ave along I-25 for use by Bustang as well as a pedestrian bridge connection between bus stops. The project is also constructing sidewalks trail connections to Sky Ridge Light Rail station and Lincoln Ave on the west side. The east side of the project is currently undeveloped and is planned to be a future city center. This pedestrian ramp and transit stop are designed to maximize flexibility for tie in by upcoming projects. There is also another adjacent project currently in preliminary design phase called Advancing Lincoln Avenue that will reconfigure Lincoln Ave from Park Meadows Drive to Oswego St. The project limits for this Mobility Hub do not overlap with the recommended alternative from Advancing Lincoln Ave, however this project has coordinated design to ensure that the two projects work together to create a safe environment for both pedestrians and vehicles through this interchange.

The drainage design will incorporate a new network of open channels/roadside ditches, storm sewer pipes, manholes, and inlets to capture and convey storm runoff generated by the proposed roadway, sidewalk, and pullout bus stop improvements. The project has one outfall location to an existing water quality pond located in the Lincoln Ave NB On-Loop Ramp that outfalls into Cottonwood Creek. All added impervious areas are being captured by and routed through this existing water quality facility for treatment prior to being released to Cottonwood Creek.

C. DISCUSSION OF DRAINAGE INVESTIGATION

The drainage conditions investigation uses aerial images, land survey, review of as-built drawings, review of drainage reports, and site field investigations. As-built information for the Ridgegate Parkway/I-25 interchange project in 2007 and an I-25 widening project in 2011 (revised 2014) form the basis of analysis for the existing drainage patterns and facilities. The area adjacent to the project limits on the west side has undergone significant development in the last ten years that have altered drainage patterns within the area. The drainage report from the construction of Kiewit Ridgegate Campus facilitated the analysis of the drainage along the west side of the project including the existing conditions of Trainstation Circle.

A field investigation was conducted focusing on areas along the west side of the southbound lane of I-25 between Sky Ridge Avenue and Lincoln Avenue to supplement as-built information related to existing drainage patterns. The site visit validated the information from the Kiewit Drainage report that runoff from areas located along Trainstation Circle are captured into a storm system and flow into an existing water quality feature prior to discharging into CDOT ROW. The flows are ultimately conveyed into a double-barrel culvert section that crosses the I-25 corridor to the east side of the interstate and into an existing extended detention basin (EDB). For more information, see **Appendix A.4 Existing Basin Maps** for basin maps obtained from existing drainage reports in the project area. Hampton Inn & Suites is located to the north at a highpoint where runoff generally flows to the west and off-site for this area. The investigation of the drainage system for the Charles Schwab building and parking area showed two existing inlets that discharge to the west. No outlets were identified that would suggest runoff from this site discharges to the project area.

The I-25 Widening project report includes design calculations for the existing water quality pond located in the loop ramp, called “A” in the original report. The tributary area for this pond has been affected by subsequent development, most notably the installation of Trainstation Circle and the Kiewit Campus.

Historic flow patterns are maintained where possible. The proposed condition flows are discussed further in Section 4. Efforts were made to reuse existing facilities to the maximum extent practicable and to limit the impacts to existing pavement area.

2. HYDROLOGY

Hydrologic analyses for the project were performed using the Rational Method for drainage areas less than 90 acres. Parameters for the Rational Method include drainage area size (A) (acres), a dimensionless runoff coefficient (C), and rainfall intensity (I) (inches/hour) for a selected storm frequency, for a duration equal to the time of concentration (Tc). A detailed description and in-depth discussion of the Rational Method can be found in the Mile High Flood District (MHFD) *Urban Strom Drainage Criteria Manual (USDCM)*.

Runoff coefficient is a fractional portion of the precipitation that appears as runoff and is expressed as a constant between zero and one as a function of the impervious land cover and the hydrologic soil group. The runoff coefficients for the roadway sub-basins were calculated using the equations found in Table 6-4 of MHFD's *USDCM Volume 1, Chapter 6 Runoff*.

Tc is estimated using the hydraulically longest flow path within a drainage basin. It is calculated by using the accumulated travel time for sheet flow, shallow concentrated flow, and concentrated flow in ditches and pipes. The time of concentration is calculated using Equations 6-2, 6-3, 6-4, and 6-5 from MHFD's *USDCM Volume 1, Chapter 6 Runoff*. The minimum value for the initial Tc reading the design point is 5 minutes for any urban basin and 10 minutes for non-urban basins. Tc values for each basin are delineated to the upstream element, ditch or inlet, where the basin is attached.

A. EXISTING BASINS

In existing conditions runoff generally flows from south to north along I-25. Flows along NB I-25 are intercepted and conveyed as shallow concentrated flow adjacent to barrier and in curb and gutter sections along the east side of the highway and off ramp. Flows along SB I-25 sheet flows into grass-lined roadside ditches. Runoff generated along Trainstation Cir are captured in curb and gutter and flow from one high point located to the north at the east entrance to Hampton Inn & Suites near station 52+50 and from a second high point located to the south from the entrance to Charles Schwab near station 40+00 to a low point along Trainstation Circle. This runoff is intercepted by two inlets, located near station 48+50, that outlet into the project site through an orifice plate in the landscape wall which provides water quality. These flows combine with highway water in ditches that flows towards a low point near station 21+50 into a double barrel crossing under I-25 into the exisitng water quality pond in the loop ramp, called Pond L within this project and report. Existing on-site basins generally consist of impervious roadway and grass/lawn roadside ditch areas.

B. PROPOSED BASINS

The proposed drainage system improvements for the I-25 southbound lane and proposed ramps between Lincoln Avenue and Ridgegate Parkway will follow the same flow patterns as the existing condition.

However, due to increases in impervious area associated with the project improvements, peak runoff rates will increase. Proposed basin maps are located in **Appendix A.3**.

Basin L
The entire project limits are within basin L and drain into the existing water quality pond in the loop ramp, EDB L. The project site captures 8.56 acres with an impervious percentage of 56%, however the overall tributary area to the pond with the proposed improvements is 31.50 acres with an impervious percentage of 71%. General flow patterns within the basin are from south to north with flow concentrating in ditches and gutters along the ramps to be captured by inlets that route the water northeast to the pond for water quality treatment. The flow patterns within Basin L are predominantly the same in proposed conditions as existing conditions, however proposed utilizes more closed pipe systems than existing.

C. PRECIPITATION DATA

Intensity-duration-frequency (IDF) data was obtained utilizing the Douglas County Storm Drainage Design and Technical Criteria Manual. 1-hour point rainfall values for Douglas County, Zone 1 were used to generate the storm event precipitation data for the 10-year, 50-year, and 100-year storm events.

TABLE 1:
INTENSITY-DURATION-FREQUENCY

	Storm Event		
Duration	10-Year	50-Year	100-Year
5 min	5.63	7.67	8.82
10 min	4.49	6.11	7.03
15 min	3.77	5.13	5.90
30 min	2.60	3.55	4.08
60 min	1.68	2.28	2.63

3. EXISTING STRUCTURE

Survey data was the primary source used for identifying existing hydraulic feature information. In addition to survey work, previous project as-builts, field visits, and photographs were used to provide information about the existing hydraulic features.

A. DRAINAGEWAYS AND FLOODPLAINS

There is one major drainageway within the vicinity of the project: Cottonwood Creek. Cottonwood Creek crosses under I-25 in a 7.75'x8' box culvert, CDOT minor structure number 025A192540BL, just south of the project limits. Cottonwood Creek is designated a Special Flood Hazard Area (SFHA) with regulatory floodway under the National Flood Insurance Program (NFIP). The 100-year floodplain boundary and regulatory floodway limits are located on the east side of I-25 and outside of the project limits therefore, this project will not impact the regulatory floodplain.

B. IRRIGATION CROSSINGS

There are no existing irrigation crossings within the limits of this project.

C. WATER QUALITY

There are two existing permanent water quality control measures within the project area. The first is located on the east side of Trainstation circle and provides water quality treatment for Trainstation Circle runoff before it enters CDOT ROW. The second provides treatment of runoff from I-25, Extended Detention Basin (EDB) L, located within the Lincoln Ave NB on-ramp loop infield. A water quality facility was installed on the east side of Trainstation Circle as part of the construction of the Trainstation Circle Roadway to treat the impervious area generated by the roadway. This facility provides water quality treatment for the portion of Trainstation Circle that runs adjacent to I-25, approximately 1.57 acres of pavement, prior to release to CDOT ROW where it combines with I-25 water and is routed through the extended detention basin located in the loop ramp. EDB L, which is understood to be owned and maintained by CDOT, is a full-spectrum facility, designed for the Excess Urban Runoff Volume (EURV). It is currently sized for a watershed area of 40.67 acres with an imperviousness of 30.2% which yields an EURV of 1.155 acre-feet.

The first facility, along Trainstation Circle, will be removed and decommissioned as part of this project and the runoff previously treated here will combine with CDOT generated runoff and receive treatment in Pond L, removing the in-series treatment. Pond L will be utilized to treat all of the additional impervious area added with this project.

4. DESIGN DISCUSSION

The proposed roadway drainage improvements include inlets, manholes, pipes, and roadside ditches. Inlets are placed along barriers and curb to adhere to project spread criteria. In accordance with the CDOT *Drainage Design Manual* (*DDM*) and drainage best practices, existing drainage patterns are maintained where possible and peak discharges will continue to be limited to pre-project discharge rates, where possible.

A. HYDRAULIC STRUCTURES

The inlet types and uses proposed for this project are:

- CDOT Type C Inlets – Area drains
- Special Type D Inlet – Area drain
- CDOT Type 16 Valley Inlet – In pedestrian walk area
- CDOT Type R Inlets – Curb and gutter sections
- Single Vane Grate Inlet – Along Type 9 barriers
- Deck Drain Inlets – On pedestrian ramp

i) Inlet/Catch Basin Design

The placement and design of inlets is dependent on the roadway horizontal and vertical geometry. CDOT *DDM*, FHWA *HEC-22,* MHFD's *USDCM,* methods and calculations within MHFD's Street Capacity and Inlet Sizing (version 5.03) spreadsheet were used to analyze gutter flow and calculate spread widths and bypass flows. For this project, allowable spreads are shown in **Table 2**, below.

TABLE 2: **ROADWAY DESIGN STORM AND FLOW SPREAD CRITERIA**

Road Classification	Design Storm	Flow Spread
I-25	10-year	Shoulder
Ramps	10-year	Shoulder * + 3 ft
Sag Point	50-year	Shoulder * + 3 ft
Pedestrian Trail	10-year	½ Trail

* Where shoulder widths are less than 4 feet, a minimum shoulder width of 4 feet was used.

Clogging factors for inlets have been applied in accordance with the CDOT *DDM*. Detailed inlet hydraulic calculations for comparison of the proposed spread to allowable are included in **Appendix B.1** of this report. Allowable depths at area inlets are confirmed by adhering to ditch capacity criteria. For the northbound lanes that are adjacent to Cottonwood Creek this depth criteria is also applied in the 100-year storm event. Since there are no channels that would capture any water that leaves the roadway in this area the project designed the storm system to capture all of the roadway water in order to ensure all impervious area is treated and not released directly into Cottonwood Creek. The deck drain inlets, located along the uncovered pedestrian ramps, utilize Neenah R-3924 grates and were designed to be bicycle safe and to not protrude into the limits of the trail to minimize impacts to users. The water collected will be piped via 6" pipe down the pier or wall to outfall onto a 5'x5' riprap pad. Small swales are provided to direct the concentrated flow from the ramp to outfall locations.

In addition to meeting design criteria for allowable spread and bypass, and according to the CDOT *DDM*, inlets are also located in the following locations:

- Sag vertical curve or sump areas;
- Flanking inlets on each side of sump inlets (these are designed in accordance with Section 4.4.6.3 of the FHWA *HEC-22 Urban Drainage Design Manual*) to function if the sump inlet becomes clogged;
- Upstream of pedestrian ramps (only placed if the flow would exceed the gutter);
- As required to meet maintenance access spacing criteria of Section 13.3.7 of the CDOT *DDM*.

The pedestrian bridge is covered with a crowned roof that drains on either side into a rectangular gutter plate. The gutter matches the profile of the bridge at 0.5% from the center pier to either end where it drains into a 6" pipe down the pier to outlet to outfall onto a 5'x5' riprap pad. Calculations showing gutter capacity are provided in **Appendix B.2**. Small swales are provided to direct the concentrated flow from the bridge to outfall locations. No concentrated water from either the bridge or ramp will outfall into a pedestrian area.

In addition, manholes for the Project are also spaced in accordance with the maintenance access spacing criteria outlined in Section 13.3.7 of the CDOT *DDM* and shown in **Table 3**. Some of the existing pipes do not meet this spacing criteria, and manholes were not added to bring them up to criteria.

TABLE 3: **MAINTENANCE ACCESS SPACING**

Size of Pipe, inches	Maximum Distance, ft
≤ 48	300
> 48	600

ii) Storm Drain Design

The hydraulic design for storm drainpipes follow MHFD, CDOT *DDM*, and *HEC-22* guidelines. The calculations were performed with the Bentley OpenRoads Designer (ORD) computer program. Within ORD the calculations are completed using Bentley Storm and Sanitary Analysis.

In accordance with CDOT Standard Specifications for Road and Bridge Construction, Section 624, soil conditions were evaluated, and a pipe material selection memo was prepared, included in **Appendix D**. For this project two pipe materials have been identified – reinforced concrete pipe (RCP) and Class 7 which permits RCP, PP, SRPE, or PVC. Class 7 is used except in locations where there is insufficient cover which require the use of RCP.

The minor design storm event for all on-site facilities is the 10-year return frequency and the major storm event is the 100-year storm. The proposed storm drainpipes are designed to maintain a minimum velocity of 3 feet per second for the 10-year return frequency peak discharge and to not exceed a maximum velocity of 22 feet per second for the 100-year return frequency storm discharge. One pipe is unable to meet velocity criteria for the 10-year storm event, P-L-84-2, is just under 3 ft/s due to the flat slope required to connect into an existing pipe crossing under the ramp.

Hydraulic Grade Line (HGL) and Energy Grade Line (EGL) calculations are included for both the 10-year and 100-year storm events. The storm drain systems are designed with HGL kept at or below the crown of pipe for the 10-year frequency peak discharge. The storm drainage systems are also designed such that the EGL at or below the surface of pavement and inlet grates for the 100-year storm event. HGL and EGL calculations were performed using ORD and can be found in **Appendix B.2** of this report.

iii) Roadside Ditch and Channel Design

All ditches will be designed to convey the 100-year storm event without the water surface exceeding the edge of pavement. Ditches are also designed to maintain a minimum of 1 foot of freeboard from the edge of pavement adjacent to I-25 during the 10-year storm event. Channel geometry is in accordance with the AASHTO *Roadside Design Guide*.

Channel linings were designed in accordance with FHWA *HEC-15 Design of Roadside Channels with Flexible Linings*. Vegetated ditch linings were calculated by assuming a standard height of vegetation of 0.33 ft, fair condition of vegetation, and a mixed growth form of vegetation. These assumptions are based on the standard values recommended in *HEC-15*. Ditch calculations for flexible linings follow the iterative process found in *HEC-15* and were calculated in Excel Spreadsheets. Manning's n values vary between ditch segments based on variables used in *HEC-15* and are not specific to lining type. Channel calculations are provided in **Appendix B.3**.

iv) Erosion Control Design

Riprap outlet protection is provided at all storm drain outfalls. Riprap aprons were designed in accordance with FHWA *HEC-14 Hydraulic Design of Energy Dissipaters for Culverts and Channels*. Outlet protection calculations are provided in **Appendix B.4**.

A) IRRIGATION CROSSINGS

There are no proposed irrigation crossings within the limits of this project.

B) DRAINAGEWAYS AND FLOODPLAINS

The Cottonwood Creek floodway is not impacted by this project. See Floodplain Evaluation memo for more information.

C) WATER QUALITY

Permanent water quality treatment is sized to provide water quality treatment for 100% of the increased impervious area per Colorado Discharge Permit System (CDPS) Permit No. C0S000005.

Under CDOT's Municipal Separate Storm Sewer System (MS4) Permit, onsite permanent water quality (PWQ) treatment is required for this project based on the permanent water quality form, seen in **Appendix C.2**. This project increases the impervious area by 54%, discharges to the Cherry Creek Reservoir basin, is part of the South I-25 Corridor and US 85 Corridor Final Environmental Impact Statement (FEIS), and discharges to a 303(d) impaired stream therefore water quality treatment is required.

i) Allowable Release Rates

The Pond was designed for a tributary area of 40.67 acres with an impervious percentage of 30.24%. RS&H delineated the tributary area for the pond to account for all of the recent offsite development. Factoring in the offsite development on the west side of I-25, the current tributary area is 29.92 acres with 68.38% imperviousness flows into EDB L. The original pond design has a 100-year release flowrate of 40.7 cfs., however the existing release rate is 34.4 with the current tributary area. Flows released from the pond travel east to outfall into Cottonwood Creek.

The proposed project increases the tributary area to 31.50 acres with 71.2% imperviousness. The pond volume has been confirmed to be able to handle the additional impervious area from the project and adjacent development. The pond outlet structure was also determined to provide the required 40 hour drain time for the proposed conditions tributary area with no required modifications. The proposed 100-year release rate is 35.8 cfs which is lower than the original design and therefore this project does not cause any adverse effects downstream.

ii) Water Quality Facilities

This project proposes to remove the existing water quality treatment facility along Trainstation Circle and would provide treatment for Trainstation Circle impervious area in the CDOT loop EDB facility.

Pond calculations are included in **Appendix C.1** and contain the design and the calculations for the permanent water quality pond for the project. Detention and sizing was calculated using MHFD's spreadsheet UD-Detention version 4.06. The major features of the pond are forebay, outlet structure with micropool and trash rack, and emergency overflow inlet none of which are being impacted by this project which does not propose any construction with the pond limits.

Advancing Lincoln Ave project is proposing to modify the tributary area to EDB L, therefore it is anticipated that the project will have to modify the facility in order to accommodate the change. With this upcoming future project in the works this project has determined not to do any physical improvements or upgrades to the exisitng facility since the calculations show that it will function properly for water quality using the exiting outlet structure configuration. Some of the noted features that do not meet current design standards include lack of a concrete trickle channel, no seal around the orifice plate, northeast inlet does not have sufficient residence time prior to discharge, and no stamped as built plan or O&M manual. These will need to be addressed when the pond is modified in the future.

5. CONCLUSION

The drainage design for the I-25 Mobility Hub (Sky Ridge @ Lone Tree) Project is performed in accordance with the CDOT *DDM*, MHFD *USDCM*, and FHWA *HEC-22* guidelines. The new storm sewer systems convey initial storm (10-year) and major storm (100-year) runoff from redeveloped roadway and ramp areas. All added impervious area will be treated prior to release offsite. The existing water quality pond has sufficient capacity to provide treatment and detention of roadway runoff resulting from the increase in impervious area.

REFERENCES

Colorado Department of Transportation. Drainage Design Manual; 2019.

Douglas County, June 2019, "Storm Drainage Design and Technical Criteria Manual"

FEMA, FIRM Panel 08035C0063H

Federal Highway Administration. September 2005. *Hydraulic Engineering Circular No. 15*, Third Edition, Design of Roadside Channels with Flexible Linings.

Federal Highway Administration. August 2013. *Hydraulic Engineering Circular No. 22*, Third Edition, Urban Drainage Design Manual.

Felsburg Holt & Ullevig. April 2014. *Hydrology & Hydraulics Report for Interstate 25 Widening from Ridgegate Parkway to County Line Road.*

Martin/Martin, Inc. June 2019. *Phase III Drainage Report for Kiewit Ridgegate Campus.*

Mile High Flood District. September 2017. *Urban Storm Drainage Criteria Manuals*, Volume 1.

Mile High Flood District. September 2017. *Urban Storm Drainage Criteria Manuals*, Volume 2.

Mile High Flood District. November 2015. *Urban Storm Drainage Criteria Manuals*, Volume 3.

RS&H. June 2024. *Floodplain Evaluation Memo.*

United States Department of Agriculture, Natural Resources Conservation Service. Web Soil Survey; https://websoilsurvey.sc.egov.usda.gov/.

U.S. Department of Transportation, Federal Highway Administration & Colorado Department of Transportation. April 2001. *South I-25 Corridor and US 85 Corridor Final Environmental Impact Statement Section 4(f) Evaluation.*

APPENDIX A – HYDROLOGIC COMPUTATIONS

APPENDIX A.1 – SOIL SURVEY

Hydrologic Soil Group—Castle Rock Area, Colorado

Map Scale: 1:6,610 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

N

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil 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 16, Aug 24, 2023

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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
FoD	Fondis clay loam, 3 to 9 percent slopes	C	33.9	75.2%
Hg	Hilly gravelly land	D	1.8	3.9%
RmE	Renohill-Buick complex, 5 to 25 percent slopes	D	0.4	0.9%
RnE	Renohill-Manzanola clay loams, 3 to 20 percent slopes	D	9.0	20.0%
Totals for Area of Interest			**45.1**	**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

APPENDIX A.2 – PROPOSED HYDROLOGY

COMPOSITE C CALCULATIONS - SYSTEM SB LANES

PROJECT: I-25 Mobility Hub (Lone Tree) FOR — PROJECT #: 24278
DESIGNED BY: NAG — CHECKED BY: MED
DATE: 6/7/2024

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NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.276}$	$C_A = 0.87i^{1.232}$	$C_A = 0.88i^{1.124}$	$C_A = 0.85i+.025$	$C_A = 0.78i+0.110$
B	$C_B = 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$

Basin ID	Land Use and Impervious Percentage							Total Area	Percentage Imperviousness	NRCS Soil Group	Runoff Coefficient					
	Paved	Open	Gravel (Packed)	Gravel	Roof	Ponds	Drive and Walks				C	C	C	C	C	C
	100%	2%	40%	13%	90%	100%	90%		(%)							
	area (ft^2)	area (ft^2)	area (ft^2)	area (ft^2)	area (ft^2)	area (ft^2)	(ft^2)	(acres)			02 yr	05 yr	10 yr	25 yr	50 yr	100 yr
A-L-12	78,761	64,119	0	496	0	0	0	3.29	56%	C/D	0.43	0.49	0.55	0.63	0.67	0.71
A-L-14	17,226	0	0	0	0	0	0	0.40	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-15	7	5,567	0	0	0	0	0	0.13	2%	C/D	0.01	0.05	0.15	0.33	0.40	0.49
A-L-16	13,353	206	0	0	0	0	0	0.31	99%	C/D	0.82	0.84	0.86	0.87	0.88	0.89
A-L-17-1	5,109	538	0	0	0	0	0	0.13	91%	C/D	0.74	0.78	0.80	0.83	0.84	0.86
A-L-17-2	140	5,681	0	0	0	0	0	0.13	4%	C/D	0.02	0.07	0.16	0.34	0.41	0.50
A-L-17-3	6,877	483	0	0	0	0	0	0.17	94%	C/D	0.77	0.80	0.82	0.84	0.85	0.87
A-L-20	12,812	6,434	0	0	0	0	0	0.44	67%	C/D	0.53	0.59	0.63	0.70	0.72	0.76
A-L-20-1	5,493	2,495	0	0	0	0	0	0.18	69%	C/D	0.55	0.60	0.65	0.71	0.73	0.77
A-L-20-2	8,464	8,238	0	0	0	0	0	0.38	52%	C/D	0.40	0.46	0.51	0.61	0.65	0.70
A-L-20-3	3,272	0	0	0	0	0	0	0.08	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-21-1	5,739	0	0	0	0	0	0	0.13	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-21-2	5,144	0	0	0	0	0	0	0.12	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
EX-A-L-21-5	36,714	8,337	0	0	0	0	0	1.03	82%	C/D	0.66	0.71	0.74	0.78	0.79	0.82
A-L-23	8,455	0	0	0	0	0	0	0.19	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-24	1,835	17,053	0	0	0	0	0	0.43	12%	C/D	0.07	0.13	0.22	0.38	0.45	0.53
A-L-24-1	8,767	0	0	0	0	0	0	0.20	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-25	6,357	37,459	0	0	0	0	0	1.01	16%	C/D	0.11	0.17	0.25	0.41	0.47	0.55
A-L-42	7,407	1,917	0	0	0	0	0	0.21	80%	C/D	0.64	0.69	0.72	0.77	0.78	0.81
A-L-45	8,696	931	0	0	0	0	0	0.22	91%	C/D	0.74	0.78	0.80	0.83	0.84	0.86
A-L-48-1N	7,844	0	0	0	0	0	0	0.18	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
EX-A-L-48-1S	10,113	801	0	0	0	0	0	0.25	93%	C/D	0.76	0.80	0.82	0.84	0.85	0.86
EX-A-L-48-2	10,235	2,183	0	0	0	0	0	0.29	83%	C/D	0.67	0.71	0.74	0.78	0.80	0.82
EX-A-L-48-3	22,515	4,524	0	0	0	0	0	0.62	84%	C/D	0.68	0.72	0.75	0.79	0.80	0.83
A-L-102	1,775	0	0	0	0	0	0	0.04	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-103	1,845	0	0	0	0	0	0	0.04	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-105	0	0	0	0	1,827	0	0	0.04	90%	C/D	0.74	0.77	0.80	0.82	0.83	0.85
DESIGN POINT 1	1,985	5,681	0	0	1,827	0	0	0.22	39%	C/D	0.29	0.36	0.42	0.54	0.59	0.65

DESIGN POINT 1 INCLUDES THE FOLLOWING BASINS: A-L-17-2, A-L-103, A-L-105

TIME OF CONCENTRATION - SYSTEM SB LANES

PROJECT: I-25 Mobility Hub (Lone Tree) FOR — PROJECT #: 24278
DESIGNED BY: NAG — CHECKED BY: MED
DATE: 6/7/2024

$$t_c = t_i + t_t \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} \qquad t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i+9)\sqrt{S_t}}$$

SUB-BASIN DATA				INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)						$t_i + t_t$	t_c URBAN CHECK	FINAL t_c USED
Basin ID	Basin Type	Area (acres)	C 05 yr	Length (L_i) (ft)	Slope (S_i) %	t_i (min)	Length (L_t) (ft)	Slope (S_t) %	Type of Land Surface	Conveyance Factor, K	Velocity (ft/sec)	t_t (min)	t_c (min)	t_{reg} (min)	t_c (min)
A-L-12	URBAN	3.29	0.49	234.58	6.21%	9.27	1117.72	1.33%	GRASSED WATERWAY	15.00	1.73	10.77	20.04	26.10	20.04
A-L-14	URBAN	0.40	0.86	95.05	2.91%	3.07	185.85	0.82%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.81	1.71	4.78	10.49	5.00
A-L-15	URBAN	0.13	0.05	58.37	11.94%	6.42	127.81	1.28%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.27	0.94	7.36	27.66	7.36
A-L-16	URBAN	0.31	0.84	119.95	2.76%	3.68	135.37	1.41%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.38	0.95	4.63	10.09	5.00
A-L-17-1	URBAN	0.13	0.78	148.78	5.02%	4.20	46.69	1.57%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.51	0.31	4.51	10.87	5.00
A-L-17-2	URBAN	0.13	0.07	17.00	32.59%	2.44	166.76	2.89%	GRASSED WATERWAY	15.00	2.55	1.09	3.53	26.96	5.00
A-L-17-3	URBAN	0.17	0.80	148.78	5.02%	3.89	142.79	1.94%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.79	0.85	4.74	10.87	5.00
A-L-20	URBAN	0.44	0.59	64.78	3.03%	5.24	208.37	1.81%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.69	1.29	6.53	15.97	6.53
A-L-20-1	URBAN	0.18	0.60	58.01	3.34%	4.63	29.21	0.58%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.53	0.32	4.95	14.54	5.00
A-L-20-2	URBAN	0.38	0.46	26.91	3.49%	4.02	94.08	0.60%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.54	1.02	5.04	18.47	5.04
A-L-20-3	URBAN	0.08	0.86	35.39	3.36%	1.78	70.04	0.37%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.22	0.96	2.74	9.83	5.00
A-L-21-1	URBAN	0.13	0.86	45.93	3.74%	1.96	110.40	1.54%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.48	0.74	2.70	9.64	5.00
A-L-21-2	URBAN	0.12	0.86	83.04	3.53%	2.69	95.99	2.05%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.87	0.56	3.25	9.49	5.00
EX-A-L-21-5	URBAN	1.03	0.71	104.37	4.16%	4.59	466.26	1.91%	GRASSED WATERWAY	15.00	2.07	3.75	8.33	14.83	8.33
A-L-23	URBAN	0.19	0.86	113.53	3.36%	3.19	117.98	2.90%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	3.41	0.58	3.77	9.50	5.00
A-L-24	NON-URBAN	0.43	0.13	44.31	4.72%	7.06	135.10	6.84%	GRASSED WATERWAY	15.00	3.92	0.57	7.64	N/A	10.00
A-L-24-1	URBAN	0.20	0.86	28.05	2.28%	1.81	332.49	2.41%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	3.10	1.79	3.59	10.55	5.00
A-L-25	NON-URBAN	1.01	0.17	98.53	4.86%	10.01	504.41	0.56%	GRASSED WATERWAY	15.00	1.12	7.50	17.51	N/A	17.51
A-L-42	URBAN	0.21	0.69	17.14	1.40%	2.78	307.56	1.70%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.61	1.97	4.75	14.37	5.00
A-L-45	URBAN	0.22	0.78	70.19	2.35%	3.73	303.04	1.91%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.76	1.83	5.56	12.30	5.56
A-L-48-1N	URBAN	0.18	0.86	17.24	0.41%	2.52	433.88	0.91%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.90	3.80	6.32	12.30	6.32

TIME OF CONCENTRATION - SYSTEM SB LANES

PROJECT: I-25 Mobility Hub (Lone Tree) FOR — PROJECT #: 24278
DESIGNED BY: NAG — CHECKED BY: MED
DATE: 6/7/2024

$t_c = t_i + t_t$ $\quad$ $t_t = \dfrac{L_t}{60K\sqrt{S_o}}$ $\quad$ $t_i = \dfrac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{\,0.33}}$ $\quad$ $t_c = (26 - 17i) + \dfrac{L_t}{60(14i + 9)\sqrt{S_t}}$

SUB-BASIN DATA				INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)						$t_i + t_t$	t_c URBAN CHECK	FINAL t_c USED
Basin ID	Basin Type	Area (acres)	C 05 yr	Length (L_i) (ft)	Slope (S_i) %	t_i (min)	Length (L_t) (ft)	Slope (S_t) %	Type of Land Surface	Conveyance Factor, K	Velocity (ft/sec)	t_t (min)	t_c (min)	t_{reg} (min)	t_c (min)
EX-A-L-48-1S	URBAN	0.25	0.80	58.22	1.53%	3.69	256.42	1.81%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.69	1.59	5.28	11.67	**5.28**
EX-A-L-48-2	URBAN	0.29	0.71	23.06	1.73%	2.83	379.13	1.13%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.12	2.97	5.80	14.82	**5.80**
EX-A-L-48-3	URBAN	0.62	0.72	18.09	2.21%	2.27	828.20	1.95%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.79	4.94	7.22	16.56	**7.22**
A-L-102	URBAN	0.04	0.86	46.83	5.89%	1.70	113.45	6.98%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	5.28	0.36	2.06	9.31	**5.00**
A-L-103	URBAN	0.04	0.86	18.00	1.72%	1.59	135.00	7.10%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	5.33	0.42	2.01	9.37	**5.00**
A-L-105	URBAN	0.04	0.77	0.00	0.00%	0.00	0.00	0.00%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	0.00	0.00	0.00	10.70	**5.00**
DESIGN POINT 1	URBAN	0.22	0.36	17.00	32.59%	1.76	166.76	2.89%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	3.40	0.82	2.57	27.82	**5.00**

DESIGN POINT 1 INCLUDES THE FOLLOWING BASINS: A-L-17-2, A-L-103, A-L-105

RUNOFF CALCULATIONS - SYSTEM SB LANES

PROJECT: I-25 Mobility Hub (Lone Tree) FOR — PROJECT #: 24278
DESIGNED BY: NAG — CHECKED BY: MED
DATE: 6/7/2024

RS&H

Basin	Area (ac.)	'c'	cA	t_c (min)	intensity (in/hr)	Q (cfs)	Storm Event	Attached To
A-L-12	3.29	0.55	1.80	20.04	3.26	5.86	10 YR	IN-L-12
		0.67	2.19		4.44	9.75	50 YR	
		0.71	2.35		5.11	11.99	100 YR	
A-L-14	0.40	0.87	0.34	5.00	5.63	1.94	10 YR	IN-L-14
		0.88	0.35		7.67	2.68	50 YR	
		0.89	0.35		8.82	3.12	100 YR	
A-L-15	0.13	0.15	0.02	7.36	5.09	0.10	10 YR	IN-L-15
		0.40	0.05		6.93	0.36	50 YR	
		0.49	0.06		7.98	0.50	100 YR	
A-L-16	0.31	0.86	0.27	5.00	5.63	1.51	10 YR	IN-L-16
		0.88	0.27		7.67	2.09	50 YR	
		0.89	0.28		8.82	2.44	100 YR	
A-L-17-1	0.13	0.80	0.10	5.00	5.63	0.59	10 YR	IN-L-17-1
		0.84	0.11		7.67	0.83	50 YR	
		0.86	0.11		8.82	0.98	100 YR	
A-L-17-2	0.13	0.16	0.02	5.00	5.63	0.12	10 YR	IN-L-17-2
		0.41	0.06		7.67	0.42	50 YR	
		0.50	0.07		8.82	0.59	100 YR	
A-L-17-3	0.17	0.82	0.14	5.00	5.63	0.78	10 YR	IN-L-17-3
		0.85	0.14		7.67	1.10	50 YR	
		0.87	0.15		8.82	1.29	100 YR	
A-L-20	0.44	0.63	0.28	6.53	5.28	1.47	10 YR	IN-L-20
		0.72	0.32		7.19	2.30	50 YR	
		0.76	0.34		8.27	2.78	100 YR	
A-L-20-1	0.18	0.65	0.12	5.00	5.63	0.67	10 YR	IN-L-20-1
		0.73	0.13		7.67	1.03	50 YR	
		0.77	0.14		8.82	1.24	100 YR	
A-L-20-2	0.38	0.51	0.20	5.04	5.62	1.11	10 YR	IN-L-20-2
		0.65	0.25		7.65	1.90	50 YR	
		0.70	0.27		8.81	2.35	100 YR	
A-L-20-3	0.08	0.87	0.07	5.00	5.63	0.37	10 YR	IN-L-20-3
		0.88	0.07		7.67	0.51	50 YR	
		0.89	0.07		8.82	0.59	100 YR	
A-L-21-1	0.13	0.87	0.11	5.00	5.63	0.65	10 YR	IN-L-21-1
		0.88	0.12		7.67	0.89	50 YR	
		0.89	0.12		8.82	1.04	100 YR	
A-L-21-2	0.12	0.87	0.10	5.00	5.63	0.58	10 YR	IN-L-21-2
		0.88	0.10		7.67	0.80	50 YR	
		0.89	0.11		8.82	0.93	100 YR	
EX-A-L-21-5	1.03	0.74	0.76	8.33	4.87	3.72	10 YR	EX-IN-L-21-5
		0.79	0.82		6.63	5.45	50 YR	
		0.82	0.85		7.63	6.47	100 YR	
A-L-23	0.19	0.87	0.17	5.00	5.63	0.95	10 YR	IN-L-23
		0.88	0.17		7.67	1.31	50 YR	
		0.89	0.17		8.82	1.53	100 YR	
A-L-24	0.43	0.22	0.09	10.00	4.49	0.42	10 YR	IN-L-24
		0.45	0.19		6.11	1.19	50 YR	
		0.53	0.23		7.03	1.62	100 YR	
A-L-24-1	0.20	0.87	0.18	5.00	5.63	0.99	10 YR	IN-L-24-1
		0.88	0.18		7.67	1.36	50 YR	
		0.89	0.18		8.82	1.59	100 YR	
A-L-25	1.01	0.25	0.25	17.51	3.52	0.89	10 YR	IN-L-25
		0.47	0.48		4.79	2.27	50 YR	
		0.55	0.55		5.51	3.05	100 YR	
A-L-42	0.21	0.72	0.15	5.00	5.63	0.87	10 YR	IN-L-42
		0.78	0.17		7.67	1.29	50 YR	
		0.81	0.17		8.82	1.53	100 YR	

RUNOFF CALCULATIONS - SYSTEM SB LANES

PROJECT: I-25 Mobility Hub (Lone Tree) FOR — PROJECT #: 24278
DESIGNED BY: NAG — CHECKED BY: MED
DATE: 6/7/2024

RS&H

Basin	Area (ac.)	'c'	cA	t_c (min)	intensity (in/hr)	Q (cfs)	Storm Event	Attached To
A-L-45	0.22	0.80	0.18	5.56	5.50	0.98	10 YR	IN-L-45
		0.84	0.18		7.49	1.39	50 YR	
		0.86	0.19		8.62	1.63	100 YR	
A-L-48-1N	0.18	0.87	0.16	6.32	5.33	0.84	10 YR	IN-L-48-1N
		0.88	0.16		7.26	1.15	50 YR	
		0.89	0.16		8.35	1.34	100 YR	
EX-A-L-48-1S	0.25	0.82	0.21	5.28	5.57	1.14	10 YR	EX-IN-L-48-1S
		0.85	0.21		7.58	1.61	50 YR	
		0.86	0.22		8.72	1.89	100 YR	
EX-A-L-48-2	0.29	0.74	0.21	5.80	5.45	1.16	10 YR	EX-IN-L-48-2
		0.80	0.23		7.42	1.69	50 YR	
		0.82	0.23		8.53	2.00	100 YR	
EX-A-L-48-3	0.62	0.75	0.47	7.22	5.13	2.39	10 YR	EX-IN-L-48-3
		0.80	0.50		6.98	3.48	50 YR	
		0.83	0.51		8.03	4.12	100 YR	
A-L-102	0.04	0.87	0.04	5.00	5.63	0.20	10 YR	IN-L-102
		0.88	0.04		7.67	0.28	50 YR	
		0.89	0.04		8.82	0.32	100 YR	
A-L-103	0.04	0.87	0.04	5.00	5.63	0.21	10 YR	IN-L-103
		0.88	0.04		7.67	0.29	50 YR	
		0.89	0.04		8.82	0.33	100 YR	
A-L-105	0.04	0.80	0.03	5.00	5.63	0.19	10 YR	N/A
		0.83	0.03		7.67	0.27	50 YR	
		0.85	0.04		8.82	0.32	100 YR	
DESIGN POINT 1	0.22	0.42	0.09	5.00	5.63	0.52	10 YR	IN-L-17-2
		0.59	0.13		7.67	0.98	50 YR	
		0.65	0.14		8.82	1.24	100 YR	

DESIGN POINT 1 INCLUDES THE FOLLOWING BASINS: A-L-17-2, A-L-103, A-L-105

COMPOSITE C CALCULATIONS - SYSTEM NB LANES

PROJECT: I-25 Mobility Hub (Lone Tree) PROJECT #: 24278
DESIGNED BY: NAG CHECKED BY: MED
DATE: 6/7/2024

NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.276}$	$C_A = 0.87i^{1.232}$	$C_A = 0.88i^{1.124}$	$C_A = 0.85i+.025$	$C_A = 0.78i+0.110$
B	$C_B = 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$

RS&H

Basin ID	Land Use and Impervious Percentage							Total Area	Percentage Imperviousness (%)	NRCS Soil Group	Runoff Coefficient					
	Paved	**Open**	**Gravel (Packed)**	**Gravel**	**Roof**	**Ponds**	**Drive and walks**				C	C	C	C	C	C
	100%	**2%**	**40%**	**13%**	**90%**	**100%**	**90%**									
	area (ft^2)	area (ft^2)	area (ft^2)	area (ft^2)	area (ft^2)	area (ft^2)	area (ft^2)	(acres)			02 yr	05 yr	10 yr	25 yr	50 yr	100 yr
A-L-108	0	0	0	0	3,024	0	0	0.07	90%	C/D	0.74	0.77	0.80	0.82	0.83	0.85
A-L-109	3,149	0	0	0	0	0	0	0.07	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-111	2,215	0	0	0	0	0	0	0.05	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-76	15,787	0	0	0	0	0	0	0.36	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-79	33,964	1,322	0	0	0	0	0	0.81	96%	C/D	0.80	0.82	0.84	0.86	0.87	0.88
A-L-80	6,307	479	0	0	0	0	0	0.16	93%	C/D	0.77	0.80	0.82	0.84	0.85	0.87
A-L-83-1	7,847	0	0	0	0	0	0	0.18	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-83-2	8,396	0	0	0	0	0	0	0.19	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-84-1	6,175	0	0	0	0	0	0	0.14	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-84-2	1,453	40,219	0	0	0	0	0	0.96	5%	C/D	0.03	0.08	0.17	0.35	0.42	0.51
A-L-85	5,876	0	0	0	0	0	0	0.13	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
A-L-87	7,192	0	0	0	0	0	0	0.17	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
EX-A-L-75	7,333	0	0	0	0	0	0	0.17	100%	C/D	0.83	0.86	0.87	0.88	0.88	0.89
DESIGN POINT 2	6,816	40,219	0	0	3,024	0	0	1.15	21%	C/D	0.14	0.20	0.28	0.43	0.49	0.57

DESIGN POINT 2 INCLUDES THE FOLLOWING BASINS: A-L-84-2, A-L-108, A-L-109, A-L-111

TIME OF CONCENTRATION - SYSTEM NB LANES

PROJECT: I-25 Mobility Hub (Lone Tree)
DESIGNED BY: NAG
DATE: 6/7/2024

PROJECT #: 24278
CHECKED BY: MED

$$t_c = t_i + t_t \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} \qquad t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

SUB-BASIN DATA				INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)						$t_i + t_t$	t_c URBAN CHECK	FINAL t_c USED
Basin ID	Basin Type	Area (acres)	C 05 yr	Length (L_i) (ft)	Slope (S_i) %	t_i (min)	Length (L_t) (ft)	Slope (S_t) %	Type of Land Surface	Conveyance Factor, K	Velocity (ft/sec)	t_t (min)	t_c (min)	t_{reg} (min)	t_c (min)
A-L-108	URBAN	0.07	0.77	155.97	1.00%	7.49	0.00	0.00%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	0.00	0.00	7.49	10.70	7.49
A-L-109	URBAN	0.07	0.86	75.47	6.60%	2.08	110.56	6.86%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	5.24	0.35	2.43	9.31	5.00
A-L-111	URBAN	0.05	0.86	76.07	6.72%	2.08	89.80	5.62%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	4.74	0.32	2.39	9.27	5.00
A-L-76	URBAN	0.36	0.86	98.83	1.75%	3.71	152.93	0.82%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.81	1.41	5.11	10.23	5.11
A-L-79	URBAN	0.81	0.82	111.41	2.02%	4.21	298.91	1.02%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.02	2.47	6.68	11.82	6.68
A-L-80	URBAN	0.16	0.80	138.99	1.63%	5.55	111.30	3.50%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	3.74	0.50	6.04	10.63	6.04
A-L-83-1	URBAN	0.18	0.86	38.25	7.29%	1.43	167.86	0.97%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.96	1.42	2.86	10.24	5.00
A-L-83-2	URBAN	0.19	0.86	59.80	5.87%	1.93	197.82	0.91%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.91	1.73	3.65	10.50	5.00
A-L-84-1	URBAN	0.14	0.86	64.96	6.43%	1.95	74.20	1.64%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.56	0.48	2.43	9.42	5.00
A-L-84-2	NON-URBAN	0.96	0.08	208.26	2.21%	20.72	447.98	1.91%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.76	2.70	23.42	N/A	23.42
A-L-85	URBAN	0.13	0.86	54.47	8.35%	1.63	104.50	0.33%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.16	1.50	3.14	10.31	5.00
A-L-87	URBAN	0.17	0.86	47.44	5.73%	1.73	181.40	1.42%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.38	1.27	3.00	10.10	5.00
EX-A-L-75	URBAN	0.17	0.86	99.09	1.84%	3.65	73.60	0.58%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	1.53	0.80	4.45	9.70	5.00
DESIGN POINT 2	NON-URBAN	1.15	0.20	208.26	2.21%	18.18	447.98	1.91%	PAVED AREAS AND SHALLOW PAVED SWALES	20.00	2.76	2.70	20.88	N/A	20.88

DESIGN POINT 2 INCLUDES THE FOLLOWING BASINS: A-L-84-2, A-L-108, A-L-109, A-L-111

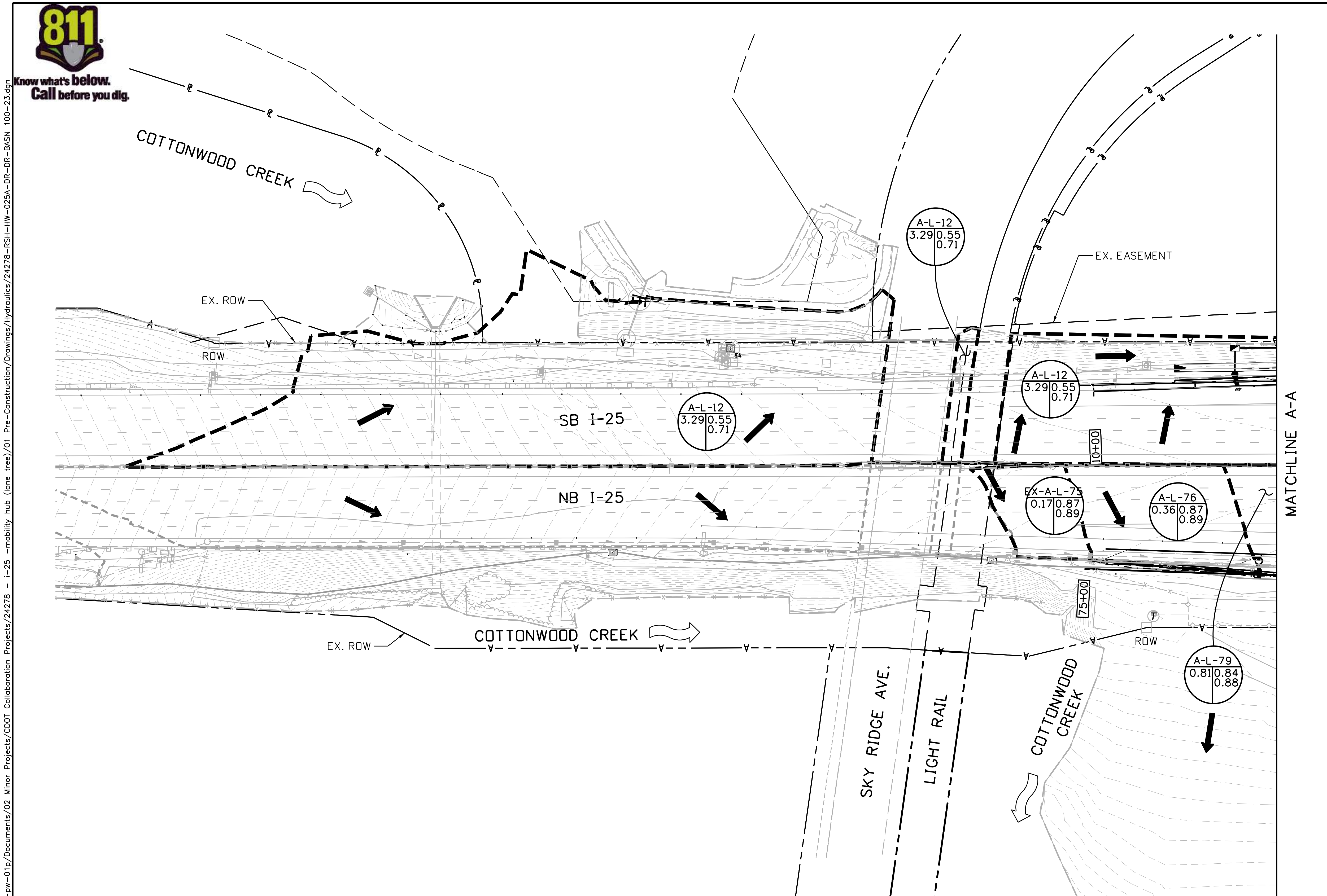
RUNOFF CALCULATIONS - SYSTEM NB LANES

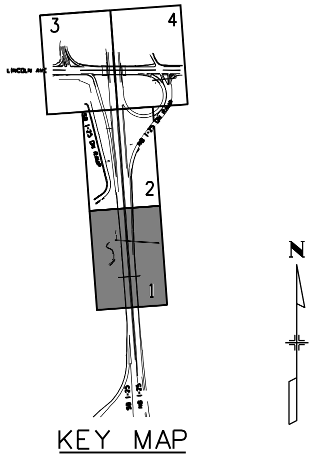
PROJECT: I-25 Mobility Hub (Lone Tree) PROJECT #: 24278
DESIGNED BY: NAG CHECKED BY: MED
DATE: 6/7/2024

Basin	Area (ac.)	'c'	cA	t_c (min)	intensity (in/hr)	Q (cfs)	Storm Event	Attached To
A-L-108	0.07	0.80	0.06	7.49	5.06	0.28	10 YR	N/A
		0.83	0.06		6.89	0.40	50 YR	
		0.85	0.06		7.93	0.47	100 YR	
A-L-109	0.07	0.87	0.06	5.00	5.63	0.35	10 YR	IN-L-109
		0.88	0.06		7.67	0.49	50 YR	
		0.89	0.06		8.82	0.57	100 YR	
A-L-111	0.05	0.87	0.04	5.00	5.63	0.25	10 YR	IN-L-111
		0.88	0.04		7.67	0.34	50 YR	
		0.89	0.05		8.82	0.40	100 YR	
A-L-76	0.36	0.87	0.32	5.11	5.60	1.77	10 YR	IN-L-76
		0.88	0.32		7.63	2.44	50 YR	
		0.89	0.32		8.78	2.84	100 YR	
A-L-79	0.81	0.84	0.68	6.68	5.25	3.59	10 YR	IN-L-79
		0.87	0.70		7.14	5.01	50 YR	
		0.88	0.71		8.22	5.85	100 YR	
A-L-80	0.16	0.82	0.13	6.04	5.39	0.69	10 YR	IN-L-80
		0.85	0.13		7.34	0.97	50 YR	
		0.87	0.13		8.45	1.14	100 YR	
A-L-83-1	0.18	0.87	0.16	5.00	5.63	0.88	10 YR	IN-L-83-1
		0.88	0.16		7.67	1.22	50 YR	
		0.89	0.16		8.82	1.42	100 YR	
A-L-83-2	0.19	0.87	0.17	5.00	5.63	0.95	10 YR	IN-L-83-2
		0.88	0.17		7.67	1.30	50 YR	
		0.89	0.17		8.82	1.52	100 YR	
A-L-84-1	0.14	0.87	0.12	5.00	5.63	0.70	10 YR	IN-L-84-1
		0.88	0.13		7.67	0.96	50 YR	
		0.89	0.13		8.82	1.12	100 YR	
A-L-84-2	0.96	0.17	0.16	23.42	3.01	0.50	10 YR	IN-L-84-2
		0.42	0.40		4.10	1.64	50 YR	
		0.51	0.48		4.72	2.28	100 YR	
A-L-85	0.13	0.87	0.12	5.00	5.63	0.66	10 YR	IN-L-85
		0.88	0.12		7.67	0.91	50 YR	
		0.89	0.12		8.82	1.06	100 YR	
A-L-87	0.17	0.87	0.14	5.00	5.63	0.81	10 YR	IN-L-87
		0.88	0.15		7.67	1.12	50 YR	
		0.89	0.15		8.82	1.30	100 YR	
EX-A-L-75	0.17	0.87	0.15	5.00	5.63	0.83	10 YR	EX-IN-L-75
		0.88	0.15		7.67	1.14	50 YR	
		0.89	0.15		8.82	1.33	100 YR	
DESIGN POINT 2	1.15	0.28	0.33	20.88	3.20	1.05	10 YR	IN-L-84-2
		0.49	0.57		4.36	2.47	50 YR	
		0.57	0.65		5.01	3.28	100 YR	

DESIGN POINT 2 INCLUDES THE FOLLOWING BASINS: A-L-84-2, A-L-108, A-L-109, A-L-111

APPENDIX A.3 – PROPOSED BASIN MAP





LEGEND:

- BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION

BASIN ID: A#
BASIN AREA (ACRES): Area
RUNOFF COEFF: C10 / C100

0' 25' 50' 100'

All seals for this set of drawings are applied to the cover page(s)	Print Date: 6/12/2024	
	File Name: 24278-RSH-HW-025A-DR-DR-BASN 100-23.dgn	
	Horiz. Scale: As Noted	Vert. Scale: As Noted
	Unit Information	SHA
	RS&H	

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
18500 E. Colfax Ave.
Aurora, CO 80011
Phone: 303-746-8639
Region 1 NB

As Constructed
No Revisions:
Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED BASIN MAP

Designer:	MED	Structure Numbers	
Detailer:	BW		
Sheet Subset:	HYDR	Subset Sheets:	1 of 4

Project No./Code
267 0252-499
24278
Sheet Number

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6/12/2024 5:20:24 PM
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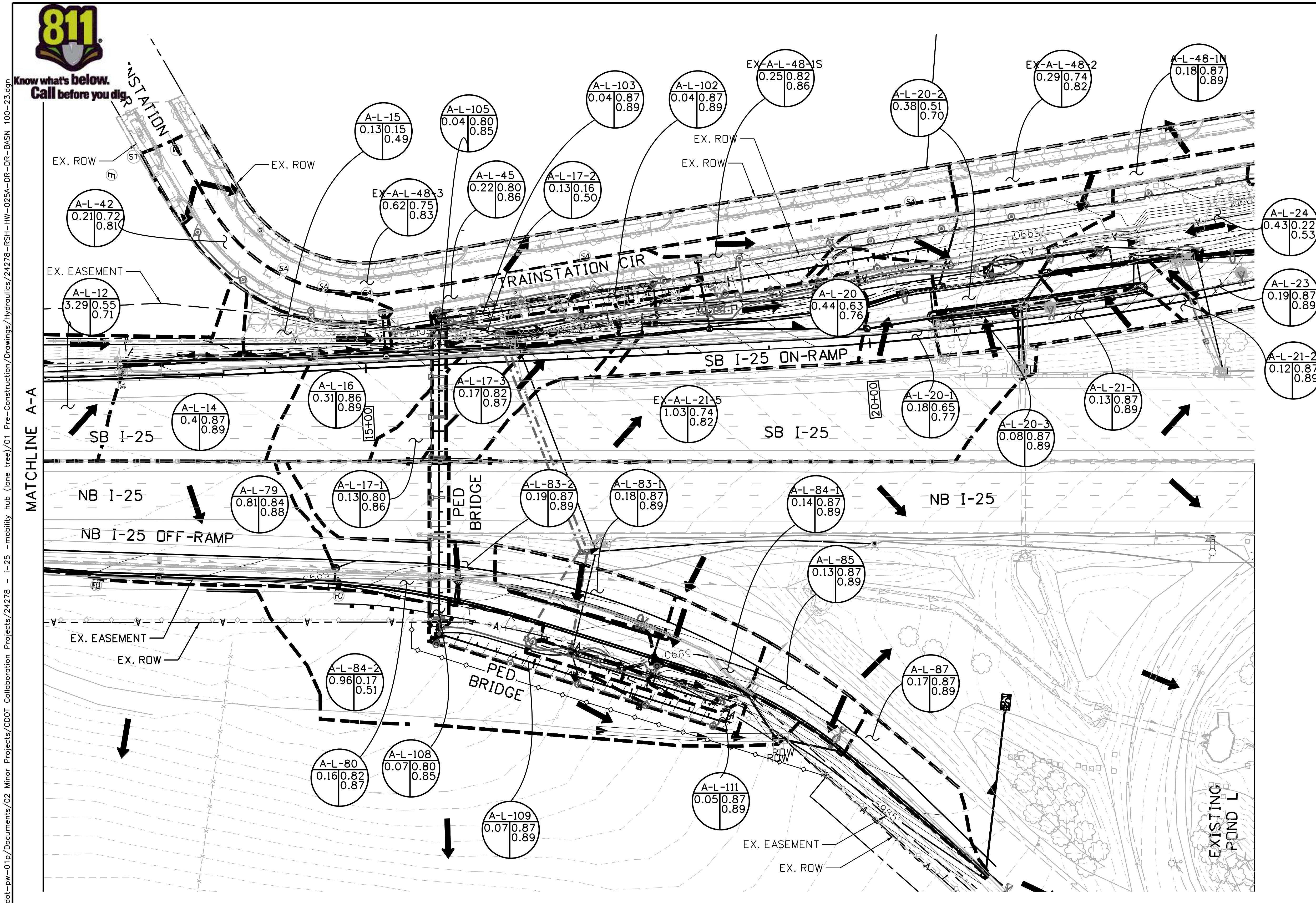

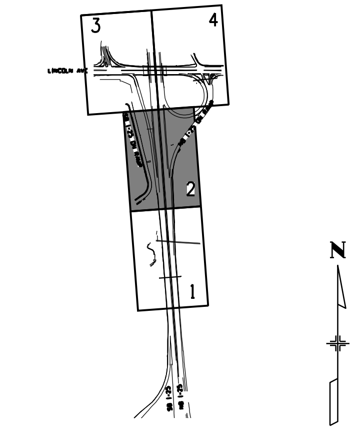

LEGEND:

- BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION

BASIN ID
A#
Area | C10 | C100
BASIN AREA (ACRES)
RUNOFF COEFF

All seals for this set of drawings are applied to the cover page(s)

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File Name: 24278-RSH-HW-025A-DR-DR-BASN 100-23.dgn
Horiz. Scale: As Noted Vert. Scale: As Noted
Unit Information SHA
RS&H

Sheet Revisions		
Date:	Comments	Init.

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Region 1 NB

As Constructed
No Revisions:
Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED BASIN MAP

Designer: MED
Detailer: BW
Sheet Subset: HYDR
Structure Numbers
Subset Sheets: 2 of 4

Project No./Code
267 0252-499
24278
Sheet Number

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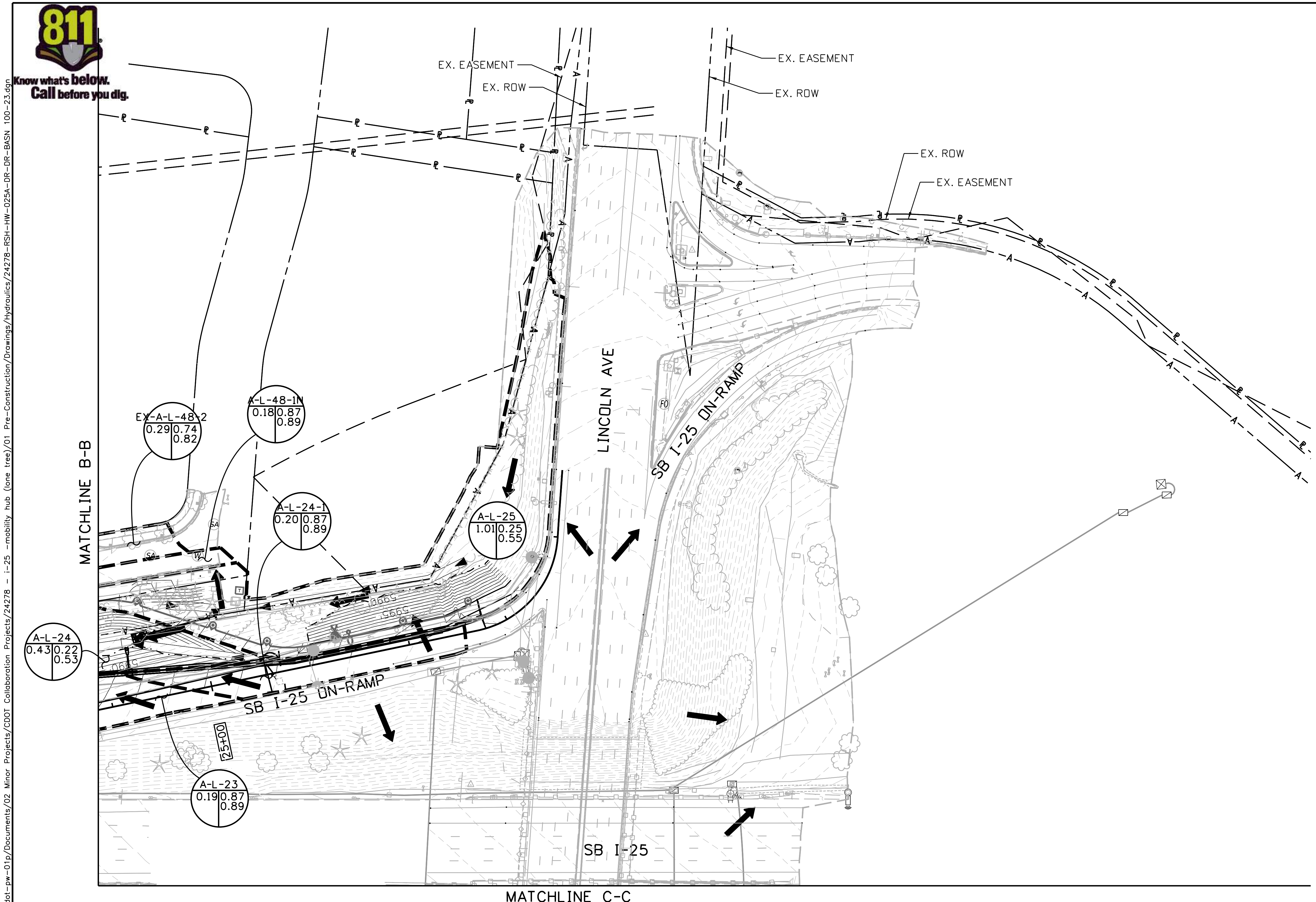
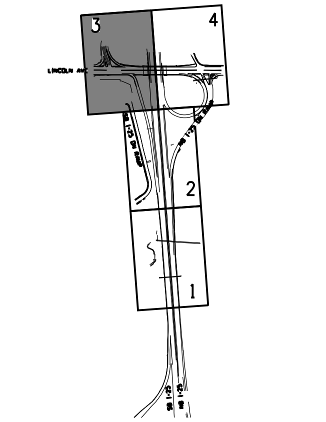


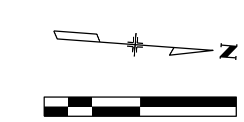


KEY MAP

LEGEND:

- BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION

BASIN ID
A#
Area C10 C100
BASIN AREA (ACRES)
RUNOFF COEFF



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	Unit Information	SHA	
	RS&H		

Sheet Revisions

Date:	Comments	Init.

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Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED BASIN MAP

Designer: MED	Structure Numbers		
Detailer: BW			
Sheet Subset: HYDR	Subset Sheets: 3 of 4		

Project No./Code
267 0252-499
24278
Sheet Number

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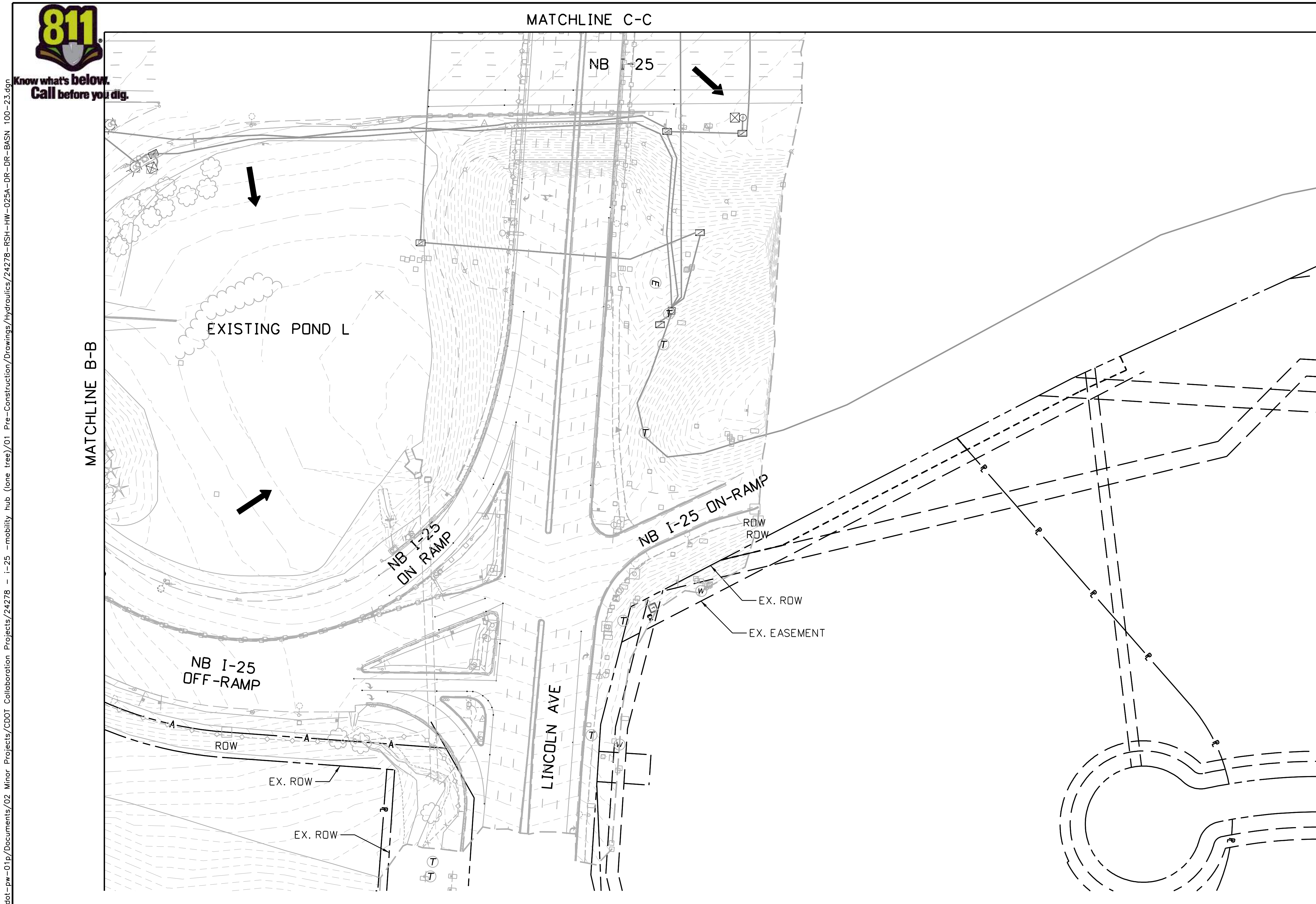
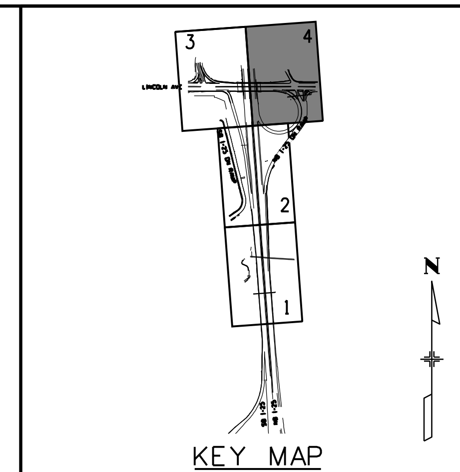
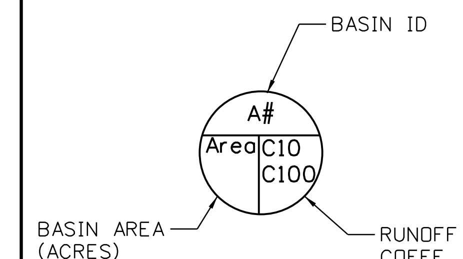
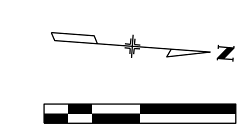




LEGEND:

- BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION





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File Name: 24278-RSH-HW-025A-DR-DR-BASN 100-23.dgn	
Horiz. Scale: As Noted	Vert. Scale: As Noted
Unit Information	SHA

RS&H

Sheet Revisions		
Date:	Comments	Init.

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As Constructed
No Revisions:
Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED BASIN MAP

Designer:	MED	Structure Numbers	
Detailer:	BW		
Sheet Subset:	HYDR	Subset Sheets:	4 of 4

Project No./Code
267 0252-499
24278
Sheet Number

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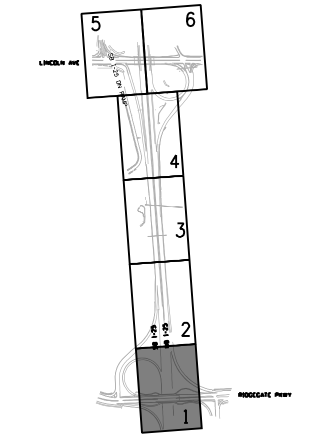

KEY MAP

LEGEND:

- WQ BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION
- TRIBUTARY WQ AREA

BASIN INFORMATION

A#
Area (AC) | Imp. Area (AC)

0' 25' 50' 100'

All seals for this set of drawings are applied to the cover page(s)	Print Date: 6/12/2024		
	File Name: 24278-RSH-HW-025A-DR-DR-WQ BASN 100-23.dgn		
	Horiz. Scale: As Noted	Vert. Scale: As Noted	
	Unit Information	SHA	
	RS&H		

Sheet Revisions

Date:	Comments	Init.

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Region 1 NB

As Constructed
No Revisions:
Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED WQ BASIN MAP

Designer:	MED	Structure Numbers	
Detailer:	BW		
Sheet Subset:	WQ	Subset Sheets:	1 of 6

Project No./Code
267 0252-499
24278
Sheet Number

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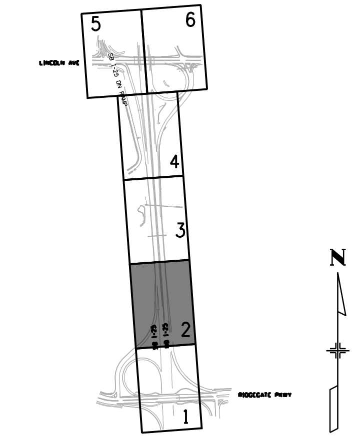
Know what's below. Call before you dig.



KEY MAP

LEGEND:

- WQ BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION
- TRIBUTARY WQ AREA

BASIN INFORMATION

A#
Area (AC) | Imp. Area (AC)

0' 25' 50' 100'

All seals for this set of drawings are applied to the cover page(s)

Print Date: 6/12/2024
File Name: 24278-RSH-HW-025A-DR-DR-WQ BASN 100-23.dgn
Horiz. Scale: As Noted Vert. Scale: As Noted
Unit Information SHA
RS&H

Sheet Revisions		
Date:	Comments	Init.

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CDOT
Region 1 NB

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Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED WQ BASIN MAP

Designer: MED
Detailer: BW
Sheet Subset: WQ
Structure Numbers
Subset Sheets: 2 of 6

Project No./Code
267 0252-499
24278
Sheet Number

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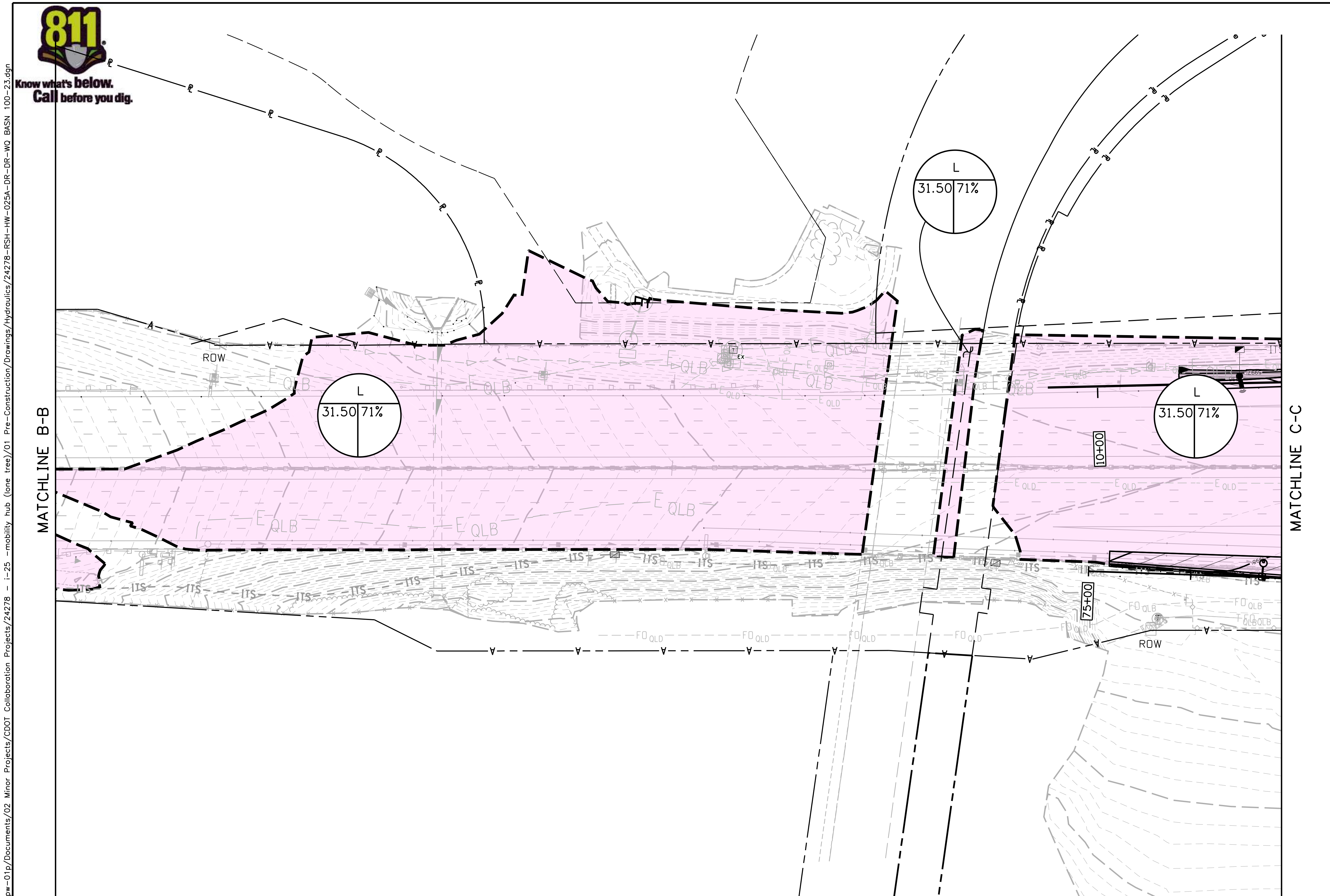

LEGEND:

- WQ BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION
- TRIBUTARY WQ AREA

BASIN INFORMATION

A#
Area (AC) | Imp. Area (AC)

0' 25' 50' 100'

All seals for this set of drawings are applied to the cover page(s)

Print Date: 6/12/2024
File Name: 24278-RSH-HW-025A-DR-DR-WQ BASN 100-23.dgn
Horiz. Scale: As Noted Vert. Scale: As Noted
Unit Information SHA
RS&H

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
18500 E. Colfax Ave.
Aurora, CO 80011
Phone: 303-746-8639
Region 1 NB

As Constructed
No Revisions:
Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED WQ BASIN MAP

Designer: MED
Detailer: BW
Sheet Subset: WQ
Structure Numbers
Subset Sheets: 3 of 6

Project No./Code
267 0252-499
24278
Sheet Number

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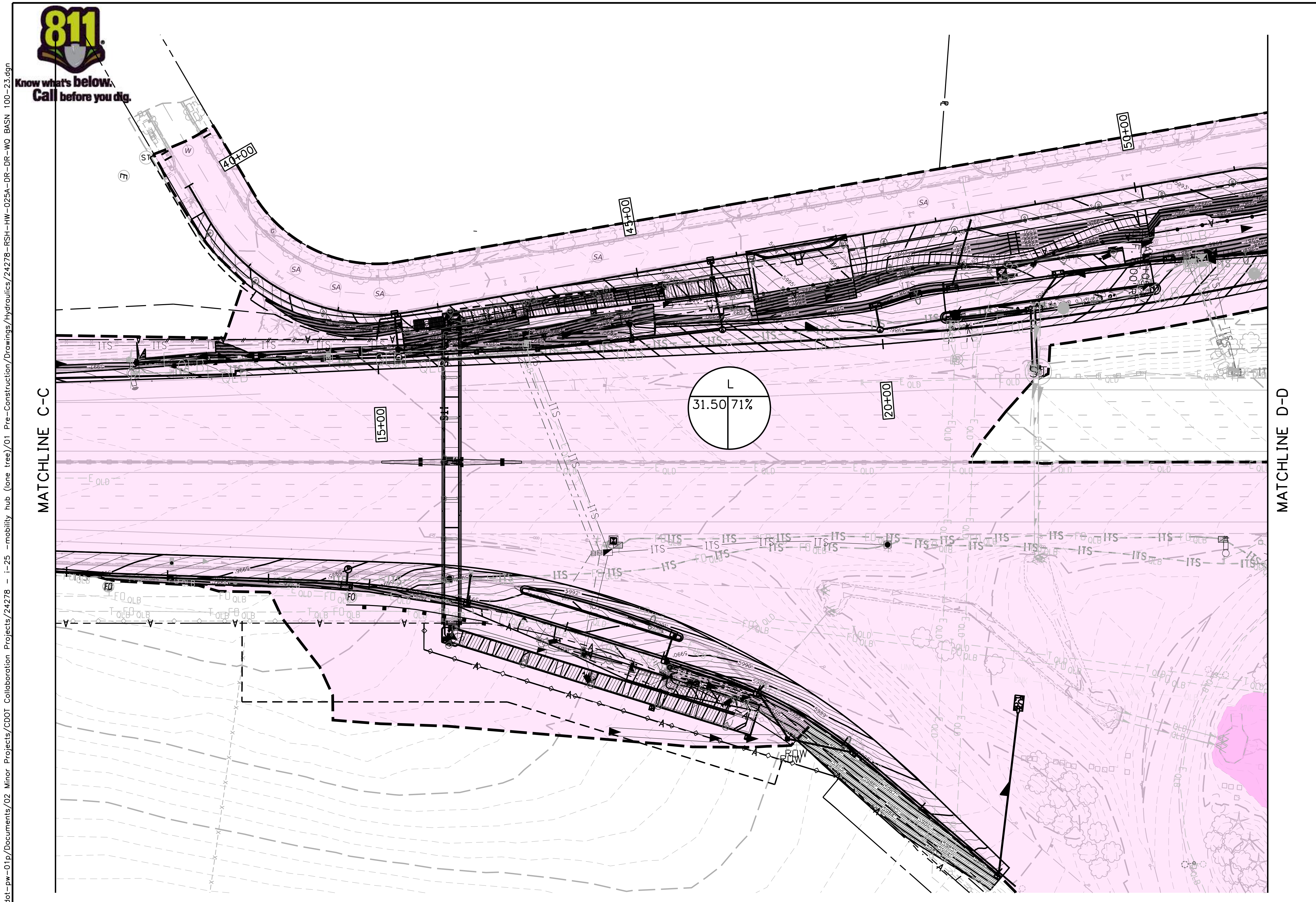

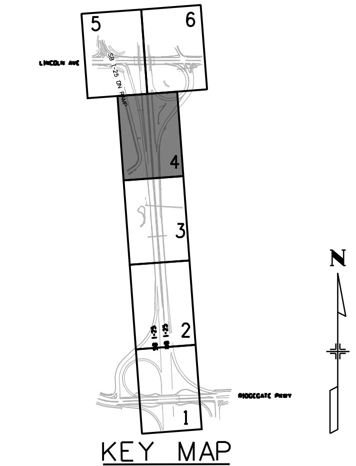

LEGEND:

- WQ BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION
- TRIBUTARY WQ AREA

BASIN INFORMATION

A#
Area (AC) | Imp. Area (AC)

0' 25' 50' 100'

All seals for this set of drawings are applied to the cover page(s)	Print Date: 6/12/2024	
	File Name: 24278-RSH-HW-025A-DR-DR-WQ BASN 100-23.dgn	
	Horiz. Scale: As Noted	Vert. Scale: As Noted
	Unit Information	SHA
	RS&H	

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
18500 E. Colfax Ave.
Aurora, CO 80011
Phone: 303-746-8639
CDOT
Region 1 NB

As Constructed
No Revisions:
Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED WQ BASIN MAP

Designer:	MED	Structure Numbers	
Detailer:	BW		
Sheet Subset:	WQ	Subset Sheets:	4 of 6

Project No./Code
267 0252-499
24278
Sheet Number

DukeM
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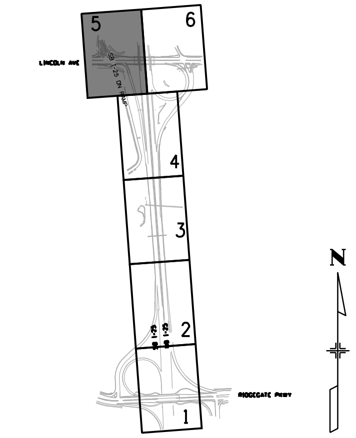
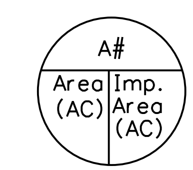


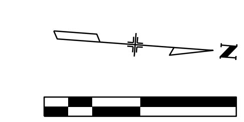
KEY MAP

LEGEND:

- WQ BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION
- TRIBUTARY WQ AREA

BASIN INFORMATION





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All seals for this set of drawings are applied to the cover page(s)

Print Date: 6/12/2024	
File Name: 24278-RSH-HW-025A-DR-DR-WQ BASN 100-23.dgn	
Horiz. Scale: As Noted	Vert. Scale: As Noted
Unit Information	SHA
RS&H	

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
18500 E. Colfax Ave.
Aurora, CO 80011
Phone: 303-746-8639
Region 1 NB

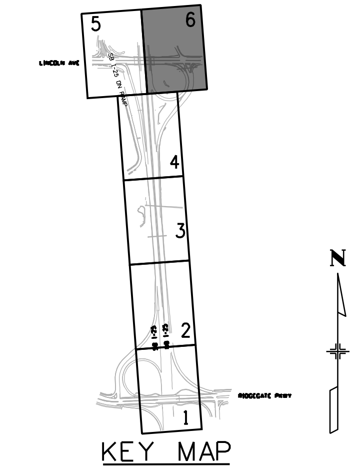
As Constructed
No Revisions:
Revised:
Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED WQ BASIN MAP

Designer:	MED	Structure Numbers	
Detailer:	BW		
Sheet Subset:	WQ	Subset Sheets:	5 of 6

Project No./Code
267 0252-499
24278
Sheet Number

Know what's below. Call before you dig. 811



LEGEND:

- WQ BASIN BOUNDARY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- FLOW DIRECTION
- TRIBUTARY WQ AREA

BASIN INFORMATION

A#

Area (AC) | Imp. Area (AC)

0' 25' 50' 100'

All seals for this set of drawings are applied to the cover page(s)

Print Date: 6/12/2024	
File Name: 24278-RSH-HW-025A-DR-WQ BASN 100-23.dgn	
Horiz. Scale: As Noted	Vert. Scale: As Noted
Unit Information	SHA

RS&H

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation

18500 E. Colfax Ave.
Aurora, CO 80011
Phone: 303-746-8639

Region 1 NB

As Constructed

No Revisions:

Revised:

Void:

I-25 MOBILITY HUB (LONE TREE)
DRAINAGE
PROPOSED WQ BASIN MAP

Designer:	MED	Structure Numbers	
Detailer:	BW		
Sheet Subset:	WQ	Subset Sheets:	6 of 6

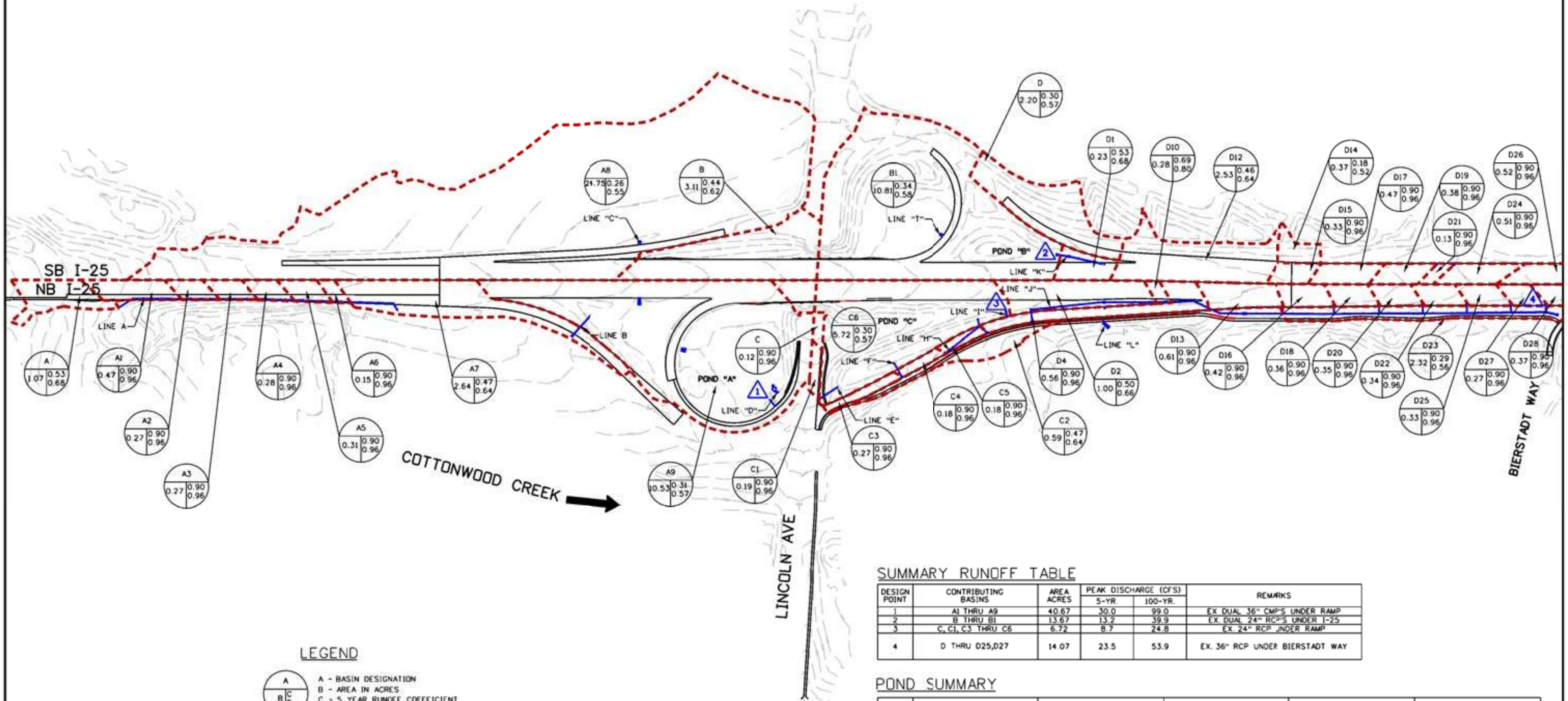
Project No./Code

267 0252-499

24278

Sheet Number

APPENDIX A.4 – EXISTING BASIN MAP



LEGEND

- A - BASIN DESIGNATION
- B - AREA IN ACRES
- C - 5 YEAR RUNOFF COEFFICIENT
- D - 100 YEAR RUNOFF COEFFICIENT
- E - CONCENTRATION POINT
- BASIN BOUNDARY

0' 200' 400' 800'

SUMMARY RUNOFF TABLE

DESIGN POINT	CONTRIBUTING BASINS	AREA ACRES	PEAK DISCHARGE (CFS) 5-YR.	PEAK DISCHARGE (CFS) 100-YR.	REMARKS
1	A1 THRU A9	40.67	30.0	99.0	EX DUAL 36" CMP'S UNDER RAMP
2	B THRU B1	13.67	13.2	39.9	EX. DUAL 24" RCP'S UNDER I-25
3	C, C1, C3 THRU C6	6.72	8.7	24.8	EX. 24" RCP UNDER RAMP
4	D THRU D25,D27	14.07	23.5	53.9	EX. 36" RCP UNDER BIERSTADT WAY

POND SUMMARY

I.D.	CONTRIBUTING BASINS	SUBWATERSHED IMPERVIOUSNESS	WATER QUALITY CAPTURE VOLUME	EXCESS URBAN RUNOFF VOLUME	MAXIMUM VOLUME
A	A1 THRU A9	30.2%	-	1.15 AC. FT.	2.19 AC. FT.
B	B THRU B1	40.4%	0.19 AC. FT.	-	0.50 AC. FT.
C	C, C1, C3 THRU C6	42.3%	0.09 AC. FT.	-	0.20 AC. FT.

Print Date: 4/3/2014	Sheet Revisions	Colorado Department of Transportation	As Constructed
File Name: 16602HYDR_Prop Basin01.dgn	Date: / Comments / Init.	7328 S. Revere Parkway, Suite 204A, Centennial, CO 80112	No Revisions:
Horiz. Scale: 1:400 / Vert. Scale: As Noted		Phone: 303-365-7234 FAX: 303-790-1037	Revised:
Unit Information / Unit Leader Initials		Region 1 / DRG	Void:

I-25 LINCOLN TO COUNTY LINE PROPOSED HYDRAULIC BASIN MAP		Project No./Code
Designer: CDT	Structure Numbers	C 0252-399
Detailer: RSA		16602
Sheet Subset: BASIN	Subset Sheets: BM-1 of 3	Sheet Number

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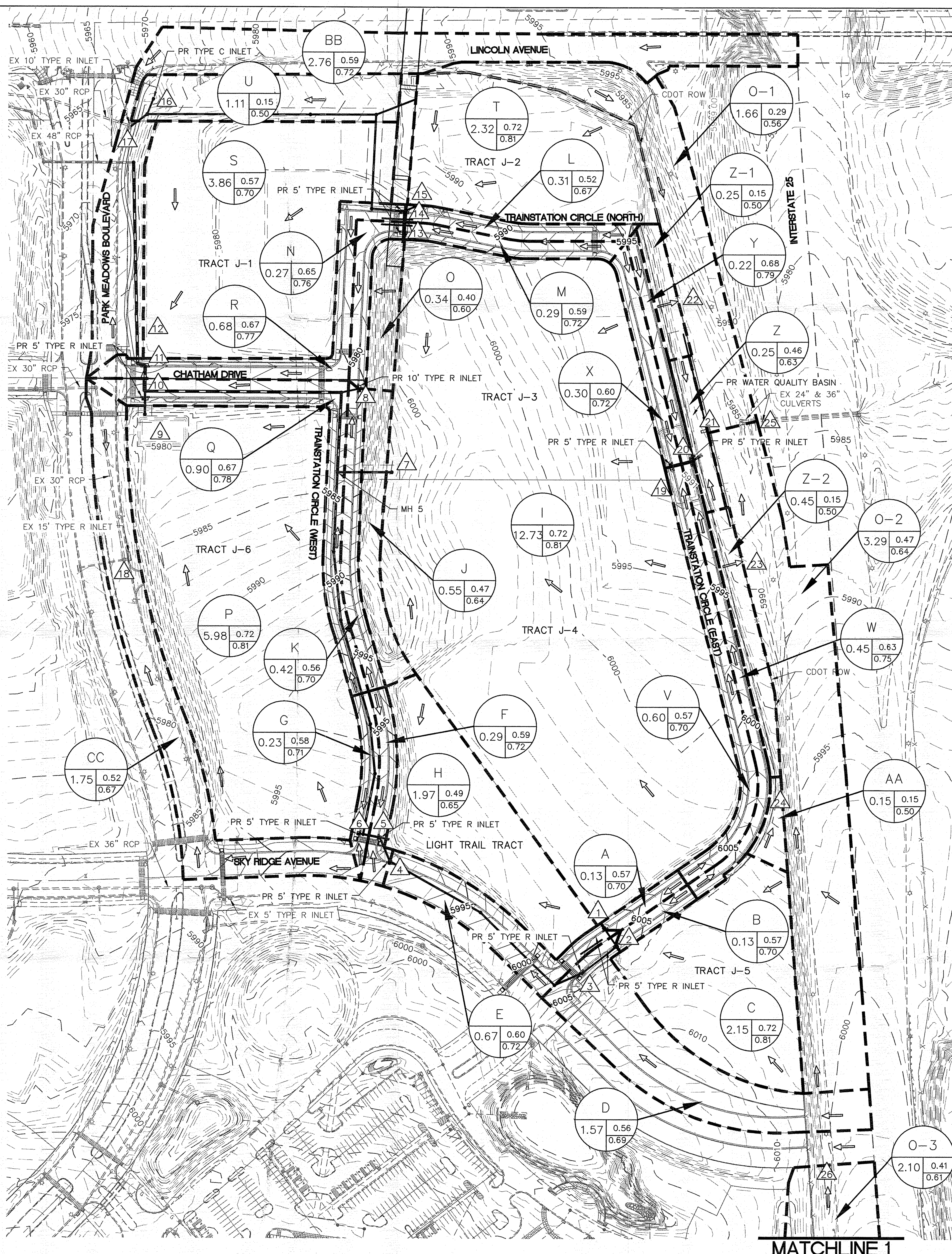
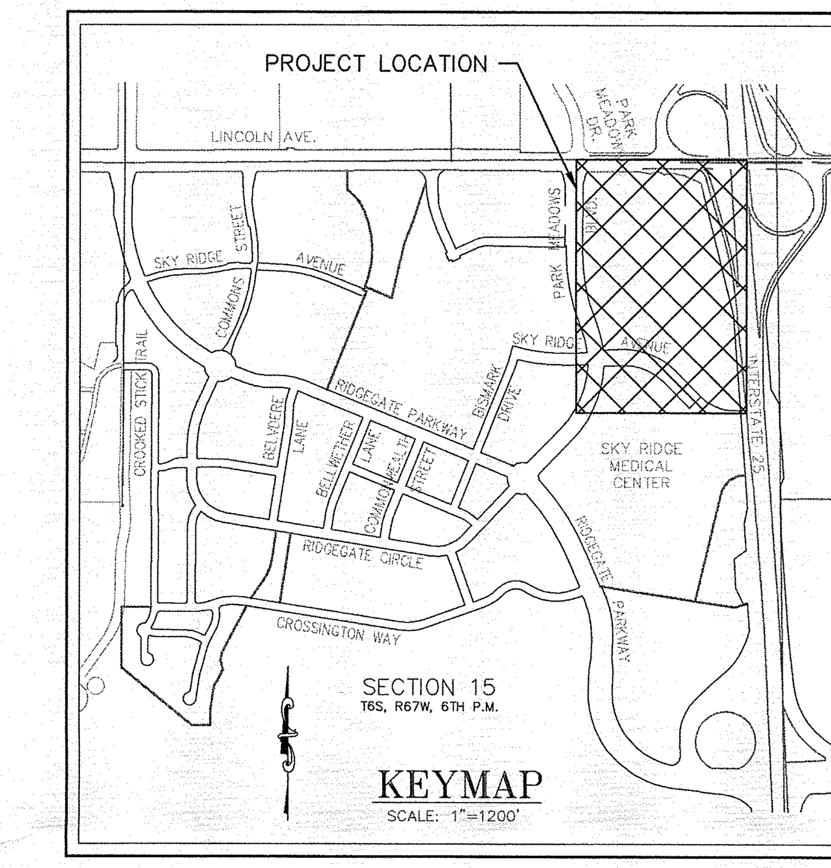


LEGEND

- BASIN DESIGNATION
- BASIN AREA (ACRES)
- 5-YR RUNOFF COEFFICIENT
- 100-YR RUNOFF COEFFICIENT
- DESIGN POINT
- DIRECTIONAL FLOW ARROWS
- DRAINAGE BASIN BOUNDARY
- EXISTING RIGHT-OF-WAY
- EXISTING PROPERTY LINE
- EXISTING EASEMENT
- 5985 EXISTING MAJOR CONTOUR
- 5986 EXISTING MAJOR CONTOUR
- EXISTING INLET, STORM SEWER, & MANHOLE
- PROPOSED, STORM SEWER, & MANHOLE
- 5985 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR

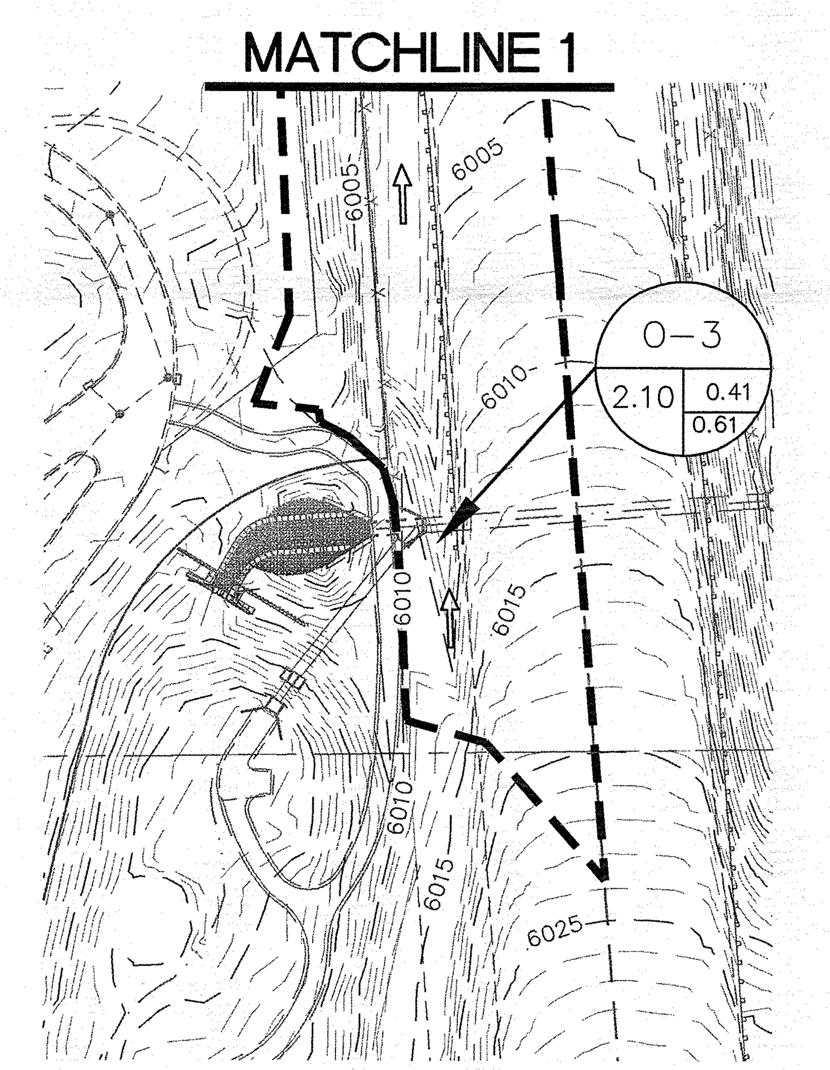


SUMMARY RUNOFF TABLE

			BASIN RUNOFF		BYPASS CONTRIBUTION			BASIN NET RUNOFF	
BASIN ID	BASIN RUNOFF TO DESIGN POINT	AREA (AC.)	Q_5 (CFS)	Q_{100} (CFS)	Q_5 (CFS)	Q_{100} (CFS)	DESCRIPTION	Q_5 (CFS)	Q_{100} (CFS)
A	1	0.13	0.4	0.8				0.4	0.8
B	2	0.13	0.4	0.8				0.4	0.8
C	2	2.15	6.6	13.5				6.6	13.5
D	3	1.57	3.1	7.0				3.1	7.0
E	4	0.67	1.8	3.9	-0.2	-1.4	BYPASS TO BASIN F	1.6	2.5
F	5	0.29	0.8	1.8	0.2	1.4	BYPASS FROM BASIN E	1.0	3.2
G	6	0.23	0.6	1.4				0.6	1.4
H	5	1.97	3.9	9.4				3.9	9.4
I	7	12.73	34.9	71.7				34.9	71.7
J	8	0.55	1.1	2.8				1.1	2.8
K	8	0.42	1.1	2.5				1.1	2.5
L	14	0.31	0.8	1.8		-0.2	BYPASS TO BASIN R	0.8	1.6
M	13	0.29	0.8	1.7		-0.1	BYPASS TO BASIN N	0.8	1.6
N	8	0.27	0.8	1.8		0.1	BYPASS FROM BASIN M	0.8	1.9
O	8	0.34	0.6	1.5				0.6	1.5
P	9	5.98	17.2	35.4				17.2	35.4
Q	10	0.90	2.6	5.4				2.6	5.4
R	11	0.68	2.0	4.3		0.2	BYPASS FROM BASIN L	2.0	4.5
S	12	3.86	8.4	18.8				8.4	18.8
T	15	2.32	7.4	15.2				7.4	15.2
U	16	1.11	0.6	3.4				0.6	3.4
V	19	0.60	1.4	3.2				1.4	3.2
W	20	0.45	1.2	2.5				1.2	2.5
X	19	0.30	0.8	1.7				0.8	1.7
Y	20	0.22	0.7	1.4				0.7	1.4
Z	21	0.25	0.5	1.3				0.5	1.3
Z-1	22	0.25	0.2	1.1				0.2	1.1
Z-2	23	0.45	0.3	2.0				0.3	2.0
AA	24	0.15	0.1	0.7				0.1	0.7
BB	17	2.76	4.9	10.9				4.9	10.9
CC	18	1.75	3.4	7.9				3.4	7.9
O-1	25	1.66	1.7	5.8				1.7	5.8
O-2	25	3.29	4.7	11.6				4.7	11.6
O-3	26	2.10	3.3	9.0				3.3	9.0

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	0.4	0.8
2	7.2	14.9
3	9.1	19.4
4	10.1	20.9
5	14.1	31.3
6	0.6	1.4
7	34.9	71.7
8	3.2	7.9
9	17.2	35.4
10	19.6	40.4
11	62.0	134.0
12	69.0	149.9
13	0.8	1.6
14	8.9	18.3
15	7.4	15.2
16	0.6	3.4
17	11.5	26.3
18	3.4	7.9
19	2.2	4.9
20	3.9	8.6
21	4.3	9.7
22	0.2	1.1
23	0.3	2.0
24	0.1	0.7
25	10.7	29.0
26	3.3	9.0

Note: Design Point flows represent total flow at Design Point in the storm sewer pipe.
Flow rates at Design Point 21 and 25 do not account for attenuation of flow at the Water Quality Pond



100' 0 50' 100' 200'
GRAPHIC SCALE

PRELIMINARY
NOT FOR CONSTRUCTION

MERRICK & COMPANY

RAMPART RANGE METRO DISTRICT NO. 1

8390 E. CRESCENT PARKWAY, SUITE 500
GREENWOOD VILLAGE, COLORADO 80111
PH: 303-779-4525/FAX: 303-773-2050

REVISIONS:

REV	REVISION DESCRIPTION	DATE	CHANGED BY	CHECKED BY	APPROVED BY

DESIGN BY:	JWH	5/6/11
DRAWN BY:	BCR	5/6/11
CHECKED BY:	JSJ	5/6/11
APPROVED BY:	KLL	5/6/11

FILING NO. 17 PHASE III
DRAINAGE REPORT

DEVELOPED DRAINAGE MAP

Kenneth L. Lindsey
Colorado Registered Professional Engineer #19366
For and on Behalf of Merrick & Company
Merrick & Company Job No. 18015087

JOB NO: 03016854
DATE: 5/6/11
SHEET 2 OF 2

E-6

APPENDIX B – HYDRAULIC COMPUTATIONS

APPENDIX B.1 – INLET/SPREAD CALCULATIONS

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-14	IN-L-15	IN-L-16
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	AREA	STREET
Hydraulic Condition	On Grade	Swale	On Grade
Inlet Type	Directional Cast Vane Grate	CDOT Type C	Directional Cast Vane Grate

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.9	0.1	1.5
Major Q_{Known} (cfs)	3.1	0.5	2.4

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	IN-L-14
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.5
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	1.2

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.9**	**0.1**	**2.1**
Major Total Design Peak Flow, Q (cfs)	**3.1**	**0.5**	**3.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.5	0.0	1.2
Major Flow Bypassed Downstream, Q_b (cfs)	1.2	0.0	2.3

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-17-1	IN-L-17-3	IN-L-20
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Directional Cast Vane Grate	Directional Cast Vane Grate	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.6	0.8	1.5
Major Q_{Known} (cfs)	1.0	1.3	2.8

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	IN-L-16	IN-L-17-1	IN-L-17-3
Minor Bypass Flow Received, Q_b (cfs)	1.2	0.4	0.5
Major Bypass Flow Received, Q_b (cfs)	2.3	1.2	1.3

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.8**	**1.1**	**2.0**
Major Total Design Peak Flow, Q (cfs)	**3.3**	**2.5**	**4.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.4	0.5	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	1.2	1.3	0.0

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-20-1	IN-L-24-1	IN-L-21-2
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.7	1.0	0.6
Major Q_{Known} (cfs)	1.2	1.6	0.9

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	IN-L-20	No Bypass Flow Received	IN-L-24-1
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.1

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.7**	**1.0**	**0.6**
Major Total Design Peak Flow, Q (cfs)	**1.3**	**1.6**	**1.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	0.1	0.0

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-20-2	IN-L-20-3	IN-L-21-1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.1	0.4	0.7
Major Q_{Known} (cfs)	2.4	0.6	1.0

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	IN-L-21-2	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.1**	**0.4**	**0.7**
Major Total Design Peak Flow, Q (cfs)	**2.4**	**0.6**	**1.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-23	EX-IN-L-48-2	EX-IN-L-48-3
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT/Denver 13 Valley Grate

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.0	1.2	2.3
Major Q_{Known} (cfs)	1.5	2.0	4.0

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.0**	**1.2**	**2.3**
Major Total Design Peak Flow, Q (cfs)	**1.5**	**2.0**	**4.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	N/A

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-12	IN-L-42	IN-L-45
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	STREET	STREET
Hydraulic Condition	Swale	On Grade	On Grade
Inlet Type	CDOT Type D (In Series)	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.9	0.9	1.0
Major Q_{Known} (cfs)	12.0	1.5	1.6

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	IN-L-42
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.1

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**5.9**	**0.9**	**1.0**
Major Total Design Peak Flow, Q (cfs)	**12.0**	**1.5**	**1.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	0.1	0.3

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	EX-IN-L-48-1	EX-IN-L-21-5	IN-L-17-2
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	AREA	AREA
Hydraulic Condition	In Sump	Swale	Swale
Inlet Type	CDOT Type R Curb Opening	CDOT Type D (In Series & Depressed)	CDOT Type C

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.0	3.7	0.1
Major Q_{Known} (cfs)	3.2	6.5	0.6

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	IN-L-45	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.3	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

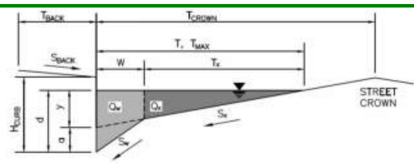
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.0**	**3.7**	**0.1**
Major Total Design Peak Flow, Q (cfs)	**3.5**	**6.5**	**0.6**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-14



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	100.0	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 =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

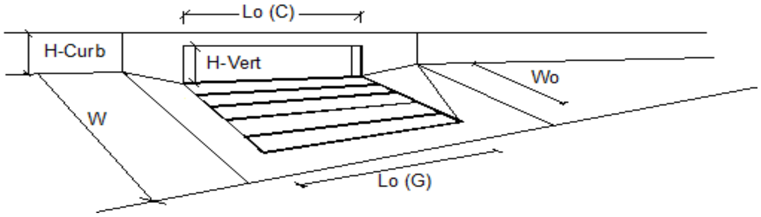
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.5	11.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.3**	**4.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.94 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.12 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

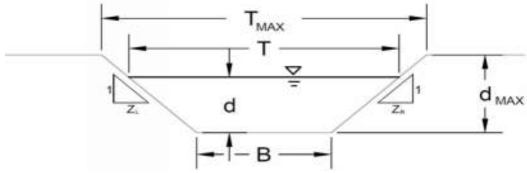


Design Information (Input)	Directional Cast Vane Grate	MINOR	MAJOR	
Type of Inlet	Type =	Directional Cast Vane Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	0.0	0.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	2.00	2.00	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	N/A	N/A	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.9	3.1	cfs
Water Spread Width	T =	7.7	9.8	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	3.9	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.701	0.586	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.6	1.3	cfs
Discharge within the Gutter Section W	Q_w =	1.4	1.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.40	0.48	sq ft
Velocity within the Gutter Section W	V_W =	3.4	3.8	fps
Water Depth for Design Condition	d_{LOCAL} =	3.4	3.9	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	3.00	3.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.701	0.586	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	7.11	7.11	fps
Interception Rate of Frontal Flow	R_f =	1.00	1.00	
Interception Rate of Side Flow	R_x =	0.23	0.20	
Interception Capacity	Q_i =	1.5	2.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.50	0.50	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	1.50	1.50	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	5.13	5.13	fps
Interception Rate of Frontal Flow	R_f =	1.00	1.00	
Interception Rate of Side Flow	R_x =	0.06	0.05	
Actual Interception Capacity	**Q_a =**	**1.4**	**1.9**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.5**	**1.2**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	N/A	N/A	ft/ft
Required Length L_T to Have 100% Interception	L_T =	N/A	N/A	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	N/A	N/A	ft
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	N/A	N/A	
Effective (Unclogged) Length	L_e =	N/A	N/A	ft
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**N/A**	**N/A**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**1.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.5**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**72**	**61**	**%**

AREA INLET IN A SWALE

Lone Tree Mobility Hub - SB

IN-L-15



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0109	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Sloe	Z2 =	8.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**9.00**	**9.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.00**	**1.00**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**6.2**	**6.2**	**cfs**
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	**0.45**	**0.45**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.1**	**0.5**	**cfs**
Water Depth	d =	**0.04**	**0.11**	**ft**

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

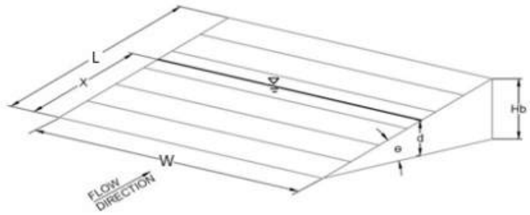
AREA INLET IN A SWALE

Lone Tree Mobility Hub - SB

IN-L-15

Inlet Design Information (Input)

Type of Inlet	CDOT Type C	Inlet Type =	CDOT Type C	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.96	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	

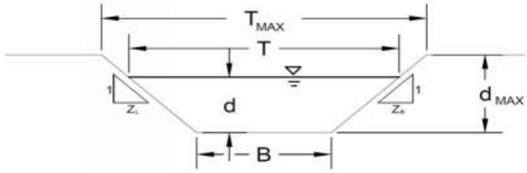


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.04	0.11	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**0.2**	**0.7**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

AREA INLET IN A SWALE

Lone Tree Mobility Hub - SB

EX-IN-L-21-5



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0100	ft/ft
Bottom Width	B =	5.50	ft
Left Side Slope	Z1 =	9.00	ft/ft
Warning 01 Right Side Sloe	Z2 =	2.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ○ **Non-Cohesive**
- ◉ **Cohesive**
- ○ **Paved**

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**30.00**	**30.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.00**	**1.00**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**35.3**	**35.3**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**1.00**	**1.00**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**3.7**	**6.5**	**cfs**
Water Depth	d =	**0.31**	**0.42**	**ft**

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

MHFD-Inlet, Version 5.03 (August 2023)

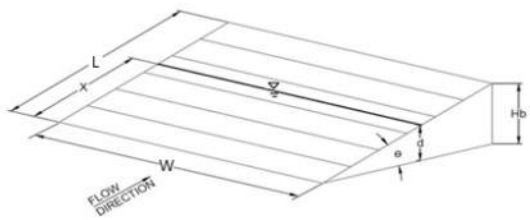
AREA INLET IN A SWALE

Lone Tree Mobility Hub - SB

EX-IN-L-21-5

Inlet Design Information (Input)

Type of Inlet	CDOT Type D (In Series & Depressed)	Inlet Type =	CDOT Type D (In Series & Depressed)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	6.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.38	
Grate Discharge Coefficient		C_d =	0.72	
Orifice Coefficient		C_o =	0.48	
Weir Coefficient		C_w =	1.53	

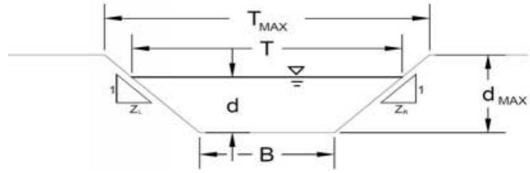


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.31	1.42	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**34.5**	**35.9**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

Warning 01: Sideslope steepness exceeds USDCM Volume I recommendation.

AREA INLET IN A SWALE

Lone Tree Mobility Hub - SB
IN-L-17-2



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0015	ft/ft
Bottom Width	B =	3.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Sloe	Z2 =	6.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**16.00**	**16.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.80**	**0.80**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**5.5**	**5.5**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.80**	**0.80**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.1**	**0.6**	**cfs**
Water Depth	d =	**0.10**	**0.25**	**ft**

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

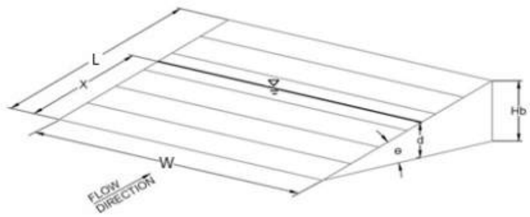
AREA INLET IN A SWALE

Lone Tree Mobility Hub - SB

IN-L-17-2

Inlet Design Information (Input)

Type of Inlet	CDOT Type C	Inlet Type =	CDOT Type C
Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	ft
Length of Grate	L =	3.00	ft
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	ft
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.96	
Orifice Coefficient	C_o =	0.64	
Weir Coefficient	C_w =	2.05	

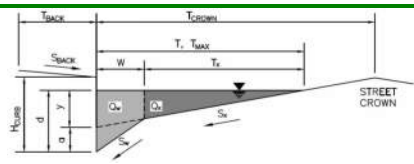


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.10	0.25	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**0.6**	**2.4**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-16



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	29.0	ft
Gutter Width	W =	6.00	ft
Street Transverse Slope	S_X =	0.016	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.016	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.017	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

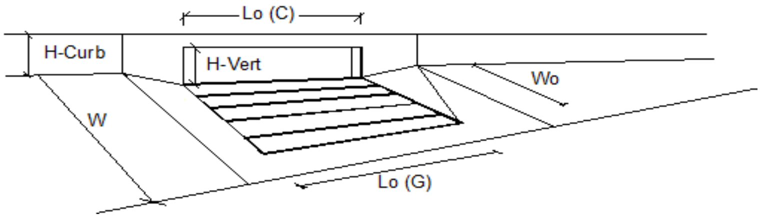
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.5	12.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.5**	**3.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.06 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.67 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



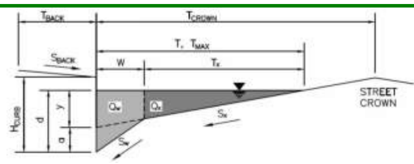
Design Information (Input)	Directional Cast Vane Grate		MINOR	MAJOR	
Type of Inlet		Type =	Directional Cast Vane Grate		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	0.0	0.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	2.00	2.00	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	N/A	N/A	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.9**	**1.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.2**	**2.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**42**	**36**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-17-1



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	34.0	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 =	0.018	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

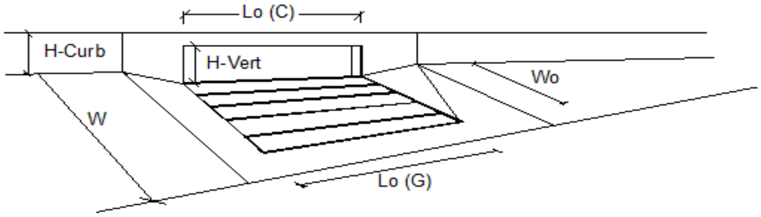
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.2**	**4.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.78 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.32 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



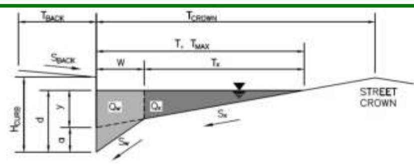
Design Information (Input)	Directional Cast Vane Grate	MINOR	MAJOR	
Type of Inlet	Type =	Directional Cast Vane Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	0.0	0.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	2.00	2.00	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	N/A	N/A	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**2.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.4**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**79**	**64**	**%**

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

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

Project: **Lone Tree Mobility Hub - SB**
Inlet ID: **IN-L-17-3**



Gutter Geometry:

Parameter	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	ft
Gutter Width	W =	6.00	ft
Street Transverse Slope	S_X =	0.021	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.021	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

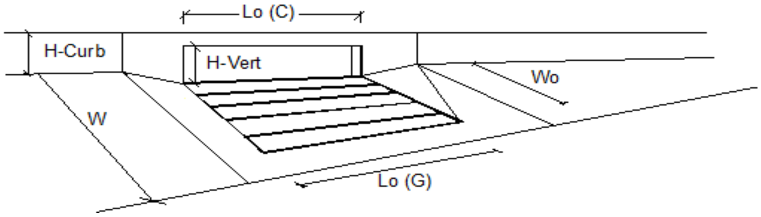
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.5	10.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.3**	**4.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.15 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.48 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

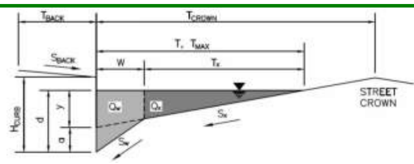


Design Information (Input)	Directional Cast Vane Grate		MINOR	MAJOR	
Type of Inlet		Type =	Directional Cast Vane Grate		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	0.0	0.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	2.00	2.00	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	N/A	N/A	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.6**	**1.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.5**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**55**	**46**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-20



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	52.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.038	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 =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

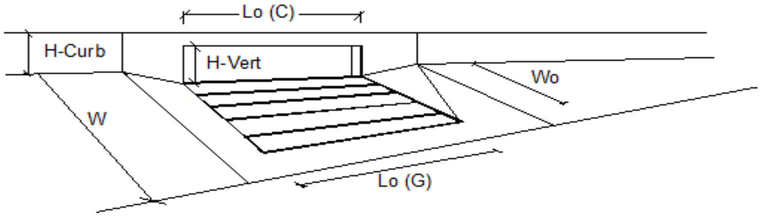
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.3**	**8.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.98 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 4.13 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



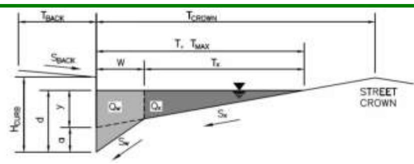
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.0**	**4.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project: **Lone Tree Mobility Hub - SB**
Inlet ID: **IN-L-20-1**



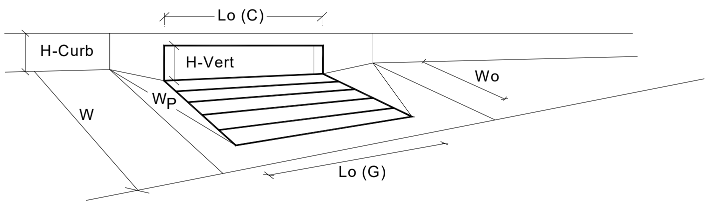
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =			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} =			
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	61.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.025		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} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	25.0	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

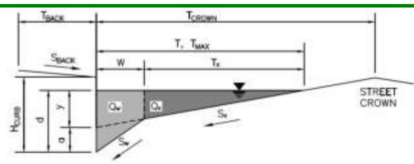


		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (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
Open Area 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	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
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	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	1.3	cfs

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-24-1



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	29.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.014	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 =	0.034	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

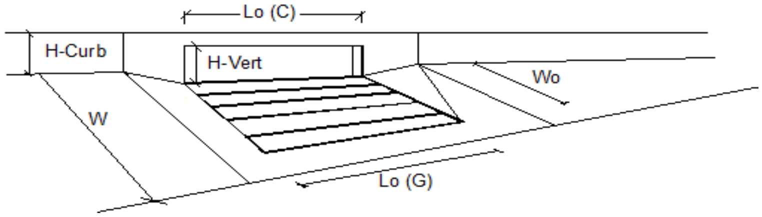
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.4**	**5.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.99 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.59 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

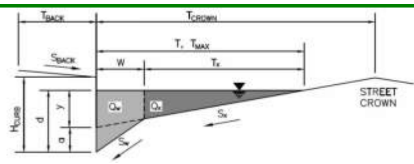


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.0**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**93**	**%**

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

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

Project: **Lone Tree Mobility Hub - SB**
Inlet ID: **IN-L-21-2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	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 =	0.013	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

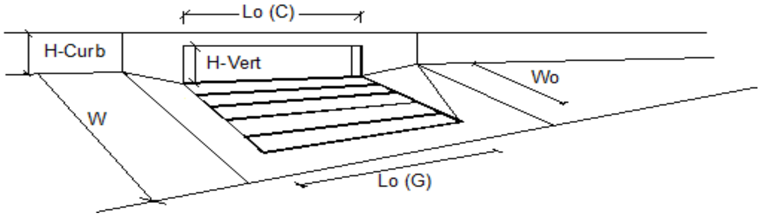
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	6.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**1.3**	**3.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.58 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.04 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



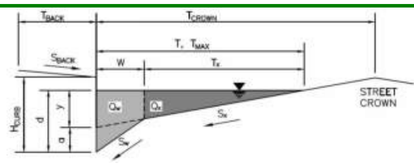
Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.6**	**1.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-20-2



Gutter Geometry:

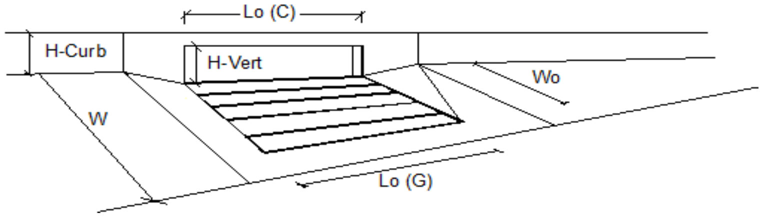
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =			ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =			ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =			
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0		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 =	0.010		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	9.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.5**	**2.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.11 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.35 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

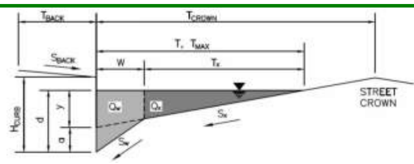


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.1**	**2.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**100**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-20-3



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	33.0	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 =	0.003	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

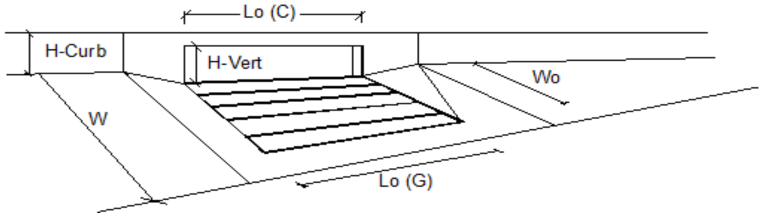
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.1**	**2.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.37 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.59 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

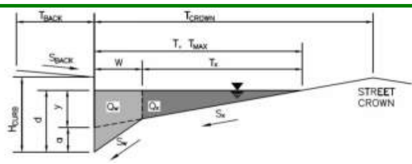


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.4**	**0.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**100**	**%**

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

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

Project: **Lone Tree Mobility Hub - SB**
Inlet ID: **IN-L-21-1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
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 =	0.022	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 =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

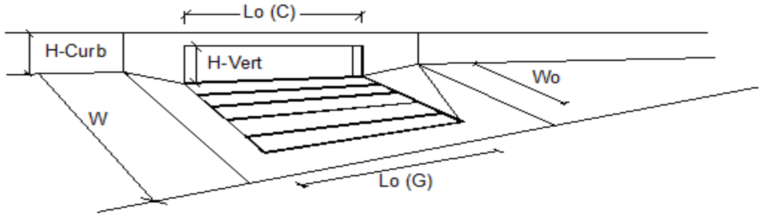
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	8.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.3**	**2.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.65 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.04 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



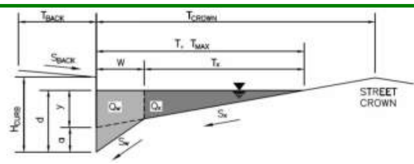
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**1.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-23



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	62.0	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 =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

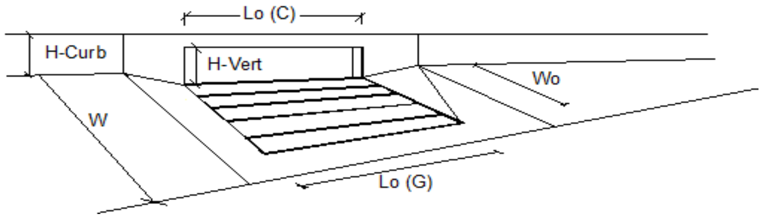
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	11.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.3**	**5.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.95 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.53 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

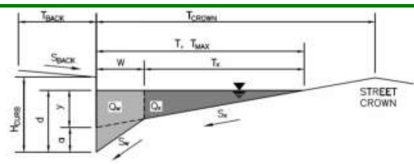


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.0**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**100**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: EX-IN-L-48-2



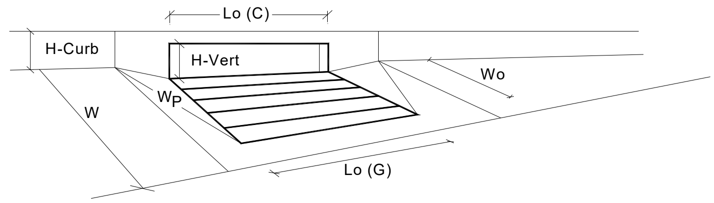
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =			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} =			
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.044		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} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	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 not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)	CDOT Type R Curb Opening	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
Open Area 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	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	

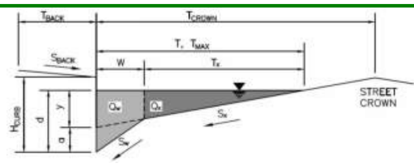
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	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)	$Q_{PEAK\ REQUIRED}$ =	1.2	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: Lone Tree Mobility Hub - SB
Inlet ID: EX-IN-L-48-3



Gutter Geometry:

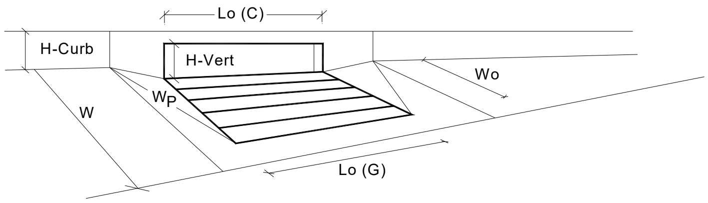
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.044	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



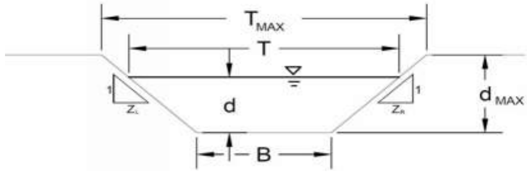
Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT/Denver 13 Valley Grate	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	9.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
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) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
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	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} =	0.52	0.77	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.94	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.6**	**4.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.3	4.0	cfs

AREA INLET IN A SWALE

Lone Tree Mobility Hub - SB
IN-L-12



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0087	ft/ft
Bottom Width	B =	3.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Sloe	Z2 =	4.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**9.00**	**9.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.00**	**1.25**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**13.8**	**13.8**	**cfs**
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	**0.86**	**0.86**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**5.9**	**12.0**	**cfs**
Water Depth	d =	**0.56**	**0.80**	**ft**

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

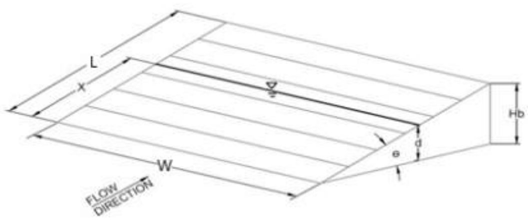
AREA INLET IN A SWALE

Lone Tree Mobility Hub - SB

IN-L-12

Inlet Design Information (Input)

Type of Inlet	CDOT Type D (In Series)	Inlet Type =	CDOT Type D (In Series)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	6.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.38	
Grate Discharge Coefficient		C_d =	0.78	
Orifice Coefficient		C_o =	0.52	
Weir Coefficient		C_w =	1.67	

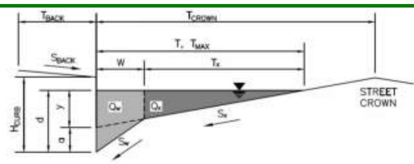


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.56	0.80	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**12.4**	**21.3**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

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

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

Project: **Lone Tree Mobility Hub - SB**
Inlet ID: **IN-L-42**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	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 =	0.021	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

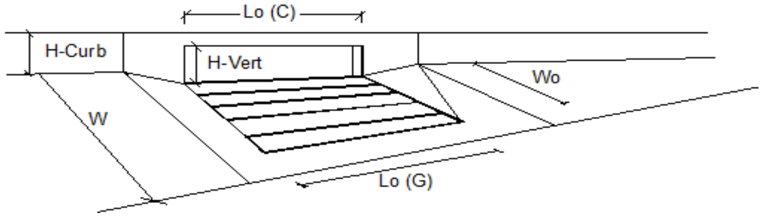
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**6.4**	**6.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.87 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.53 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

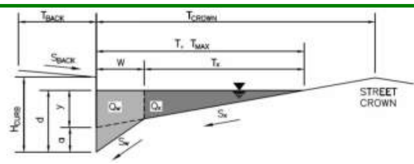


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.9**	**1.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**93**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: IN-L-45



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.004	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 =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

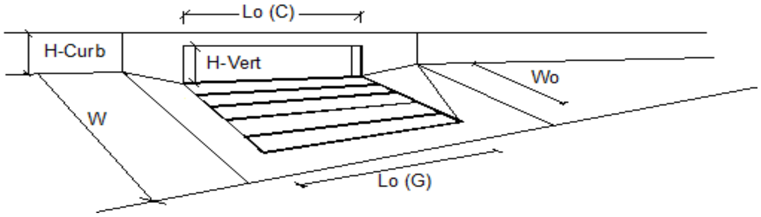
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.8**	**1.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.98 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.74 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

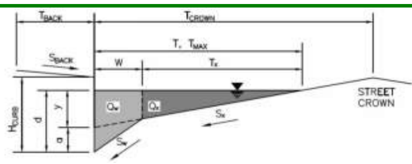


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.0**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**85**	**%**

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

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

Project: Lone Tree Mobility Hub - SB
Inlet ID: EX-IN-L-48-1



Gutter Geometry:

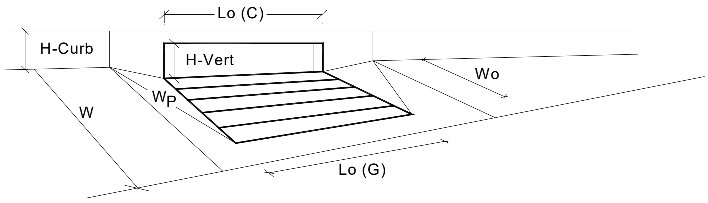
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.024	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	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 not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
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
Open Area 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	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
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	$\mathbf{Q_a}$ =	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.0	3.5	cfs

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	EX-IN-L-75	IN-L-76	IN-L-79
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Directional Cast Vane Grate	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.8	1.8	3.6
Major Q_{Known} (cfs)	1.3	2.8	5.9

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	EX-IN-L-75	IN-L-76
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.1	0.2
Major Bypass Flow Received, Q_b (cfs)	0.0	0.3	0.9

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.8**	**1.9**	**3.8**
Major Total Design Peak Flow, Q (cfs)	**1.3**	**3.2**	**6.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.1	0.2	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.3	0.9	0.9

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-80	IN-L-83-2	IN-L-83-1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.7	1.0	0.9
Major Q_{Known} (cfs)	1.1	1.5	1.4

Bypass (Carry-Over) Flow from Upstream Inlet:

Receive Bypass Flow from:	IN-L-79	IN-L-80	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.9	0.2	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.7**	**1.0**	**0.9**
Major Total Design Peak Flow, Q (cfs)	**2.1**	**1.7**	**1.4**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.2	0.1	0.0

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-84-1	IN-L-84-2	IN-L-85
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	AREA	STREET
Hydraulic Condition	On Grade	Swale	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type C	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.7	0.7	0.7
Major Q_{Known} (cfs)	1.1	2.6	1.1

Bypass (Carry-Over) Flow from Upstream Inlet:

Receive Bypass Flow from:	IN-L-83-2	No Bypass Flow Received	IN-L-84-1
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.1	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.7**	**0.7**	**0.7**
Major Total Design Peak Flow, Q (cfs)	**1.3**	**2.6**	**1.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	IN-L-87
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	STREET
Hydraulic Condition	On Grade
Inlet Type	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.8
Major Q_{Known} (cfs)	1.3

Bypass (Carry-Over) Flow from Upstream Inlets

Receive Bypass Flow from:	IN-L-85
Minor Bypass Flow Received, Q_b (cfs)	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	

Watershed Profile

Overland Slope (ft/ft)	
Overland Length (ft)	
Channel Slope (ft/ft)	
Channel Length (ft)	

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

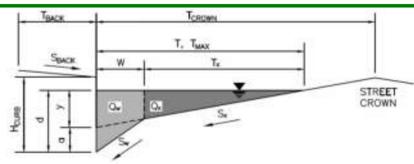
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.8**
Major Total Design Peak Flow, Q (cfs)	**1.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.1

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

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

Project: **Lone Tree Mobility Hub - NB**
Inlet ID: **EX-IN-L-75**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	88.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.016	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 =	0.009	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

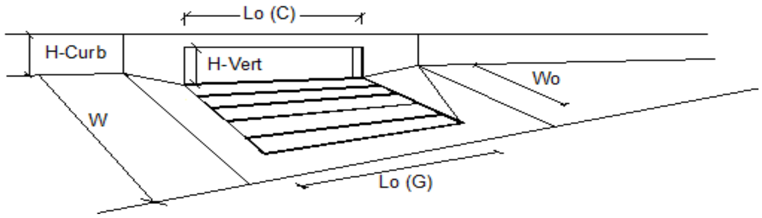
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**1.1**	**15.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.83 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.33 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



		MINOR	MAJOR	
Design Information (Input) — Directional Cast Vane Grate		MINOR	MAJOR	
Type of Inlet	Type =	Directional Cast Vane Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	0.0	0.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	2.00	2.00	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	N/A	N/A	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.8	1.3	cfs
Water Spread Width	T =	5.8	7.8	ft
Water Depth at Flowline (outside of local depression)	d =	2.7	3.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.864	0.737	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.1	0.3	cfs
Discharge within the Gutter Section W	Q_w =	0.7	1.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.28	0.35	sq ft
Velocity within the Gutter Section W	V_W =	2.5	2.8	fps
Water Depth for Design Condition	d_{LOCAL} =	2.7	3.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	4.00	4.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.864	0.737	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	8.34	8.34	fps
Interception Rate of Frontal Flow	R_f =	1.00	1.00	
Interception Rate of Side Flow	R_x =	0.40	0.38	
Interception Capacity	Q_i =	0.8	1.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.50	0.50	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	2.00	2.00	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	5.96	5.96	fps
Interception Rate of Frontal Flow	R_f =	1.00	1.00	
Interception Rate of Side Flow	R_x =	0.12	0.11	
Actual Interception Capacity	**Q_a =**	**0.7**	**1.0**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.1**	**0.3**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	N/A	N/A	ft/ft
Required Length L_T to Have 100% Interception	L_T =	N/A	N/A	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	N/A	N/A	ft
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	N/A	N/A	
Effective (Unclogged) Length	L_e =	N/A	N/A	ft
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**N/A**	**N/A**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**1.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**88**	**77**	**%**

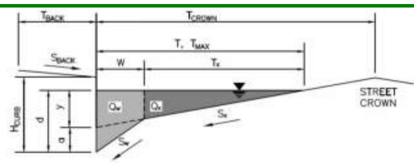
MHFD-Inlet, Version 5.03 (August 2023)

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

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

Project: Lone Tree Mobility Hub - NB

Inlet ID: IN-L-76



Gutter Geometry:

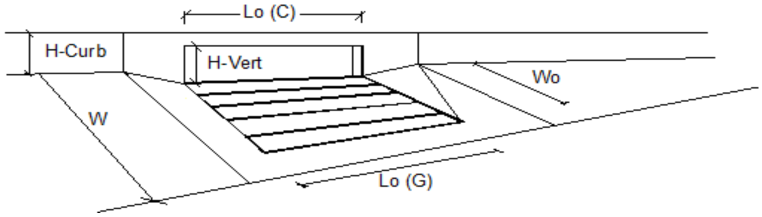
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =			ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =			ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =			
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	106.0		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 =	0.014		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	31.0	45.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**16.4**	**16.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.87 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.15 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

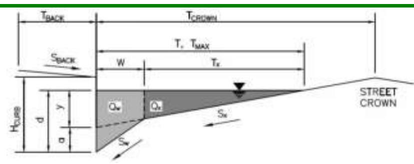


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.9	3.2	cfs
Water Spread Width	T =	7.1	9.3	ft
Water Depth at Flowline (outside of local depression)	d =	3.2	3.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.744	0.614	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.5	1.2	cfs
Discharge within the Gutter Section W	Q_w =	1.4	1.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.37	0.46	sq ft
Velocity within the Gutter Section W	V_W =	3.8	4.2	fps
Water Depth for Design Condition	d_{LOCAL} =	6.2	6.7	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.160	0.136	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.36	8.96	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.8	2.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	**1.7**	**2.3**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.2**	**0.9**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.7**	**2.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**89**	**72**	**%**

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

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

Project: Lone Tree Mobility Hub - NB
Inlet ID: IN-L-79



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	122.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.028	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 =	0.016	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

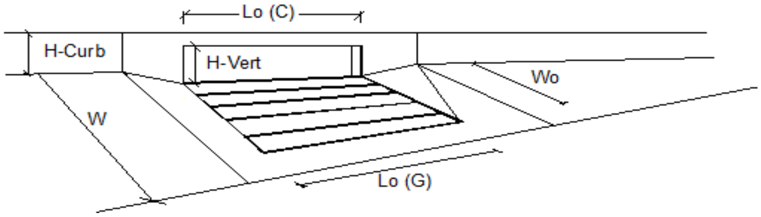
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	37.0	45.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.0**	**14.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 3.79 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 6.75 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

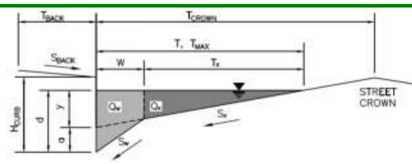


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)		Q_o =	3.8	6.7	cfs
Water Spread Width		T =	8.0	10.3	ft
Water Depth at Flowline (outside of local depression)		d =	4.0	4.8	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.637	0.518	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	1.4	3.2	cfs
Discharge within the Gutter Section W		Q_w =	2.4	3.5	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.50	0.63	sq ft
Velocity within the Gutter Section W		V_W =	4.8	5.5	fps
Water Depth for Design Condition		d_{LOCAL} =	7.0	7.8	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e		S_e =	0.143	0.121	ft/ft
Required Length L_T to Have 100% Interception		L_T =	9.68	13.99	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	9.68	10.00	ft
Interception Capacity		Q_i =	3.8	6.0	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoeff =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	9.38	9.38	ft
Actual Interception Capacity		**Q_a =**	**3.8**	**5.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**0.9**	**cfs**
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**3.8**	**5.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**86**	**%**

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

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

Project: Lone Tree Mobility Hub - NB
Inlet ID: IN-L-80



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.045	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 =	0.012	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

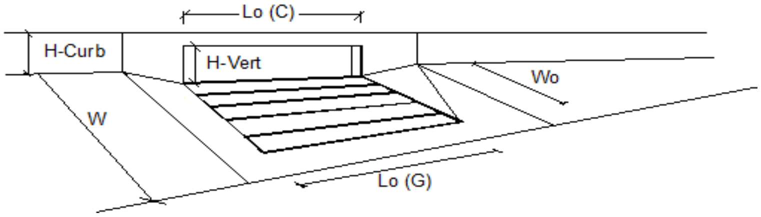
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	5.5	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**2.6**	**9.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.70 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.06 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

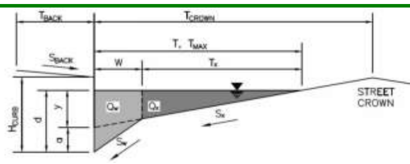


Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.7	2.1	cfs
Water Spread Width	T =	2.9	5.0	ft
Water Depth at Flowline (outside of local depression)	d =	2.5	3.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.977	0.804	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.4	cfs
Discharge within the Gutter Section W	Q_w =	0.7	1.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.25	0.43	sq ft
Velocity within the Gutter Section W	V_W =	2.8	3.8	fps
Water Depth for Design Condition	d_{LOCAL} =	5.5	6.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.204	0.176	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.41	6.34	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.41	5.00	ft
Interception Capacity	Q_i =	0.7	1.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	3.41	4.50	ft
Actual Interception Capacity	**Q_a =**	**0.7**	**1.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**1.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**89**	**%**

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

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

Project: **Lone Tree Mobility Hub - NB**
Inlet ID: **IN-L-83-2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	21.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.022	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 =	0.013	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

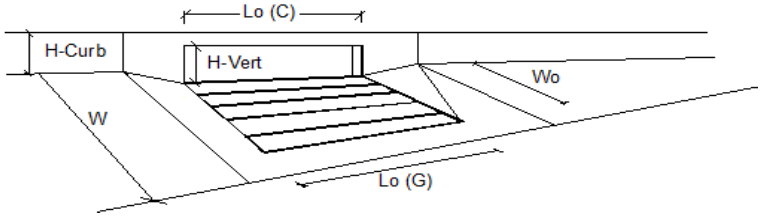
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	21.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**2.5**	**14.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.95 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.74 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

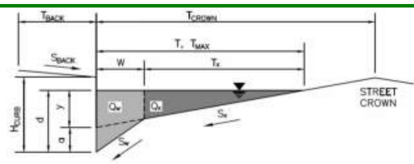


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.0	1.7	cfs
Water Spread Width	T =	4.6	6.6	ft
Water Depth at Flowline (outside of local depression)	d =	2.7	3.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.906	0.763	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.1	0.4	cfs
Discharge within the Gutter Section W	Q_w =	0.9	1.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.28	0.37	sq ft
Velocity within the Gutter Section W	V_W =	3.1	3.6	fps
Water Depth for Design Condition	d_{LOCAL} =	5.7	6.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.191	0.164	ft/ft
Required Length L_T to Have 100% Interception	L_T =	4.14	6.04	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	4.14	5.00	ft
Interception Capacity	Q_i =	1.0	1.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.14	4.50	ft
Actual Interception Capacity	**Q_a =**	**1.0**	**1.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.0**	**1.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**91**	**%**

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

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

Project: **Lone Tree Mobility Hub - NB**
Inlet ID: **IN-L-83-1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	37.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.083	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 =	0.004	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

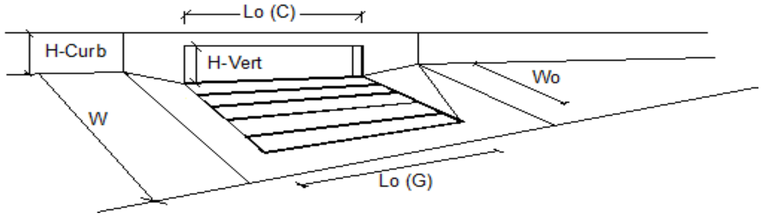
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	4.0	37.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**1.4**	**4.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.88 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.42 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



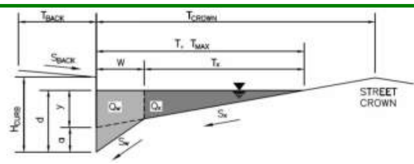
		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.9	1.4	cfs
Water Spread Width	T =	3.4	4.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	4.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.907	0.837	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.1	0.2	cfs
Discharge within the Gutter Section W	Q_w =	0.8	1.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.40	0.51	sq ft
Velocity within the Gutter Section W	V_W =	2.0	2.3	fps
Water Depth for Design Condition	d_{LOCAL} =	6.4	7.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.196	0.188	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.65	4.76	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.65	4.76	ft
Interception Capacity	Q_i =	0.9	1.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	3.65	4.50	ft
Actual Interception Capacity	**Q_a =**	**0.9**	**1.4**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.9**	**1.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**99**	**%**

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

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

Project: Lone Tree Mobility Hub - NB

Inlet ID: IN-L-84-1



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	48.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.083	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

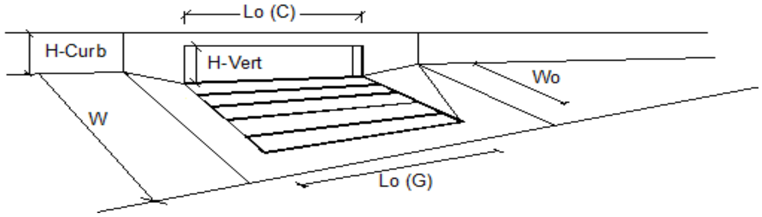
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	4.0	48.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**2.7**	**8.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.70 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.27 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

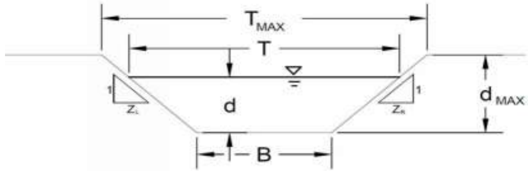
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**1.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

MHFD-Inlet, Version 5.03 (August 2023)

AREA INLET IN A SWALE

Lone Tree Mobility Hub - NB

IN-L-84-2



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

	NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =	D	
	Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
	Channel Invert Slope	S_O =	0.0202	ft/ft
	Bottom Width	B =	4.00	ft
Warning 01	Left Side Slope	Z1 =	0.04	ft/ft
Warning 01	Right Side Sloe	Z2 =	0.05	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ○ Non-Cohesive
- ◉ Cohesive
- ○ Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**8.00**	**8.00**	ft
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.50**	**1.00**	ft

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**3.4**	**15.9**	cfs
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.50**	**1.00**	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.7**	**2.6**	cfs
Water Depth	d =	**0.30**	**0.46**	ft

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

MHFD-Inlet, Version 5.03 (August 2023)

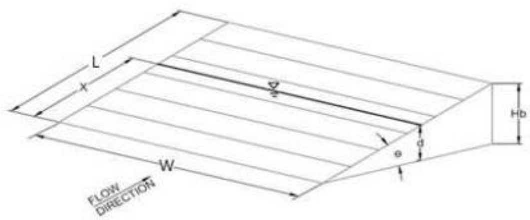
AREA INLET IN A SWALE

Lone Tree Mobility Hub - NB

IN-L-84-2

Inlet Design Information (Input)

Type of Inlet	CDOT Type C	Inlet Type =	CDOT Type C	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.96	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.30	0.46	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.1**	**5.7**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

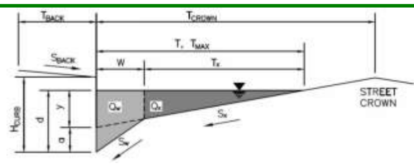
Warning 01: Sideslope steepness exceeds USDCM Volume I recommendation.
Warning 02: Depth (d) exceeds USDCM Volume I recommendation.

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

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

Project: Lone Tree Mobility Hub - NB

Inlet ID: IN-L-85



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		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} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	47.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.054	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 =	0.006	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

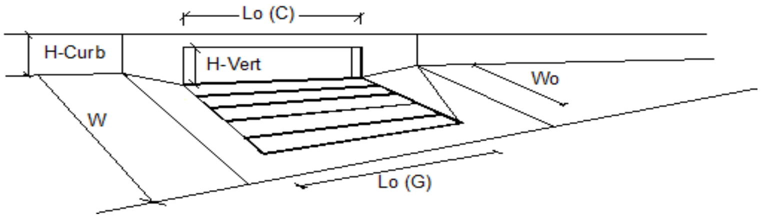
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	47.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.2**	**6.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.66 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.06 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

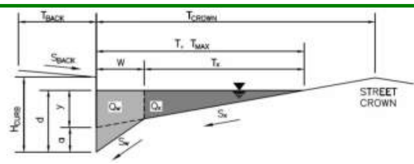


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)		Q_o =	0.7	1.1	cfs
Water Spread Width		T =	3.2	4.0	ft
Water Depth at Flowline (outside of local depression)		d =	2.7	3.3	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.951	0.881	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.0	0.1	cfs
Discharge within the Gutter Section W		Q_w =	0.6	0.9	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.29	0.38	sq ft
Velocity within the Gutter Section W		V_W =	2.2	2.5	fps
Water Depth for Design Condition		d_{LOCAL} =	5.7	6.3	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e		S_e =	0.200	0.190	ft/ft
Required Length L_T to Have 100% Interception		L_T =	3.21	4.21	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	3.21	4.21	ft
Interception Capacity		Q_i =	0.7	1.1	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.10	0.10	
Effective (Unclogged) Length		L_e =	3.21	4.21	ft
Actual Interception Capacity		**Q_a =**	**0.7**	**1.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**0.0**	**cfs**
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.7**	**1.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**100**	**%**

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

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

Project: **Lone Tree Mobility Hub - NB**
Inlet ID: **IN-L-87**



Gutter Geometry:

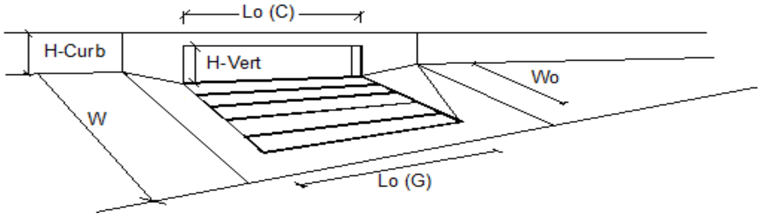
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =			ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =			ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =			
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	48.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.004		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 =	0.021		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	48.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**0.9**	**19.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.81 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.30 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.8**	**1.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**100**	**96**	**%**

Worksheet for IN-L-103

Project Description

Solve For	Efficiency

Input Data

Discharge	0.21 cfs
Slope	0.081 ft/ft
Gutter Width	3.00 ft
Gutter Cross Slope	0.015 ft/ft
Road Cross Slope	0.015 ft/ft
Roughness Coefficient	0.016
Grate Width	2.94 ft
Grate Length	1.1 ft
Grate Type	P-30 mm (P-1 -7/8")
Clogging	50.0 %

Options

Grate Flow Option	Exclude None

Results

Efficiency	99.82 %
Intercepted Flow	0.21 cfs
Bypass Flow	0.00 cfs
Spread	3.2 ft
Depth	0.6 in
Flow Area	0.1 ft²
Gutter Depression	0.0 in
Total Depression	0.0 in
Velocity	2.66 ft/s
Splash Over Velocity	3.31 ft/s
Frontal Flow Factor	1.000
Side Flow Factor	0.004
Grate Flow Ratio	0.998
Active Grate Length	0.5 ft

Worksheet for IN-L-109

Project Description	
Solve For	Efficiency

Input Data	
Discharge	0.35 cfs
Slope	0.081 ft/ft
Gutter Width	3.00 ft
Gutter Cross Slope	0.015 ft/ft
Road Cross Slope	0.015 ft/ft
Roughness Coefficient	0.016
Grate Width	2.94 ft
Grate Length	1.1 ft
Grate Type	P-30 mm (P-1 -7/8")
Clogging	50.0 %

Options	
Grate Flow Option	Exclude None

Results	
Efficiency	97.48 %
Intercepted Flow	0.34 cfs
Bypass Flow	0.01 cfs
Spread	3.9 ft
Depth	0.7 in
Flow Area	0.1 ft²
Gutter Depression	0.0 in
Total Depression	0.0 in
Velocity	3.02 ft/s
Splash Over Velocity	3.31 ft/s
Frontal Flow Factor	1.000
Side Flow Factor	0.003
Grate Flow Ratio	0.975
Active Grate Length	0.5 ft

Worksheet for IN-L-111

Project Description	
Solve For	Efficiency

Input Data	
Discharge	0.25 cfs
Slope	0.017 ft/ft
Gutter Width	0.00 ft
Gutter Cross Slope	0.016 ft/ft
Road Cross Slope	0.016 ft/ft
Roughness Coefficient	0.016
Grate Width	2.94 ft
Grate Length	1.1 ft
Grate Type	P-30 mm (P-1 -7/8")
Clogging	50.0 %

Options	
Grate Flow Option	Exclude None

Results	
Efficiency	94.41 %
Intercepted Flow	0.24 cfs
Bypass Flow	0.01 cfs
Spread	4.5 ft
Depth	0.9 in
Flow Area	0.2 ft²
Gutter Depression	0.0 in
Total Depression	0.0 in
Velocity	1.57 ft/s
Splash Over Velocity	3.31 ft/s
Frontal Flow Factor	1.000
Side Flow Factor	0.011
Grate Flow Ratio	0.943
Active Grate Length	0.5 ft

APPENDIX B.2 – STORM SEWER CAPACITY, HGL AND EGL

B.3A STORM SEWER HYDRAULIC CALCULATIONS (10-YEAR STORM)

PROJECT:	I-25 Mobility Hub (Lone Tree)	PROJECT #:	24278
DESIGNED BY:	NAG	CHECKED BY:	MED
DATE:	12/15/2023		

DESIGN FREQUENCY - 10 YEAR - SYSTEM SB Lanes

PIPE ID	UPSTREAM NODE	DOWNSTREAM NODE	SHAPE	MATERIAL	DIAMETER	N VALUE	LENGTH (FT)	SLOPE	INV UPSTREAM (FT)	INV DOWNSTREAM (FT)	Q (CFS)	CRITICAL DEPTH (FT)	ACTUAL DEPTH (FT)	CAPACITY (CFS)	VELOCITY (FT/SEC)	HGL UPSTREAM (FT)	HGL DOWNSTREAM (FT)	EGL UPSTREAM (FT)	EGL DOWNSTREAM (FT)
EX-P-L-21S	EX-IN-L-21-5	EX-FES-L-21S	CIRCULAR	CLASS 7 PIPE	30"	0.013	185.16	1.17%	5978.11	5975.92	19.91	1.05	1.05	88.86	7.30	5979.17	5976.73	5979.56	5977.55
EX-P-L-48-2	EX-IN-L-48-2	EX-IN-L-48-1	CIRCULAR	CLASS 7 PIPE	18"	0.013	36.07	0.67%	5988.87	5988.62	3.35	0.70	1.12	8.59	4.56	5989.99	5989.98	5990.08	5990.04
EX-P-L-48-3	EX-IN-L-48-3	EX-IN-L-48-2	CIRCULAR	CLASS 7 PIPE	18"	0.013	1.39	0.29%	5988.89	5988.88	2.32	0.58	1.20	5.61	3.03	5990.09	5990.09	5990.13	5990.12
P-L-12	IN-L-12	IN-L-14	CIRCULAR	CLASS 7 PIPE	18"	0.010	184.43	0.35%	5991.36	5990.71	4.38	0.80	0.80	8.12	4.68	5992.17	5991.82	5992.49	5991.97
P-L-14	IN-L-14	MH-L-15-1	CIRCULAR	CLASS 7 PIPE	18"	0.010	72.69	1.06%	5990.51	5989.71	5.42	0.90	0.90	14.08	7.45	5991.41	5990.84	5991.78	5991.06
P-L-15	IN-L-15	MH-L-15-1	CIRCULAR	CLASS 7 PIPE	18"	0.010	5.52	3.74%	5991.01	5990.71	0.92	0.36	0.36	26.41	7.01	5991.37	5990.94	5991.50	5991.40
P-L-15-1	MH-L-15-1	IN-L-16	CIRCULAR	CLASS 7 PIPE	18"	0.010	74.58	1.30%	5989.51	5988.51	5.98	0.94	0.94	15.55	8.23	5990.46	5989.85	5990.86	5990.05
P-L-16	IN-L-16	IN-L-17-1	CIRCULAR	CLASS 7 PIPE	18"	0.010	60.54	1.65%	5988.31	5987.31	7.14	1.0	1.04	17.55	9.42	5989.35	5988.02	5989.82	5989.20
P-L-17-1	IN-L-17-1	IN-L-17-3	CIRCULAR	CLASS 7 PIPE	24"	0.010	93.51	2.03%	5986.80	5984.90	8.15	1.0	1.02	41.92	10.34	5987.82	5986.21	5988.22	5986.42
P-L-17-2	IN-L-17-2	IN-L-17-3	CIRCULAR	RCP	18"	0.013	13.76	2.18%	5985.51	5985.21	0.34	0.2	0.91	15.51	3.57	5986.42	5986.42	5986.42	5986.42
P-L-17-3	IN-L-17-3	MH-L-18	CIRCULAR	CLASS 7 PIPE	24"	0.010	90.41	1.99%	5984.71	5982.91	8.99	1.1	1.07	41.49	10.55	5985.78	5983.57	5986.21	5985.12
P-L-18	MH-L-18	MH-L-19	CIRCULAR	RCP	30"	0.013	156.09	1.41%	5982.41	5980.21	9.53	1.03	1.03	48.69	7.70	5983.44	5981.98	5983.83	5982.08
P-L-19	MH-L-19	IN-L-20-3	CIRCULAR	CLASS 7 PIPE	30"	0.010	69.26	0.72%	5980.01	5979.51	14.86	1.30	1.30	45.30	8.27	5981.31	5981.08	5981.83	5981.35
P-L-20	IN-L-20	MH-L-19	CIRCULAR	RCP	24"	0.013	22.42	1.34%	5980.71	5980.41	8.64	1.05	1.05	26.17	7.47	5981.76	5981.90	5982.18	5982.08
P-L-20-1	IN-L-20-1	IN-L-20	CIRCULAR	RCP	24"	0.013	41.3	0.73%	5981.21	5980.91	6.76	0.92	0.92	19.28	5.60	5982.13	5982.24	5982.49	5982.39
P-L-20-2	IN-L-20-2	IN-L-20-1	CIRCULAR	RCP	24"	0.013	36.85	0.81%	5981.71	5981.41	6.18	0.88	0.88	20.41	5.69	5982.59	5982.44	5982.93	5982.67
P-L-20-3	IN-L-20-3	IN-L-21-1	CIRCULAR	CLASS 7 PIPE	30"	0.010	84.35	0.59%	5979.31	5978.81	14.83	1.30	1.30	41.05	7.69	5980.61	5979.88	5981.13	5980.74
P-L-21-1S	IN-L-21-1	EX-IN-L-21-5	CIRCULAR	CLASS 7 PIPE	30"	0.010	56.61	0.53%	5978.51	5978.21	17.60	0.99	0.99	77.63	6.40	5979.50	5979.61	5979.87	5979.76
P-L-21-2	IN-L-21-2	IN-L-21-1	CIRCULAR	CLASS 7 PIPE	18"	0.010	42.8	1.40%	5980.11	5979.51	3.41	0.70	0.70	16.17	7.25	5980.82	5980.00	5981.09	5980.72
P-L-23	IN-L-23	IN-L-21-2	CIRCULAR	CLASS 7 PIPE	18"	0.010	110.64	1.72%	5982.21	5980.31	3.00	0.66	0.66	17.89	7.52	5982.87	5981.01	5983.12	5981.23
P-L-24-1	IN-L-24-1	IN-L-23	CIRCULAR	CLASS 7 PIPE	18"	0.010	128.45	1.87%	5984.81	5982.41	2.28	0.57	0.57	18.66	7.16	5985.38	5983.13	5985.59	5983.25
P-L-24-2	FES-L-24-2U	IN-L-24-1	CIRCULAR	CLASS 7 PIPE	18"	0.010	18.74	2.00%	5985.39	5985.01	1.48	0.46	0.46	19.31	6.46	5985.84	5985.69	5986.01	5985.74
P-L-42	IN-L-42	IN-L-15	CIRCULAR	CLASS 7 PIPE	18"	0.010	36.37	4.40%	5992.81	5991.21	0.45	0.3	0.25	28.64	5.99	5993.06	5991.51	5993.15	5991.56
P-L-45	IN-L-45	IN-L-102	CIRCULAR	CLASS 7 PIPE	18"	0.010	19.91	5.02%	5988.51	5987.51	0.83	0.34	0.34	30.61	7.52	5988.85	5987.69	5988.97	5988.46
P-L-48-1	EX-IN-L-48-1	IN-L-20-2	CIRCULAR	RCP	18"	0.013	73.38	8.72%	5988.61	5982.21	5.23	0.88	0.88	31.02	13.05	5989.49	5982.63	5989.86	5985.28
P-L-52	HW-L-52U	FES-L-52D	CIRCULAR	CLASS 7 PIPE	18"	0.010	68.42	2.19%	5987.61	5986.11	1.10	0.39	0.39	20.22	6.11	5988.00	5986.70	5988.14	5986.74
P-L-102	IN-L-102	MH-L-18	CIRCULAR	CLASS 7 PIPE	18"	0.010	50.83	5.90%	5986.51	5983.51	1.00	0.37	0.37	33.17	8.40	5986.88	5983.93	5987.02	5984.02

B.3A STORM SEWER HYDRAULIC CALCULATIONS (10-YEAR STORM)

PROJECT:	I-25 Mobility Hub (Lone Tree)	PROJECT #:	24278
DESIGNED BY:	NAG	CHECKED BY:	MED
DATE:	6/11/2024		

DESIGN FREQUENCY - 10 YEAR - SYSTEM NB Lanes

PIPE ID	UPSTREAM NODE	DOWNSTREAM NODE	SHAPE	MATERIAL	DIAMETER	N VALUE	LENGTH (FT)	SLOPE	INV UPSTREAM (FT)	INV DOWNSTREAM (FT)	Q (CFS)	CRITICAL DEPTH (FT)	ACTUAL DEPTH (FT)	CAPACITY (CFS)	VELOCITY (FT/SEC)	HGL UPSTREAM (FT)	HGL DOWNSTREAM (FT)	EGL UPSTREAM (FT)	EGL DOWNSTREAM (FT)
EX-P-L-75	EX-IN-L-75	MH-L-76-1	CIRCULAR	RCP	24"	0.013	161.1	0.90%	5994.71	5993.29	11.17	1.20	1.20	20.94	6.77	5995.91	5995.04	5996.41	5995.27
EX-P-L-76-1	MH-L-76-1	EX-IN-L-78	CIRCULAR	RCP	24"	0.013	128.63	0.90%	5993.24	5992.11	11.89	1.24	1.24	20.86	6.86	5994.48	5993.56	5995.01	5993.93
EX-P-L-78	EX-IN-L-78	MH-L-79-1	CIRCULAR	RCP	24"	0.013	170.4	1.60%	5991.91	5989.18	11.81	1.23	1.23	28.27	8.59	5993.15	5990.85	5993.67	5991.13
EX-P-L-79-1	MH-L-79-1	EX-IN-L-80	CIRCULAR	RCP	24"	0.013	117.05	1.50%	5989.09	5987.21	12.05	1.25	1.25	28.11	8.60	5990.33	5988.75	5990.87	5989.08
EX-P-L-80	EX-IN-L-80	EX-FES-L-80D	CIRCULAR	RCP	24"	0.013	346.04	1.70%	5987.01	5981.11	12.31	1.26	1.26	29.48	8.96	5988.27	5982.01	5988.81	5983.26
EX-P-L-84-1	CC-L-84-1	EX-FES-L-84-1D	CIRCULAR	RCP	24"	0.013	96.88	1.00%	5982.01	5981.06	2.02	0.49	0.49	22.40	4.42	5982.50	5981.47	5982.68	5981.77
P-L-76	IN-L-76	MH-L-76-1	CIRCULAR	RCP	18"	0.013	9.92	3.30%	5993.91	5993.51	1.57	0.47	1.35	18.98	6.50	5995.26	5995.26	5995.27	5995.27
P-L-79	IN-L-79	MH-L-79-1	CIRCULAR	CLASS 7 PIPE	18"	0.01	13.49	2.70%	5990.01	5989.61	0.59	0.28	1.12	22.27	5.41	5991.13	5991.13	5991.13	5991.13
P-L-80	IN-L-80	EX-IN-L-80	CIRCULAR	RCP	18"	0.013	25.38	2.20%	5987.81	5987.21	0.61	0.29	1.27	15.44	4.24	5989.08	5989.08	5989.08	5989.08
P-L-83-1	IN-L-83-1	IN-L-83-2	CIRCULAR	CLASS 7 PIPE	18"	0.01	24.62	1.40%	5986.11	5985.71	0.79	0.33	0.33	16.43	4.79	5986.44	5986.22	5986.56	5986.25
P-L-83-2	IN-L-83-2	IN-L-84-1	CIRCULAR	CLASS 7 PIPE	18"	0.01	91.88	3.30%	5985.51	5982.31	1.62	0.48	0.48	24.79	7.93	5985.99	5982.57	5986.16	5983.55
P-L-84-1	IN-L-84-1	CC-L-84-1	CIRCULAR	RCP	24"	0.013	9.54	1.10%	5982.11	5982.01	2.02	0.49	0.49	23.93	4.64	5982.60	5982.43	5982.78	5982.71
P-L-84-2	IN-L-84-2	IN-L-84-1	CIRCULAR	RCP	18"	0.013	50.36	0.50%	5982.41	5982.11	0.86	0.35	0.44	7.76	2.89	5982.85	5982.85	5982.91	5982.87
P-L-85	IN-L-85	IN-L-84-2	CIRCULAR	RCP	18"	0.013	63.08	1.50%	5983.41	5982.41	0.59	0.29	0.29	12.76	3.68	5983.70	5982.92	5983.80	5982.94
P-L-87	IN-L-87	FES-L-87D	CIRCULAR	CLASS 7 PIPE	18"	0.01	162.22	0.80%	5980.81	5979.48	0.69	0.31	0.31	12.40	3.78	5981.12	5979.72	5981.23	5979.94

B.3B STRUCTURE HYDRAULIC CALCULATIONS (10-YEAR STORM)

PROJECT:	I-25 Mobility Hub (Lone Tree)		
DESIGNED BY:	CAK	PROJECT #:	24278
DATE:	12/15/2023	CHECKED BY:	MED

DESIGN FREQUENCY - 10 YEAR - SYSTEM SB Lanes

STRUCTURE ID	Q (CFS)	RIM/ GRATE ELEVATION (FT)	HGL (FT)	EGL (FT)
EX-IN-L-21-5	19.9	5983.24	5979.36	5979.76
EX-IN-L-48-1	5.2	5991.19	5989.68	5990.04
EX-IN-L-48-2	3.4	5990.44	5990.04	5990.12
EX-IN-L-48-3	2.3	5990.39	5990.11	5990.14
IN-L-12	4.4	5996.37	5992.33	5992.65
IN-L-14	5.4	5995.48	5991.60	5991.97
IN-L-15	0.9	5995.26	5991.43	5991.56
IN-L-16	7.1	5993.10	5989.58	5990.05
IN-L-17-1	8.2	5991.98	5988.02	5988.42
IN-L-17-2	0.3	5988.91	5986.42	5986.42
IN-L-17-3	9.0	5990.10	5986.00	5986.43
IN-L-20	8.6	5985.36	5981.97	5982.39
IN-L-20-1	6.8	5985.29	5982.31	5982.67
IN-L-20-2	6.2	5985.30	5982.76	5983.09
IN-L-20-3	14.8	5985.76	5980.73	5981.24
IN-L-21-1	17.6	5986.09	5979.69	5980.05
IN-L-21-2	3.4	5985.77	5980.95	5981.22
IN-L-23	3.0	5987.66	5983.00	5983.25
IN-L-24-1	2.3	5991.37	5985.51	5985.72
IN-L-42	0.5	6001.67	5993.10	5993.19
IN-L-45	0.8	5995.56	5988.91	5989.03
IN-L-102	1.0	5996.28	5986.88	5987.02
MH-L-15-1	6.0	5994.47	5990.66	5991.06
MH-L-18	9.5	5988.27	5983.64	5984.02
MH-L-19	14.9	5986.07	5981.57	5982.09

B.3B STRUCTURE HYDRAULIC CALCULATIONS (10-YEAR STORM)

PROJECT:	I-25 Mobility Hub (Lone Tree)		
DESIGNED BY:	NAG	PROJECT #:	24278
DATE:	6/11/2024	CHECKED BY:	MED

DESIGN FREQUENCY - 10 YEAR - SYSTEM NB Lanes

STRUCTURE ID	Q (CFS)	RIM/ GRATE ELEVATION (FT)	HGL (FT)	EGL (FT)
EX-IN-L-75	11.2	5999.16	5996.16	5996.66
EX-IN-L-78	11.8	5996.75	5993.41	5993.93
EX-IN-L-80	12.3	5993.13	5988.54	5989.08
IN-L-76	1.6	5997.72	5995.27	5995.28
IN-L-79	0.6	5994.48	5991.13	5991.13
IN-L-80	0.6	5991.81	5989.08	5989.09
IN-L-83-1	0.8	5990.59	5986.50	5986.62
IN-L-83-2	1.6	5989.93	5986.08	5986.25
IN-L-84-1	2.0	5988.14	5982.69	5982.87
IN-L-84-2	0.9	5985.21	5982.88	5982.94
IN-L-85	0.6	5987.89	5983.75	5983.85
IN-L-87	0.7	5984.96	5981.18	5981.28
MH-L-76-1	11.9	5997.92	5994.74	5995.27
MH-L-79-1	12.1	5995.01	5990.60	5991.13

B.3A STORM SEWER HYDRAULIC CALCULATIONS (100-YEAR STORM)

PROJECT: I-25 Mobility Hub (Lone Tree) PROJECT #: 24278
DESIGNED BY: NAG CHECKED BY: MED
DATE: 12/15/2023

DESIGN FREQUENCY - 100 YEAR - SYSTEM SB Lanes

PIPE ID	UPSTREAM NODE	DOWNSTREAM NODE	SHAPE	MATERIAL	DIAMETER	N VALUE	LENGTH (FT)	SLOPE	INV UPSTREAM (FT)	INV DOWNSTREAM (FT)	Q (CFS)	CRITICAL DEPTH (FT)	ACTUAL DEPTH (FT)	CAPACITY (CFS)	VELOCITY (FT/SEC)	HGL UPSTREAM (FT)	HGL DOWNSTREAM (FT)	EGL UPSTREAM (FT)	EGL DOWNSTREAM (FT)
EX-P-L-21S	EX-IN-L-21-5	EX-FES-L-21S	CIRCULAR	CLASS 7 PIPE	30"	0.013	185.16	1.17%	5978.11	5975.92	42.82	1.57	1.57	88.86	8.97	5979.69	5977.15	5980.36	5978.40
EX-P-L-48-2	EX-IN-L-48-2	EX-IN-L-48-1	CIRCULAR	CLASS 7 PIPE	18"	0.013	36.07	0.67%	5988.87	5988.62	5.90	0.94	1.73	8.59	3.34	5990.60	5990.48	5990.78	5990.66
EX-P-L-48-3	EX-IN-L-48-3	EX-IN-L-48-2	CIRCULAR	CLASS 7 PIPE	18"	0.013	1.39	0.29%	5988.89	5988.88	4.04	0.77	1.55	5.61	2.29	5990.44	5990.44	5990.52	5990.52
P-L-12	IN-L-12	IN-L-14	CIRCULAR	CLASS 7 PIPE	18"	0.010	181.65	0.35%	5991.36	5990.71	12.15	1.32	4.12	8.12	6.87	5995.49	5994.03	5996.22	5994.76
P-L-14	IN-L-14	MH-L-15-1	CIRCULAR	CLASS 7 PIPE	18"	0.010	71.27	1.06%	5990.51	5989.71	13.80	1.4	2.83	14.08	7.81	5993.34	5992.57	5994.29	5993.52
P-L-15	IN-L-15	MH-L-15-1	CIRCULAR	CLASS 7 PIPE	24"	0.010	4.06	3.74%	5991.01	5990.71	2.09	0.6	2.49	26.41	1.18	5993.50	5993.50	5993.52	5993.52
P-L-15-1	MH-L-15-1	IN-L-16	CIRCULAR	RCP	18"	0.010	75.89	1.30%	5989.51	5988.51	15.07	1.4	2.31	15.55	8.53	5991.83	5990.89	5992.96	5992.02
P-L-16	IN-L-16	IN-L-17-1	CIRCULAR	CLASS 7 PIPE	24"	0.010	60.54	1.65%	5988.31	5987.31	17.20	1.4	1.44	17.55	11.32	5989.75	5988.58	5991.26	5990.39
P-L-17-1	IN-L-17-1	IN-L-17-3	CIRCULAR	RCP	30"	0.010	93.55	2.03%	5986.80	5984.90	19.08	1.57	1.57	41.92	13.03	5988.37	5987.12	5989.18	5987.70
P-L-17-2	IN-L-17-2	IN-L-17-3	CIRCULAR	CLASS 7 PIPE	30"	0.013	12.9	2.18%	5985.51	5985.21	0.89	0.35	2.18	15.51	0.50	5987.69	5987.69	5987.70	5987.70
P-L-17-3	IN-L-17-3	MH-L-18	CIRCULAR	RCP	24"	0.010	89.07	1.99%	5984.71	5982.91	20.94	1.64	1.64	41.49	13.23	5986.35	5984.00	5987.25	5986.22
P-L-18	MH-L-18	MH-L-19	CIRCULAR	RCP	24"	0.013	156.09	1.41%	5982.41	5980.21	21.84	1.59	1.59	48.69	9.65	5984.00	5983.08	5984.69	5983.39
P-L-19	MH-L-19	IN-L-20-3	CIRCULAR	RCP	24"	0.010	66.78	0.72%	5980.01	5979.51	31.83	1.92	2.35	45.30	10.00	5982.36	5982.16	5983.05	5982.81
P-L-20	IN-L-20	MH-L-19	CIRCULAR	CLASS 7 PIPE	30"	0.013	23.44	1.34%	5980.71	5980.41	15.94	1.44	2.39	26.17	5.07	5983.10	5982.99	5983.50	5983.39
P-L-20-1	IN-L-20-1	IN-L-20	CIRCULAR	CLASS 7 PIPE	30"	0.013	41.27	0.73%	5981.21	5980.91	12.11	1.25	2.38	19.28	3.86	5983.59	5983.47	5983.82	5983.70
P-L-20-2	IN-L-20-2	IN-L-20-1	CIRCULAR	CLASS 7 PIPE	18"	0.013	36.92	0.81%	5981.71	5981.41	11.09	1.19	2.12	20.41	3.53	5983.83	5983.75	5984.03	5983.94
P-L-20-3	IN-L-20-3	IN-L-21-1	CIRCULAR	CLASS 7 PIPE	18"	0.010	74.33	0.59%	5979.31	5978.81	32.09	1.93	1.93	41.05	9.25	5981.24	5980.51	5982.21	5981.78
P-L-21-1S	IN-L-21-1	EX-IN-L-21-5	CIRCULAR	CLASS 7 PIPE	18"	0.010	55.3	0.53%	5978.51	5978.21	38.73	1.49	1.89	77.63	7.90	5980.40	5980.42	5980.77	5980.69
P-L-21-2	IN-L-21-2	IN-L-21-1	CIRCULAR	CLASS 7 PIPE	18"	0.010	35.29	1.40%	5980.11	5979.51	8.58	1.13	1.13	16.17	9.28	5981.25	5980.36	5981.80	5981.44
P-L-23	IN-L-23	IN-L-21-2	CIRCULAR	CLASS 7 PIPE	18"	0.010	100.68	1.72%	5982.21	5980.31	7.80	1.1	1.08	17.89	9.78	5983.29	5981.77	5983.80	5982.08
P-L-24-1	IN-L-24-1	IN-L-23	CIRCULAR	CLASS 7 PIPE	18"	0.010	130.95	1.87%	5984.81	5982.41	6.66	1.00	1.00	18.66	9.68	5985.81	5983.82	5986.25	5984.05
P-L-24-2	FES-L-24-2U	IN-L-24-1	CIRCULAR	RCP	18"	0.010	15.07	2.00%	5985.39	5985.01	5.41	0.90	1.33	19.31	9.38	5986.72	5986.71	5986.88	5986.86
P-L-42	IN-L-42	IN-L-15	CIRCULAR	CLASS 7 PIPE	18"	0.010	34.24	4.40%	5992.81	5991.21	0.89	0.35	0.71	28.64	7.31	5993.52	5993.53	5993.54	5993.53
P-L-45	IN-L-45	IN-L-102	CIRCULAR	CLASS 7 PIPE	18"	0.010	19.24	5.02%	5988.51	5987.51	1.39	0.44	0.44	30.61	8.77	5988.95	5987.75	5989.11	5988.68
P-L-48-1	EX-IN-L-48-1	IN-L-20-2	CIRCULAR	RCP	18"	0.013	67.79	8.72%	5988.61	5982.21	9.05	1.16	1.16	31.02	15.22	5989.78	5983.72	5990.36	5984.13
P-L-52	HW-L-52U	FES-L-52D	CIRCULAR	CLASS 7 PIPE	18"	0.010	68.42	2.19%	5987.61	5986.11	3.86	0.75	0.75	20.22	8.82	5988.36	5987.15	5988.66	5987.28
P-L-102	IN-L-102	MH-L-18	CIRCULAR	CLASS 7 PIPE	18"	0.010	50.83	5.90%	5986.51	5983.51	1.65	0.48	0.48	33.17	9.76	5986.99	5985.01	5987.17	5985.03

B.3A STORM SEWER HYDRAULIC CALCULATIONS (100-YEAR STORM)

PROJECT:	I-25 Mobility Hub (Lone Tree)		PROJECT #:	24278
DESIGNED BY:	NAG		CHECKED BY:	MED
DATE:	6/11/2023			

DESIGN FREQUENCY - 100 YEAR - SYSTEM SB Lanes

PIPE ID	UPSTREAM NODE	DOWNSTREAM NODE	SHAPE	MATERIAL	DIAMETER	N VALUE	LENGTH (FT)	SLOPE	INV UPSTREAM (FT)	INV DOWNSTREAM (FT)	Q (CFS)	CRITICAL DEPTH (FT)	ACTUAL DEPTH (FT)	CAPACITY (CFS)	VELOCITY (FT/SEC)	HGL UPSTREAM (FT)	HGL DOWNSTREAM (FT)	EGL UPSTREAM (FT)	EGL DOWNSTREAM (FT)
EX-P-L-75	EX-IN-L-75	MH-L-76-1	CIRCULAR	RCP	24"	0.013	161.1	0.90%	5994.71	5993.29	22.33	1.69	3.39	20.94	7.11	5998.10	5996.49	5998.88	5997.27
EX-P-L-76-1	MH-L-76-1	EX-IN-L-78	CIRCULAR	RCP	24"	0.013	128.63	0.90%	5993.24	5992.11	23.56	1.72	2.72	20.86	7.50	5995.96	5994.52	5996.84	5995.39
EX-P-L-78	EX-IN-L-78	MH-L-79-1	CIRCULAR	RCP	24"	0.013	170.4	1.60%	5991.91	5989.18	23.40	1.72	2.19	28.27	7.45	5994.10	5992.23	5994.96	5993.09
EX-P-L-79-1	MH-L-79-1	EX-IN-L-80	CIRCULAR	RCP	24"	0.013	117.05	1.50%	5989.09	5987.21	27.04	1.81	2.28	28.11	8.61	5991.37	5989.63	5992.52	5990.78
EX-P-L-80	EX-IN-L-80	EX-FES-L-80D	CIRCULAR	RCP	24"	0.013	346.04	1.70%	5987.01	5981.11	27.46	1.82	1.82	29.48	10.66	5988.83	5982.64	5990.13	5984.41
EX-P-L-84-1	CC-L-84-1	EX-FES-L-84-1D	CIRCULAR	RCP	24"	0.013	96.88	1.00%	5982.01	5981.06	5.05	0.79	0.79	22.40	5.76	5982.80	5981.71	5983.10	5982.22
P-L-76	IN-L-76	MH-L-76-1	CIRCULAR	RCP	18"	0.013	9.92	3.30%	5993.91	5993.51	2.72	0.6	3.33	18.98	1.54	5997.24	5997.24	5997.28	5997.27
P-L-79	IN-L-79	MH-L-79-1	CIRCULAR	CLASS 7 PIPE	18"	0.01	13.49	2.70%	5990.01	5989.61	6.84	1.0	2.89	22.27	3.87	5992.90	5992.86	5993.13	5993.09
P-L-80	IN-L-80	EX-IN-L-80	CIRCULAR	RCP	18"	0.013	25.38	2.20%	5987.81	5987.21	1.05	0.38	2.97	15.44	0.59	5990.78	5990.78	5990.79	5990.78
P-L-83-1	IN-L-83-1	IN-L-83-2	CIRCULAR	CLASS 7 PIPE	18"	0.01	24.62	1.40%	5986.11	5985.71	1.37	0.44	0.44	16.43	5.63	5986.55	5986.47	5986.71	5986.51
P-L-83-2	IN-L-83-2	IN-L-84-1	CIRCULAR	CLASS 7 PIPE	18"	0.01	91.88	3.30%	5985.51	5982.31	2.81	0.64	0.64	24.79	9.30	5986.15	5983.26	5986.39	5983.35
P-L-84-1	IN-L-84-1	CC-L-84-1	CIRCULAR	RCP	24"	0.013	9.54	1.10%	5982.11	5982.01	5.05	0.79	0.79	23.93	6.04	5982.90	5982.69	5983.20	5983.14
P-L-84-2	IN-L-84-2	IN-L-84-1	CIRCULAR	RCP	18"	0.013	50.36	0.50%	5982.41	5982.11	2.87	0.64	0.89	7.76	4.06	5983.30	5983.29	5983.41	5983.35
P-L-85	IN-L-85	IN-L-84-2	CIRCULAR	RCP	18"	0.013	63.08	1.50%	5983.41	5982.41	1.02	0.38	0.38	12.76	4.33	5983.79	5983.45	5983.92	5983.46
P-L-87	IN-L-87	FES-L-87D	CIRCULAR	CLASS 7 PIPE	18"	0.01	162.22	0.80%	5980.81	5979.48	1.28	0.4	0.42	12.40	4.53	5981.24	5979.80	5981.39	5980.12

B.3B STRUCTURE HYDRAULIC CALCULATIONS (100-YEAR STORM)

PROJECT:	I-25 Mobility Hub (Lone Tree)		
DESIGNED BY:	CAK	PROJECT #:	24278
DATE:	12/15/2023	CHECKED BY:	MED

DESIGN FREQUENCY - 100 YEAR - SYSTEM SB Lanes

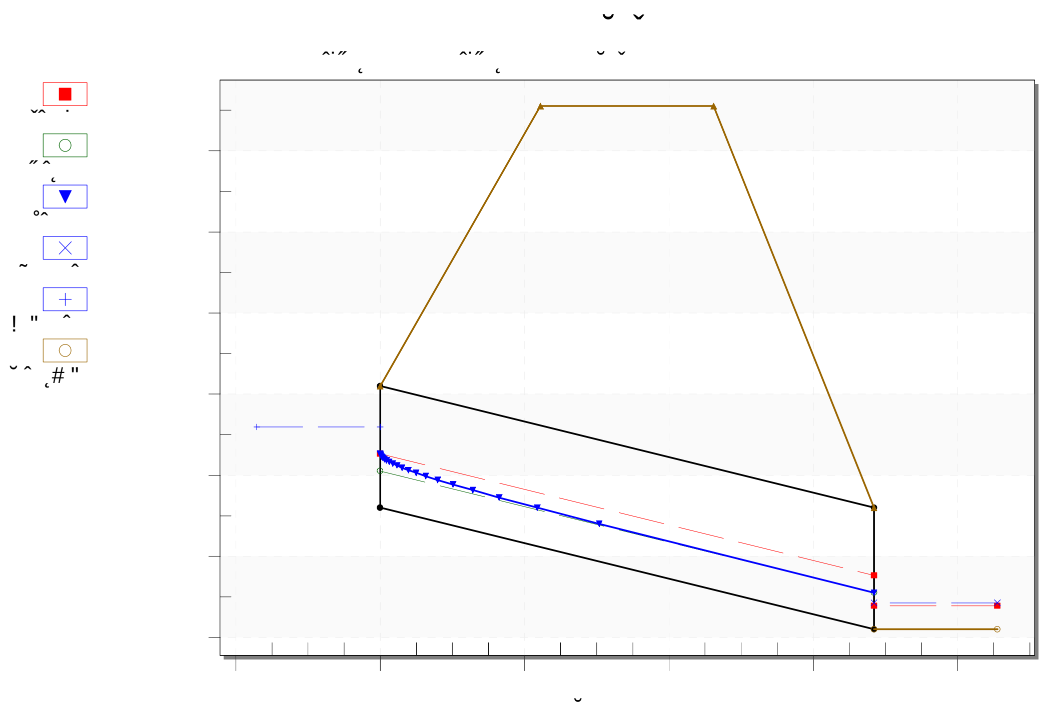
STRUCTURE ID	Q (CFS)	RIM/ GRATE ELEVATION (FT)	HGL (FT)	EGL (FT)
EX-IN-L-21-5	42.8	5983.24	5980.02	5980.69
EX-IN-L-48-1	9.1	5991.19	5990.07	5990.66
EX-IN-L-48-2	5.9	5990.44	5990.52	5990.70
EX-IN-L-48-3	4.0	5990.39	5990.44	5990.52
IN-L-12	12.2	5996.37	5995.85	5,996.59
IN-L-14	13.8	5995.48	5993.82	5994.76
IN-L-15	2.1	5995.26	5993.51	5993.53
IN-L-16	17.2	5993.10	5990.51	5,992.02
IN-L-17-1	19.1	5991.98	5988.77	5989.58
IN-L-17-2	0.9	5988.91	5987.69	5987.70
IN-L-17-3	20.9	5990.10	5986.80	5987.70
IN-L-20	15.9	5985.36	5983.30	5983.70
IN-L-20-1	12.1	5985.29	5983.71	5983.94
IN-L-20-2	11.1	5985.30	5983.93	5984.12
IN-L-20-3	32.1	5985.76	5981.58	5982.55
IN-L-21-1	38.7	5986.09	5980.59	5980.95
IN-L-21-2	8.6	5985.77	5981.52	5982.08
IN-L-23	7.8	5987.66	5983.55	5984.05
IN-L-24-1	6.7	5991.37	5986.36	5986.80
IN-L-42	0.9	6001.67	5993.53	5993.55
IN-L-45	1.4	5995.56	5989.03	5989.19
IN-L-102	1.7	5996.28	5986.99	5987.17
MH-L-15-1	15.1	5994.47	5992.39	5993.52
MH-L-18	21.8	5988.27	5984.34	5985.03
MH-L-19	31.8	5986.07	5982.70	5983.39

B.3B STRUCTURE HYDRAULIC CALCULATIONS (100-YEAR STORM)

PROJECT:	I-25 Mobility Hub (Lone Tree)		
DESIGNED BY:	NAG	PROJECT #:	24278
DATE:	6/11/2023	CHECKED BY:	MED

DESIGN FREQUENCY - 100 YEAR - SYSTEM SB Lanes

STRUCTURE ID	Q (CFS)	RIM/ GRATE ELEVATION (FT)	HGL (FT)	EGL (FT)
EX-IN-L-75	22.3	5999.16	5998.49	5999.28
EX-IN-L-78	23.4	5996.75	5994.53	5995.39
EX-IN-L-80	27.5	5993.13	5989.48	5990.78
IN-L-76	2.7	5997.72	5997.26	5997.30
IN-L-79	6.8	5994.48	5993.02	5993.25
IN-L-80	1.1	5991.81	5990.78	5990.79
IN-L-83-1	1.4	5990.59	5986.63	5986.79
IN-L-83-2	2.8	5989.93	5986.27	5986.51
IN-L-84-1	5.1	5988.14	5983.05	5983.35
IN-L-84-2	2.9	5985.21	5983.36	5983.46
IN-L-85	1.0	5987.89	5983.86	5983.99
IN-L-87	1.3	5984.96	5981.31	5981.46
MH-L-76-1	23.6	5997.92	5996.40	5997.27
MH-L-79-1	27.0	5995.01	5991.94	5993.09



Crossing Properties

Name: FES-L-25D

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Recurrence	
Discharge List	Define...	
TAILWATER DATA		
Channel Type	Triangular Channel	
Side Slope (H:V)	17.000	_:1
Channel Slope	0.0173	ft/ft
Manning's n (channel)	0.035	
Channel Invert Elevation	5986.100	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	24.000	ft
Crest Elevation	5992.550	ft
Roadway Surface	Paved	
Top Width	24.000	ft

Culvert Properties

FES-L-25D

Add Culvert

Duplicate Culvert

Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	FES-L-25D	
Shape	Circular	
Material	Concrete	
Diameter	1.500	ft
Embedment Depth	0.000	in
Manning's n	0.013	
Culvert Type	Straight	
Inlet Configuration	Mitered to Conform to Slope (Ke=0.7)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	5987.600	ft
Outlet Station	68.400	ft
Outlet Elevation	5986.100	ft
Number of Barrels	1	
Computed Culvert Slope	0.021930	ft/ft

Culvert Summary Table - FES-L-25D

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10 year	0.89	0.89	5988.11	**0.51**	-1.14	1-S2n	0.24	0.35	0.24	0.21	4.79	1.23
50 year	2.27	2.27	5988.44	**0.84**	-0.86	1-S2n	0.39	0.57	0.39	0.29	6.29	1.55
100 year	3.05	3.05	5988.59	**0.99**	-0.70	1-S2n	0.45	0.66	0.45	0.33	6.85	1.67

APPENDIX B.3 – CHANNEL CALCUATIONS

Worksheet for Bridge Gutter

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B.2 ROADSIDE DITCH CALCULATIONS (10-YEAR STORM)

PROJECT: Lone Tree Mobility Hub PROJECT #: 24278
DESIGNED BY: NAG CHECKED BY: MED
DATE: 6/11/2024

RS&H

DESIGN FREQUENCY - 10 YEAR - SYSTEM L

DITCH ID	SECTION	BEGIN STATION	OFFSET	BEGIN INV ELEV (FT)	END STATION	OFFSET	END INV ELEV (FT)	ALIGNMENT	B (FT)	Z (LT)	Z (RT)	LONG. SLOPE	N VALUE	Q (CFS)	FLOW DEPTH (FT)	SHEAR STRESS (LB/SF)	MINIMUM LINING	COMMENTS
CH-L-12N-A	Triangular	13+31.47	20.88' LT	5996.58	12+61.09	16.77' LT	5996.35	SB I-25 ON RAMP	0.00	16.67%	33.33%	0.33%	0.064	12.0	1.55	0.319	VEGETATED	
CH-L-12N-B	Triangular	13+78.25	18.97' LT	5997.00	13+31.47	20.88' LT	5996.58	SB I-25 ON RAMP	0.00	16.67%	33.33%	0.90%	0.048	12.0	1.15	0.648	VEGETATED	
CH-L-12S	Triangular	10+80.01	20.00' LT	5997.63	12+61.09	16.77' LT	5996.35	SB I-25 ON RAMP	0.00	40.00%	16.67%	0.71%	0.051	12.1	1.26	0.560	VEGETATED	
CH-L-15	Triangular	13+81.41	18.89' LT	5997.00	15+20.35	18.75' LT	5995.25	SB I-25 ON RAMP	0.00	33.33%	16.67%	1.27%	0.066	0.5	0.37	0.293	VEGETATED	
CH-L-17-2-A	Triangular	16+80.22	24.65' LT	5990.44	17+50.47	32.85' LT	5988.90	SB I-25 ON RAMP	0.00	33.33%	25.00%	2.23%	0.049	1.2	0.46	0.640	VEGETATED	
CH-L-17-2-B	Triangular	15+82.93	20.36' LT	5993.70	16+80.22	24.65' LT	5990.44	SB I-25 ON RAMP	0.00	33.33%	25.00%	3.34%	0.043	1.2	0.41	0.851	VEGETATED	
CH-L-24-2N	Trapezoidal	25+36.65	20.53' LT	5994.24	24+25.35	59.38' LT	5985.65	SB I-25 ON RAMP	2.00	25.00%	33.33%	7.29%	0.040	1.6	0.00	0.000	VEGETATED	
CH-L-24-2S	Trapezoidal	22+69.14	66.53' LT	5986.59	24+25.35	59.38' LT	5985.65	SB I-25 ON RAMP	2.00	33.33%	25.00%	0.61%	0.069	1.6	0.51	0.196	VEGETATED	
CH-L-52N	Triangular	54+78.68	36.77' LT	5990.00	52+51.51	9.94' LT	5987.60	MULTI-USE TRAIL	0.00	33.33%	33.33%	1.12%	0.052	3.1	0.80	0.557	VEGETATED	
CH-L-52S-A	Triangular	52+48.91	16.30' LT	5987.82	52+51.51	9.94' LT	5987.60	MULTI-USE TRAIL	0.00	25.00%	25.00%	3.20%	0.040	3.1	0.53	1.057	VEGETATED	
CH-L-52S-B	Triangular	52+01.69	4.83' LT	5989.00	52+48.91	16.30' LT	5987.82	MULTI-USE TRAIL	0.00	25.00%	25.00%	2.44%	0.043	3.1	0.57	0.873	VEGETATED	
CH-L-82-2E-A	Trapezoidal	83+86.97	58.10' RT	5985.45	84+49.72	29.59' RT	5985.20	NB I-25 OFF RAMP	2.00	33.33%	33.33%	0.56%	0.064	2.8	0.69	0.241	VEGETATED	
CH-L-82-2E-B	Triangular	82+70.71	86.56' RT	5988.65	83+86.97	58.10' RT	5985.45	NB I-25 OFF RAMP	0.00	5.00%	5.00%	2.53%	0.052	2.8	0.32	0.512	VEGETATED	
CH-L-82-2W-A	Triangular	84+09.57	10.92' RT	5983.01	84+49.72	29.59' RT	5981.21	NB I-25 OFF RAMP	0.00	33.33%	33.33%	4.39%	0.041	0.9	0.36	0.997	VEGETATED	
CH-L-82-2W-B	Triangular	83+49.94	13.80' RT	5983.78	84+09.57	10.92' RT	5983.01	NB I-25 OFF RAMP	0.00	33.33%	33.33%	1.33%	0.057	0.9	0.52	0.428	VEGETATED	

APPENDIX B.4 – EROSION CONTROL

Project Name:	**I-25 Mobility Hub (Lone Tree) FOR**
Job No.:	**24278**
Date:	**6/11/2024**
Designed By:	**JMM**
Checked by:	**MED**

CDOT CULVERT OUTLET PAVING

Hydraulic Data

Structure ID = FES-L-25D

NOTE: Riprap Pads uniformly sized to highest flowrate

Flow =	3.05 cfs
Shape =	Circular
Pipe Type =	RCP
Diameter (D_c), Rise (H) =	18 inches
Span (W) =	18 inches
Outlet Velocity =	6.85 fps
Outlet Depth (Y_t)=	0.33 ft
Jurisiction =	CDOT
Outlet Froude Number =	2.10 Supercritical

Riprap Calculation

Figures 9-35 and 9-36

$Q/D^{2.5}$ or $Q/WH^{3/2}$ (curves) =	**1.11**	
Y_t / Dt or Y_t / H (x axis) =	0.220	
Expansion Factor (y axis) =	4.30	Use Figure 9-35 or Figure 9-36

Figures 9-38 and 9-39

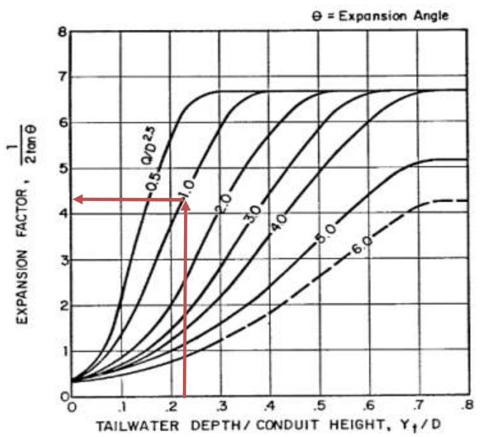
D_c or H_c (Subcritical or Critical Flow) =	1.500	ft
D_a or H_a (Supercritical Flow) =	0.915	ft
D_{50} =	3.27	inches
Y_t / Dt or Y_t / H (x axis) =	0.220	
$Q/D^{1.5}$ or $Q/WH^{0.5}$ (y axis) =	1.66	
Riprap Classification (region) =	L	Use Figure 9-38 or Figure 9-39
Riprap D_{50} =	9	inches
Filter Material or Geotextile =	Geotextile (Drainage) (Class 1)	
Filter Material Thickness		inches

Quantity Summary

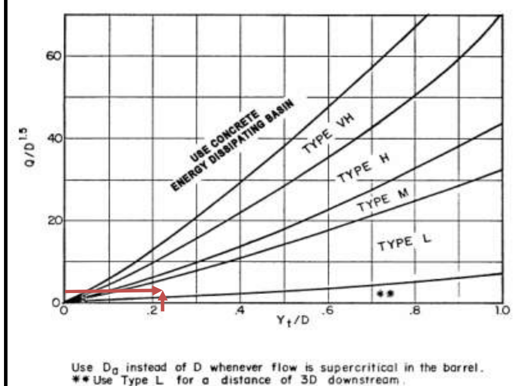
End Section Width at End =	60	inches	(per CDOT M-603-10)
Riprap Size (D_{50}) =	**9**	inches	
Riprap Thickness =	18	inches	(2 x Riprap Size D_{50})
Outlet Paving Length =	20.0	feet	
Outlet Paving Width =	15.0	feet	
Riprap Area =	320	sf	
Riprap Vol =	18	cy	
Filter Material Class A =	N/A	cy	
Geotextile (Erosion Control Class I) =	300	sf	

Riprap Sizing Figures

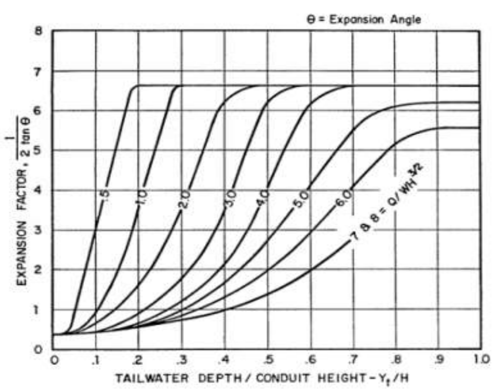
Expansion Factor Circular Culverts (Figure 9-35)



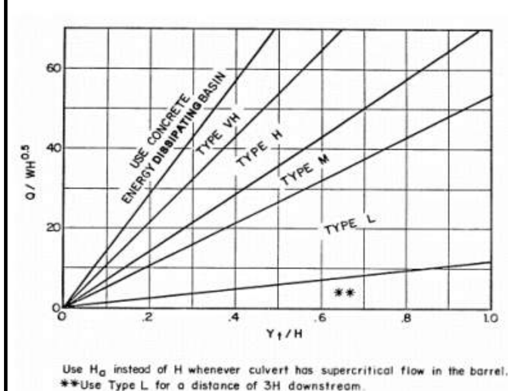
Circular Culverts (Figure 9-38)



Expansion Factor Rectangular Culverts (Figure 9-36)



Rectangular Culverts (Figure 9-39)



Project Name:	I-25 Mobility Hub (Lone Tree) FOR
Job No.:	24278
Date:	6/11/2024
Designed By:	JMM
Checked by:	MED

CDOT CULVERT OUTLET PAVING

Hydraulic Data

Structure ID = FES-L-52D

NOTE: Riprap Pads uniformly sized to highest flowrate

Flow =	1.10 cfs
Shape =	Circular
Pipe Type =	RCP
Diameter (D_c), Rise (H) =	18 inches
Span (W) =	18 inches
Outlet Velocity =	6.11 fps
Outlet Depth (Y_t)=	0.39 ft
Jurisiction =	CDOT
Outlet Froude Number =	1.72 Supercritical

Riprap Calculation

Figures 9-35 and 9-36

$Q/D^{2.5}$ or $Q/WH^{3/2}$ (curves) =	**0.40**		
Y_t / Dt or Y_t / H (x axis) =	0.260		
Expansion Factor (y axis) =	6.60	Use Figure 9-35 or Figure 9-36	

Figures 9-38 and 9-39

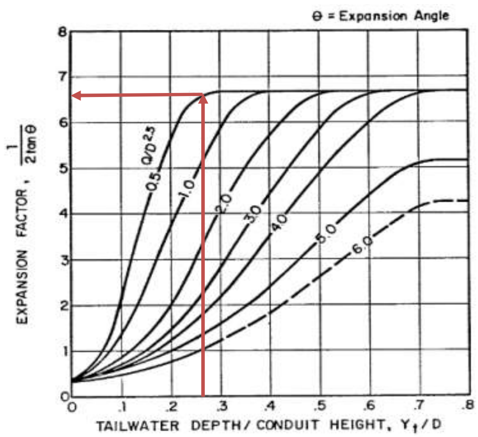
D_c or H_c (Subcritical or Critical Flow) =	1.500	ft	
D_a or H_a (Supercritical Flow) =	0.945	ft	
D_{50} =	0.96	inches	
Y_t / Dt or Y_t / H (x axis) =	0.260		
$Q/D^{1.5}$ or $Q/WH^{0.5}$ (y axis) =	0.60		
Riprap Classification (region) =	L	Use Figure 9-38 or Figure 9-39	
Riprap D_{50} =	9	inches	
Filter Material or Geotextile =	Geotextile (Drainage) (Class 1)		
Filter Material Thickness		inches	

Quantity Summary

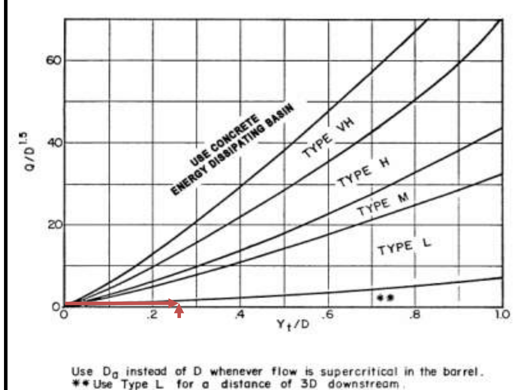
End Section Width at End =	60	inches	(per CDOT M-603-10)
Riprap Size (D_{50}) =	**9**	inches	
Riprap Thickness =	18	inches	(2 x Riprap Size D_{50})
Outlet Paving Length =	20.0	feet	
Outlet Paving Width =	15.0	feet	
Riprap Area =	320	sf	
Riprap Vol =	18	cy	
Filter Material Class A =	N/A	cy	
Geotextile (Erosion Control Class I) =	300	sf	

Riprap Sizing Figures

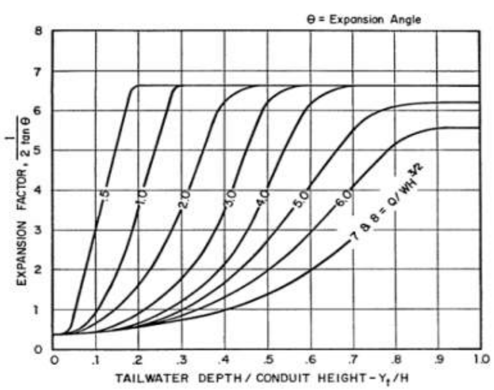
Expansion Factor Circular Culverts (Figure 9-35)



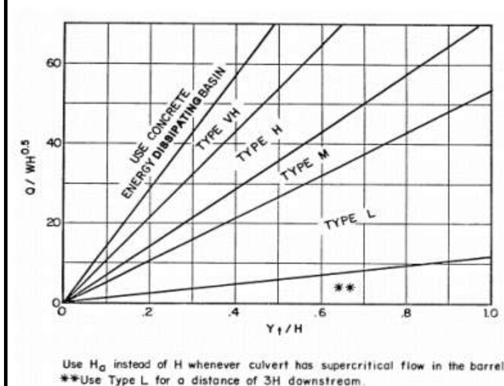
Circular Culverts (Figure 9-38)



Expansion Factor Rectangular Culverts (Figure 9-36)



Rectangular Culverts (Figure 9-39)



Project Name:	**I-25 Mobility Hub (Lone Tree) FOR**
Job No.:	**24278**
Date:	**6/11/2024**
Designed By:	**JMM**
Checked by:	**MED**

RS&H

CDOT CULVERT OUTLET PAVING

Hydraulic Data

Structure ID = **RIPRAP PAD**

NOTE: Riprap Pads uniformly sized to highest flowrate

Flow =	0.35 cfs
Shape =	Circular
Pipe Type =	RCP
Diameter (D_c), Rise (H) =	9 inches
Span (W) =	9 inches
Outlet Velocity =	2.00 fps
Outlet Depth (Y_t)=	0.90 ft
Jurisiction =	CDOT
Outlet Froude Number =	0.37 Subcritical

Riprap Calculation

Figures 9-35 and 9-36

$Q/D^{2.5}$ or $Q/WH^{3/2}$ (curves) =	**0.72**	
Y_t / Dt or Y_t / H (x axis) =	1.200	
Expansion Factor (y axis) =	6.75	Use Figure 9-35 or Figure 9-36

Figures 9-38 and 9-39

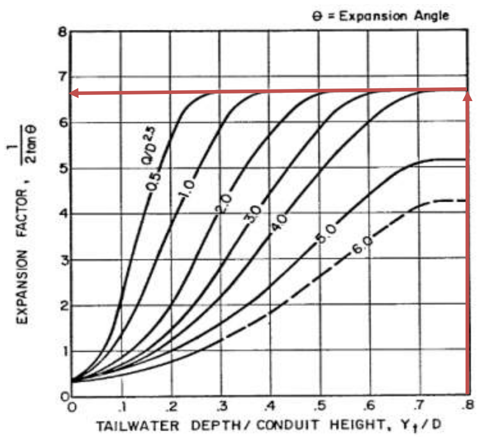
D_c or H_c (Subcritical or Critical Flow) =	0.750	ft
D_a or H_a (Supercritical Flow) =	N/A	ft
D_{50} =	0.12	inches
Y_t / Dt or Y_t / H (x axis) =	1.200	
$Q/D^{1.5}$ or $Q/WH^{0.5}$ (y axis) =	0.54	
Riprap Classification (region) =	L	Use Figure 9-38 or Figure 9-39
Riprap D_{50} =	9	inches
Filter Material or Geotextile =	Geotextile (Drainage) (Class 1)	
Filter Material Thickness		inches

Quantity Summary

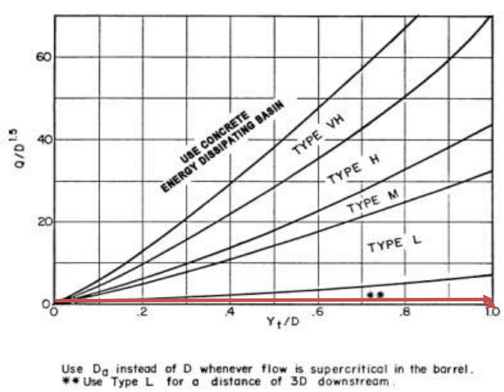
End Section Width at End =	60	inches	(per CDOT M-603-10)
Riprap Size (D_{50}) =	**9**	inches	
Riprap Thickness =	18	inches	(2 x Riprap Size D_{50})
Outlet Paving Length =	20.0	feet	
Outlet Paving Width =	15.0	feet	
Riprap Area =	320	sf	
Riprap Vol =	18	cy	
Filter Material Class A =	N/A	cy	
Geotextile (Erosion Control Class I) =	300	sf	

Riprap Sizing Figures

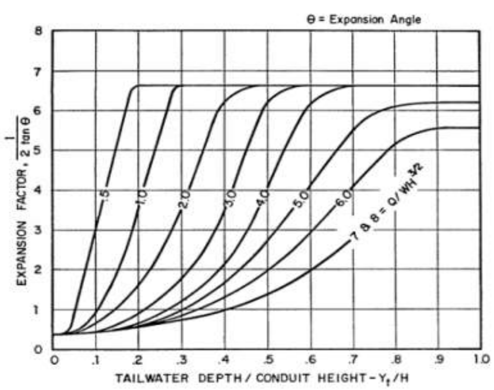
Expansion Factor Circular Culverts (Figure 9-35)



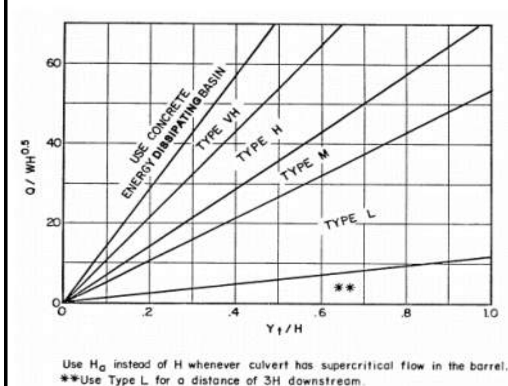
Circular Culverts (Figure 9-38)



Expansion Factor Rectangular Culverts (Figure 9-36)



Rectangular Culverts (Figure 9-39)



APPENDIX C – WATER QUALITY ENHANCEMENT BMPS

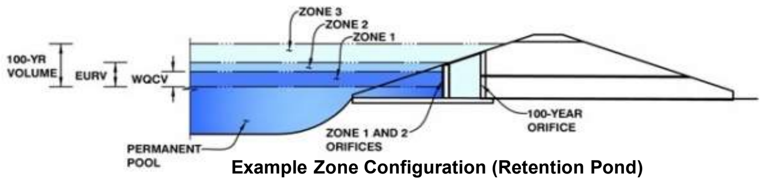
APPENDIX C.1 – DESIGN AND SIZING

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Lone Tree Mobility Hub**

Basin ID: **Pond L - Proposed**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**		**Note: L / W Ratio > 8**	
Watershed Area =	31.50	acres	**L / W Ratio = 9.29**	
Watershed Length =	3,571	ft		
Watershed Length to Centroid =	500	ft		
Watershed Slope =	0.028	ft/ft		
Watershed Imperviousness =	71.22%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	100.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.737	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.183	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	1.458	acre-feet		inches
5-yr Runoff Volume (P1 = 1.1 in.) =	2.067	acre-feet		inches
10-yr Runoff Volume (P1 = 1.33 in.) =	2.650	acre-feet		inches
25-yr Runoff Volume (P1 = 1.68 in.) =	3.661	acre-feet		inches
50-yr Runoff Volume (P1 = 1.97 in.) =	4.452	acre-feet		inches
100-yr Runoff Volume (P1 = 2.28 in.) =	5.357	acre-feet		inches
500-yr Runoff Volume (P1 = 3.07 in.) =	7.564	acre-feet		inches
Approximate 2-yr Detention Volume =	1.378	acre-feet		
Approximate 5-yr Detention Volume =	2.003	acre-feet		
Approximate 10-yr Detention Volume =	2.381	acre-feet		
Approximate 25-yr Detention Volume =	2.798	acre-feet		
Approximate 50-yr Detention Volume =	2.994	acre-feet		
Approximate 100-yr Detention Volume =	3.332	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.737	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.447	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.149	acre-feet
Total Detention Basin Volume =	3.332	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	227	0.005		
5965	--	0.50	--	--	--	301	0.007	132	0.003
	--	1.50	--	--	--	4,083	0.094	2,324	0.053
	--	2.50	--	--	--	14,138	0.325	11,434	0.262
	--	3.50	--	--	--	31,084	0.714	34,045	0.782
	--	4.50	--	--	--	53,250	1.222	76,212	1.750
5970 - Overflow	--	5.50	--	--	--	76,918	1.766	141,296	3.244
	--	6.50	--	--	--	99,884	2.293	229,697	5.273
	--	7.50	--	--	--	117,749	2.703	338,514	7.771
	--	8.50	--	--	--	131,701	3.023	463,239	10.634
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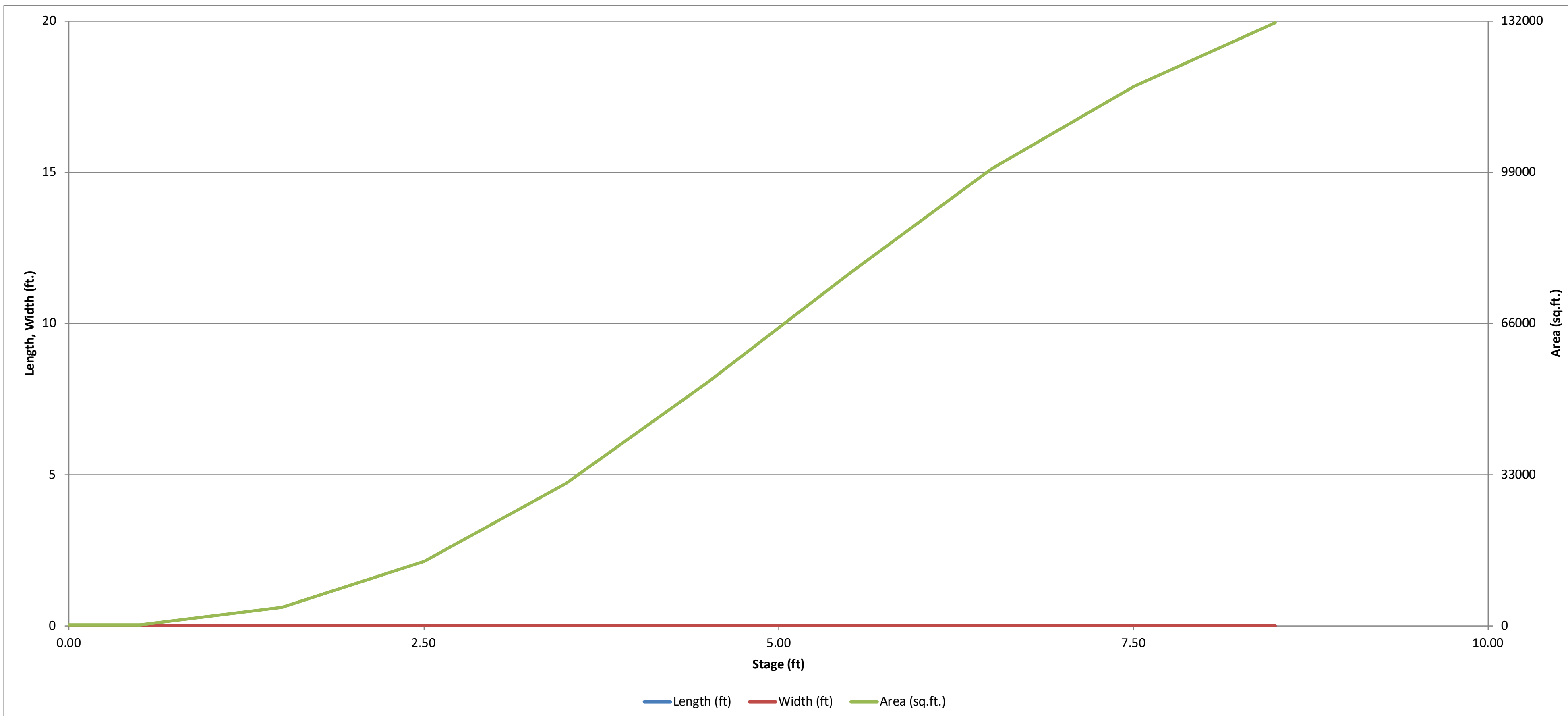
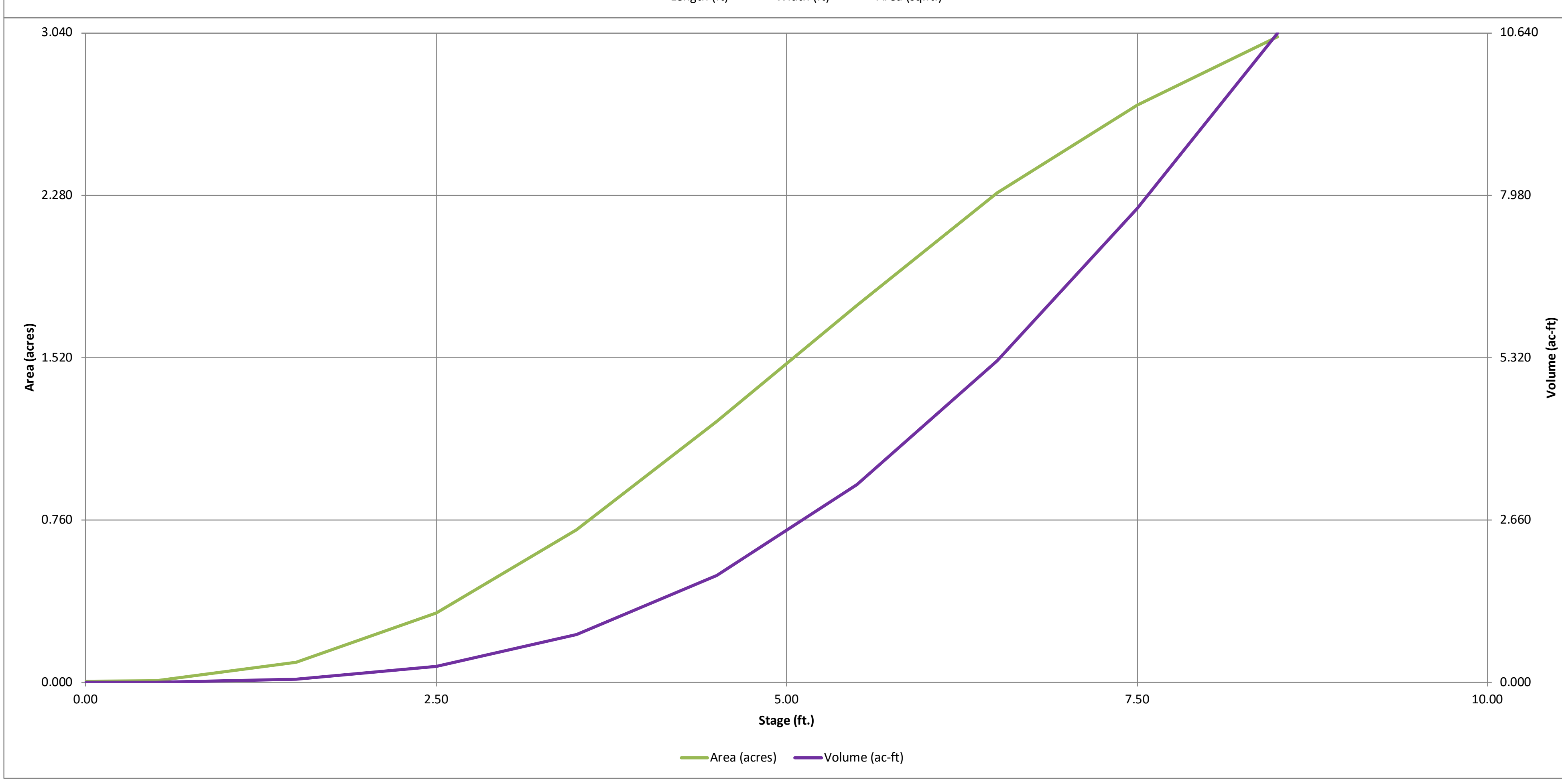
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

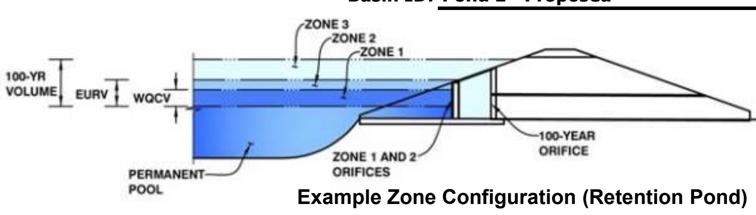




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Lone Tree Mobility Hub
Basin ID: Pond L - Proposed



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.44	0.737	Orifice Plate
Zone 2 (EURV)	4.84	1.447	Weir&Pipe (Restrict)
Zone 3 (100-year)	5.55	1.149	
Total (all zones)		3.332	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =		ft^2
Underdrain Orifice Centroid =		feet

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.83	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.75	sq. inches (diameter = 15/16 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	5.208E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.33	0.67	1.00	1.33	1.67	2.00	2.33
Orifice Area (sq. inches)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)	2.67	3.00	3.33					
Orifice Area (sq. inches)	0.75	0.75	0.75					

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =		N/A	ft^2
Vertical Orifice Centroid =		N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.83		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	7.00		feet
Overflow Weir Grate Slope =	0.00		H:V
Horiz. Length of Weir Sides =	3.92		feet
Overflow Grate Type =	Type C Grate		
Debris Clogging % =	50%		%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.83		feet
Overflow Weir Slope Length =	3.92		feet
Grate Open Area / 100-yr Orifice Area =	5.40		
Overflow Grate Open Area w/o Debris =	19.10		ft^2
Overflow Grate Open Area w/ Debris =	9.55		ft^2

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

	Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.06		ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00		inches
Restrictor Plate Height Above Pipe Invert =	18.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Restrictor	Not Selected	
Outlet Orifice Area =	3.53		ft^2
Outlet Orifice Centroid =	0.86		feet
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	6.50	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.44	feet
Stage at Top of Freeboard =	7.94	feet
Basin Area at Top of Freeboard =	2.84	acres
Basin Volume at Top of Freeboard =	8.96	acre-ft

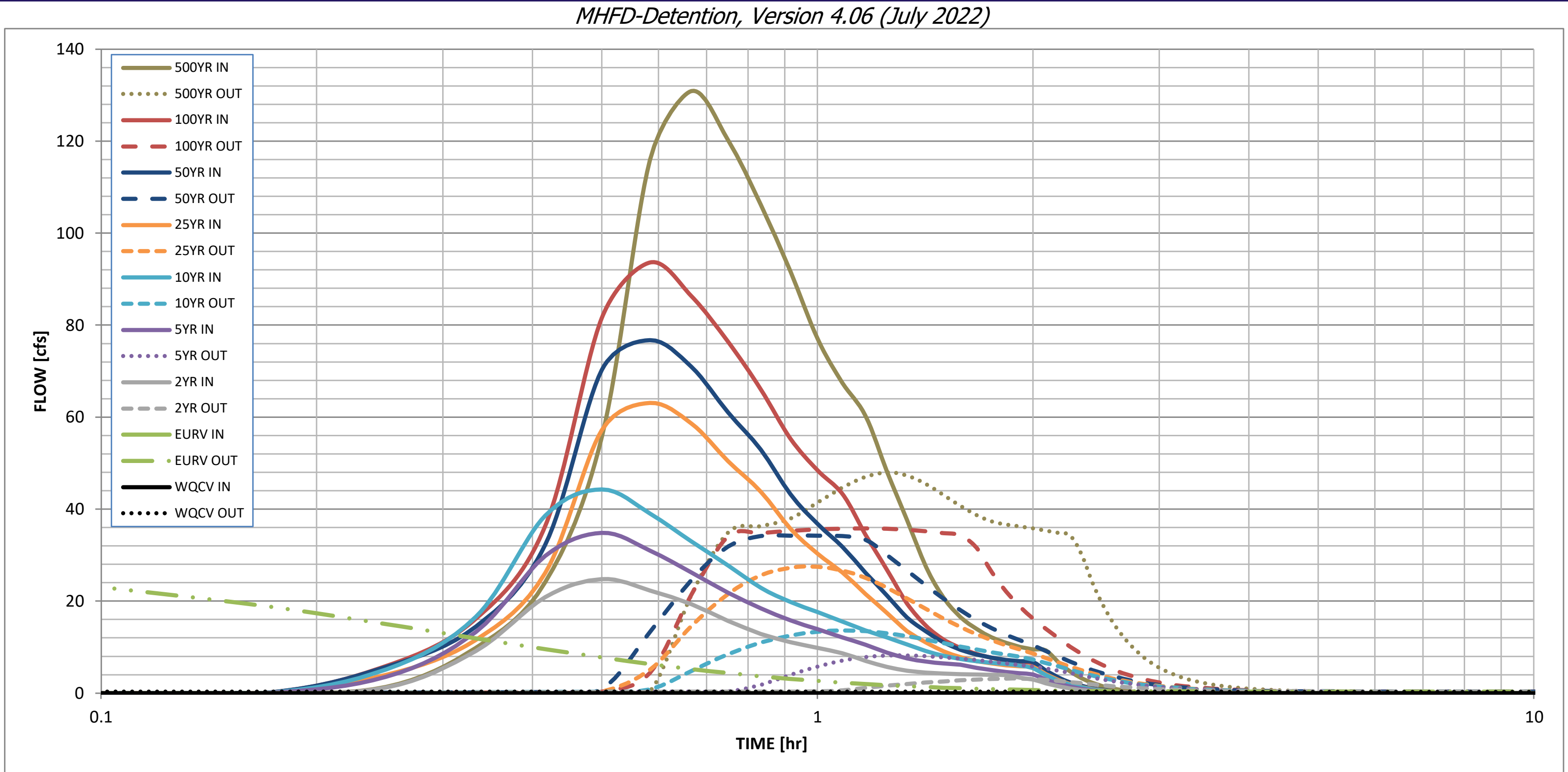
Routed Hydrograph Results

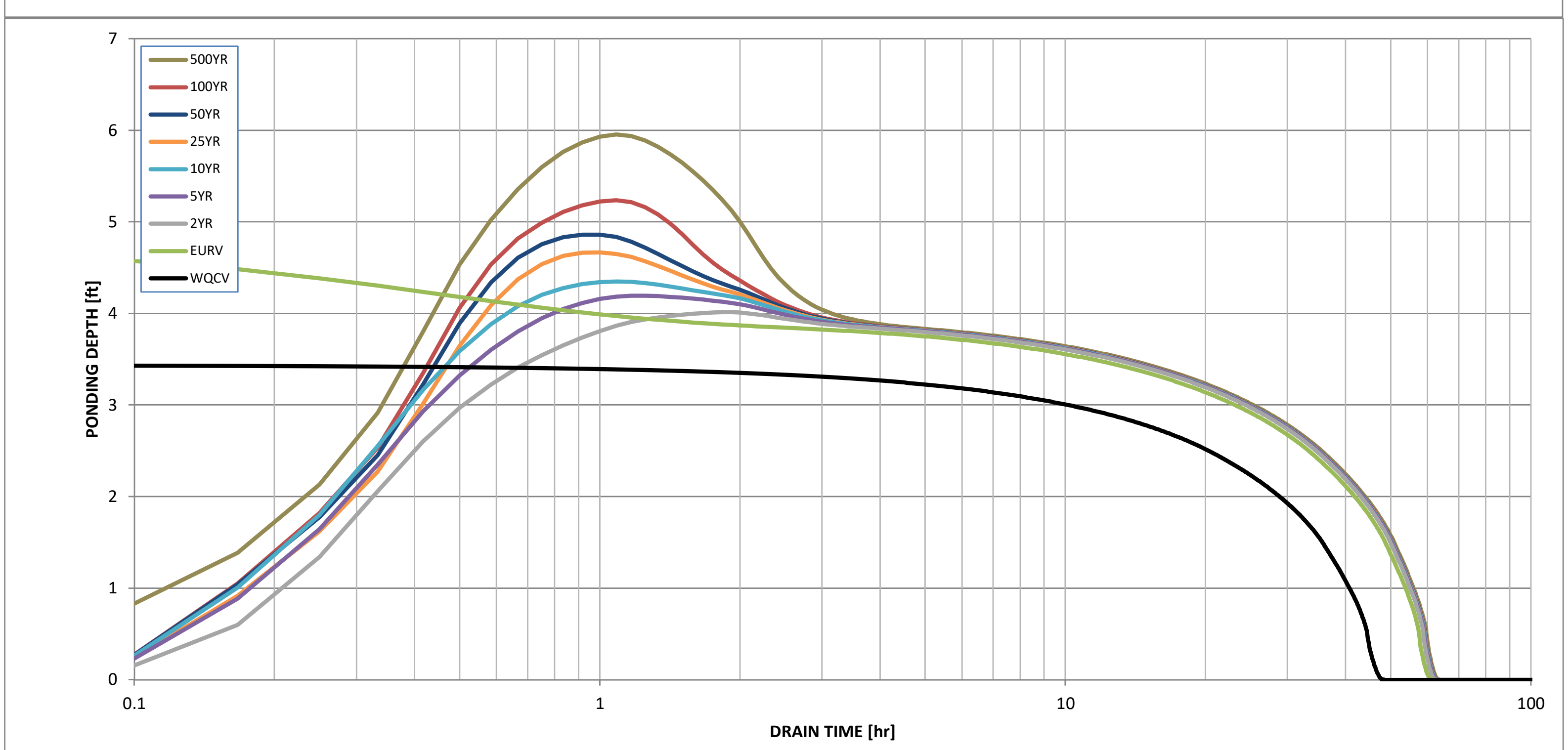
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

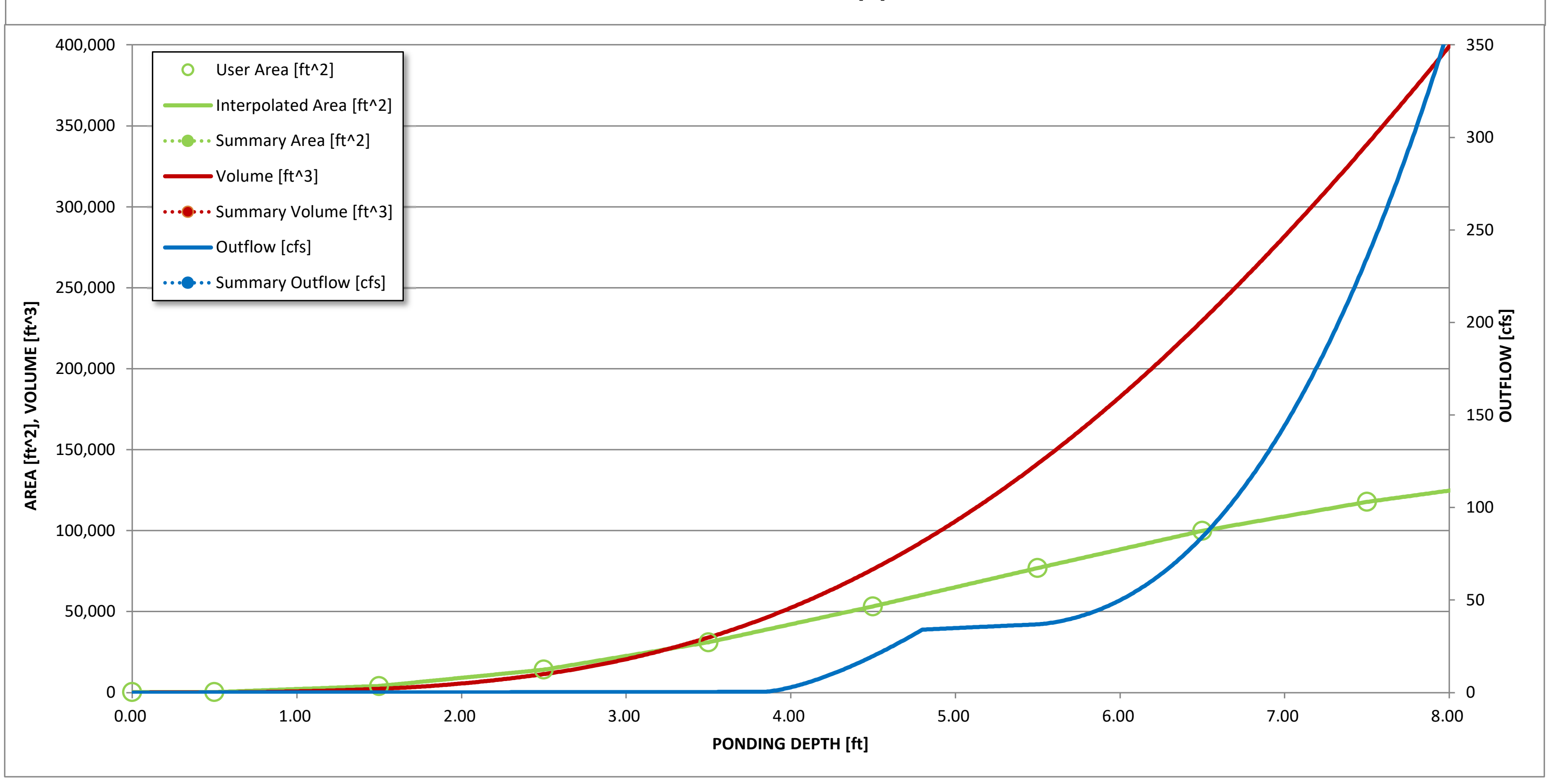
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.10	1.33	1.68	1.97	2.28	3.07
CUHP Runoff Volume (acre-ft) =	0.737	2.183	1.458	2.067	2.650	3.661	4.452	5.357	7.564
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.458	2.067	2.650	3.661	4.452	5.357	7.564
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	2.9	7.7	19.8	27.1	36.7	57.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.09	0.25	0.63	0.86	1.17	1.82
Peak Inflow Q (cfs) =	N/A	N/A	24.8	34.9	44.3	63.1	76.8	93.7	130.9
Peak Outflow Q (cfs) =	0.3	31.6	3.2	8.2	13.6	27.5	34.3	35.8	48.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.8	1.8	1.4	1.3	1.0	0.8
Structure Controlling Flow =	Plate	Outlet Plate 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	1.76	0.14	0.4	0.7	1.4	1.8	1.8	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	48	51	49	48	45	43	41	38
Time to Drain 99% of Inflow Volume (hours) =	**43**	53	56	55	54	52	52	51	49
Maximum Ponding Depth (ft) =	3.44	4.84	4.01	4.20	4.35	4.67	4.86	5.24	5.96
Area at Maximum Ponding Depth (acres) =	0.69	1.41	0.97	1.06	1.15	1.31	1.42	1.62	2.00
Maximum Volume Stored (acre-ft) =	0.739	2.197	1.212	1.395	1.572	1.952	2.225	2.787	4.092

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

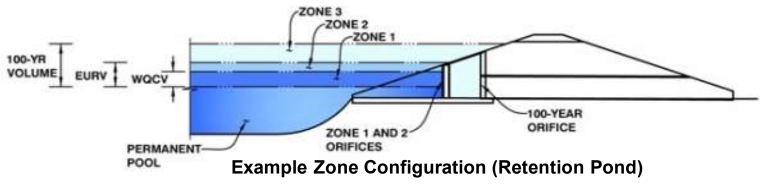
Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41
	0:15:00	0.00	0.00	1.24	3.58	5.21	3.98	5.73	5.92	9.89
	0:20:00	0.00	0.00	9.20	13.31	16.61	11.59	14.49	16.19	24.10
	0:25:00	0.00	0.00	20.87	29.82	38.58	26.12	32.24	36.32	55.67
	0:30:00	0.00	0.00	24.83	34.87	44.29	57.18	70.30	81.55	115.86
	0:35:00	0.00	0.00	22.35	31.03	39.05	63.10	76.78	93.66	130.91
	0:40:00	0.00	0.00	19.34	26.26	33.00	58.66	70.99	86.35	120.26
	0:45:00	0.00	0.00	15.75	21.88	27.80	50.46	61.04	76.41	106.26
	0:50:00	0.00	0.00	12.93	18.45	22.93	43.85	52.99	66.05	91.70
	0:55:00	0.00	0.00	11.12	15.83	19.85	35.75	43.24	55.35	77.03
	1:00:00	0.00	0.00	9.85	13.90	17.64	30.35	36.78	48.46	67.48
	1:05:00	0.00	0.00	8.68	12.16	15.58	26.25	31.84	43.32	60.31
	1:10:00	0.00	0.00	7.07	10.56	13.67	21.57	26.21	34.48	48.18
	1:15:00	0.00	0.00	5.73	8.84	12.12	17.45	21.24	26.84	37.68
	1:20:00	0.00	0.00	4.92	7.58	10.61	13.53	16.45	19.51	27.49
	1:25:00	0.00	0.00	4.50	6.88	9.14	11.05	13.43	14.65	20.73
	1:30:00	0.00	0.00	4.26	6.46	8.13	9.11	11.04	11.67	16.55
	1:35:00	0.00	0.00	4.15	6.18	7.43	7.85	9.48	9.83	13.96
	1:40:00	0.00	0.00	4.06	5.53	6.94	7.00	8.42	8.55	12.14
	1:45:00	0.00	0.00	4.00	5.02	6.61	6.46	7.74	7.70	10.95
	1:50:00	0.00	0.00	3.95	4.65	6.37	6.08	7.26	7.09	10.09
	1:55:00	0.00	0.00	3.42	4.38	6.02	5.83	6.95	6.71	9.55
	2:00:00	0.00	0.00	2.98	4.06	5.42	5.68	6.76	6.56	9.32
	2:05:00	0.00	0.00	2.17	2.95	3.91	4.14	4.92	4.79	6.79
	2:10:00	0.00	0.00	1.52	2.06	2.72	2.89	3.42	3.36	4.76
	2:15:00	0.00	0.00	1.05	1.42	1.90	2.01	2.38	2.35	3.34
	2:20:00	0.00	0.00	0.72	0.96	1.29	1.38	1.63	1.61	2.28
	2:25:00	0.00	0.00	0.47	0.62	0.86	0.91	1.08	1.07	1.51
	2:30:00	0.00	0.00	0.30	0.42	0.57	0.62	0.73	0.72	1.02
	2:35:00	0.00	0.00	0.17	0.26	0.34	0.38	0.45	0.45	0.63
	2:40:00	0.00	0.00	0.08	0.13	0.17	0.20	0.24	0.24	0.33
	2:45:00	0.00	0.00	0.03	0.05	0.06	0.08	0.09	0.09	0.13
	2:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Lone Tree Mobility Hub

Basin ID: Pond L - Existing



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**		**Note: L / W Ratio > 8**
Watershed Area =	29.92	acres	**L / W Ratio = 12.28**
Watershed Length =	4,000	ft	
Watershed Length to Centroid =	1,400	ft	
Watershed Slope =	0.028	ft/ft	
Watershed Imperviousness =	68.38%	percent	
Percentage Hydrologic Soil Group A =	0.0%	percent	
Percentage Hydrologic Soil Group B =	0.0%	percent	
Percentage Hydrologic Soil Groups C/D =	100.0%	percent	
Target WQCV Drain Time =	40.0	hours	
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court		

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.668	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.985	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	1.338	acre-feet		inches
5-yr Runoff Volume (P1 = 1.1 in.) =	1.908	acre-feet		inches
10-yr Runoff Volume (P1 = 1.33 in.) =	2.462	acre-feet		inches
25-yr Runoff Volume (P1 = 1.68 in.) =	3.434	acre-feet		inches
50-yr Runoff Volume (P1 = 1.97 in.) =	4.190	acre-feet		inches
100-yr Runoff Volume (P1 = 2.28 in.) =	5.063	acre-feet		inches
500-yr Runoff Volume (P1 = 3.07 in.) =	7.179	acre-feet		inches
Approximate 2-yr Detention Volume =	1.250	acre-feet		
Approximate 5-yr Detention Volume =	1.831	acre-feet		
Approximate 10-yr Detention Volume =	2.173	acre-feet		
Approximate 25-yr Detention Volume =	2.557	acre-feet		
Approximate 50-yr Detention Volume =	2.740	acre-feet		
Approximate 100-yr Detention Volume =	3.068	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.668	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.317	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.084	acre-feet
Total Detention Basin Volume =	3.068	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	227	0.005		
5965	--	0.50	--	--	--	301	0.007	132	0.003
	--	1.50	--	--	--	4,083	0.094	2,324	0.053
	--	2.50	--	--	--	14,138	0.325	11,434	0.262
	--	3.50	--	--	--	31,084	0.714	34,045	0.782
	--	4.50	--	--	--	53,250	1.222	76,212	1.750
5970 - Overflow	--	5.50	--	--	--	76,918	1.766	141,296	3.244
	--	6.50	--	--	--	99,884	2.293	229,697	5.273
	--	7.50	--	--	--	117,749	2.703	338,514	7.771
	--	8.50	--	--	--	131,701	3.023	463,239	10.634
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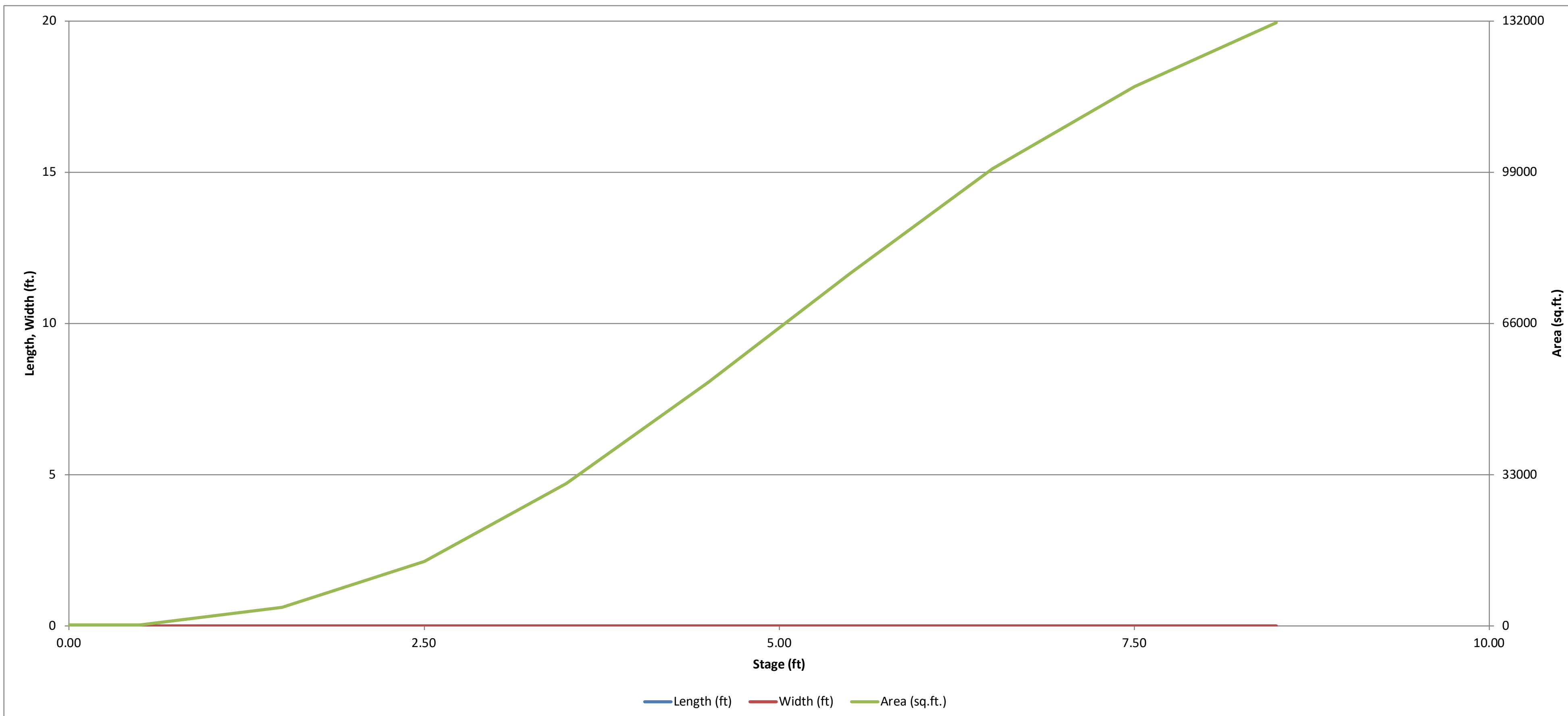
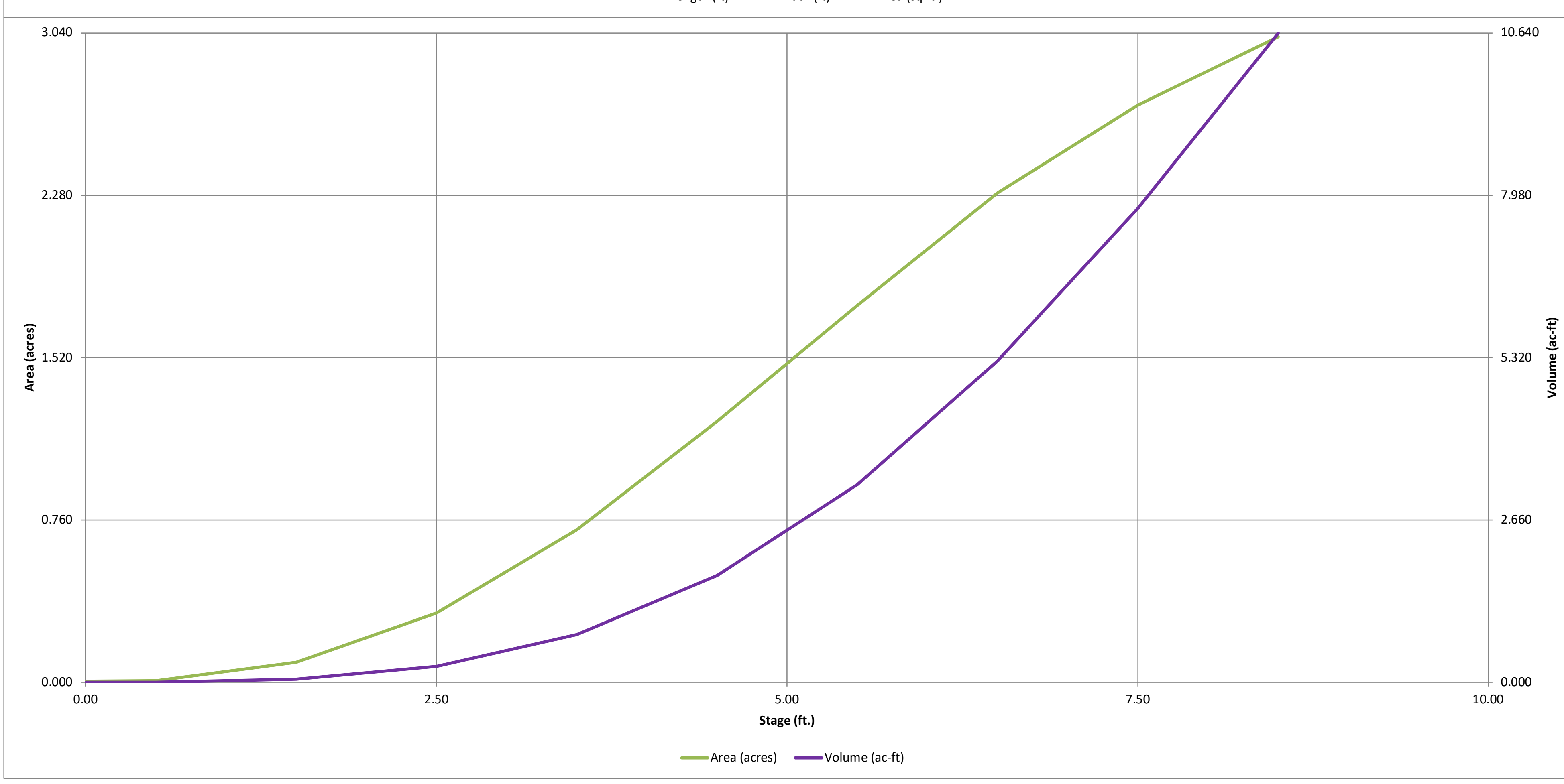
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

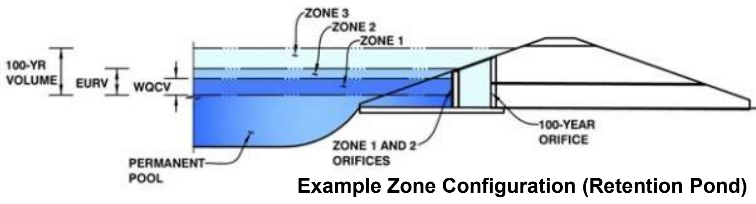




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Lone Tree Mobility Hub
Basin ID: Pond L - Existing



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.34	0.668	Orifice Plate
Zone 2 (EURV)	4.69	1.317	Weir&Pipe (Restrict)
Zone 3 (100-year)	5.40	1.084	
Total (all zones)		3.068	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.208E-03	ft^2
Depth at top of Zone using Orifice Plate =	3.83	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.75	sq. inches (diameter = 15/16 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20	1.50	1.80	2.10
Orifice Area (sq. inches)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)	2.40	2.70	3.00					
Orifice Area (sq. inches)	0.75	0.75	0.75					

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 2 Weir	Not Selected			Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.83		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.83		feet
Overflow Weir Front Edge Length =	7.00		feet	Overflow Weir Slope Length =	3.92		feet
Overflow Weir Grate Slope =	0.00		H:V	Grate Open Area / 100-yr Orifice Area =	5.40		
Horiz. Length of Weir Sides =	3.92		feet	Overflow Grate Open Area w/o Debris =	19.10		ft^2
Overflow Grate Type =	Type C Grate			Overflow Grate Open Area w/ Debris =	9.55		ft^2
Debris Clogging % =	50%		%				

Calculated Parameters for Overflow Weir

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

	Zone 2 Restrictor	Not Selected			Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.06		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.53		ft^2
Outlet Pipe Diameter =	36.00		inches	Outlet Orifice Centroid =	0.86		feet
Restrictor Plate Height Above Pipe Invert =	18.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.16	feet
Spillway Crest Length =	6.50	feet	Stage at Top of Freeboard =	7.66	feet
Spillway End Slopes =	10.00	H:V	Basin Area at Top of Freeboard =	2.75	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	8.21	acre-ft

Calculated Parameters for Spillway

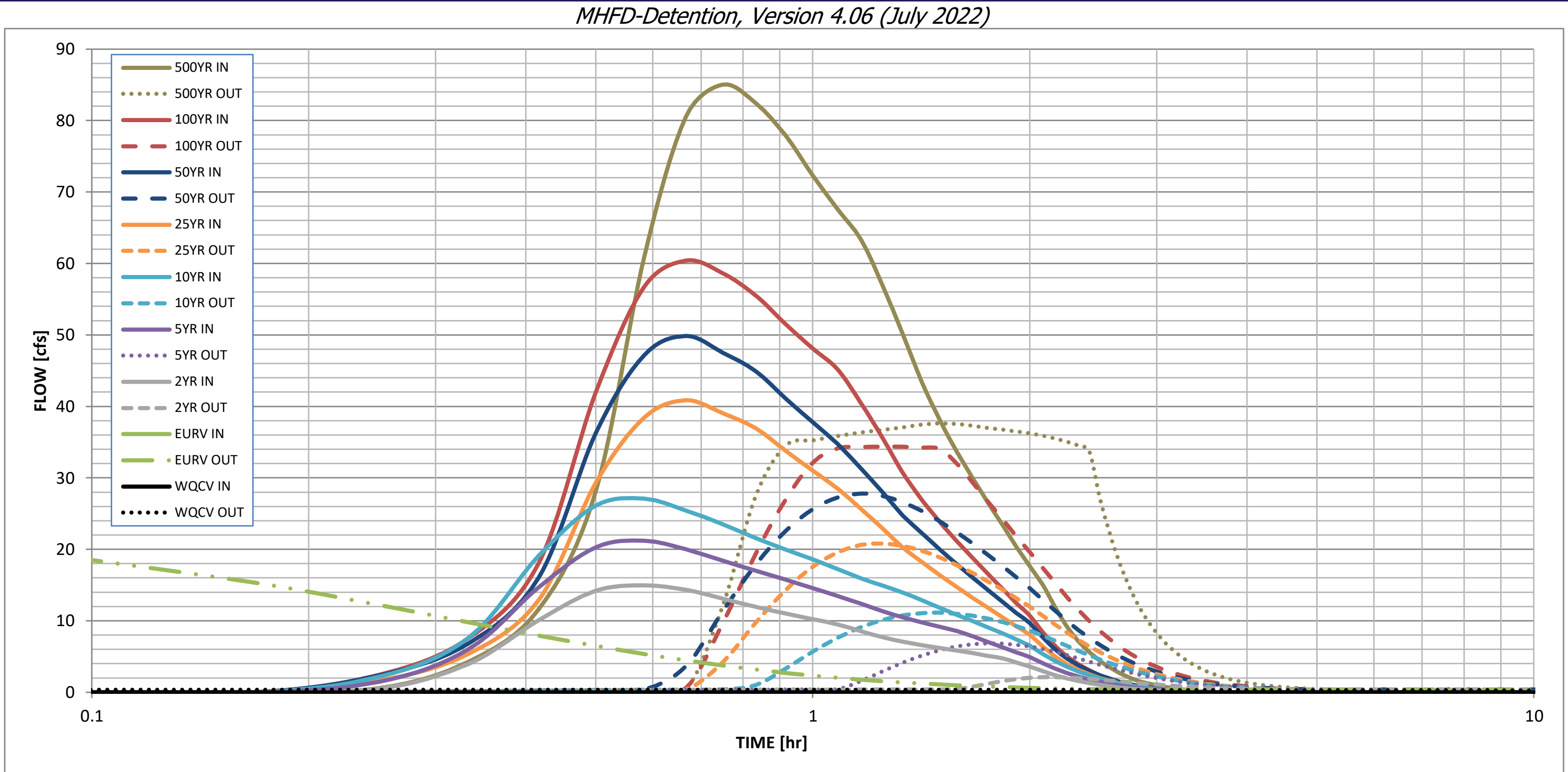
Routed Hydrograph Results

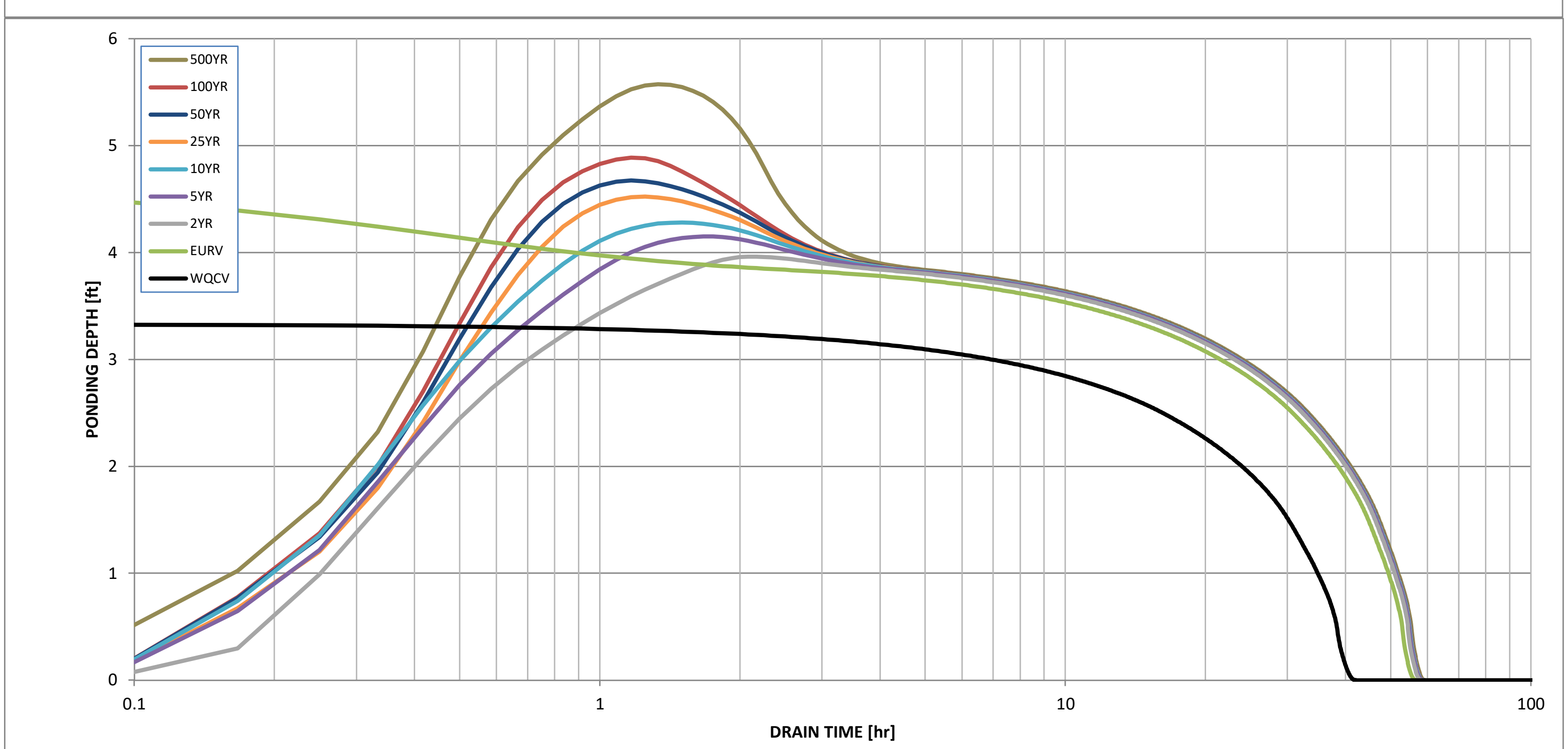
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

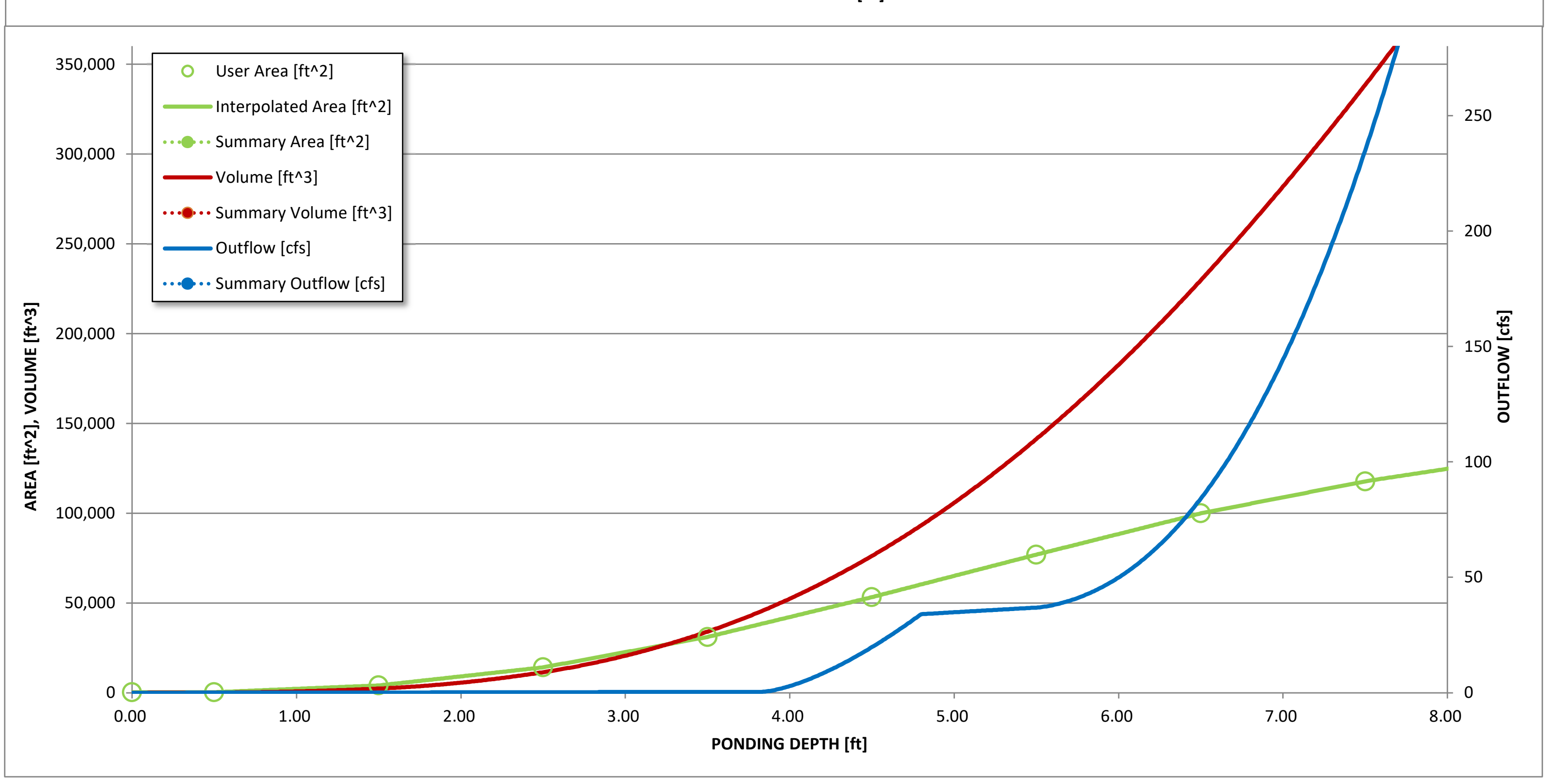
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.10	1.33	1.68	1.97	2.28	3.07
CUHP Runoff Volume (acre-ft) =	0.668	1.985	1.338	1.908	2.462	3.434	4.190	5.063	7.179
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.338	1.908	2.462	3.434	4.190	5.063	7.179
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	1.6	4.4	11.9	16.4	22.6	35.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.05	0.15	0.40	0.55	0.76	1.19
Peak Inflow Q (cfs) =	N/A	N/A	15.0	21.2	27.1	40.9	49.9	60.4	85.0
Peak Outflow Q (cfs) =	0.4	25.1	2.1	6.9	11.2	20.8	27.8	34.4	37.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	4.2	2.5	1.7	1.7	1.5	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	1.47	0.09	0.3	0.6	1.1	1.4	1.8	1.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	34	44	48	46	45	43	41	39	36
Time to Drain 99% of Inflow Volume (hours) =	**37**	49	52	51	50	49	48	47	46
Maximum Ponding Depth (ft) =	3.34	4.69	3.96	4.15	4.28	4.52	4.68	4.89	5.58
Area at Maximum Ponding Depth (acres) =	0.65	1.33	0.95	1.04	1.11	1.23	1.31	1.43	1.80
Maximum Volume Stored (acre-ft) =	0.672	1.992	1.164	1.353	1.493	1.774	1.965	2.253	3.369

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

Time Interval: 5.00 min

SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58
0:15:00	0.00	0.00	0.51	1.48	2.16	1.65	2.38	2.46	4.32
0:20:00	0.00	0.00	3.99	6.06	7.68	5.42	6.89	7.63	11.64
0:25:00	0.00	0.00	10.13	14.72	19.13	12.94	16.11	18.15	28.16
0:30:00	0.00	0.00	14.23	20.31	26.13	29.33	36.28	42.00	60.89
0:35:00	0.00	0.00	14.98	21.21	27.10	38.44	47.17	56.75	80.55
0:40:00	0.00	0.00	14.35	20.01	25.45	40.87	49.87	60.40	85.04
0:45:00	0.00	0.00	13.11	18.41	23.54	39.05	47.55	58.66	82.41
0:50:00	0.00	0.00	11.95	17.02	21.57	36.93	44.93	55.52	77.90
0:55:00	0.00	0.00	11.03	15.76	19.99	33.78	41.11	51.49	72.29
1:00:00	0.00	0.00	10.26	14.60	18.60	31.02	37.78	48.12	67.55
1:05:00	0.00	0.00	9.50	13.46	17.24	28.49	34.72	45.13	63.35
1:10:00	0.00	0.00	8.55	12.39	15.96	25.67	31.31	40.44	56.84
1:15:00	0.00	0.00	7.70	11.34	14.91	22.89	27.95	35.53	50.08
1:20:00	0.00	0.00	7.08	10.49	13.97	20.25	24.74	30.70	43.39
1:25:00	0.00	0.00	6.63	9.79	12.90	18.25	22.28	26.94	38.10
1:30:00	0.00	0.00	6.23	9.17	11.84	16.39	19.99	23.83	33.69
1:35:00	0.00	0.00	5.86	8.59	10.86	14.74	17.94	21.19	29.94
1:40:00	0.00	0.00	5.49	7.83	9.96	13.21	16.05	18.78	26.52
1:45:00	0.00	0.00	5.12	7.05	9.10	11.82	14.32	16.56	23.36
1:50:00	0.00	0.00	4.76	6.29	8.27	10.48	12.65	14.44	20.36
1:55:00	0.00	0.00	4.18	5.59	7.41	9.21	11.09	12.47	17.58
2:00:00	0.00	0.00	3.61	4.93	6.51	8.04	9.66	10.70	15.07
2:05:00	0.00	0.00	2.96	4.08	5.38	6.43	7.71	8.44	11.91
2:10:00	0.00	0.00	2.40	3.32	4.39	5.03	6.02	6.51	9.23
2:15:00	0.00	0.00	1.96	2.70	3.59	3.96	4.75	5.07	7.20
2:20:00	0.00	0.00	1.61	2.21	2.94	3.16	3.79	3.97	5.65
2:25:00	0.00	0.00	1.31	1.80	2.40	2.52	3.02	3.10	4.42
2:30:00	0.00	0.00	1.07	1.46	1.94	2.02	2.41	2.42	3.45
2:35:00	0.00	0.00	0.86	1.18	1.55	1.60	1.91	1.86	2.66
2:40:00	0.00	0.00	0.69	0.93	1.23	1.25	1.49	1.43	2.04
2:45:00	0.00	0.00	0.55	0.73	0.96	0.98	1.16	1.11	1.58
2:50:00	0.00	0.00	0.44	0.57	0.75	0.77	0.91	0.87	1.24
2:55:00	0.00	0.00	0.35	0.45	0.59	0.61	0.72	0.70	1.00
3:00:00	0.00	0.00	0.27	0.35	0.46	0.47	0.56	0.55	0.78
3:05:00	0.00	0.00	0.20	0.26	0.35	0.36	0.42	0.42	0.59
3:10:00	0.00	0.00	0.14	0.18	0.25	0.26	0.31	0.31	0.43
3:15:00	0.00	0.00	0.09	0.12	0.17	0.18	0.21	0.21	0.30
3:20:00	0.00	0.00	0.05	0.08	0.10	0.11	0.13	0.13	0.18
3:25:00	0.00	0.00	0.03	0.04	0.05	0.06	0.07	0.07	0.10
3:30:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.04
3:35:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX C.2 – PERMANENT WATER QUALITY FORM

Permanent Water Quality Form

Please complete this form for every transportation and Property Management project in your Region to assess PWQ requirements per CDOT's MS4 permit. Information about number of projects reviewed for PWQ requirements and projects that install PWQ is reported to CDPHE in annual reports. Please email the completed Form and any changes to PWQ Program Manager Rachel.hansgen@state.co.us. Thank you!

Date 6/12/2024

Region 1 Completed by Mary Duke

Subaccount # & Project Description 24278 - I-25 - Mobility Hub (Lone Tree)

Please circle Y or N for the Primary Criteria

Primary Criteria		
1. Inside or partially inside CDOT MS4 area	2. Disturb more than 1 acre or disturb less than 1 acre but is part of a larger common plan of development	3. Increases impervious surface by 20% or more
Y (circled) or N	Y (circled) or N	Y (circled) or N

Is/Does the project:

1. Inside or partially inside CDOT's MS4 area?

   Use C-Plan https://cdot.maps.arcgis.com/apps/webappviewer/index.html?id=129bef3793774ade81cfca5ec9baff7d

2. Disturb more than 1 acre or disturb less than 1 acre but is part of a larger common plan of development[1]?
3. Increase impervious surface by 20% or more?

   Use formula: New Impervious Surface / Existing Impervious Surface X 100

   New 1.67 ac Existing 3.10 ac Percent Increase 54%

<u>If the answer to one or more of questions 1-3 is NO, PWQ is NOT required on the project.</u>

<u>If the answer to ALL questions above is YES, answer the following 3 questions:</u>

[1] Common Plan of Development A "common plan of development or sale" is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related. Consistent with EPA guidance, "contiguous" is interpreted to mean construction activities located in close proximity to each other (within ¼ mile). Construction activities are considered to be "related" if they share the same development plan, builder or contractor, equipment, storage areas, etc. (CDOT MS4 Permit)

Please circle Y or N for the Secondary Criteria

Secondary Criteria		
4. Discharges to a 303(d) listed stream for a CDOT Roadway Pollutant of Concern	5. Discharges to the Cherry Creek Reservoir drainage basin	6. Is part of an EA or EIS
Y or N	Y or N	Y or N

Is/Does the project:

4. Discharge to a 303(d) listed stream for a CDOT pollutant of concern?

   Use CDPHE map and identify 303 (d) list pollutants
   https://cdphe.maps.arcgis.com/apps/Viewer/index.html?appid=f1541d2f21834642ba1551c674fd4a79

   Use table of CDOT "Roadway pollutants of concern" and check the "Yes only" column if the stream is listed on the 303(d) list:

Roadway pollutant and (form)	Chemical Formula	YES only
Total Suspended Solids	TSS	
Cadmium (total & potentially dissolved)	Cd	
Chromium (total & potentially dissolved)	Cr	
Copper (total & potentially dissolved)	Cu	X
Iron (total & potentially dissolved)	Fe	X
Lead (total & potentially dissolved)	Pb	
Magnesium (total & potentially dissolved)	Mg	
Manganese (total & potentially dissolved)	Mn	
Nickel (total & potentially dissolved)	Ni	
Zinc	Zn	
Total Inorganic Nitrogen	$TKN + NO_2 + NO_3$	
Total Phosphorus	TP	
Chloride	Cl^-	
Sodium	Na	
Oil		
Grease		

5. Discharge to the Cherry Creek Reservoir Basin?

   Use Environmental Scoping Tool - sign on using your CDOT login:
   https://dtdinternalapps.dot.state.co.us/environmentalscoping/

   Or view Cherry Creek Drainage Basin Map here:
   https://www.cherrycreekbasin.org/maps

6. Part of an Environmental Assessment or Environmental Impact Statement?

   Check with Region NEPA or Environmental staff

If answer to any question 4-6 is YES, PWQ is REQUIRED on the project. Please access the PWQ Program Manual and website for information about next steps or contact PWQ Program Manager Rachel.hansgen@state.co.us.

APPENDIX D – PIPE SELECTION MEMO

DATE: June 12, 2024
FROM: Mary Duke, P.E. (RS&H)
TO: Samer AlHaj, P.E. (CDOT), Jiovanna Toppi, P.E. (CDOT)
CC: David Woolfall, P.E. (RS&H)
SUBJECT: Pipe Selection Report

BACKGROUND

This memorandum is to summarize pipe material selected for the project based upon the Colorado Department of Transportation's (CDOT) *CDOT Pipe Material Selection Guide* dated April 30. 2015 for the I-25 Mobility Hub (Sky Ridge @ Lone Tree) Project.

The *CDOT Pipe Material Selection Guide's* purpose is to enable Project Managers (PM) to select the allowable pipe material options based on a myriad of site specifications that are important to the longevity of the material due to exterior influences. By meeting the corrosion and abrasion criteria defined by the guide and installing the pipe per plans and specifications is assumed to have a 50-year service life. There are a few exemptions to the policy, the only one applicable to this project is the utilization of subsurface drains.

DISCUSSION

A Pipe Selection Report was completed regarding the type of pipe material to be utilized in order to allow a contractor to select the most cost-effective materials. CDOT has five primary steps in determining the pipe materials permitted to be utilized:

1. Determine Drainage Application
2. Determine Abrasion Level
3. Determine Corrosion Level
4. Pipe Selection, and
5. Verify Fill Height.

Based upon the location of the pipe CDOT has defined 3 types of applications: cross drains, side drains, and storm drains. Definitions for each type of pipe applications are found in the CDOT Drainage Design Manual (DDM) in Chapter 9 Appendix C. This project is utilizing side drains and storm drains for the drainage design.

The second step in determining pipe material is the abrasion level the pipe will encounter. Four levels of abrasion are discussed in the memorandum and after consideration an Abrasion Level 2 will best reflect the pipe's bed load and velocities. Abrasion Level 2 applies where low abrasive conditions exist. Low abrasive conditions exist in areas of minor bed loads of sand and velocities of 5 fps or less. Though minor bed loads are more likely, Abrasion Level 2 was selected due to the propensity of lower velocities. Velocities are based upon a 2-year storm-event.

Determining the corrosion level requires the use of borings. A draft geotechnical report titled *Draft Subsurface Exploration Report for* Lone Tree Mobility Hub – Pedestrian Bridge dated May 2024 written by Geocal. This report includes information about the chloride and sulfate levels within each of the borings. These were compared to the values in Table 1 from the *CDOT Pipe Selection Guide* to determine a CR 1 level.

Using Figure 1 in the CDOT Pipe Selection Guide for cross drains and side drains materials permitted are all materials for class 1. Figure 2, which is used for storm drains, permits RCP, PP, SRPE, or PVC for Class 7. For simplicity, all pipes within the project shall adhere to the more conservative pipe material and shall meet the requirements of Class 7 pipe. Pipe shall have a minimum Class 3 pipe strength.

Depth of pipe will need to be considered to ensure strength of pipe is adequate in locations where the pipe has minimal cover, in these locations, concrete pipe is specified.