Attachment D

RANGE

5th Revised Traffic Impact Analysis

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I. INTRODUCTION

Range is a proposed development near the Town of Louviers in Douglas County, Colorado, that is planned to be constructed with 550 single-family detached homes along the east side of United States (US) 85 opposite the US 85/Airport Road intersection. These homes will be constructed on mostly vacant property covering about 400 acres. **Figure 1** provides a vicinity map of the project location.

A series of interconnected streets will provide access between smaller enclaves of residential homes, while the primary access point for the property is proposed at the US 85/Airport Road intersection. A secondary point of access is planned near the south property line and it will provide not only an alternate route for residential home users, but another route for emergency services. The secondary access point will align with a new intersection that was recently constructed by the Colorado Department of Transportation (CDOT) as part of US 85 widening.

This report also includes shared access opportunities for potential future development parcels to the north and south of Range. These parcels are referred to as the Poet and Barenburg properties for the remainder of this report. The Poet property is an 84 acre parcel to the north of Range which would have shared access at Airport Road, while the Barenburg property is to the south of Range, and it has 236 acres with the shared access opportunity being at the Range's secondary access point.

The primary purpose for this Traffic Impact Analysis (TIA) revision is to address changes in the daily traffic volume projections on the internal street network given recent revisions to the lot payout. The total number of single-family homes has not changed, however.

Range will partially abut US 85, and each of the two access locations on US 85 will require coordination with CDOT for processing of access permits per the requirements contained in CDOT's *State Highway Access Code* (the *Code*).

The following specific elements are included in this Traffic Impact Analysis:

- Daily and peak hour traffic volume data at, and adjacent to, the US 85/Airport Road intersection (only at this intersection based on coordination with CDOT and Douglas County)
- Evaluation of existing operational conditions
- Estimates of background traffic volume projections for the Build-Out and Year 2040 timeframes
- Projections of vehicle trips for the Poet and Barenburg properties
- Evaluation of projected background operational conditions for Build-Out and Year 2040 timeframes based on current and potential future roadway improvements
- Estimates of trip generation for the proposed Range land use
- Analysis of project impacts and access evaluation for Build-Out and Year 2040
- Recommendations for public improvements

The following sections of this report provide specific information on each of these issues.

Of note, this *5th Revised Traffic Impact Analysis* was prepared to specifically address the lot layout revisions contained in **Section IV.H, Street Classifications**.

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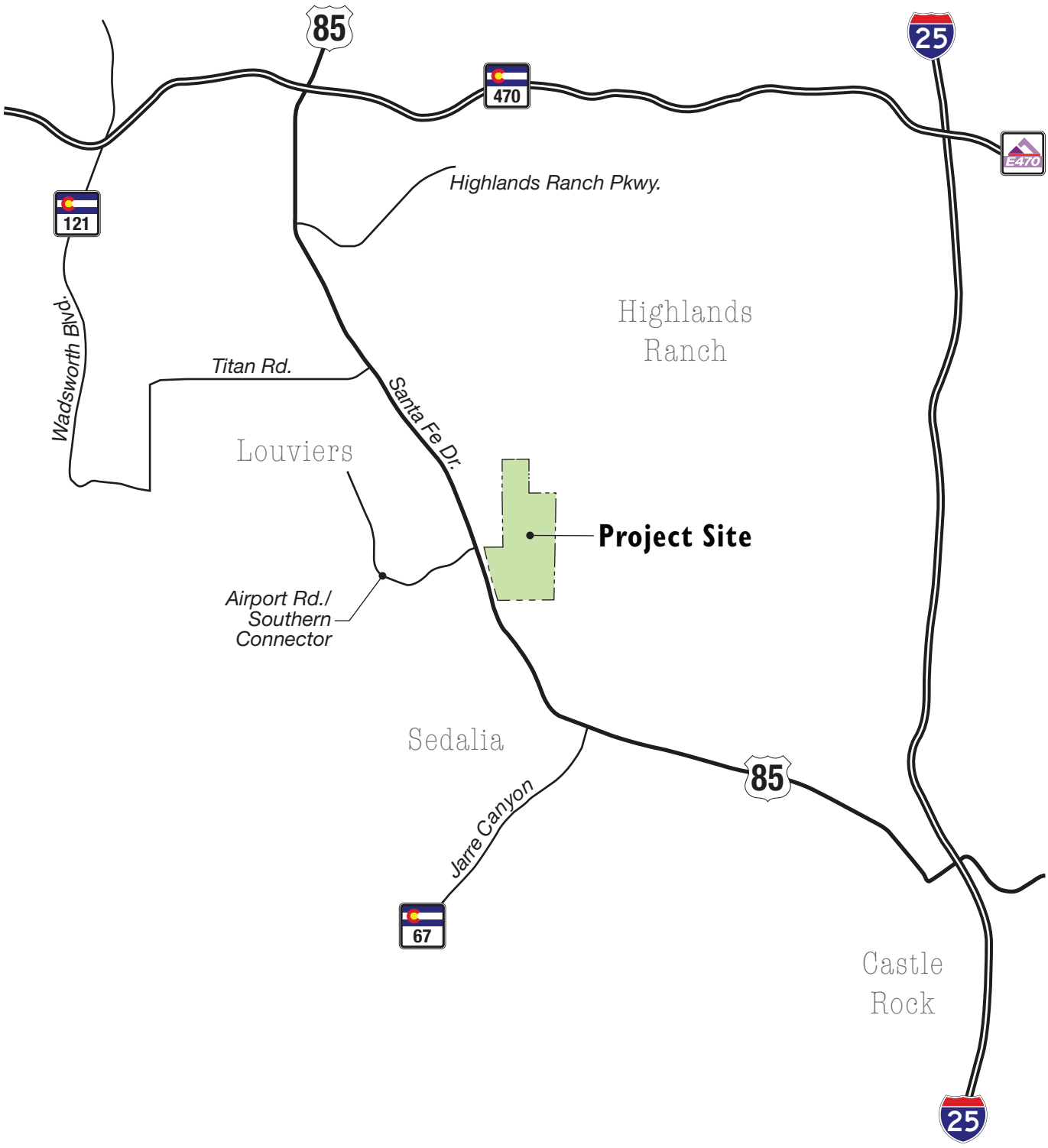
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NORTH

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NOTE: Drawing Not to Scale

FIGURE 1
Vicinity Map

Range TIA- UPDATE 120-308-01 8/7/24

Range Preliminary Plan
Project File# SB2024-048

II. EXISTING CONDITIONS

II.A. Land Use

Range is proposed to be constructed along the east side of US 85 near the Town of Louviers in Douglas County, Colorado. The property is essentially vacant and surrounded by a variety of private property, Douglas County open space, and light industrial land uses. The Union Pacific (UP) and Burlington Northern & Santa Fe (BNSF) railway lines are adjacent to the west side of US 85.

Light industrial businesses located parallel to US 85 contain numerous types of facilities such as truss manufacturing, shooting supplies, recreational vehicle storage, and paintball recreation. Large acre residential lots also exist somewhat sporadically along the US 85 corridor.

The Town of Louviers is to the northwest of US 85 and the project site. It is a relatively small enclave of residential homes that was originally constructed as a company town to support the E.I. du Pont de Nemours dynamite manufacturing facilities and it is one of the best preserved company towns in Colorado. The Town of Sedalia is located about 2.5 miles to the south of Airport Road, and it is also a relatively small community of residential homes and businesses, along with the Sedalia Elementary School.

II.B. Roadway System

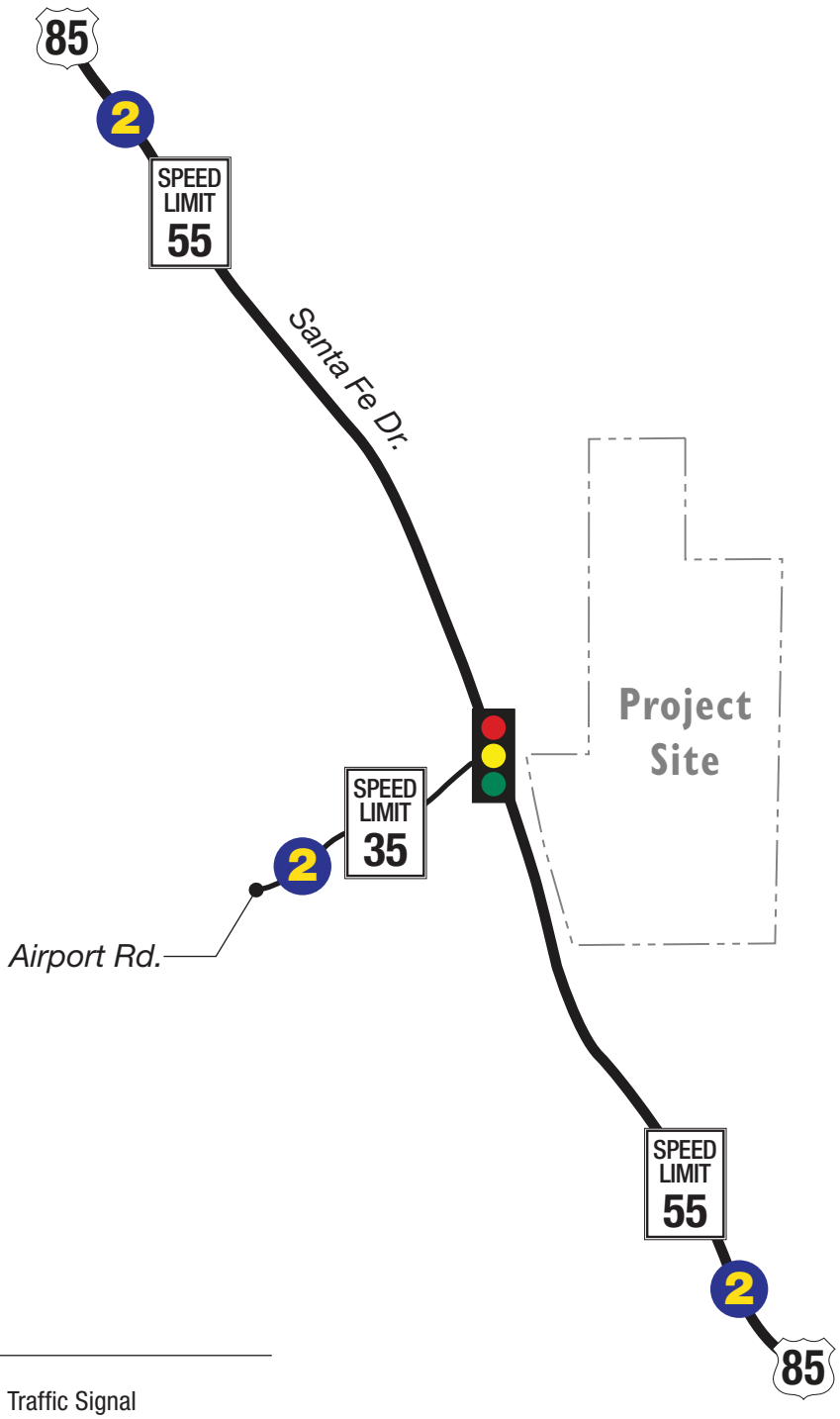
Figure 2 provides a representation of the adjacent roadway network, its laneage, and speed limit characteristics. Following are more detailed descriptions of the two primary roadways that influence vehicular access adjacent the project site.

US 85 – Range is situated along the east side of US 85, a major United States and State of Colorado highway. It has a north-south orientation and extends beyond the State of Colorado border from Texas to North Dakota. US 85 provides local connectivity for Douglas County residents while also providing regional access between I-25 at Castle Rock and through the Denver metropolitan area.

Adjacent to the project site, US 85 is classified as a Regional Highway (RA) by CDOT with a posted speed limit of 55 miles per hour (mph). US 85 transitions between two and four lanes just outside the study area. It has a northbound left turn deceleration lane, and southbound right turn deceleration and acceleration lanes at its intersection with Airport Road. US 85 was recently widened to a consistent four-lane facility between Titan Road and Sedalia (more detail is included in **Section III.B**).

Airport Road (Douglas County Road 16) – This east-west street provides connectivity between US 85 and the Town of Louviers, and it also provides access to several large lot residential properties, light industrial parcels, and ranch land. Airport Road has a posted speed limit of 35 mph and there is one through lane in each direction.

A Douglas County project to extend Airport Road westward from Louviers Boulevard towards the Sterling Ranch development and Titan Road was recently completed and is open to the public. This extension is also referred to as the Southern Connector.



LEGEND

= Traffic Signal

X = Number of Through Lanes

SPEED LIMIT XX = Posted Speed Limit

NORTH

FIGURE 2
Surrounding Roadway Characteristics

Range TIA- UPDATE 120-308-01 8/7/24

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NOTE: Drawing Not to Scale

II.C. Traffic Volumes

The existing traffic volumes shown on **Figure 3** are a compilation of both daily and peak hour traffic data that were recorded in July 2020 on a typical weekday. As can be imagined, COVID-19 has influenced traffic volumes throughout Colorado. As such, to reflect a "normal" level of vehicle movements, the CDOT Online Transportation Information System (OTIS) database was researched to understand pre-COVID 19 traffic volume levels.

If data in OTIS on US 85 from November 2019 (just north of SH 67 in Sedalia) can be considered a "normal" pre-COVID-19 condition (20,000 vehicles per day [vpd]), it indicates that data collected in July 2020 is only 5 percent below pre-COVID-19 levels. While the segment of US 85 between SH 67 and Airport Road has very few access points that would add or subtract daily traffic volumes, it is recognized that the Intermountain Rural Electric Association offices and the Sedalia Landfill could affect these adjustments. To be conservative in the COVID-19 traffic volume influence, the recorded daily and peak hour traffic volumes were adjusted upward by 10 percent.

Figure 3 shows the adjusted traffic volumes (rounded), and **Appendix A** includes the originally recorded traffic volume data.

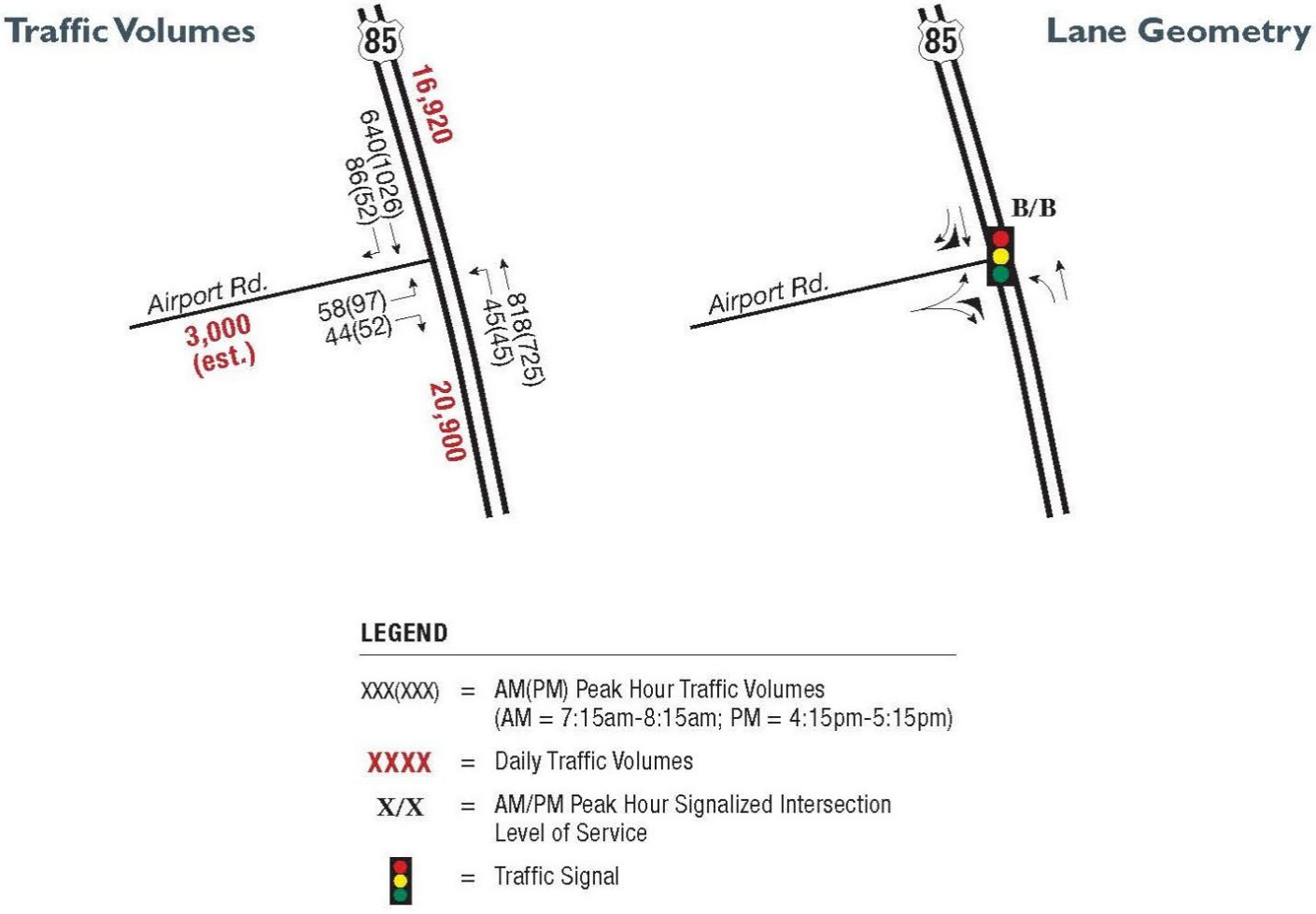


Figure 3. Existing Traffic Conditions

II.D. Traffic Operations

Traffic operations for the US 85/Airport Road intersection were evaluated according to techniques documented in the *Highway Capacity Manual*, 6th Edition (Transportation Research Board, 2016) using the existing traffic volumes, intersection geometry, and traffic control. Level of Service (LOS) is a qualitative measure of traffic operational conditions based on roadway capacity and vehicle delay and it is described by a letter designation ranging from A to F. LOS A represents almost free-flow travel, while LOS F represents congested conditions.

The evaluation of an intersection controlled by a traffic signal provides average vehicle delay and LOS information for the entire intersection, as well as for individual movements. **Figure 3** also shows the LOS results for existing conditions which finds that the US 85/Airport Road intersection is currently operating at LOS B during the AM and PM peak hours. Given the relatively high traffic demand on US 85, however, eastbound movements on Airport Road are currently experiencing LOS E during the AM peak hour and LOS F during the PM peak hour.

Of note, the operational analyses are based on signal timing data provided by CDOT and it is understood that this intersection operates in a "free" mode which allows the traffic signal to fluctuate to meet vehicle movement demand without a specified cycle length. As such, the traffic signal controller appears to allocate more "green time" to movements along US 85, which, in turn, creates a higher level of delay for the eastbound Airport Road movements that result in the poor eastbound LOS.

Appendix B provides the LOS criteria, and **Appendix C** includes the analysis worksheets for existing conditions.

III. BACKGROUND CONDITIONS

III.A. Projected Build-Out Timeframe

It is understood that the Build-Out timeframe for completion of the 550 dwelling units is projected to be in 2028, eight years from the initial preparation of this report. As such, information in this section includes projections and operational analyses for both 2028 (Build-Out) and Year 2040, the 20-year planning horizon.

III.B. Roadway Network

This segment of US 85 was recently reconstructed to widen US 85 from two to four through lanes with accompanying auxiliary lanes. The construction plans show the installation of a northbound left turn deceleration lane, and southbound right turn deceleration and acceleration lanes, for movements to/from Airport Road. The construction plans also include a southbound left turn deceleration lane for movements onto a realigned private access where the Ranges' primary access will be. The widening project will also create a new access approximately ½ mile to the south of Airport Road where the secondary access for Range is proposed. This access will have northbound and southbound left turn lanes. The additional through lanes will essentially double the current capacity for northbound and southbound movements on US 85.

III.C. Future Traffic Volumes

Data Sources – Background traffic volume projections start with the COVID-19 adjusted traffic volumes on **Figure 3** of this report. There are several resources available to predict future traffic volumes for the Build-Out and Year 2040 timeframes. A Planning and Environmental Linkages (PEL) study was updated in 2019, while the Denver Regional Council of Governments' (DRCOG) travel demand model for Year 2040 can be used. Data from CDOT's OTIS database is also available.

Each of these documents were reviewed to understand the potential growth that could occur over the next 20 years. Using data from a count station to the north of SH 67 at Sedalia, OTIS predicts that growth along US 85 will have about a 36 percent increase, or about a 1.42 percent compounded annual growth rate.

The PEL study and DRCOG information found that traffic is predicted to grow at a much higher compounded annual growth rate, ranging from 3.09 percent to 3.27 percent depending on which side of Airport Road the calculations were based. The average rate was 3.18 percent for a total growth over 20 years of about 87 percent.

US 85 – When considering the US 85 widening improvements that make it a more attractive travel route, and the continuing development of Sterling Ranch and surrounding areas of Douglas County, the traffic volume growth projections from the PEL study and from DRCOG provide the best indication of vehicle growth. As such, movements along US 85 reflect the average compounded growth rate of the PEL and DRCOG data, being 3.18 percent per year.

Airport Road – The new roadway connection of Airport Road (Southern Connector) to/from Sterling Ranch and Titan Road will increase Airport Road traffic volumes above historic growth rates. Traffic modeling information provided by Douglas County that was used in their *2040 Douglas County Transportation Master Plan* finds that traffic on Airport Road is projected to grow to about 12,700 vpd by 2040, which is a significant increase from current levels that are estimated to be about 3,000 vpd based on peak hour to daily volume relationships on US 85. This level of growth correlates to a compounded annual growth rate of about 7.5 percent.

Movements to/from Airport Road are not expected to each grow proportionately given how the Southern Connector will likely change travel patterns at this intersection. For example, current traffic volumes find that eastbound left turn movements are larger than eastbound right turn movements during the AM and PM peak hours. It is anticipated that the Southern Connector will reverse that distribution since the Southern Connector provides a more convenient route for Sterling Ranch residents between Titan Road and Castle Rock than the current Titan Road to US 85 route.

This assumption is confirmed by the travel demand modeling that was conducted for the *2040 Douglas County Transportation Master Plan* which shows a higher level of daily traffic to the south of Airport Road than to the north of Airport Road.

Build-Out Timeframe – Given the projected Year 2028 Build-Out timeframe for Range, the compounded growth rate equates to a total of about 28.5 percent for movements along US 85 and about 78 percent on Airport Road.

Background traffic volume projections for the Build-Out and Year 2040 time periods are reflected on **Figure 4**.

III.D. Traffic Control and Intersection Operations

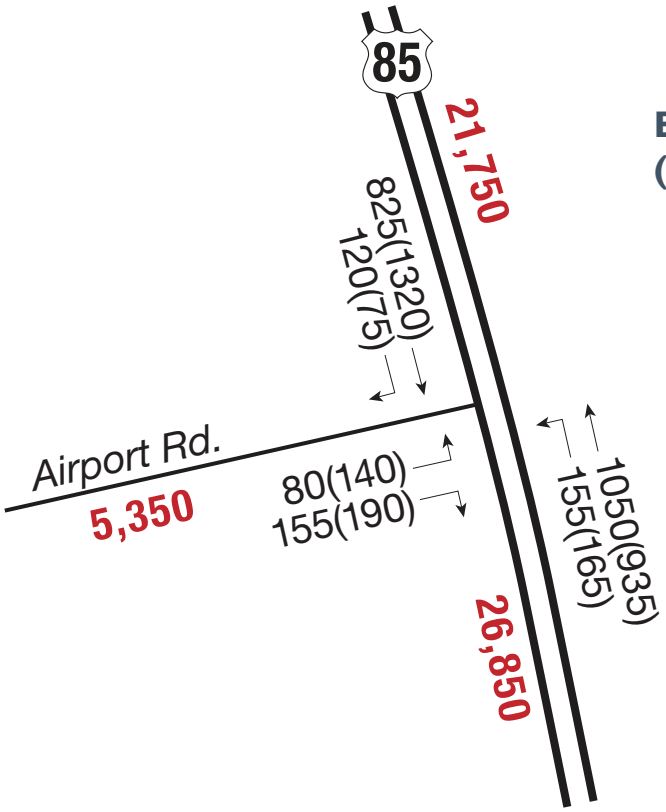
Background traffic volume projections for the Build-Out and Year 2040 timeframes were analyzed using the same HCM methodologies as identified in **Section II.D**. Intersection geometry is based on information provided by CDOT related to the US 85 improvements that are forthcoming. and the lane assignments are as noted in **Section III.B**, Roadway Network. The CDOT data did not focus on lane usage for Airport Road, however. As such, eastbound movements are assumed to include an exclusive left turn lane and a shared through/right lane. Since the westbound approach will serve only a private property for Background conditions, all westbound movements are shared in a single lane.

Build-Out Timeframe – Intersection movements for this timeframe can function at LOS B during both the AM and PM peak hours, with individual movements each being LOS C or better. No geometric or operational revisions are required. **Figure 5** represents the LOS analyses and **Appendix D** contains the operational analysis worksheets.

2040 Timeframe – With increases in vehicle movements along US 85 and on Airport Road, operational conditions at this intersection will deteriorate without additional intersection laneage. To achieve acceptable LOS during peak hours, the following improvements for an at-grade intersection will be necessary:

- Dual northbound left turn lanes on US 85
- Dual eastbound left turn lanes on Airport Road
- Free-flow eastbound right turn movement (acceleration lane on US 85 is currently being constructed)

It is understood that a diamond interchange concept is already being considered as noted in the US 85 PEL. As such, an alternative analysis of Year 2040 conditions was conducted to reflect this infrastructure change. As can be imagined, once northbound and southbound US 85 movements are removed from the operational analyses since they would not be required to stop, both interchange ramp terminals are projected to operate at good levels of service, being LOS B or better during peak hour conditions; all individual movements are also LOS B or better. Refer to **Figure 5** for the Year 2040 operational analyses. LOS worksheets can be found in **Appendix E**.

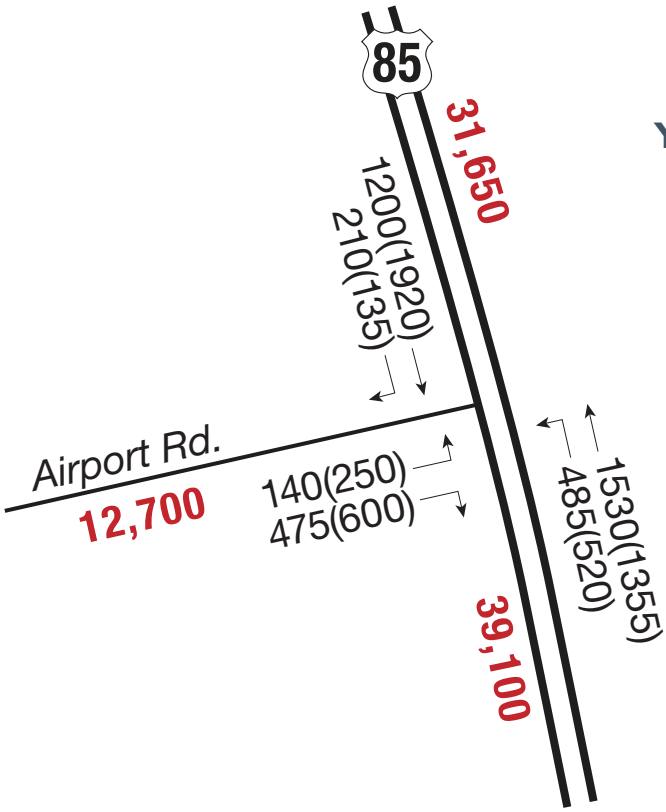


Build-Out (Year 2028)

LEGEND

XXX(XXX) = AM(PM) Peak Hour Traffic Volumes

XXXX = Daily Traffic Volumes



Year 2040

NORTH

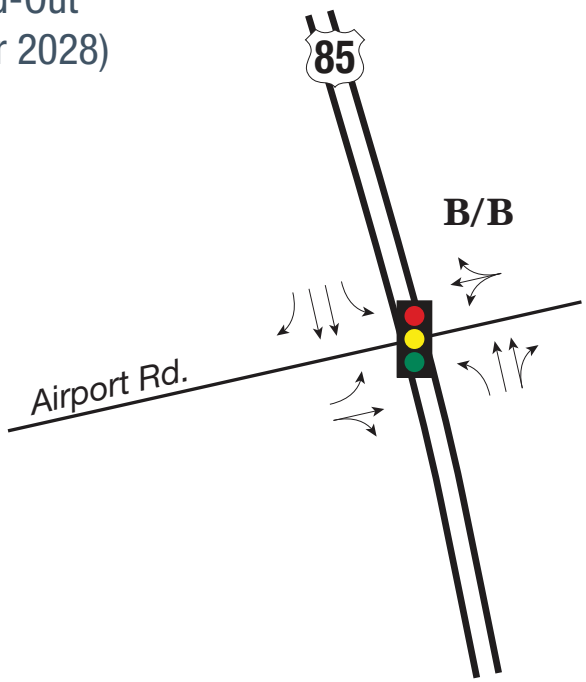
FIGURE 4
Background Traffic Volume Projections

Range TIA- UPDATE 120-308-01 8/7/24

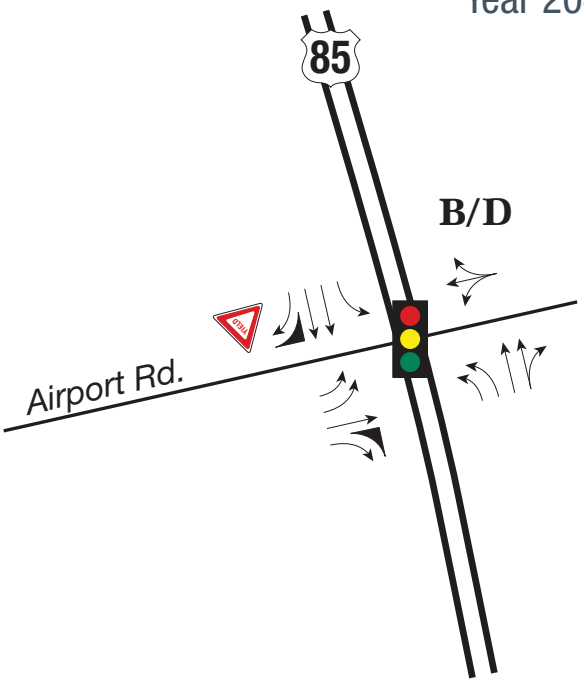
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NOTE: Drawing Not to Scale

Build-Out
(Year 2028)



Year 2040



LEGEND

X/X = AM/PM Peak Hour Signalized Intersection Level of Service

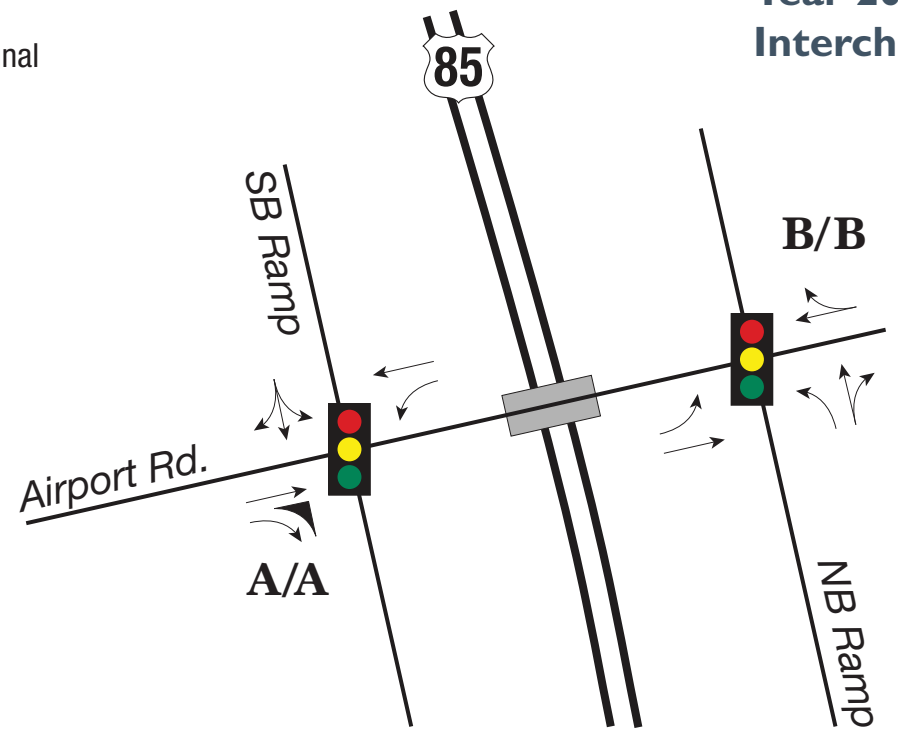
= Lane Assignment

= Yield Sign

= Traffic Signal

At-Grade Concept

Year 2040 Interchange Concept



NORTH

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NOTE: Drawing Not to Scale

FIGURE 5
Background Traffic Operations

Range TIA- UPDATE 120-308-01 8/7/24

IV. PROPOSED CONDITIONS FOR RANGE DEVELOPMENT

This section summarizes the proposed land uses, the daily and peak hour traffic volume projections, the Build-Out and Year 2040 operational analyses, and the recommended infrastructure improvements for the completion of the Range project.

IV.A. Land Uses

Range is planned to construct 550 single-family dwelling units on a currently vacant parcel of land located adjacent to US 85 near Louviers, Colorado. **Figure 6** represents the proposed Range site plan. As can be seen on this figure, two residential planning areas are included with connectivity throughout the site.

IV.B. Project Access

Range proposes to have two points of access. The northernmost location will be at Airport Road as the 4th leg of a signalized intersection. Plans for access at this location have been anticipated by CDOT as evidenced by the relocation of an existing private access from its current location to opposite Airport Road as part of the US 85 reconstruction.

The second point of access will be to the south of Airport Road and it will align with a new intersection that is also being constructed as part of the US 85 widening. This access will be called the South Access for the remainder of this report. Only ¾ movements (no outbound left turns) are considered for Build-Out (Year 2028) analyses, while Year 2040 analyses evaluate the South Access with all vehicle movements being permitted.

IV.C. Trip Generation Estimates and Trip Assignment

Range Trip Generation – **Table 1** includes the trip generation estimates for the entire construction of Range and these estimates are based on information contained in *Trip Generation*, 10th Edition, by the Institute of Transportation Engineers (ITE), 2017.

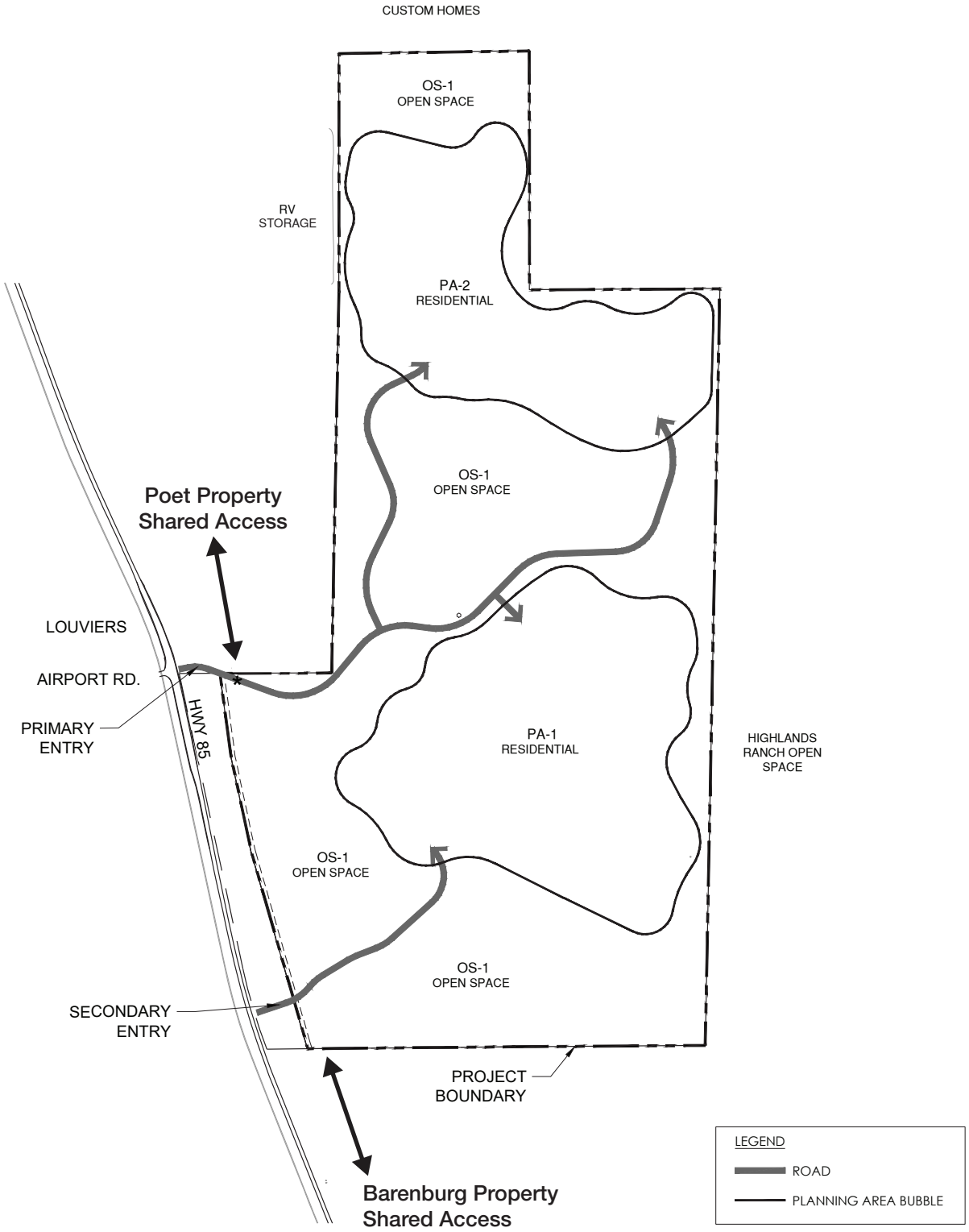
Table 1. Range Trip Generation Estimates

Land Use	Unit	Size	Daily	AM Peak Hour			PM Peak Hour		
				In	Out	Total	In	Out	Total
Single Family Residential[1]	DU	550	4,990	99	297	396	329	193	522

[1] Land Use Code 210.

Shared Access Trip Generation – As noted previously, the Poet and Barenburg properties to the north and south of Range, respectively, are proposed to have shared access opportunities at Airport Road (Poet property) and at the South Access (Barenburg property). As such, trip generation estimates for these properties are required to understand the complete impact to traffic operations at Airport Road and the South Access.

Each property is analyzed in this report as being developed with residential dwelling units and the number of units is estimated based on the property acreage and by using the density of the Range project which is approximately 1.4 dwelling units per acre. **Table 2** on page 13 summarizes the trip generation estimates for the Poet and Barenburg properties.



p:\ventana capital\range\cad dwg\range bubblesite plan-11-17-20.dwg

Range
Land Use Plan

NOVEMBER 17, 2020

terracina design
10200 E. Girard Ave, Ste A-314
Denver, CO 80231
ph: 303.632.8867

Scale: 1"=1,000'
0 250 500 1000

NORTH

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NOTE: Drawing Not to Scale

FIGURE 6
Site Plan

Range TIA- UPDATE 120-308-01 8/7/24

Table 2. Poet and Barenburg Trip Generation Estimates

Land Use	Acres	Size	Daily	AM Peak Hour			PM Peak Hour		
				In	Out	Total	In	Out	Total
Poet Property[1]	84	116 DU	1,192	21	66	87	74	43	117
Barenburg Property[1]	236	326 DU	3,084	59	178	237	146	86	232

[1] Single Family Residential - Land Use Code 210.

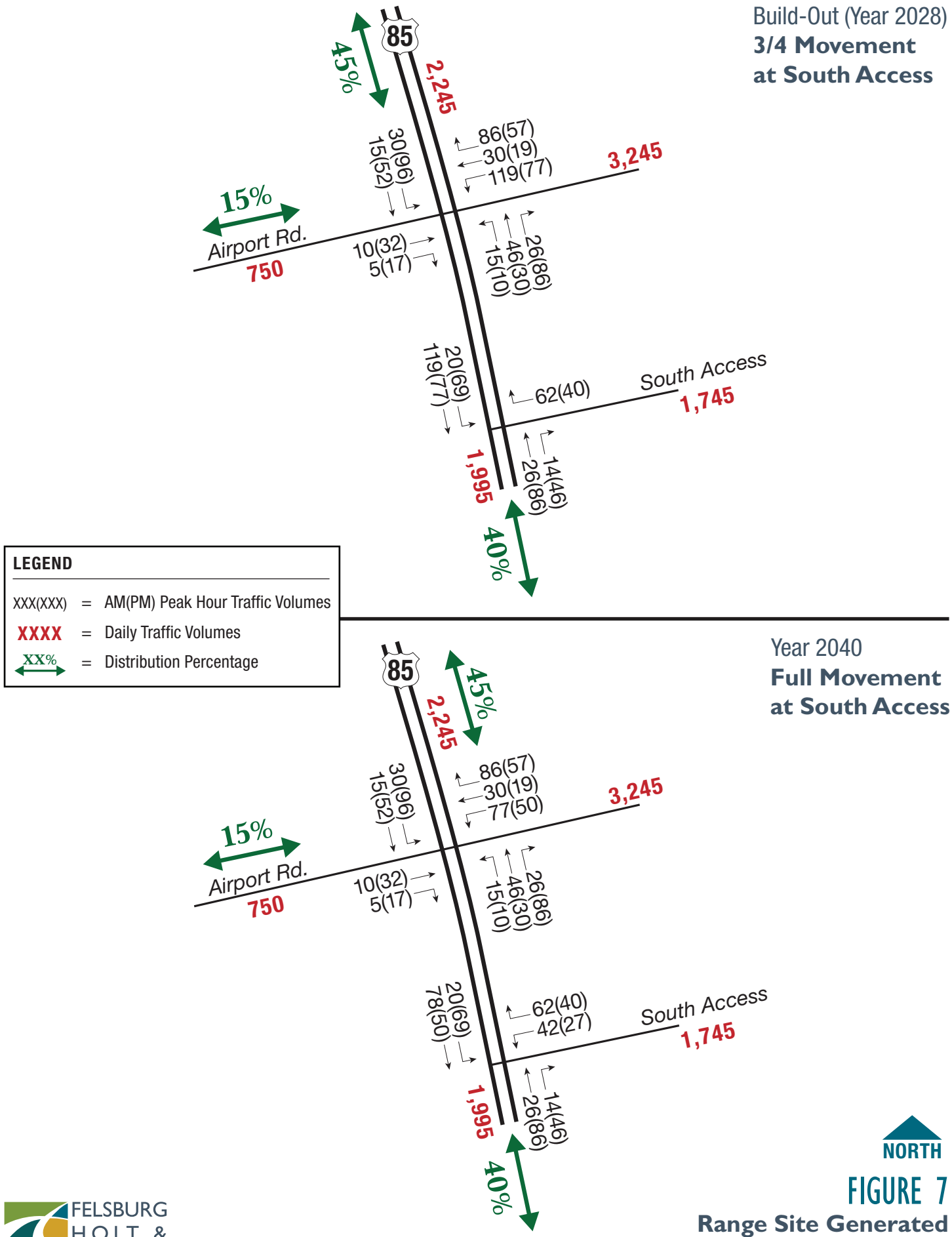
Trip Assignment – The assignment of Range and adjoining property vehicle-trips through the two access intersections along US 85 is primarily based on transportation modeling information from the varying sources noted previously, along with engineering judgment, while also considering vehicle movements to/from Airport Road/Southern Connector. As can be imagined, many of the vehicle movements will be oriented to/from the north and the employment and activity centers surrounding the Denver metropolitan area. Movements to/from the south along US 85 reflect access to the Town of Castle Rock and its retail and employment centers, along with access to I-25. Airport Road/Southern Connector trips can access land parcels in northwestern Douglas County and near Chatfield Reservoir, with connection to SH 121 and ultimately C-470, as well as the large employment base at the Lockheed-Martin facility in Waterton Canyon.

Figure 7 provides a representation of the trip generation assignments for Range, one for the Build-Out (Year 2028) development scenario when vehicle movements at the South Access are restricted (no outbound left turns), and one for the Year 2040 when the South Access is considered to allow all vehicle movements.

Based on discussions with Douglas County and CDOT, the vehicle trip assignments for the adjoining properties were conducted with the understanding that the Poet property will have shared access with Airport Road as noted previously, but they would also retain a right-in/right-out (RIRO) access approximately 1,100' to the north of Airport Road. As such, vehicle trips for the Poet property are assigned across two access points, one full movement and one restricted to right turns. The Barenburg property, however, would have their access limited to only the South Access where all vehicle movements will be allowed.

The vehicle trips for both of these properties are *not* considered for the Build-Out (2028) development scenario, however. They are only considered for the Year 2040 evaluation per the discussions with Douglas County and CDOT. **Figure 8** summarizes the vehicle trip assignments for the Poet and Barenburg properties.

The combination of site generated traffic volumes for Range and the Poet and Barenburg properties are shown on **Figure 9** for the Build-Out (Year 2028) and Year 2040 timeframes.

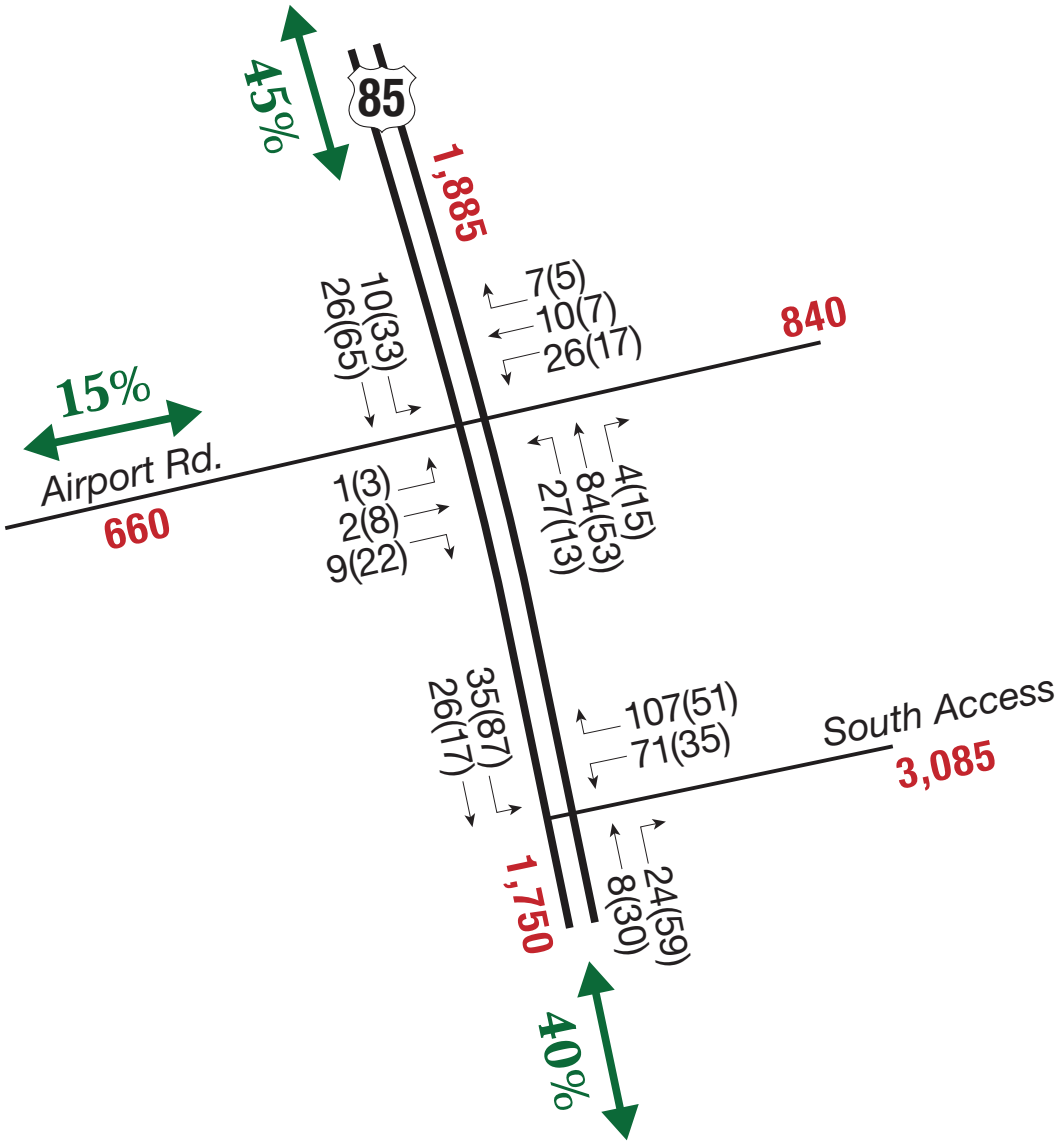


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NOTE: Drawing Not to Scale

FIGURE 7
Range Site Generated Traffic Volumes

Range TIA- UPDATE 120-308-01 8/7/24



LEGEND

XXX(XXX)	=	AM(PM) Peak Hour Traffic Volumes
XXXX	=	Daily Traffic Volumes
XX%	=	Distribution Percentage

NORTH

FIGURE 8

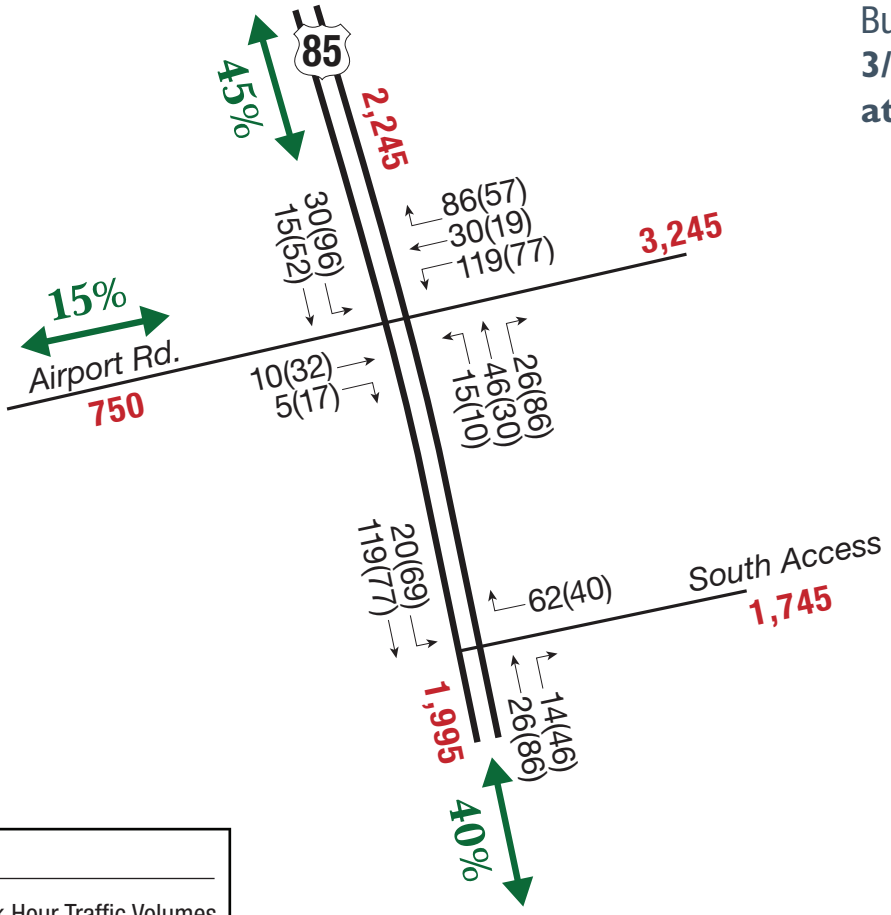
Year 2040 Poet & Barenburg Property Site Generated Traffic Volumes

Range TIA- UPDATE 120-308-01 8/7/24

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NOTE: Drawing Not to Scale

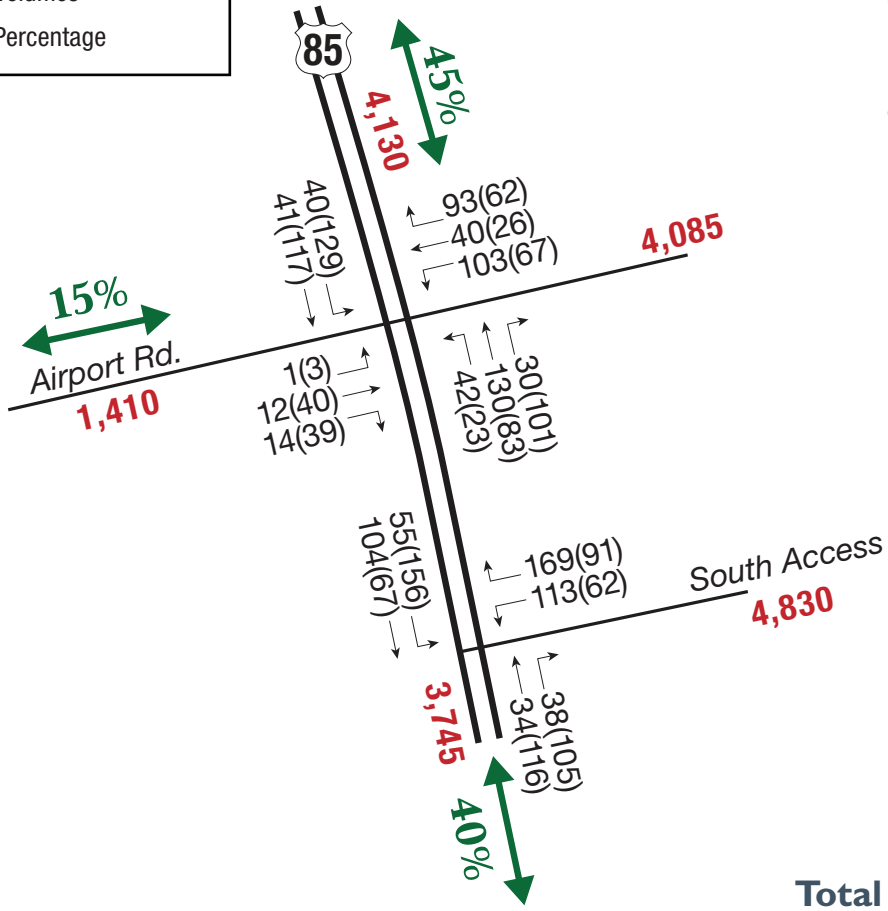
Build-Out (Year 2028)
3/4 Movement at South Access



LEGEND

XXX(XXX)	=	AM(PM) Peak Hour Traffic Volumes
XXXX	=	Daily Traffic Volumes
XX%	=	Distribution Percentage

Year 2040
Full Movement at South Access



NORTH

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NOTE: Drawing Not to Scale

FIGURE 9
Total Site Generated Traffic Volumes

Range TIA- UPDATE 120-308-01 8/7/24

IV.D. Total Traffic Volumes

Figure 10 and **Figure 11** represent the compilation of the site generated traffic volumes and the Build-Out and Year 2040 Background traffic volumes, respectively. As can be seen on these figures, vehicle movements along US 85 are projected to grow to 24,000 to 28,850 vpd by Year 2028, the Build-Out timeframe for Range, while daily traffic on US 85 is projected to grow to about 34,000 vpd to the north of Airport Road and to about 41,000 vpd to the south of Airport Road by the Year 2040.

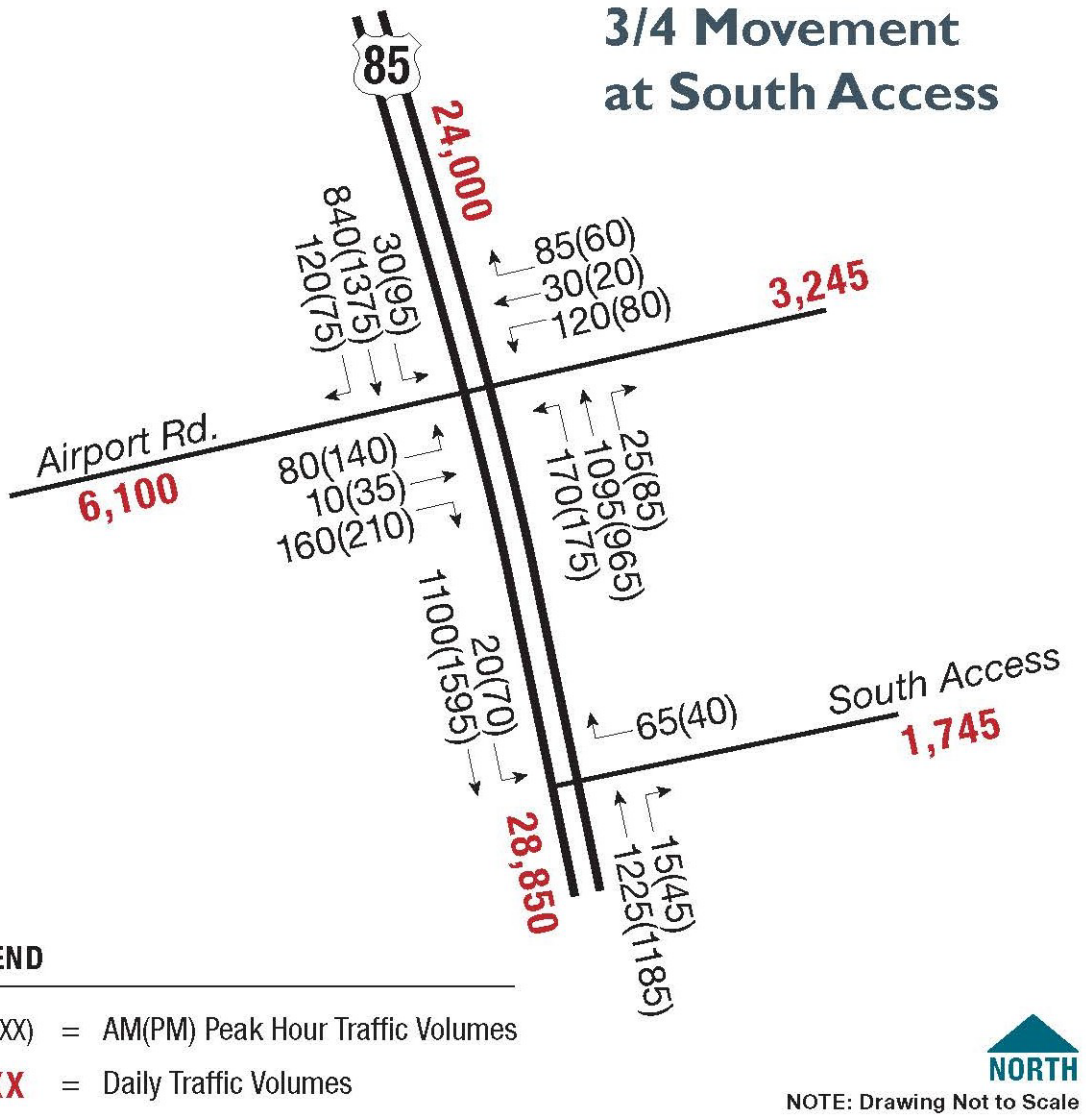


Figure 10. Build-Out (Year 2028) Total Traffic Volumes – At-Grade Intersection

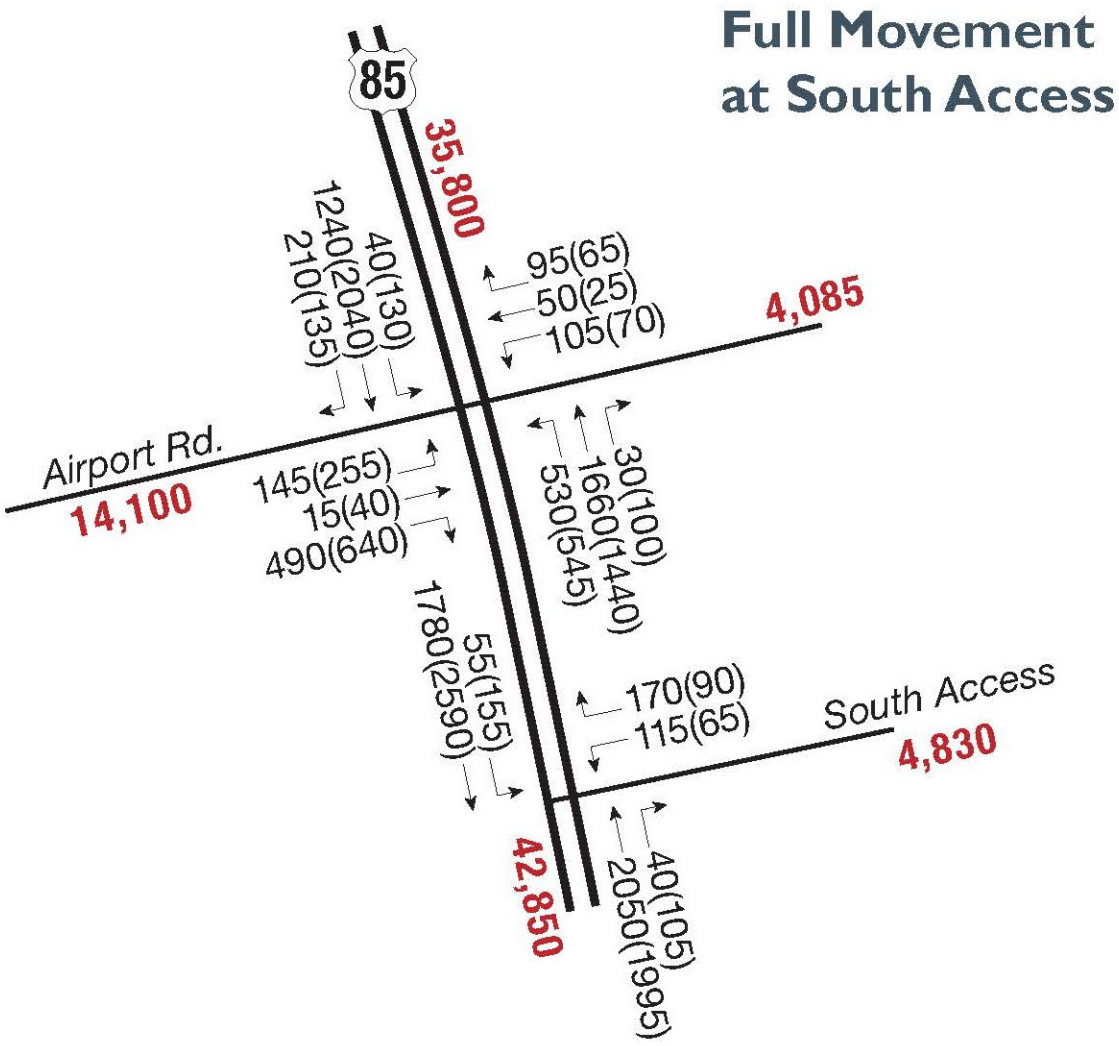


Figure 11. Year 2040 Total Traffic Volumes – At-Grade Intersection

Figure 12 represents the Year 2040 peak hour traffic volumes when considering an interchange concept at Airport Road (diamond interchange is used for this purpose).

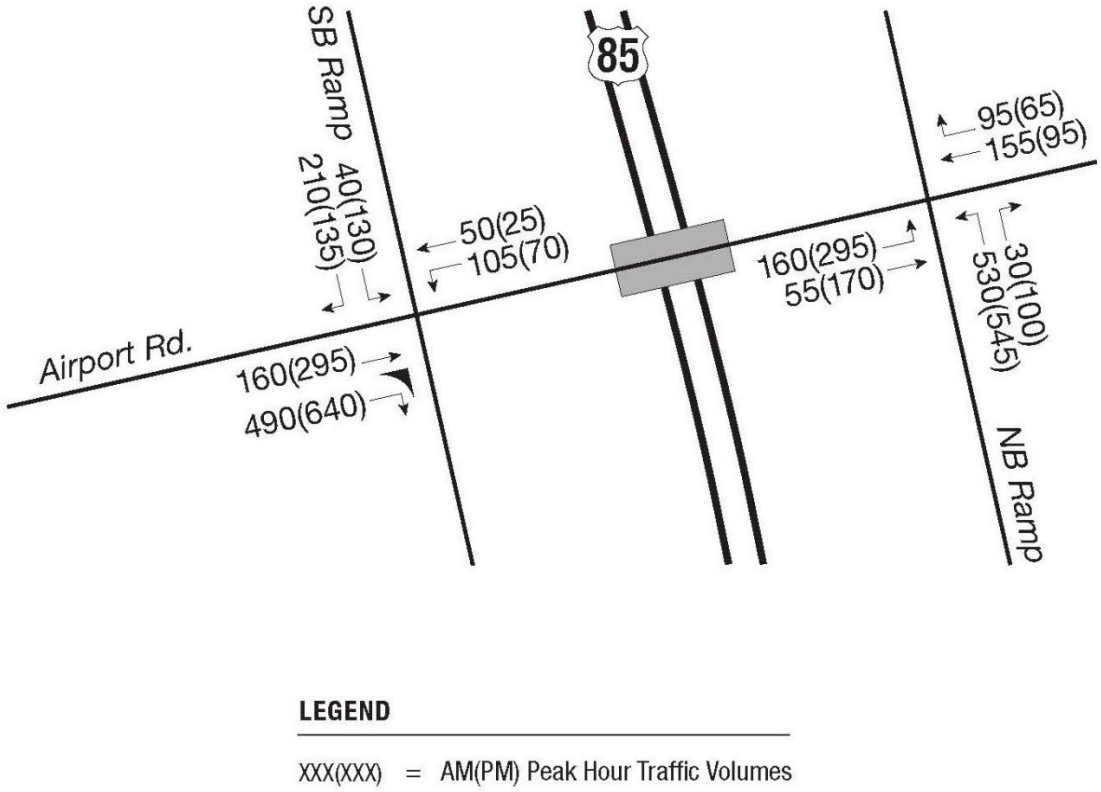


Figure 12. 2040 Interchange Concept Traffic Volumes

IV.E. Traffic Signalization Assessment

The US 85/Airport Road intersection is currently controlled by a traffic signal and it will continue to do so as Range develops. In regard to the South Access, the Build-Out development scenario for Range will have restricted access and, therefore, a traffic signalization analyses is not needed.

For the Year 2040, when it is projected that the Barenburg property will share the South Access with Range, a review of Warrant 3, Peak Hour traffic volume criteria in the *Manual on Uniform Traffic Control Devices* (MUTCD), finds that vehicle movements at the South Access are projected to meet the volume-based criteria of Warrant 3 for the installation of a traffic signal during the AM peak hour.

The analysis was conducted with the understanding that this analysis meets the Rural criteria since the posted speed limit of US 85 is 55mph. With the addition of a westbound to northbound right turn acceleration lane on US 85 (see next section), all right turn traffic movements were removed from the analysis. See **Appendix F** for a representation of the Warrant 3 graph.

As can be seen on this graph, the level of vehicle movements on US 85 are quite significant, being three times the maximum level represented in the MUTCD for traffic volumes on the Major Street. As such, it can be clearly understood that a traffic signal will be required at the South Access upon construction of the Barenburg property to reduce vehicle delay and to provide a safe operating environment.

IV.F. Auxiliary Lane Requirements

As noted in **Section II.B**, US 85 is classified by CDOT as a Regional Highway (RA). Like all state highways, there are auxiliary lane criteria related to when an auxiliary lane should be constructed and once determined, its dimensions. The *Code* provides the criteria for when an auxiliary lane should be installed on a RA highway and they are summarized as:

- Left Turn Deceleration Lane = >10 vph
- Right Turn Deceleration Lane = > 25 vph
- Right Turn Acceleration Lane = > 50 vph when posted speed is greater than 40 mph
- Left Turn Acceleration Lane = Required when it benefits safety and roadway operation

Using these criteria, auxiliary lanes are required as follows:

Airport Road Intersection

- Southbound left turn deceleration lane (constructed as part of the US 85 widening)
- Northbound right turn deceleration lane
- Westbound to northbound right turn acceleration lane
- Westbound to southbound left turn acceleration lane is not required at a signalized intersection

South Access

- Southbound left turn deceleration lane (constructed as part of the US 85 widening)
- Northbound right turn deceleration lane
- Westbound to northbound right turn acceleration lane
- Westbound to southbound left turn acceleration lane is not required at a signalized intersection

Auxiliary Lane Dimensions

Table 3 summarizes the lane dimensions for the auxiliary lanes noted above using *Code* criteria.

Table 3. Auxiliary Lane Dimensions – Range Build-Out

Auxiliary Lane Type	Direction	Maximum Projected Volume[1]	Decel Length (A)	Taper Length[2]	Vehicle Storage (B)	Total (A) & (B)
US 85/Airport Road Intersection						
Left Turn Deceleration	Southbound	95 vph	600'	222'	100'	700'
Right Turn Deceleration	Northbound	85 vph	600'		NA	600'
US 85/South Access Intersection						
Left Turn Deceleration	Southbound	70 vph	600'	222'	75'	675'
Right Turn Deceleration	Northbound	45 vph	600'		NA	600'
Right Turn Acceleration	Westbound to Northbound	65 vph	960'		NA	960'

[1] Build-Out (Year 2028) traffic volumes.

[2] Taper length is included in deceleration lane length. Length based on 55 mph posted speed with a 12' wide lane.

With the inclusion of a westbound to northbound right turn acceleration lane on US 85 at the South Access, and construction of a northbound right turn deceleration lane at Airport Road, a question to answer is how close these two lanes will be to each other and whether they should be constructed as a continuous acceleration/deceleration lane. As seen in **Table 2**, the combined length of these two lanes (including vehicle storage and the two tapers) is 1,560'. The approximate distance between Airport Road and the location of the South Access is about 2,445'. As such, the remaining distance between the end point and beginning point of these auxiliary lane tapers is about 885'. Since the auxiliary lane dimensions can meet CDOT *Code* criteria, it is not deemed necessary to connect the acceleration and deceleration lanes.

IV.G. Traffic Control and Intersection Operations

Operational analyses were conducted following the HCM methodologies noted previously in this report. The results of these analyses are included in the following sections.

Build-Out

The US 85/Airport Road intersection is projected to operate at LOS C or better when Range traffic volumes are added to the street network. Operational analyses for the South Access find that LOS F will occur for westbound left turn movements onto US 85 if they were permitted. However, it is recommended for the Build-Out timeframe that westbound left turn movements be restricted as shown on **Figure 13**. All other movements are projected to operate at LOS C or better during both peak hours. The LOS operational worksheets are included in **Appendix G**.

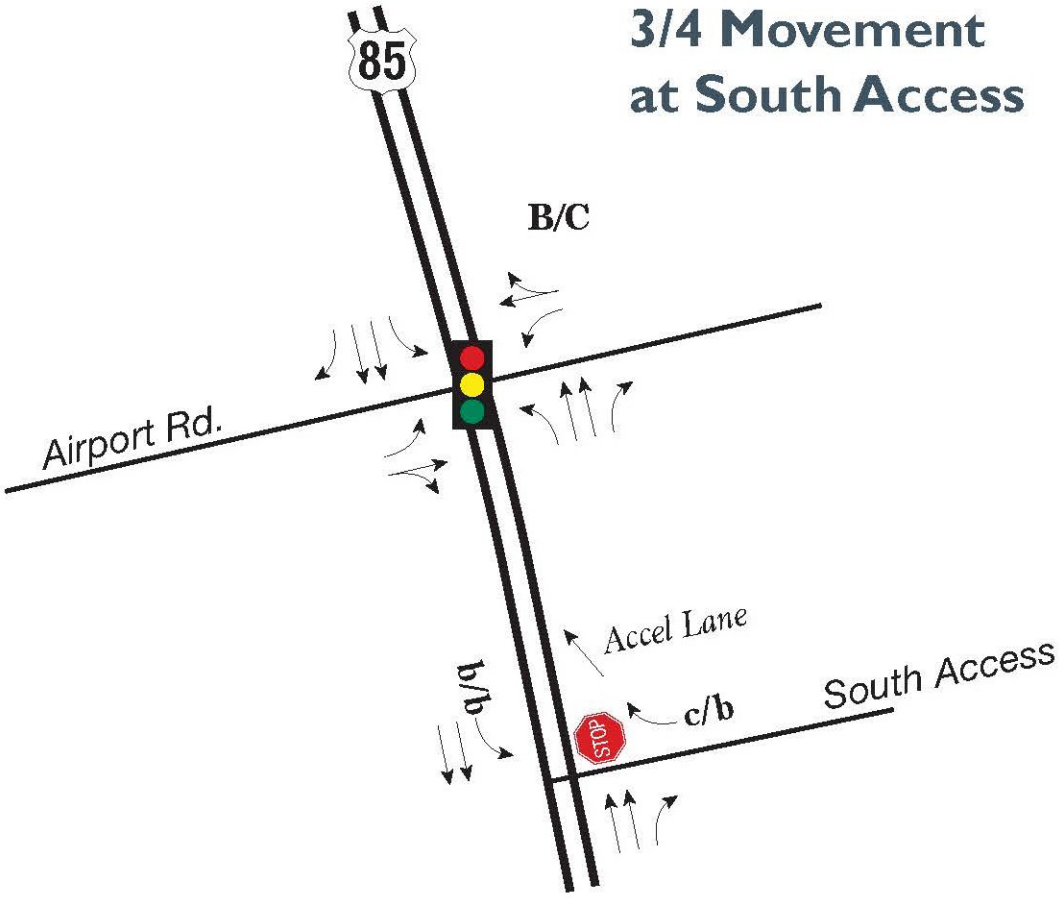


Figure 13. Build-Out (Year 2028) Operational Conditions – At-Grade Intersection

Year 2040

Operational analyses for Year 2040 are found on **Figure 14** and the results indicate that the US 85/ Airport Road intersection can operate at LOS E or better during peak hour conditions. Due to the increase in vehicle volume, particularly along US 85, some movements will experience LOS F during the peak hours, however. Of note, while the entire intersection LOS does not change, there are some reductions in vehicle delay for westbound movements if a separate right turn lane is included.

The South Access will operate well at LOS C or better with individual movements operating at LOS D or better during the AM peak hour and at LOS E during the PM peak hour.

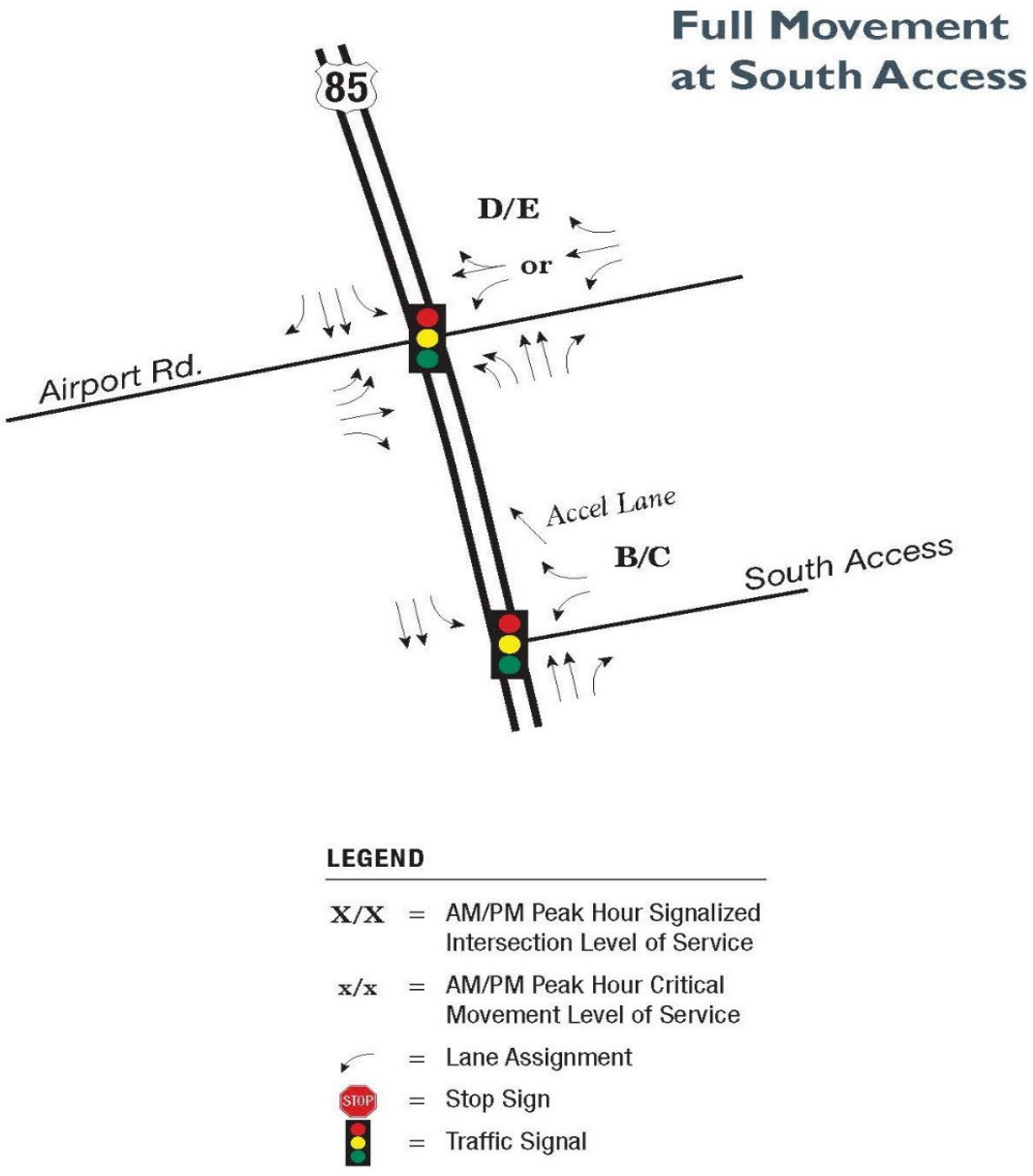


Figure 14. Year 2040 Operational Conditions – At-Grade Intersection

If a diamond interchange is constructed at the US 85/Airport Road intersection, intersection operations will be LOS B or better, while each movement at each ramp terminal is projected to operate at LOS C or better during the AM and PM peak hours (see **Figure 15**). **Appendix H** includes the LOS worksheets for the Year 2040 analyses.

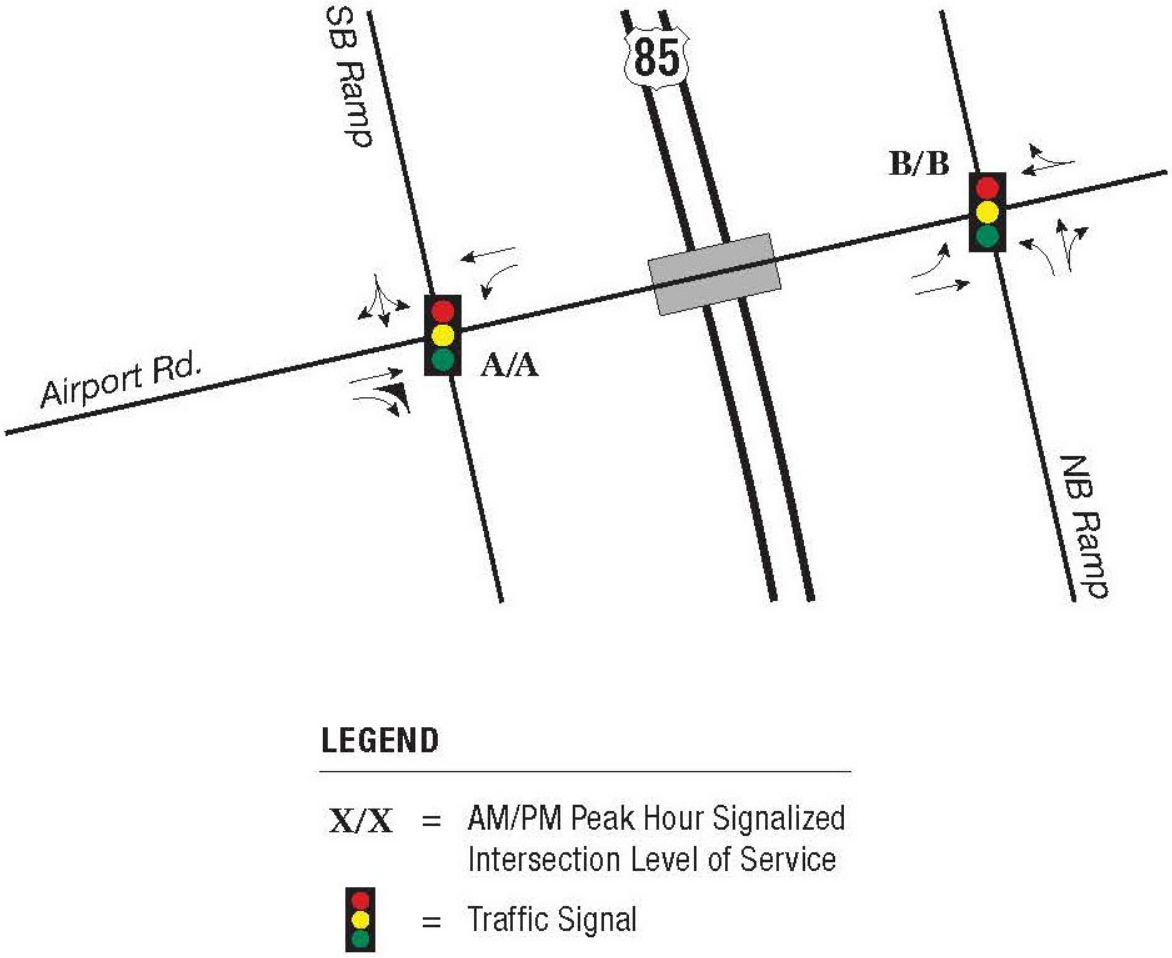


Figure 15. Year 2040 Operational Conditions – Interchange Concept

IV.H. Street Classifications

Figure 16 provides a graphical representation of the street classifications that should be used for the construction of the internal Range street network. Classification information is based on criteria contained in Table 4-1 of the *Douglas County Roadway Design and Construction Standards* relative to the Maximum Design Traffic Volume identified in Vehicles per Day.

Criteria applicable to this evaluation include:

- Cul-de-Sac = Maximum of 400 vpd
- Urban Local (Type I) = Maximum of 1,500 vpd
- Urban Collector = Maximum of 7,000 vpd

Figure 16 includes the recommended street classifications for the two US 85 access routes for Range, along with a few of the main internal streets that will capture the higher traffic volume levels – daily traffic volume estimates are provided for these streets.

The highlighted streets should be classified as Urban Collectors for certain segments closest to US 85 or as Urban Local (Type I) streets. Streets not highlighted can also be constructed as Urban Local (Type I) streets – they are not highlighted on **Figure 16** only for graphical simplicity. Of course, the cul-de-sac streets match the cul-de-sac classification designation.

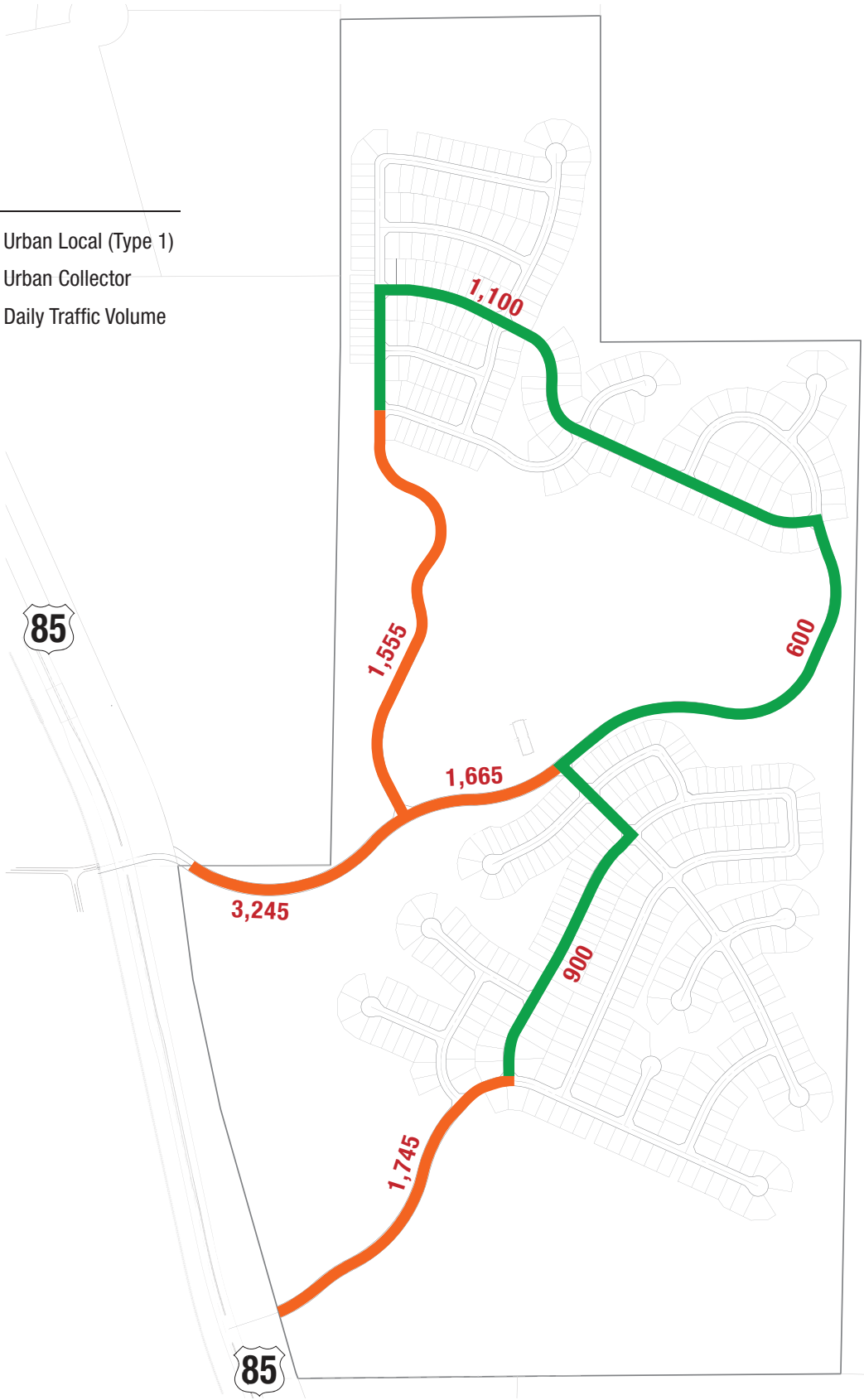
IV.I. Improvement Recommendations

As noted previously, the primary Range access will be at the US 85/Airport Road intersection. The US 85 widening project planned for the 4th leg of this current "T" intersection and it will construct a new southbound left turn lane on US 85 for movements onto the Range access. As such, minimal improvements are required at this intersection. The South Access will align with a new access that is being constructed as part of the US 85 widening project.

The southbound left turn lane requirements to meet *Code* criteria at Airport Road are about 25' longer than what is being constructed. At the South Access intersection, what is being constructed is about 5' within meeting the *Code* criteria. Increasing these turn lanes are not recommended due to:

- **Airport Road** – The impacts it will have to the bridge structure being constructed on US 85 north of Airport Road. Signal timing parameters should be monitored as Range-related traffic grows and adjusted as necessary to limit vehicle queuing to the extent possible.
- **South Access** – The left turn lane that is being constructed by CDOT essentially meets the Code criteria.

Considering the information contained in this report, **Table 4** on page 27 summarizes the recommended physical and operational improvements for the Range development.



FELSBURG HOLT & ULLEVIG

NOTE: Drawing Not to Scale

FIGURE 16

Recommended Street Classifications

Range TIA- UPDATE 120-308-01 8/7/24

Table 4. Recommended Improvements

Location	Improvement
US 85/Airport Road Intersection	Provide separate left turn, through, and right turn lanes on the westbound approach.
	Construct northbound right turn deceleration and acceleration lanes.
	Modify traffic signal timing parameters as traffic volumes to/from Range and along US 85 and Airport Road grow. Provide traffic signal equipment additions/modifications during the construction plan approval process.
	Dedicate right-of-way to support the installation of an interchange by Douglas County and CDOT.
US 85/South Access Intersection (3/4 Movement Access)	Construct a right turn lane on the westbound approach with a channelizing island and northbound right turn acceleration lane on US 85.
	Construct a northbound right turn deceleration lane.
	Monitor for the installation of a traffic signal when the adjoining property to the south of Range develops.
Internal Street Network	Construct the internal street network to Urban Collector and Urban Local (Type I) classifications as noted in Section IV. H. and on Figure 16.
Note: All auxiliary lanes to be constructed to meet *State Highway Access Code* dimensions for a 55 mph roadway.	

V. SUMMARY AND RECOMMENDATIONS

Range is a planned development encompassing 550 single-family homes in Douglas County along the east side of US 85 near the Town of Louviers. Public access to Range will be provided at the US 85/Airport Road intersection as well as through a secondary access near the south property line for residents and also emergency vehicles (referred to as the South Access).

Projected vehicle-trips for Range is almost 5,000 vehicles per day with approximately 400 during the AM peak hour and about 525 during the PM peak hour (see the following table).

Land Use	Unit	Size	Daily	AM Peak Hour			PM Peak Hour		
				In	Out	Total	In	Out	Total
Single Family Residential[1]	DU	550	4,990	99	297	396	329	193	522
[1] Land Use Code 210.									

The US 85 widening project constructed a southbound left turn lane at the US 85/Airport Road intersection for movements into Range. The widening project also constructed a new access about ½ mile to the south of Airport Road and Range will align their South Access at this new intersection.

Range should not preclude opportunities for shared access with the Poet property to the north and the Barenburg property to the south if, and when, those properties develop.

Infrastructure Recommendations for Build-Out of the Range

Location	Improvement
US 85/Airport Road Intersection	Provide separate left turn, through, and right turn lanes on the westbound approach.
	Construct northbound right turn deceleration and acceleration lanes.
	Modify traffic signal timing parameters as traffic volumes to/from Range and along US 85 and Airport Road grow. Provide traffic signal equipment additions/modifications during the construction plan approval process.
	Dedicate right-of-way to support the installation of an interchange by Douglas County and CDOT.
US 85/South Access Intersection (3/4 Movement Access)	Construct a right turn lane on the westbound approach with a channelizing island and northbound right turn acceleration lane on US 85.
	Construct a northbound right turn deceleration lane.
	Monitor for the installation of a traffic signal when the adjoining property to the south of Range develops.
Internal Street Network	Construct the internal street network to Urban Collector and Urban Local (Type I) classifications as noted in Section IV. H. and on Figure 16.
Note: All auxiliary lanes to be constructed to meet *State Highway Access Code* dimensions for a 55 mph roadway.	

APPENDIX A. RECORDED TRAFFIC VOLUMES

Location: US 85 S/O AIRPORT RD
Date Range: 7/14/2020 - 7/20/2020
Site Code: 01

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	7/14/2020			7/15/2020			7/16/2020			7/17/2020			7/18/2020			7/19/2020			7/20/2020			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	21	17	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	17	38
1:00 AM	9	17	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	17	26
2:00 AM	18	4	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	4	22
3:00 AM	18	10	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	10	28
4:00 AM	89	35	124	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	89	35	124
5:00 AM	351	129	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	351	129	480
6:00 AM	673	386	1,059	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	673	386	1,059
7:00 AM	793	608	1,401	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	793	608	1,401
8:00 AM	729	618	1,347	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	729	618	1,347
9:00 AM	560	558	1,118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	560	558	1,118
10:00 AM	578	535	1,113	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	578	535	1,113
11:00 AM	538	604	1,142	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	538	604	1,142
12:00 PM	587	631	1,218	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	587	631	1,218
1:00 PM	669	620	1,289	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	669	620	1,289
2:00 PM	585	641	1,226	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	585	641	1,226
3:00 PM	669	853	1,522	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	669	853	1,522
4:00 PM	680	998	1,678	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	680	998	1,678
5:00 PM	685	915	1,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	685	915	1,600
6:00 PM	402	548	950	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	402	548	950
7:00 PM	261	348	609	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	261	348	609
8:00 PM	209	244	453	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	209	244	453
9:00 PM	148	168	316	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	148	168	316
10:00 PM	67	73	140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	73	140
11:00 PM	44	61	105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44	61	105
Total	**9,383**	**9,621**	**19,004**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**9,383**	**9,621**	**19,004**
Percent	**49%**	**51%**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**49%**	**51%**	-

1. Mid-week average includes data between Tuesday and Thursday.

Mark Skaggs:425-250-0777
mark.skaggs@idaxdata.com

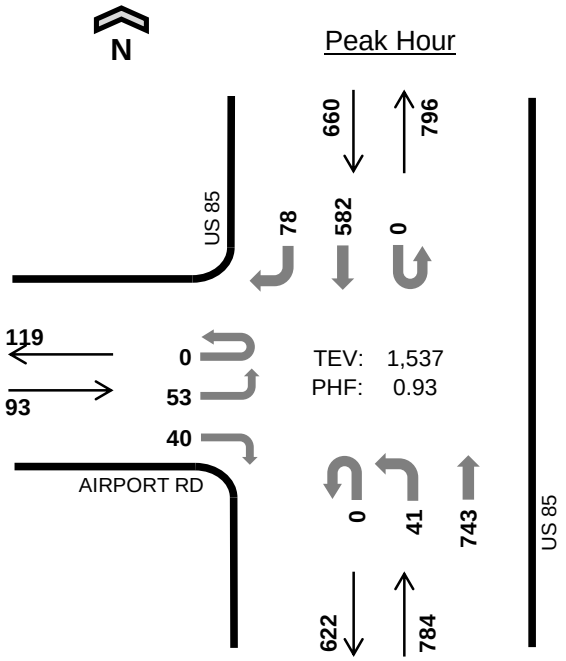
Location: US 85 N/O AIRPORT RD
Date Range: 7/14/2020 - 7/20/2020
Site Code: 02

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Mid-Week Average		
	7/14/2020			7/15/2020			7/16/2020			7/17/2020			7/18/2020			7/19/2020			7/20/2020					
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	22	19	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	19	41
1:00 AM	10	18	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	18	28
2:00 AM	18	4	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	4	22
3:00 AM	21	10	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	10	31
4:00 AM	92	46	138	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	46	138
5:00 AM	333	160	493	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	333	160	493
6:00 AM	642	483	1,125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	642	483	1,125
7:00 AM	793	662	1,455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	793	662	1,455
8:00 AM	810	618	1,428	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	810	618	1,428
9:00 AM	587	586	1,173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	587	586	1,173
10:00 AM	616	564	1,180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	616	564	1,180
11:00 AM	589	617	1,206	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	589	617	1,206
12:00 PM	610	656	1,266	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	610	656	1,266
1:00 PM	574	507	1,081	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	574	507	1,081
2:00 PM	488	376	864	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	488	376	864
3:00 PM	595	714	1,309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	595	714	1,309
4:00 PM	450	430	880	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	450	430	880
5:00 PM	424	272	696	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	424	272	696
6:00 PM	249	59	308	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	249	59	308
7:00 PM	221	17	238	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	221	17	238
8:00 PM	179	9	188	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	179	9	188
9:00 PM	123	5	128	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	123	5	128
10:00 PM	63	0	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63	0	63
11:00 PM	41	1	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	1	42
Total	**8,550**	**6,833**	**15,383**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**8,550**	**6,833**	**15,383**
Percent	**56%**	**44%**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**56%**	**44%**	-

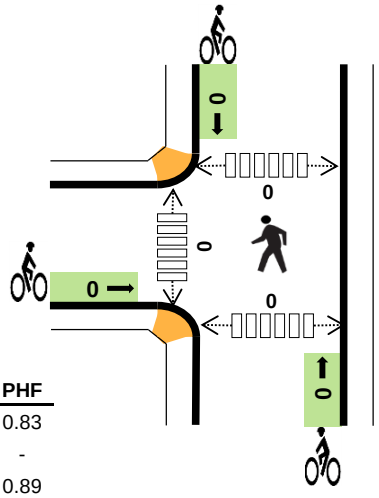
1. Mid-week average includes data between Tuesday and Thursday.

Mark Skaggs:425-250-0777
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US 85
AIRPORT RD



Date: Tue, Jul 14, 2020
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 7:15 AM to 8:15 AM



	HV %:	PHF
EB	39.8%	0.83
WB	-	-
NB	4.6%	0.89
SB	8.3%	0.96
TOTAL	8.3%	0.93

Two-Hour Count Summaries

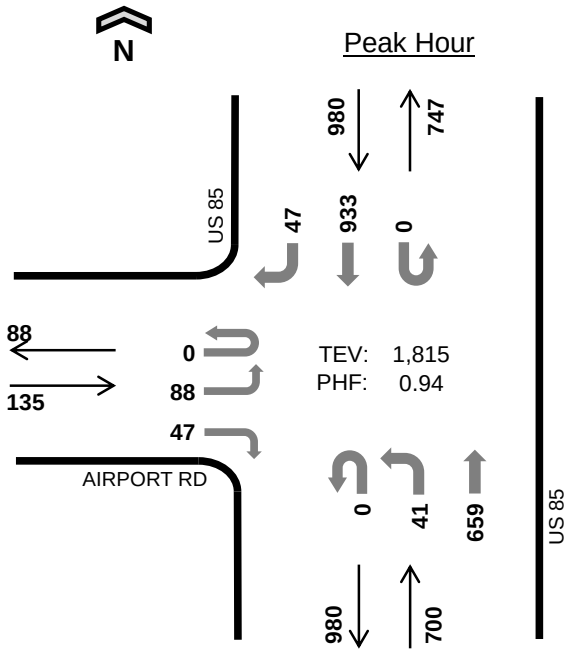
Interval Start	AIRPORT RD Eastbound				0 Westbound				US 85 Northbound				US 85 Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	8	0	8	0	0	0	0	0	15	171	0	0	0	118	25	345	0
7:15 AM	**0**	**9**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**14**	**206**	**0**	**0**	**0**	**151**	**19**	**412**	0
7:30 AM	**0**	**10**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**10**	**191**	**0**	**0**	**0**	**146**	**20**	**386**	0
7:45 AM	**0**	**19**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**9**	**175**	**0**	**0**	**0**	**147**	**24**	**383**	1,526
8:00 AM	**0**	**15**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**8**	**171**	**0**	**0**	**0**	**138**	**15**	**356**	**1,537**
8:15 AM	0	24	0	8	0	0	0	0	0	13	181	0	0	0	142	18	386	1,511
8:30 AM	0	18	0	10	0	0	0	0	0	7	178	0	0	0	142	14	369	1,494
8:45 AM	0	23	0	9	0	0	0	0	0	8	164	0	0	0	145	7	356	1,467
Count Total	0	126	0	75	0	0	0	0	0	84	1,437	0	0	0	1,129	142	2,993	0
Peak Hour	**0**	**53**	**0**	**40**	**0**	**0**	**0**	**0**	**0**	**41**	**743**	**0**	**0**	**0**	**582**	**78**	**1,537**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

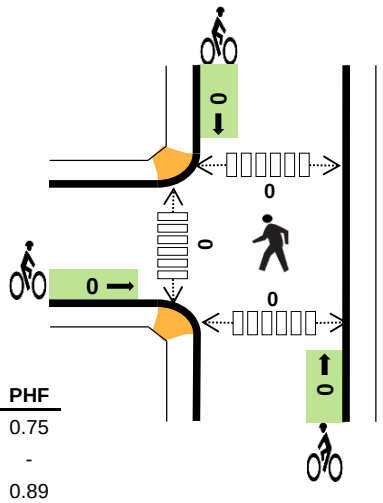
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	4	0	1	15	*20*	0	0	0	0	*0*	0	0	0	0	*0*
7:15 AM	**10**	**0**	**10**	**12**	***32***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
7:30 AM	**6**	**0**	**9**	**14**	***29***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
7:45 AM	**9**	**0**	**8**	**13**	***30***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:00 AM	**12**	**0**	**9**	**16**	***37***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
8:15 AM	7	0	13	16	*36*	0	0	0	0	*0*	0	0	0	0	*0*
8:30 AM	6	0	10	16	*32*	0	0	0	0	*0*	0	0	0	0	*0*
8:45 AM	15	0	11	16	*42*	0	0	0	1	*1*	0	0	0	0	*0*
Count Total	69	0	71	118	*258*	0	0	0	1	*1*	0	0	0	0	*0*
Peak Hr	**37**	**0**	**36**	**55**	***128***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***

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US 85
AIRPORT RD



Date: Tue, Jul 14, 2020
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:00 PM to 5:00 PM



	HV %:	PHF
EB	4.4%	0.75
WB	-	-
NB	5.1%	0.89
SB	1.9%	0.95
TOTAL	3.4%	0.94

Two-Hour Count Summaries

Interval Start	AIRPORT RD Eastbound				0 Westbound				US 85 Northbound				US 85 Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	**0**	**27**	**0**	**18**	**0**	**0**	**0**	**0**	**0**	**12**	**177**	**0**	**0**	**0**	**230**	**10**	**474**	0
4:15 PM	**0**	**19**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**11**	**185**	**0**	**0**	**0**	**249**	**10**	**481**	0
4:30 PM	**0**	**24**	**0**	**16**	**0**	**0**	**0**	**0**	**0**	**7**	**127**	**0**	**0**	**0**	**233**	**16**	**423**	0
4:45 PM	**0**	**18**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**11**	**170**	**0**	**0**	**0**	**221**	**11**	**437**	**1,815**
5:00 PM	0	39	0	14	0	0	0	0	0	5	169	0	0	0	205	14	446	1,787
5:15 PM	0	24	0	13	0	0	0	0	0	9	193	0	0	0	215	19	473	1,779
5:30 PM	0	9	0	5	0	0	0	0	0	7	161	0	0	0	258	5	445	1,801
5:45 PM	0	17	0	13	0	0	0	0	0	4	143	0	0	0	172	5	354	1,718
Count Total	0	177	0	92	0	0	0	0	0	66	1,325	0	0	0	1,783	90	3,533	0
Peak Hour	**0**	**88**	**0**	**47**	**0**	**0**	**0**	**0**	**0**	**41**	**659**	**0**	**0**	**0**	**933**	**47**	**1,815**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	**2**	**0**	**9**	**7**	***18***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
4:15 PM	**1**	**0**	**11**	**6**	***18***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
4:30 PM	**3**	**0**	**7**	**3**	***13***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
4:45 PM	**0**	**0**	**9**	**3**	***12***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
5:00 PM	3	0	5	0	*8*	0	0	0	0	*0*	0	0	0	0	*0*
5:15 PM	2	0	10	2	*14*	0	0	0	0	*0*	0	0	0	0	*0*
5:30 PM	1	0	1	1	*3*	0	0	0	0	*0*	0	0	0	0	*0*
5:45 PM	0	0	3	3	*6*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	12	0	55	25	*92*	0	0	0	0	*0*	0	0	0	0	*0*
Peak Hr	**6**	**0**	**36**	**19**	***61***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***

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APPENDIX B. LEVEL OF SERVICE CRITERIA

TABLE B1
LEVEL OF SERVICE CRITERIA FOR
TWO-WAY STOP CONTROLLED (TWSC) INTERSECTIONS

Level of Service	Delay Range (sec/veh)
A	0.0 - 10.0
B	>10.0 - 15.0
C	>15.0 - 25.0
D	>25.0 - 35.0
E	>35.0 - 50.0
F	> 50.0
Adapted from: *Highway Capacity Manual*, Transportation Research Board, 2010.	

TABLE B2
LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

Level of Service	Control Delay (sec/veh)	Qualitative Description
A	≤ 10.0	Good progression, short cycles, very few vehicle-stops.
B	>10.0 - 20.0	Good progression, and/or short cycle lengths, more vehicle-stops.
C	>20.0 - 35.0	Fair progression and/or longer cycle lengths, some individual cycle failures, many vehicle-stops
D	>35.0 - 55.0	Noticeable congestion and cycle failures, unfavorable progression, high v/c ratios, several stops.
E	>55.0 - 80.0	Limit of acceptable delay, poor progression, long cycles, high v/c ratios, frequent cycle failures.
F	> 80.0	Delay is unacceptable to most drivers, volume exceeds capacity, breakdown of traffic flow.
Adapted from: *Highway Capacity Manual*, Transportation Research Board, 2010.		

APPENDIX C. ANALYSIS WORKSHEETS – EXISTING CONDITIONS

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	58	44	45	818	640	86
Future Volume (vph)	58	44	45	818	640	86
Satd. Flow (prot)	1289	1154	1719	1810	1759	1495
Flt Permitted	0.950		0.335			
Satd. Flow (perm)	1289	1154	606	1810	1759	1495
Satd. Flow (RTOR)		53				90
Lane Group Flow (vph)	70	53	51	919	667	90
Turn Type	Prot	Free	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		Free	2			6
Total Split (s)	20.0		20.0	110.0	90.0	90.0
Total Lost Time (s)	6.0		6.0	7.5	7.5	7.5
Act Effct Green (s)	11.3	126.8	106.2	106.3	96.5	96.5
Actuated g/C Ratio	0.09	1.00	0.84	0.84	0.76	0.76
v/c Ratio	0.61	0.05	0.09	0.61	0.50	0.08
Control Delay	78.3	0.1	2.9	6.9	9.9	1.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	78.3	0.1	2.9	6.9	9.9	1.4
LOS	E	A	A	A	A	A
Approach Delay	44.6			6.7	8.9	
Approach LOS	D			A	A	
Queue Length 50th (ft)	57	0	7	258	239	0
Queue Length 95th (ft)	99	0	15	375	353	16
Internal Link Dist (ft)	2426			641	3536	
Turn Bay Length (ft)		55	350			400
Base Capacity (vph)	142	1154	630	1517	1338	1158
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.05	0.08	0.61	0.50	0.08

Intersection Summary	
Cycle Length: 130	
Actuated Cycle Length: 126.8	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.61	
Intersection Signal Delay: 10.1	Intersection LOS: B
Intersection Capacity Utilization 57.6%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 3: US 85 & Airport Road



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	97	52	45	725	1026	52
Future Volume (vph)	97	52	45	725	1026	52
Satd. Flow (prot)	1736	1553	1719	1810	1863	1583
Flt Permitted	0.950		0.158			
Satd. Flow (perm)	1736	1553	286	1810	1863	1583
Satd. Flow (RTOR)		39				55
Lane Group Flow (vph)	129	69	51	815	1080	55
Turn Type	Prot	Free	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		Free	2			6
Total Split (s)	20.0		20.0	140.0	120.0	120.0
Total Lost Time (s)	6.0		6.0	7.5	7.5	7.5
Act Effct Green (s)	13.7	159.7	134.0	132.5	122.6	122.6
Actuated g/C Ratio	0.09	1.00	0.84	0.83	0.77	0.77
v/c Ratio	0.87	0.04	0.17	0.54	0.76	0.04
Control Delay	117.0	0.1	3.4	5.8	15.4	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	117.0	0.1	3.4	5.8	15.4	1.3
LOS	F	A	A	A	B	A
Approach Delay	76.3			5.7	14.8	
Approach LOS	E			A	B	
Queue Length 50th (ft)	136	0	7	222	602	0
Queue Length 95th (ft)	#191	0	14	282	813	12
Internal Link Dist (ft)	2426			641	3536	
Turn Bay Length (ft)		55	350			400
Base Capacity (vph)	151	1553	365	1501	1430	1227
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.04	0.14	0.54	0.76	0.04

Intersection Summary

Cycle Length: 160
Actuated Cycle Length: 159.7
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 16.7 — Intersection LOS: B
Intersection Capacity Utilization 70.6% — ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: US 85 & Airport Road



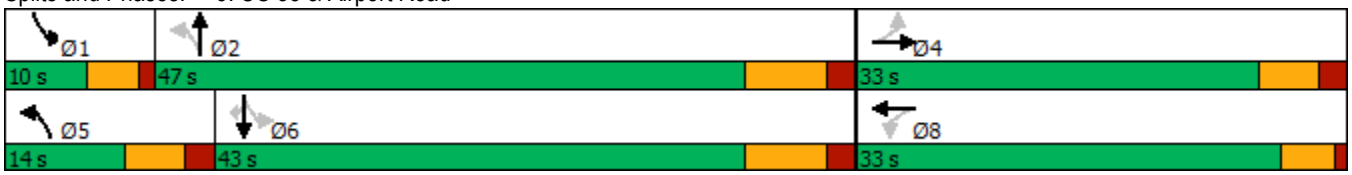
APPENDIX D. ANALYSIS WORKSHEETS BUILD-OUT BACKROUND CONDITIONS

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	1	155	1	1	1	155	1050	1	1	825	120
Future Volume (vph)	80	1	155	1	1	1	155	1050	1	1	825	120
Satd. Flow (prot)	1289	1157	0	0	1750	0	1719	3438	0	1770	3343	1495
Flt Permitted	0.756				0.926		0.244			0.235		
Satd. Flow (perm)	1026	1157	0	0	1647	0	442	3438	0	438	3343	1495
Satd. Flow (RTOR)		187			1							125
Lane Group Flow (vph)	96	188	0	0	3	0	174	1181	0	1	859	125
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Total Split (s)	33.0	33.0		33.0	33.0		14.0	47.0		10.0	43.0	43.0
Total Lost Time (s)	6.0	6.0			4.5		6.0	7.5		4.5	7.5	7.5
Act Effct Green (s)	12.2	12.2			13.7		50.5	47.6		44.2	35.7	35.7
Actuated g/C Ratio	0.16	0.16			0.18		0.67	0.63		0.59	0.47	0.47
v/c Ratio	0.58	0.55			0.01		0.41	0.54		0.00	0.54	0.16
Control Delay	43.0	11.1			21.3		8.1	10.5		5.0	16.4	3.4
Queue Delay	0.0	0.0			0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	43.0	11.1			21.3		8.1	10.5		5.0	16.4	3.4
LOS	D	B			C		A	B		A	B	A
Approach Delay		21.9			21.3			10.2			14.7	
Approach LOS		C			C			B			B	
Queue Length 50th (ft)	42	0			1		25	129		0	142	0
Queue Length 95th (ft)	80	52			7		59	308		2	230	29
Internal Link Dist (ft)		2426			184			641			3536	
Turn Bay Length (ft)							350			350		400
Base Capacity (vph)	370	536			627		433	2175		355	1585	774
Starvation Cap Reductn	0	0			0		0	0		0	0	0
Spillback Cap Reductn	0	0			0		0	0		0	0	0
Storage Cap Reductn	0	0			0		0	0		0	0	0
Reduced v/c Ratio	0.26	0.35			0.00		0.40	0.54		0.00	0.54	0.16

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 75.2
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.58
Intersection Signal Delay: 13.2 — Intersection LOS: B
Intersection Capacity Utilization 59.3% — ICU Level of Service B
Analysis Period (min) 15

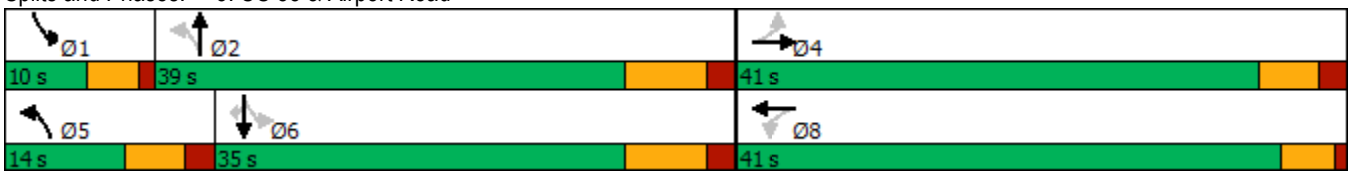
Splits and Phases: 3: US 85 & Airport Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	140	1	190	1	1	1	165	935	1	1	825	120
Future Volume (vph)	140	1	190	1	1	1	165	935	1	1	825	120
Satd. Flow (prot)	1289	1156	0	0	1750	0	1719	3438	0	1770	3343	1495
Flt Permitted	0.756				0.937		0.212			0.271		
Satd. Flow (perm)	1026	1156	0	0	1667	0	384	3438	0	505	3343	1495
Satd. Flow (RTOR)		202			1							125
Lane Group Flow (vph)	169	230	0	0	3	0	185	1052	0	1	859	125
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Total Split (s)	41.0	41.0		41.0	41.0		14.0	39.0		10.0	35.0	35.0
Total Lost Time (s)	6.0	6.0			4.5		6.0	7.5		4.5	7.5	7.5
Act Effct Green (s)	17.1	17.1			18.6		42.9	40.0		36.3	27.7	27.7
Actuated g/C Ratio	0.24	0.24			0.26		0.59	0.55		0.50	0.38	0.38
v/c Ratio	0.70	0.54			0.01		0.50	0.55		0.00	0.67	0.19
Control Delay	40.7	10.0			16.3		12.9	14.2		8.0	22.9	4.8
Queue Delay	0.0	0.0			0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	40.7	10.0			16.3		12.9	14.2		8.0	22.9	4.8
LOS	D	B			B		B	B		A	C	A
Approach Delay		23.0			16.3			14.0			20.6	
Approach LOS		C			B			B			C	
Queue Length 50th (ft)	69	10			1		33	134		0	162	0
Queue Length 95th (ft)	117	64			6		83	322		2	277	35
Internal Link Dist (ft)		2426			184			641			3536	
Turn Bay Length (ft)							350			350		400
Base Capacity (vph)	499	666			847		375	1897		350	1279	649
Starvation Cap Reductn	0	0			0		0	0		0	0	0
Spillback Cap Reductn	0	0			0		0	0		0	0	0
Storage Cap Reductn	0	0			0		0	0		0	0	0
Reduced v/c Ratio	0.34	0.35			0.00		0.49	0.55		0.00	0.67	0.19

Intersection Summary		
Cycle Length: 90		
Actuated Cycle Length: 72.4		
Control Type: Actuated-Uncoordinated		
Maximum v/c Ratio: 0.70		
Intersection Signal Delay: 17.9	Intersection LOS: B	
Intersection Capacity Utilization 62.6%	ICU Level of Service B	
Analysis Period (min) 15		

Splits and Phases: 3: US 85 & Airport Road



APPENDIX E. ANALYSIS WORKSHEETS YEAR 2040 BACKGROUND CONDITIONS

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	140	1	475	1	1	1	485	1530	1	1	1200	210
Future Volume (vph)	140	1	475	1	1	1	485	1530	1	1	1200	210
Satd. Flow (prot)	2501	1863	1154	0	1750	0	3335	3438	0	1770	3343	1495
Flt Permitted	0.976						0.138			0.117		
Satd. Flow (perm)	2570	1863	1154	0	1779	0	484	3438	0	218	3343	1495
Satd. Flow (RTOR)			490		1							219
Lane Group Flow (vph)	169	1	572	0	3	0	545	1720	0	1	1250	219
Turn Type	pm+pt	NA	Free	Perm	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	7	4			8		5	2		1	6	
Permitted Phases	4		Free	8			2			6		6
Total Split (s)	34.0	46.0		12.0	12.0		28.0	94.0		10.0	76.0	76.0
Total Lost Time (s)	4.5	6.0			4.5		6.0	7.5		4.5	7.5	7.5
Act Effct Green (s)	15.5	9.6	120.4		5.8		94.4	91.1		77.6	69.1	69.1
Actuated g/C Ratio	0.13	0.08	1.00		0.05		0.78	0.76		0.64	0.57	0.57
v/c Ratio	0.52	0.01	0.50		0.03		0.68	0.66		0.00	0.65	0.23
Control Delay	54.8	48.0	1.5		53.7		15.7	10.7		6.0	21.2	2.8
Queue Delay	0.0	0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	54.8	48.0	1.5		53.7		15.7	10.7		6.0	21.2	2.8
LOS	D	D	A		D		B	B		A	C	A
Approach Delay		13.7			53.7			11.9			18.5	
Approach LOS		B			D			B			B	
Queue Length 50th (ft)	64	1	0		2		61	246		0	322	0
Queue Length 95th (ft)	93	6	0		13		161	667		2	558	43
Internal Link Dist (ft)		2426			184			641			3536	
Turn Bay Length (ft)	300		300				350			350		400
Base Capacity (vph)	622	623	1154		112		903	2601		211	1918	951
Starvation Cap Reductn	0	0	0		0		0	0		0	0	0
Spillback Cap Reductn	0	0	0		0		0	0		0	0	0
Storage Cap Reductn	0	0	0		0		0	0		0	0	0
Reduced v/c Ratio	0.27	0.00	0.50		0.03		0.60	0.66		0.00	0.65	0.23

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 120.4
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 14.4 — Intersection LOS: B
Intersection Capacity Utilization 73.2% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 3: US 85 & Airport Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	250	1	600	1	1	1	520	1355	1	1	1920	135
Future Volume (vph)	250	1	600	1	1	1	520	1355	1	1	1920	135
Satd. Flow (prot)	2501	1863	1154	0	1750	0	3335	3438	0	1770	3343	1495
Flt Permitted	0.952						0.045			0.163		
Satd. Flow (perm)	2506	1863	1154	0	1779	0	158	3438	0	304	3343	1495
Satd. Flow (RTOR)			380		1							131
Lane Group Flow (vph)	301	1	723	0	3	0	584	1523	0	1	2000	141
Turn Type	pm+pt	NA	Free	Perm	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	7	4			8		5	2		1	6	
Permitted Phases	4		Free	8			2			6		6
Total Split (s)	23.0	35.0		12.0	12.0		28.0	105.0		10.0	87.0	87.0
Total Lost Time (s)	4.5	6.0			4.5		6.0	7.5		4.5	7.5	7.5
Act Effct Green (s)	20.0	9.8	139.6		5.8		109.1	105.7		88.1	79.6	79.6
Actuated g/C Ratio	0.14	0.07	1.00		0.04		0.78	0.76		0.63	0.57	0.57
v/c Ratio	0.84	0.01	0.63		0.04		0.94	0.59		0.00	1.05	0.16
Control Delay	78.8	55.0	2.6		59.3		66.9	9.6		6.0	65.1	3.4
Queue Delay	0.0	0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	78.8	55.0	2.6		59.3		66.9	9.6		6.0	65.1	3.4
LOS	E	D	A		E		E	A		A	E	A
Approach Delay		25.0			59.3			25.5			61.0	
Approach LOS		C			E			C			E	
Queue Length 50th (ft)	139	1	0		2		219	245		0	~1016	4
Queue Length 95th (ft)	174	6	0		13		#369	520		2	#1308	38
Internal Link Dist (ft)		2426			184			641			3536	
Turn Bay Length (ft)	300		300				350			350		400
Base Capacity (vph)	369	387	1154		96		624	2603		249	1905	908
Starvation Cap Reductn	0	0	0		0		0	0		0	0	0
Spillback Cap Reductn	0	0	0		0		0	0		0	0	0
Storage Cap Reductn	0	0	0		0		0	0		0	0	0
Reduced v/c Ratio	0.82	0.00	0.63		0.03		0.94	0.59		0.00	1.05	0.16

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 139.6
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.05
Intersection Signal Delay: 39.8 — Intersection LOS: D
Intersection Capacity Utilization 98.0% — ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: US 85 & Airport Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	140	1	0	0	1	1	485	1	1	0	0	0
Future Volume (vph)	140	1	0	0	1	1	485	1	1	0	0	0
Satd. Flow (prot)	1770	1863	0	0	1736	0	1770	1723	0	0	0	0
Flt Permitted	0.757						0.950					
Satd. Flow (perm)	1410	1863	0	0	1736	0	1770	1723	0	0	0	0
Satd. Flow (RTOR)					1			1				
Lane Group Flow (vph)	152	1	0	0	2	0	527	2	0	0	0	0
Turn Type	Perm	NA			NA		Prot	NA				
Protected Phases		4			8		5	2				
Permitted Phases	4											
Total Split (s)	23.0	23.0			23.0		37.0	37.0				
Total Lost Time (s)	4.5	4.5			4.5		4.5	4.5				
Act Effct Green (s)	18.5	18.5			18.5		32.5	32.5				
Actuated g/C Ratio	0.31	0.31			0.31		0.54	0.54				
v/c Ratio	0.35	0.00			0.00		0.55	0.00				
Control Delay	6.9	2.0			13.0		11.7	5.5				
Queue Delay	0.0	0.0			0.0		0.0	0.0				
Total Delay	6.9	2.0			13.0		11.7	5.5				
LOS	A	A			B		B	A				
Approach Delay		6.9			13.0			11.7				
Approach LOS		A			B			B				
Queue Length 50th (ft)	42	0			0		112	0				
Queue Length 95th (ft)	86	m1			4		189	3				
Internal Link Dist (ft)		472			293			414			397	
Turn Bay Length (ft)	200											
Base Capacity (vph)	434	574			535		958	933				
Starvation Cap Reductn	0	0			0		0	0				
Spillback Cap Reductn	0	0			0		0	0				
Storage Cap Reductn	0	0			0		0	0				
Reduced v/c Ratio	0.35	0.00			0.00		0.55	0.00				

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 60	
Offset: 24 (40%), Referenced to phase 4:EBTL and 8:WBT, Start of Yellow	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.55	
Intersection Signal Delay: 10.6	Intersection LOS: B
Intersection Capacity Utilization 58.0%	ICU Level of Service B
Analysis Period (min) 15	

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NB Ramp & Airport Road

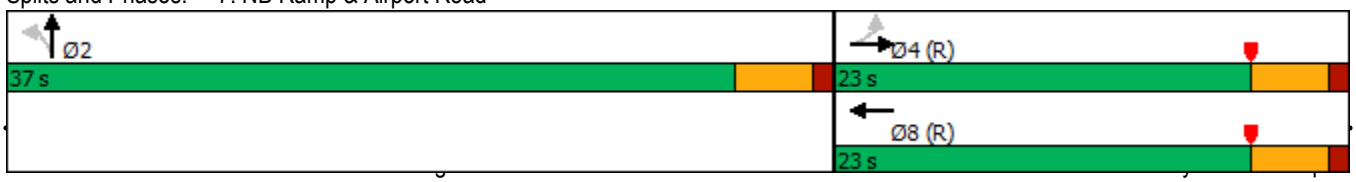


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	250	1	0	0	1	1	520	1	1	0	0	0
Future Volume (vph)	250	1	0	0	1	1	520	1	1	0	0	0
Satd. Flow (prot)	1770	1863	0	0	1736	0	1770	1723	0	0	0	0
Flt Permitted	0.757						0.950					
Satd. Flow (perm)	1410	1863	0	0	1736	0	1770	1723	0	0	0	0
Satd. Flow (RTOR)					1			1				
Lane Group Flow (vph)	272	1	0	0	2	0	565	2	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Total Split (s)	23.0	23.0			23.0		37.0	37.0				
Total Lost Time (s)	4.5	4.5			4.5		4.5	4.5				
Act Effct Green (s)	18.5	18.5			18.5		32.5	32.5				
Actuated g/C Ratio	0.31	0.31			0.31		0.54	0.54				
v/c Ratio	0.63	0.00			0.00		0.59	0.00				
Control Delay	12.1	2.0			13.0		12.4	5.5				
Queue Delay	0.0	0.0			0.0		0.0	0.0				
Total Delay	12.1	2.0			13.0		12.4	5.5				
LOS	B	A			B		B	A				
Approach Delay		12.1			13.0			12.4				
Approach LOS		B			B			B				
Queue Length 50th (ft)	83	0			0		124	0				
Queue Length 95th (ft)	#155	m0			4		209	3				
Internal Link Dist (ft)		472			293			414			397	
Turn Bay Length (ft)	200											
Base Capacity (vph)	434	574			535		958	933				
Starvation Cap Reductn	0	0			0		0	0				
Spillback Cap Reductn	0	0			0		0	0				
Storage Cap Reductn	0	0			0		0	0				
Reduced v/c Ratio	0.63	0.00			0.00		0.59	0.00				

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 24 (40%), Referenced to phase 4:EBTL and 8:WBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 12.3 Intersection LOS: B
Intersection Capacity Utilization 65.7% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NB Ramp & Airport Road

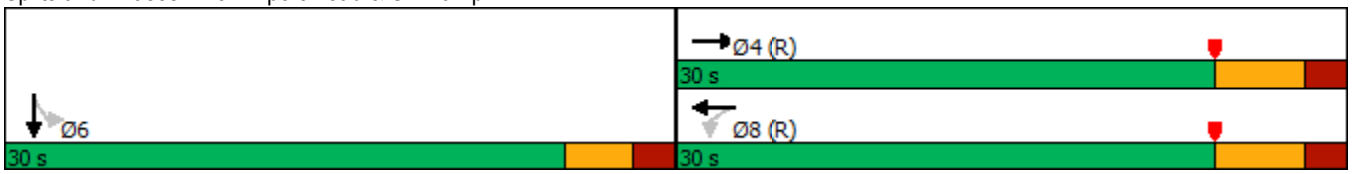


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	140	475	1	1	0	0	0	0	1	1	210
Future Volume (vph)	0	140	475	1	1	0	0	0	0	1	1	210
Satd. Flow (prot)	0	1863	1154	1770	1863	0	0	0	0	0	1524	0
Flt Permitted				0.660								
Satd. Flow (perm)	0	1863	1154	1229	1863	0	0	0	0	0	1524	0
Satd. Flow (RTOR)			572								219	
Lane Group Flow (vph)	0	152	572	1	1	0	0	0	0	0	221	0
Turn Type		NA	Free	Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases			Free	8						6		
Total Split (s)		30.0		30.0	30.0					30.0	30.0	
Total Lost Time (s)		6.0		6.0	6.0						5.0	
Act Effct Green (s)		24.0	60.0	24.0	24.0						25.0	
Actuated g/C Ratio		0.40	1.00	0.40	0.40						0.42	
v/c Ratio		0.20	0.50	0.00	0.00						0.29	
Control Delay		12.7	1.5	2.0	2.0						3.1	
Queue Delay		0.0	0.0	0.0	0.0						0.0	
Total Delay		12.7	1.5	2.0	2.0						3.1	
LOS		B	A	A	A						A	
Approach Delay		3.9			2.0						3.1	
Approach LOS		A			A						A	
Queue Length 50th (ft)		34	0	0	0						0	
Queue Length 95th (ft)		68	0	m0	m0						34	
Internal Link Dist (ft)		2426			472			641			3536	
Turn Bay Length (ft)				200								
Base Capacity (vph)		745	1154	491	745						762	
Starvation Cap Reductn		0	0	0	0						0	
Spillback Cap Reductn		0	0	0	0						0	
Storage Cap Reductn		0	0	0	0						0	
Reduced v/c Ratio		0.20	0.50	0.00	0.00						0.29	

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 12 (20%), Referenced to phase 4:EBT and 8:WBTL, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.50
Intersection Signal Delay: 3.7 Intersection LOS: A
Intersection Capacity Utilization 53.0% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Airport Road & SB Ramp

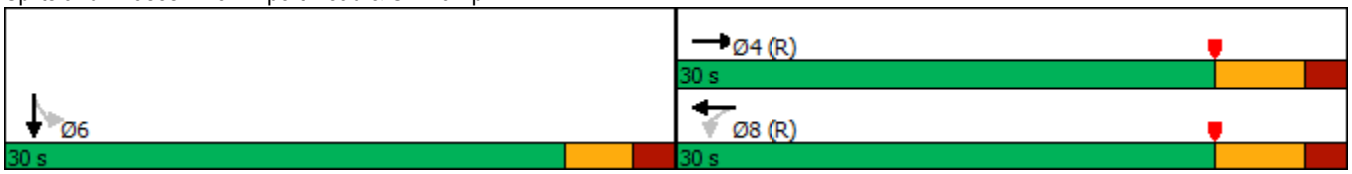


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	250	600	1	1	0	0	0	0	1	1	135
Future Volume (vph)	0	250	600	1	1	0	0	0	0	1	1	135
Satd. Flow (prot)	0	1863	1154	1770	1863	0	0	0	0	0	1526	0
Flt Permitted				0.582								
Satd. Flow (perm)	0	1863	1154	1084	1863	0	0	0	0	0	1526	0
Satd. Flow (RTOR)			723								141	
Lane Group Flow (vph)	0	272	723	1	1	0	0	0	0	0	143	0
Turn Type		NA	Free	Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases			Free	8						6		
Total Split (s)		30.0		30.0	30.0					30.0	30.0	
Total Lost Time (s)		6.0		6.0	6.0						5.0	
Act Effct Green (s)		24.0	60.0	24.0	24.0						25.0	
Actuated g/C Ratio		0.40	1.00	0.40	0.40						0.42	
v/c Ratio		0.37	0.63	0.00	0.00						0.20	
Control Delay		14.4	2.6	2.0	2.0						3.3	
Queue Delay		0.0	0.0	0.0	0.0						0.0	
Total Delay		14.4	2.6	2.0	2.0						3.3	
LOS		B	A	A	A						A	
Approach Delay		5.8			2.0						3.3	
Approach LOS		A			A						A	
Queue Length 50th (ft)		66	0	0	0						0	
Queue Length 95th (ft)		118	0	m0	m0						27	
Internal Link Dist (ft)		2426			472			641			3536	
Turn Bay Length (ft)				200								
Base Capacity (vph)		745	1154	433	745						718	
Starvation Cap Reductn		0	0	0	0						0	
Spillback Cap Reductn		0	0	0	0						0	
Storage Cap Reductn		0	0	0	0						0	
Reduced v/c Ratio		0.37	0.63	0.00	0.00						0.20	

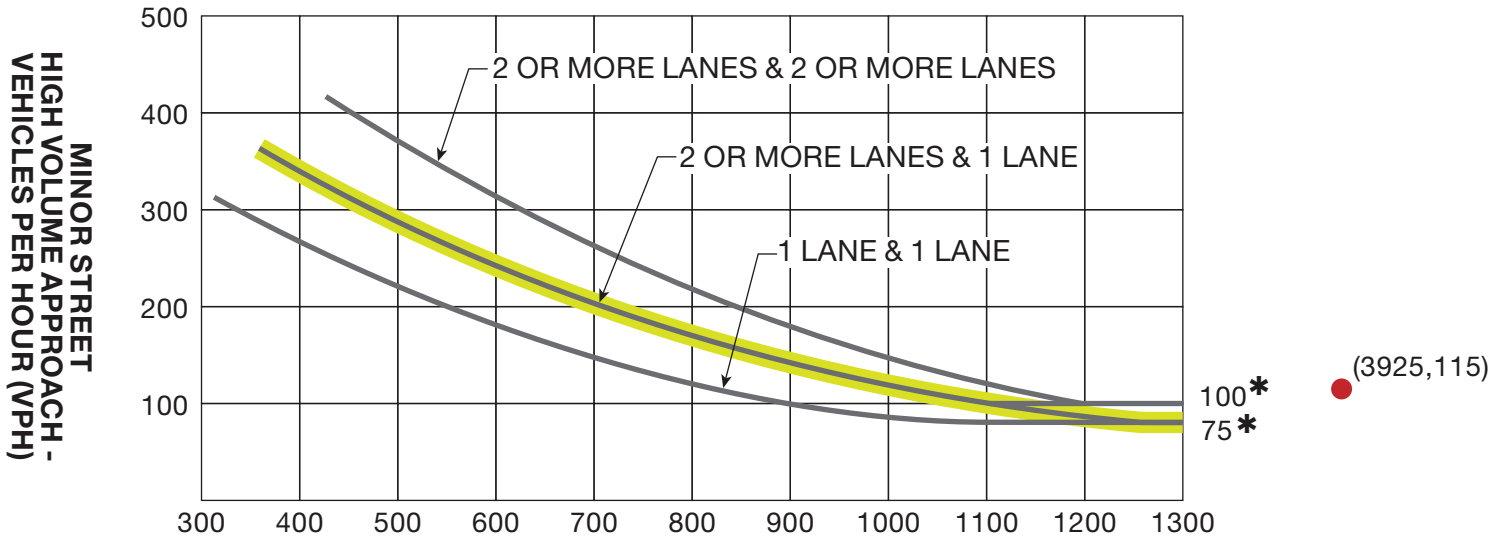
Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 13 (22%), Referenced to phase 4:EBT and 8:WBTL, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 5.5 Intersection LOS: A
Intersection Capacity Utilization 60.7% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Airport Road & SB Ramp



APPENDIX F. SOUTH ACCESS TRAFFIC SIGNALIZATION WARRANT ANALYSIS – WARRANT 3, YEAR 2040



* Note:100 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor street approach with one lane.

LEGEND

● = AM Peak Hour

WARRANT 3

Year 2040 - South Access
Peak Hour (70% Factor)
(Community Less than 10,000 Population or Above 40 mph On Major Street)

Range TIA- UPDATE 120-308-01 8/7/24

APPENDIX G. ANALYSIS WORKSHEETS – BUILD-OUT CONDITIONS

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	10	160	120	30	85	170	1095	25	30	840	120
Future Volume (vph)	80	10	160	120	30	85	170	1095	25	30	840	120
Satd. Flow (prot)	1289	1182	0	1770	1658	0	1719	3438	1583	1770	3343	1495
Flt Permitted	0.574			0.370			0.226			0.177		
Satd. Flow (perm)	779	1182	0	689	1658	0	409	3438	1583	330	3343	1495
Satd. Flow (RTOR)		193			92				135			197
Lane Group Flow (vph)	96	204	0	130	125	0	191	1230	27	33	875	125
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		6
Total Split (s)	13.0	26.0		11.0	24.0		18.0	57.0	57.0	11.0	50.0	50.0
Total Lost Time (s)	5.0	5.0		5.0	5.0		6.0	7.5	7.5	6.0	7.5	7.5
Act Effct Green (s)	17.7	10.0		15.6	10.8		60.2	52.8	52.8	50.0	43.4	43.4
Actuated g/C Ratio	0.19	0.11		0.17	0.12		0.65	0.57	0.57	0.54	0.47	0.47
v/c Ratio	0.50	0.68		0.70	0.45		0.48	0.63	0.03	0.13	0.56	0.16
Control Delay	40.0	19.2		52.4	19.6		11.0	17.0	0.0	8.6	20.3	0.8
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.0	19.2		52.4	19.6		11.0	17.0	0.0	8.6	20.3	0.8
LOS	D	B		D	B		B	B	A	A	C	A
Approach Delay		25.9			36.3			15.9			17.6	
Approach LOS		C			D			B			B	
Queue Length 50th (ft)	48	6		65	19		38	265	0	6	183	0
Queue Length 95th (ft)	84	75		#123	72		81	395	0	19	294	6
Internal Link Dist (ft)		2426			184			793			3536	
Turn Bay Length (ft)				200			600		600	750		400
Base Capacity (vph)	195	417		185	414		437	1957	959	255	1566	805
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.49		0.70	0.30		0.44	0.63	0.03	0.13	0.56	0.16

Intersection Summary

Cycle Length: 105
Actuated Cycle Length: 92.7
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 19.2 — Intersection LOS: B
Intersection Capacity Utilization 71.1% — ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: US 85 & Airport Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	140	35	210	80	20	60	175	965	85	95	1375	75
Future Volume (vph)	140	35	210	80	20	60	175	965	85	95	1375	75
Satd. Flow (prot)	1289	1224	0	1770	1654	0	1719	3438	1583	1770	3343	1495
Flt Permitted	0.381			0.727			0.079			0.264		
Satd. Flow (perm)	517	1224	0	1354	1654	0	143	3438	1583	492	3343	1495
Satd. Flow (RTOR)		242			65				177			164
Lane Group Flow (vph)	169	291	0	87	87	0	197	1084	92	103	1432	78
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		6
Total Split (s)	26.0	28.0		11.0	13.0		18.0	69.0	69.0	12.0	63.0	63.0
Total Lost Time (s)	5.0	5.0		5.0	5.0		6.0	7.5	7.5	6.0	7.5	7.5
Act Effct Green (s)	27.1	18.6		11.5	6.8		63.4	61.9	61.9	57.8	56.3	56.3
Actuated g/C Ratio	0.24	0.16		0.10	0.06		0.56	0.54	0.54	0.51	0.50	0.50
v/c Ratio	0.69	0.72		0.55	0.55		0.82	0.58	0.10	0.33	0.86	0.09
Control Delay	52.4	20.7		49.7	33.1		53.2	19.9	0.2	24.1	33.7	0.2
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.4	20.7		49.7	33.1		53.2	19.9	0.2	24.1	33.7	0.2
LOS	D	C		D	C		D	B	A	C	C	A
Approach Delay		32.3			41.4			23.4			31.5	
Approach LOS		C			D			C			C	
Queue Length 50th (ft)	108	32		51	16		97	290	0	42	515	0
Queue Length 95th (ft)	161	135		94	69		#226	367	0	77	#697	0
Internal Link Dist (ft)		2426			184			793			3536	
Turn Bay Length (ft)				200			600		600	750		400
Base Capacity (vph)	276	442		159	177		247	1873	943	318	1656	823
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.61	0.66		0.55	0.49		0.80	0.58	0.10	0.32	0.86	0.09

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 113.6
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 29.0 Intersection LOS: C
Intersection Capacity Utilization 86.5% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: US 85 & Airport Road



Intersection	
Int Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	65	1225	15	20	1100
Future Vol, veh/h	0	65	1225	15	20	1100
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	600	700	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	71	1332	16	22	1196

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	666	0	0	1348	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	4.14	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	2.22	-
Pot Cap-1 Maneuver	0	402	-	-	507	-
Stage 1	0	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	402	-	-	507	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.9	0	0.2
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	402	507	-
HCM Lane V/C Ratio	-	-	0.176	0.043	-
HCM Control Delay (s)	-	-	15.9	12.4	-
HCM Lane LOS	-	-	C	B	-
HCM 95th %tile Q(veh)	-	-	0.6	0.1	-

Intersection	
Int Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	40	1185	45	70	1595
Future Vol, veh/h	0	40	1185	45	70	1595
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	600	700	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	43	1288	49	76	1734

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	644	0	0	1337	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	4.14	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	2.22	-
Pot Cap-1 Maneuver	0	416	-	-	512	-
Stage 1	0	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	416	-	-	512	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14.7	0	0.6
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	416	512	-
HCM Lane V/C Ratio	-	-	0.105	0.149	-
HCM Control Delay (s)	-	-	14.7	13.3	-
HCM Lane LOS	-	-	B	B	-
HCM 95th %tile Q(veh)	-	-	0.3	0.5	-

APPENDIX H. ANALYSIS WORKSHEETS – YEAR 2040 CONDITIONS

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	145	15	490	105	50	95	530	1660	30	40	1240	210
Future Volume (vph)	145	15	490	105	50	95	530	1660	30	40	1240	210
Satd. Flow (prot)	1289	1863	1154	1770	1680	0	3335	3438	1583	1770	3343	1495
Flt Permitted	0.657			0.436			0.950			0.950		
Satd. Flow (perm)	892	1863	1154	812	1680	0	3335	3438	1583	1770	3343	1495
Satd. Flow (RTOR)			437		71				144			219
Lane Group Flow (vph)	175	16	590	114	157	0	596	1865	33	43	1292	219
Turn Type	pm+pt	NA	Free	pm+pt	NA		Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		Free	8					2			6
Total Split (s)	17.0	23.0		12.0	18.0		26.0	64.0	64.0	11.0	49.0	49.0
Total Lost Time (s)	5.0	5.0		5.0	5.0		6.0	7.5	7.5	6.0	7.5	7.5
Act Effct Green (s)	19.0	10.6	107.2	23.3	10.1		20.0	58.8	58.8	5.0	41.5	41.5
Actuated g/C Ratio	0.18	0.10	1.00	0.22	0.09		0.19	0.55	0.55	0.05	0.39	0.39
v/c Ratio	0.87	0.09	0.51	0.34	0.70		0.96	0.99	0.04	0.52	1.00	0.31
Control Delay	77.3	42.1	1.6	36.2	43.2		71.3	44.0	0.1	73.8	58.3	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.3	42.1	1.6	36.2	43.2		71.3	44.0	0.1	73.8	58.3	4.3
LOS	E	D	A	D	D		E	D	A	E	E	A
Approach Delay		19.4			40.2			49.9			51.1	
Approach LOS		B			D			D			D	
Queue Length 50th (ft)	~150	11	0	63	57		213	~735	0	30	~471	0
Queue Length 95th (ft)	158	30	0	111	128		#327	#882	0	#81	#648	48
Internal Link Dist (ft)		2426			184			504			3536	
Turn Bay Length (ft)			300	200			600		600	750		400
Base Capacity (vph)	202	312	1154	338	266		622	1886	933	82	1295	713
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.87	0.05	0.51	0.34	0.59		0.96	0.99	0.04	0.52	1.00	0.31

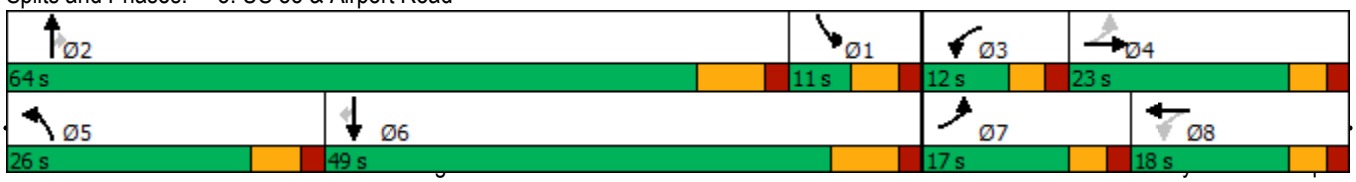
Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 107.2
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 45.1 — Intersection LOS: D
Intersection Capacity Utilization 86.1% — ICU Level of Service E
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: US 85 & Airport Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	145	15	490	105	50	95	530	1660	30	40	1240	210
Future Volume (vph)	145	15	490	105	50	95	530	1660	30	40	1240	210
Satd. Flow (prot)	1289	1863	1154	1770	1863	1583	3335	3438	1583	1770	3343	1495
Flt Permitted	0.722			0.438			0.950			0.950		
Satd. Flow (perm)	980	1863	1154	816	1863	1583	3335	3438	1583	1770	3343	1495
Satd. Flow (RTOR)			437						144			219
Lane Group Flow (vph)	175	16	590	114	54	103	596	1865	33	43	1292	219
Turn Type	pm+pt	NA	Free	pm+pt	NA	Prot	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8	8	5	2		1	6	
Permitted Phases	4		Free	8					2			6
Total Split (s)	17.0	23.0		12.0	18.0	18.0	26.0	64.0	64.0	11.0	49.0	49.0
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	6.0	7.5	7.5	6.0	7.5	7.5
Act Effct Green (s)	19.1	10.6	108.2	24.2	11.2	11.2	20.0	58.8	58.8	5.0	41.5	41.5
Actuated g/C Ratio	0.18	0.10	1.00	0.22	0.10	0.10	0.18	0.54	0.54	0.05	0.38	0.38
v/c Ratio	0.85	0.09	0.51	0.32	0.28	0.63	0.97	1.00	0.04	0.53	1.01	0.31
Control Delay	74.4	42.3	1.6	35.7	48.5	64.1	73.6	46.8	0.1	74.6	61.0	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	74.4	42.3	1.6	35.7	48.5	64.1	73.6	46.8	0.1	74.6	61.0	4.4
LOS	E	D	A	D	D	E	E	D	A	E	E	A
Approach Delay		18.8			49.1			52.6			53.4	
Approach LOS		B			D			D			D	
Queue Length 50th (ft)	~153	11	0	63	35	70	216	~753	0	30	~507	0
Queue Length 95th (ft)	158	30	0	111	75	128	#327	#882	0	#81	#648	48
Internal Link Dist (ft)		2426			184			504			3536	
Turn Bay Length (ft)			300	200			600		600	750		400
Base Capacity (vph)	207	309	1154	351	224	190	616	1868	926	81	1283	708
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.05	0.51	0.32	0.24	0.54	0.97	1.00	0.04	0.53	1.01	0.31

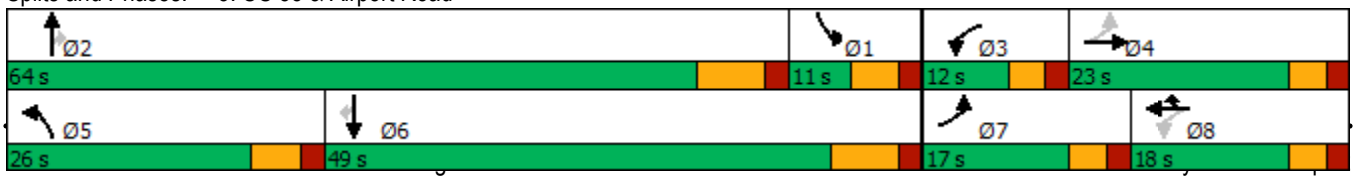
Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 108.2
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.01
Intersection Signal Delay: 47.5 — Intersection LOS: D
Intersection Capacity Utilization 80.2% — ICU Level of Service D
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: US 85 & Airport Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	255	40	640	70	25	65	545	1440	100	130	2040	135
Future Volume (vph)	255	40	640	70	25	65	545	1440	100	130	2040	135
Satd. Flow (prot)	2501	1863	1154	1770	1660	0	3335	3438	1583	1770	3343	1495
Flt Permitted	0.694			0.523			0.950			0.950		
Satd. Flow (perm)	1827	1863	1154	974	1660	0	3335	3438	1583	1770	3343	1495
Satd. Flow (RTOR)			254		71				109			113
Lane Group Flow (vph)	307	43	771	76	98	0	612	1618	109	141	2125	141
Turn Type	pm+pt	NA	Free	pm+pt	NA		Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		Free	8					2			6
Total Split (s)	10.0	22.0		11.0	23.0		28.0	96.0	96.0	21.0	89.0	89.0
Total Lost Time (s)	5.0	5.0		5.0	5.0		6.0	7.5	7.5	6.0	7.5	7.5
Act Effct Green (s)	12.6	8.8	141.6	16.4	9.6		22.0	88.5	88.5	15.0	81.5	81.5
Actuated g/C Ratio	0.09	0.06	1.00	0.12	0.07		0.16	0.62	0.62	0.11	0.58	0.58
v/c Ratio	1.65	0.37	0.67	0.48	0.55		1.18	0.75	0.11	0.75	1.10	0.16
Control Delay	351.7	72.9	3.1	66.4	33.9		150.7	22.0	2.2	86.2	85.0	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	351.7	72.9	3.1	66.4	33.9		150.7	22.0	2.2	86.2	85.0	4.3
LOS	F	E	A	E	C		F	C	A	F	F	A
Approach Delay		101.2			48.1			54.8			80.4	
Approach LOS		F			D			D			F	
Queue Length 50th (ft)	~204	39	0	64	24		~348	527	0	128	~1171	11
Queue Length 95th (ft)	#256	81	0	115	84		#477	651	24	#241	#1360	44
Internal Link Dist (ft)		2426			184			504			3536	
Turn Bay Length (ft)			300	200			600		600	750		400
Base Capacity (vph)	186	223	1154	157	273		518	2149	1030	187	1924	908
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	1.65	0.19	0.67	0.48	0.36		1.18	0.75	0.11	0.75	1.10	0.16

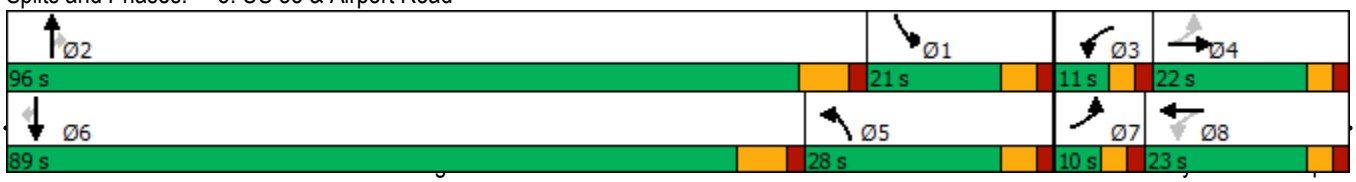
Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 141.6
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.65
Intersection Signal Delay: 73.4 — Intersection LOS: E
Intersection Capacity Utilization 101.3% — ICU Level of Service G
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: US 85 & Airport Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	255	40	640	70	25	65	545	1440	100	130	2040	135
Future Volume (vph)	255	40	640	70	25	65	545	1440	100	130	2040	135
Satd. Flow (prot)	2501	1863	1154	1770	1863	1583	3335	3438	1583	1770	3343	1495
Flt Permitted	0.740			0.672			0.950			0.950		
Satd. Flow (perm)	1948	1863	1154	1252	1863	1583	3335	3438	1583	1770	3343	1495
Satd. Flow (RTOR)			253						109			113
Lane Group Flow (vph)	307	43	771	76	27	71	612	1618	109	141	2125	141
Turn Type	pm+pt	NA	Free	pm+pt	NA	Prot	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8	8	5	2		1	6	
Permitted Phases	4		Free	8					2			6
Total Split (s)	10.0	22.0		11.0	23.0	23.0	28.0	96.0	96.0	21.0	89.0	89.0
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	6.0	7.5	7.5	6.0	7.5	7.5
Act Effct Green (s)	14.6	10.6	141.6	16.2	11.7	11.7	22.1	88.7	88.7	15.0	81.7	81.7
Actuated g/C Ratio	0.10	0.07	1.00	0.11	0.08	0.08	0.16	0.63	0.63	0.11	0.58	0.58
v/c Ratio	1.39	0.31	0.67	0.46	0.18	0.55	1.18	0.75	0.11	0.75	1.10	0.15
Control Delay	244.9	68.3	3.1	64.1	63.4	78.7	149.7	22.6	2.4	86.8	84.3	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	244.9	68.3	3.1	64.1	63.4	78.7	149.7	22.6	2.4	86.8	84.3	4.6
LOS	F	E	A	E	E	E	F	C	A	F	F	A
Approach Delay		71.8			70.0			54.9			79.7	
Approach LOS		E			E			D			E	
Queue Length 50th (ft)	~186	39	0	64	24	65	~357	551	0	131	~1203	11
Queue Length 95th (ft)	#230	80	0	115	56	119	#494	692	26	#249	#1412	46
Internal Link Dist (ft)		2426			184			504			3536	
Turn Bay Length (ft)			300	200			600		600	750		400
Base Capacity (vph)	221	224	1154	164	237	201	519	2154	1032	188	1928	910
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.39	0.19	0.67	0.46	0.11	0.35	1.18	0.75	0.11	0.75	1.10	0.15

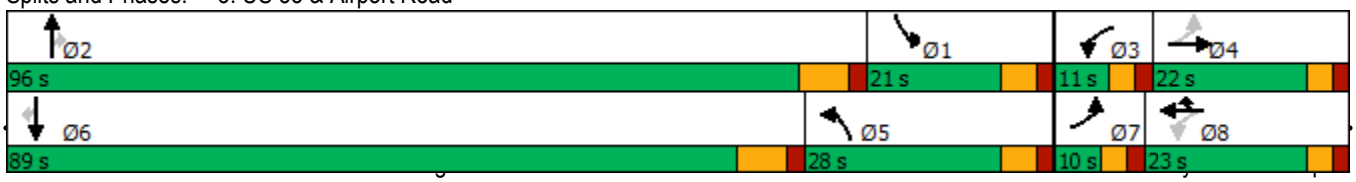
Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 141.6
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.39
Intersection Signal Delay: 68.4 — Intersection LOS: E
Intersection Capacity Utilization 101.3% — ICU Level of Service G
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: US 85 & Airport Road



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	115	170	2050	40	55	1780
Future Volume (vph)	115	170	2050	40	55	1780
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.950				0.052	
Satd. Flow (perm)	1770	1583	3539	1583	97	3539
Satd. Flow (RTOR)		109		43		
Lane Group Flow (vph)	125	185	2228	43	60	1935
Turn Type	Prot	Perm	NA	Perm	pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Total Split (s)	24.0	24.0	74.0	74.0	12.0	86.0
Total Lost Time (s)	5.0	5.0	6.0	6.0	5.0	6.0
Act Effct Green (s)	12.7	12.7	72.2	72.2	82.4	81.4
Actuated g/C Ratio	0.12	0.12	0.69	0.69	0.78	0.77
v/c Ratio	0.58	0.64	0.92	0.04	0.34	0.71
Control Delay	54.4	29.3	23.4	2.4	11.5	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.4	29.3	23.4	2.4	11.5	8.2
LOS	D	C	C	A	B	A
Approach Delay	39.4		23.0			8.3
Approach LOS	D		C			A
Queue Length 50th (ft)	79	47	634	0	7	274
Queue Length 95th (ft)	139	120	#1002	13	32	444
Internal Link Dist (ft)	486		797			566
Turn Bay Length (ft)				600	700	
Base Capacity (vph)	320	375	2431	1100	187	2740
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.49	0.92	0.04	0.32	0.71

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 105.1
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 17.7 — Intersection LOS: B
Intersection Capacity Utilization 76.4% — ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: South Access & US 85



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	65	90	1995	105	155	2590
Future Volume (vph)	65	90	1995	105	155	2590
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.950				0.037	
Satd. Flow (perm)	1770	1583	3539	1583	69	3539
Satd. Flow (RTOR)		98		114		
Lane Group Flow (vph)	71	98	2168	114	168	2815
Turn Type	Prot	Perm	NA	Perm	pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Total Split (s)	23.0	23.0	109.0	109.0	18.0	127.0
Total Lost Time (s)	5.0	5.0	6.0	6.0	5.0	6.0
Act Effct Green (s)	11.1	11.1	103.9	103.9	122.0	121.0
Actuated g/C Ratio	0.08	0.08	0.73	0.73	0.85	0.85
v/c Ratio	0.52	0.46	0.84	0.10	0.83	0.94
Control Delay	76.9	18.3	18.8	1.3	69.7	17.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.3
Total Delay	76.9	18.3	18.8	1.3	69.7	17.5
LOS	E	B	B	A	E	B
Approach Delay	42.9		17.9			20.5
Approach LOS	D		B			C
Queue Length 50th (ft)	65	0	698	0	102	812
Queue Length 95th (ft)	118	56	918	19	#233	#1314
Internal Link Dist (ft)	486		797			566
Turn Bay Length (ft)				600	700	
Base Capacity (vph)	222	284	2569	1180	213	2993
Starvation Cap Reductn	0	0	0	0	0	21
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.35	0.84	0.10	0.79	0.95

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 143.1
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 20.1 — Intersection LOS: C
Intersection Capacity Utilization 84.9% — ICU Level of Service E
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: South Access & US 85



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	160	55	0	0	155	95	530	30	1	0	0	0
Future Volume (vph)	160	55	0	0	155	95	530	30	1	0	0	0
Satd. Flow (prot)	1770	1863	0	0	1768	0	1770	1855	0	0	0	0
Flt Permitted	0.501						0.950					
Satd. Flow (perm)	933	1863	0	0	1768	0	1770	1855	0	0	0	0
Satd. Flow (RTOR)					53			1				
Lane Group Flow (vph)	174	60	0	0	271	0	576	34	0	0	0	0
Turn Type	Perm	NA			NA		Prot	NA				
Protected Phases		4			8		5	2				
Permitted Phases	4											
Total Split (s)	23.0	23.0			23.0		37.0	37.0				
Total Lost Time (s)	4.5	4.5			4.5		4.5	4.5				
Act Effct Green (s)	18.5	18.5			18.5		32.5	32.5				
Actuated g/C Ratio	0.31	0.31			0.31		0.54	0.54				
v/c Ratio	0.61	0.10			0.47		0.60	0.03				
Control Delay	20.6	7.2			16.5		12.7	6.5				
Queue Delay	0.0	0.0			0.0		0.0	0.0				
Total Delay	20.6	7.2			16.5		12.7	6.5				
LOS	C	A			B		B	A				
Approach Delay		17.2			16.5			12.3				
Approach LOS		B			B			B				
Queue Length 50th (ft)	54	4			61		128	5				
Queue Length 95th (ft)	#129	12			121		215	15				
Internal Link Dist (ft)		472			293			414			397	
Turn Bay Length (ft)	200											
Base Capacity (vph)	287	574			581		958	1005				
Starvation Cap Reductn	0	0			0		0	0				
Spillback Cap Reductn	0	0			0		0	0				
Storage Cap Reductn	0	0			0		0	0				
Reduced v/c Ratio	0.61	0.10			0.47		0.60	0.03				

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 24 (40%), Referenced to phase 4:EBTL and 8:WBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 14.3 — Intersection LOS: B
Intersection Capacity Utilization 66.3% — ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: NB Ramp & Airport Road

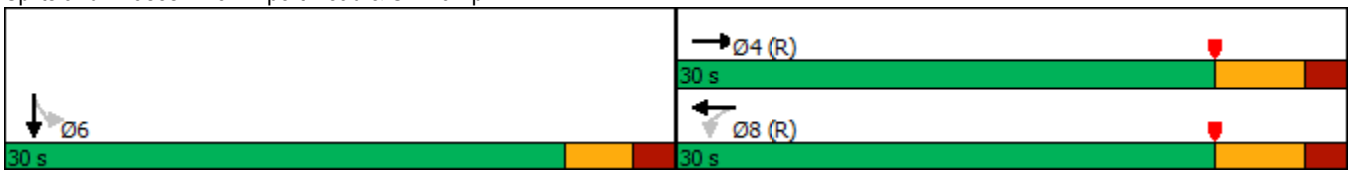


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	160	490	105	50	0	0	0	0	40	1	210
Future Volume (vph)	0	160	490	105	50	0	0	0	0	40	1	210
Satd. Flow (prot)	0	1863	1154	1770	1863	0	0	0	0	0	1564	0
Flt Permitted				0.647							0.992	
Satd. Flow (perm)	0	1863	1154	1205	1863	0	0	0	0	0	1564	0
Satd. Flow (RTOR)			590								219	
Lane Group Flow (vph)	0	174	590	114	54	0	0	0	0	0	263	0
Turn Type		NA	Free	Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases			Free	8						6		
Total Split (s)		30.0		30.0	30.0					30.0	30.0	
Total Lost Time (s)		6.0		6.0	6.0						5.0	
Act Effct Green (s)		24.0	60.0	24.0	24.0						25.0	
Actuated g/C Ratio		0.40	1.00	0.40	0.40						0.42	
v/c Ratio		0.23	0.51	0.24	0.07						0.34	
Control Delay		13.0	1.6	7.6	6.0						4.3	
Queue Delay		0.0	0.0	0.0	0.0						0.0	
Total Delay		13.0	1.6	7.6	6.0						4.3	
LOS		B	A	A	A						A	
Approach Delay		4.2			7.1						4.3	
Approach LOS		A			A						A	
Queue Length 50th (ft)		40	0	14	5						9	
Queue Length 95th (ft)		77	0	m28	m10						47	
Internal Link Dist (ft)		2426			472			641			3536	
Turn Bay Length (ft)				200								
Base Capacity (vph)		745	1154	482	745						779	
Starvation Cap Reductn		0	0	0	0						0	
Spillback Cap Reductn		0	0	0	0						0	
Storage Cap Reductn		0	0	0	0						0	
Reduced v/c Ratio		0.23	0.51	0.24	0.07						0.34	

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 12 (20%), Referenced to phase 4:EBT and 8:WBTL, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.51
Intersection Signal Delay: 4.6 Intersection LOS: A
Intersection Capacity Utilization 61.7% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Airport Road & SB Ramp



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	295	170	0	0	95	65	545	1	100	0	0	0
Future Volume (vph)	295	170	0	0	95	65	545	1	100	0	0	0
Satd. Flow (prot)	1770	1863	0	0	1760	0	1770	1585	0	0	0	0
Flt Permitted	0.647						0.950					
Satd. Flow (perm)	1205	1863	0	0	1760	0	1770	1585	0	0	0	0
Satd. Flow (RTOR)					60			109				
Lane Group Flow (vph)	321	185	0	0	174	0	592	110	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Total Split (s)	23.0	23.0			23.0		37.0	37.0				
Total Lost Time (s)	4.5	4.5			4.5		4.5	4.5				
Act Effct Green (s)	18.5	18.5			18.5		32.5	32.5				
Actuated g/C Ratio	0.31	0.31			0.31		0.54	0.54				
v/c Ratio	0.87	0.32			0.30		0.62	0.12				
Control Delay	39.7	11.8			12.1		13.0	2.1				
Queue Delay	0.0	0.0			0.0		0.0	0.0				
Total Delay	39.7	11.8			12.1		13.0	2.1				
LOS	D	B			B		B	A				
Approach Delay		29.5			12.1			11.3				
Approach LOS		C			B			B				
Queue Length 50th (ft)	114	24			30		133	0				
Queue Length 95th (ft)	#246	58			71		225	18				
Internal Link Dist (ft)		472			293			414			397	
Turn Bay Length (ft)	200											
Base Capacity (vph)	371	574			584		958	908				
Starvation Cap Reductn	0	0			0		0	0				
Spillback Cap Reductn	0	0			0		0	0				
Storage Cap Reductn	0	0			0		0	0				
Reduced v/c Ratio	0.87	0.32			0.30		0.62	0.12				

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 24 (40%), Referenced to phase 4:EBTL and 8:WBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 18.1 Intersection LOS: B
Intersection Capacity Utilization 69.3% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: NB Ramp & Airport Road

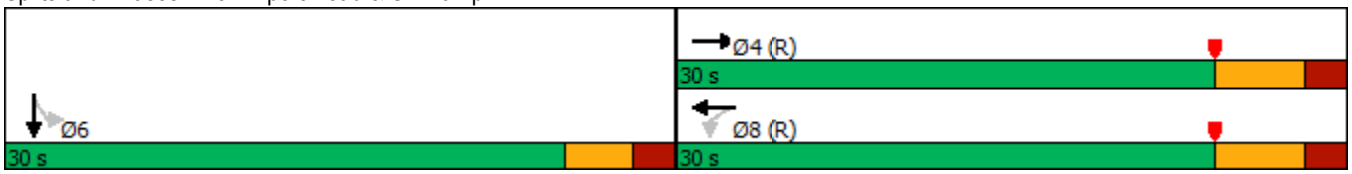


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	295	640	70	25	0	0	0	0	130	1	135
Future Volume (vph)	0	295	640	70	25	0	0	0	0	130	1	135
Satd. Flow (prot)	0	1863	1154	1770	1863	0	0	0	0	0	1648	0
Flt Permitted				0.523							0.976	
Satd. Flow (perm)	0	1863	1154	974	1863	0	0	0	0	0	1648	0
Satd. Flow (RTOR)			771								102	
Lane Group Flow (vph)	0	321	771	76	27	0	0	0	0	0	283	0
Turn Type		NA	Free	Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases			Free	8						6		
Total Split (s)		30.0		30.0	30.0					30.0	30.0	
Total Lost Time (s)		6.0		6.0	6.0						5.0	
Act Effct Green (s)		24.0	60.0	24.0	24.0						25.0	
Actuated g/C Ratio		0.40	1.00	0.40	0.40						0.42	
v/c Ratio		0.43	0.67	0.20	0.04						0.38	
Control Delay		15.3	3.1	3.2	1.8						9.3	
Queue Delay		0.0	0.0	0.0	0.0						0.0	
Total Delay		15.3	3.1	3.2	1.8						9.3	
LOS		B	A	A	A						A	
Approach Delay		6.7			2.9						9.3	
Approach LOS		A			A						A	
Queue Length 50th (ft)		81	0	5	1						41	
Queue Length 95th (ft)		140	0	m6	m2						90	
Internal Link Dist (ft)		2426			472			641			3536	
Turn Bay Length (ft)				200								
Base Capacity (vph)		745	1154	389	745						746	
Starvation Cap Reductn		0	0	0	0						0	
Spillback Cap Reductn		0	0	0	0						0	
Storage Cap Reductn		0	0	0	0						0	
Reduced v/c Ratio		0.43	0.67	0.20	0.04						0.38	

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 13 (22%), Referenced to phase 4:EBT and 8:WBTL, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.67
Intersection Signal Delay: 6.9 Intersection LOS: A
Intersection Capacity Utilization 52.6% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Airport Road & SB Ramp



PHASE II DRAINAGE REPORT

Range

Douglas County, Colorado

RICK Job No. D-02215
March 28, 2025

RICK

PHASE II DRAINAGE REPORT
FOR
RANGE
DOUGLAS COUNTY, COLORADO

Job Number: D-2215

Prepared for:
Range, LLC
8678 Concord Center Dr., Unit #200
Englewood, CO 80112

Prepared by:
RICK
8678 Concord Center Dr., Unit #200
Englewood, CO 80112

August 9, 2024
Revised: December 20, 2024
Revised: March 28, 2025

Certification

Professional Engineer:

"This report and plan for the Phase II drainage design of Range was prepared by me (or under my direct supervision) in accordance with the provisions of Douglas County Drainage Design and Technical Criteria for the owners thereof. I understand Douglas County does not and will not assume liability for drainage facilities designed by others."

_____

Troy Bales, P.E.
R.C.E. # No. 50961

State of Colorado No.: _____

Company: Rick Engineering Company

Developer:

"Range, LLC hereby certifies that the drainage facilities for Range shall be constructed according to the design presented in this report. I understand that Douglas County does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that Douglas County reviews drainage plans pursuant to Colorado Revised Statutes, Title 30, Article 28; but cannot, on behalf of Range, guarantee that final drainage design review will absolve Range, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design."

_____

Name of Developer

_____

Authorized Signature

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I. GENERAL LOCATION AND DESCRIPTION

A. Site Location:

Range is a proposed residential development consisting of single-family homes and open space on approximately 400 acres in Douglas County, Colorado. The portion of the site addressed in this report is currently undeveloped. Site development will include single family detached homes, open space, and associated roadways and infrastructure. The site is bound by undeveloped acreage to the north and south, US Highway 85 to the west, and Highlands Ranch open space to the east. Range is located within Section 34, Township 6 South, and Sections 2 and 3, Township 7 South, Range 68 West, of the Sixth Principal Meridian, County of Douglas, State of Colorado.

A vicinity map containing Range is located in Appendix A.

B. Description Of Property

The Range site is currently undeveloped, and the planned land use consists of residential homes and open space. The proposed Range development includes approximately 550 single family lots, two public access roads with associated infrastructure, ten full-spectrum detention ponds, and dedicated open space.

The existing Range site is undeveloped and is comprised of native grasses with mixed scrub oak. Soil data for the site was obtained from the USDA's Natural Resources Conservation Service (NRCS) Web Soil Survey. Soils on the site are predominately Fondis-Kutch association (hydrologic soils group C). Soils belonging to Hydrologic Soils Group C have a slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water on soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission. The NRCS soils data is provided in Appendix A.

Existing slope conditions generally range from 5% to 30% where development is proposed.

There are no known irrigation canals or ditch facilities located within the site.

There are no significant geologic features within the development.

The site lies within FEMA Flood Insurance Rate Map (FIRM) panels 08035C0151F and 08035C0153G, which are included in Appendix A. Daniels Park Drain traverses west to east through the site and is designated as Zone AE floodplain. Most of the proposed Range development is located within FEMA designated Zone X; however, there are two proposed roadway crossings over the Daniels Park Drain Zone AE floodplain to connect the northern and southern half of the development.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins:

The Range property is located entirely within the Plum Creek Drainage Basin. A large portion of the proposed development drains to Daniels Park Drain, which is tributary to Plum Creek. The remaining portions of the site drain west and north via unnamed minor drainages and are conveyed under US Highway 85 via existing culverts.

The main source of hydrologic information for Daniels Park Drain adjacent to the project site was established by the Outfall Systems Planning Study completed by WRC Engineering, Inc. (now a division of RESPEC) (WRC) in July 2003 entitled *Plum Creek Watershed Outfall Systems Planning Preliminary Design Report for Douglas County and Urban Drainage & Flood Control District* (2003 OSP). The OSP identifies peak flows within the drainageway to be 400 cubic feet per second (cfs) for the 5-year, 820 cfs for the 10-year, and 4,100 cfs for the 100-year. The OSP was prepared in conjunction with the *Flood Hazard Area Delineation Plum Creek Watershed for Douglas County and Urban Drainage & Flood Control District* by WRC (2001 FHAD). This FHAD was completed and incorporated into the effective FIS and FIRM. The hydrology and hydraulic models for this project were taken from the 2001 FHAD and 2003 OSP. Excerpts from both reports are included in Appendix D.

An ecological assessment of the site was performed by ERO Resources Corporation in August of 2023. The findings of the report state that the project area consists of land previously used for agricultural cattle ranching. Due to historic grazing and low baseflow, portions of Daniels Park Drain, and the surrounding tributaries on site, have steep banks, lack wetlands, and contain limited riparian habitat. Additionally, the soils are considered predominantly nonhydric. The healthy stream reaches of Daniels Park Drain and its tributaries show no signs of erosion and appear capable of handling high-flow events due to the presence of a wide accessible upland floodplain along the channel. Portions of Daniels Park Drain consist of a multithreaded channel which provides space for the channel to migrate, and multiple flow paths are available. Due to limited hydrology and sandy soils, no wetlands are present in Daniels Park Drain. The eroded banks lack stabilized vegetation and have bare bank slopes. For further analysis, input from a geomorphologist will be provided with subsequent submittals.

The project has implemented hydromodification management and conducted detailed hydraulic modeling using SMMM to mitigate minor storm events, ranging from 10% of the 2-year flow (0.1Q2) to the 10-year storm, and to provide detention for the 100-year storm. By addressing these lower storm events, the project aims to reduce increases in

runoff and volume to the stream, minimizing adverse effects on the drainageway. Mitigation will be achieved through on-site stormwater detention using various Stormwater Control Measures (SCMs) and hydromodification management, as outlined in Section III-D below. Additionally, the project proposes two roadway crossings over Daniels Park Drain. The preliminary design for these crossings accommodates both low and high flows by positioning the culverts at varying elevations. The proposed culverts' conveyance area is designed to allow low flows to meander and facilitate sediment movement, replicating pre-project conditions and enabling the stream to move naturally. Daniels Park Drain is included in the Douglas County Flood Insurance Study (FIS) number 08035CV001D.

Most of the existing off-site flows will be captured on site and routed to one of the nine proposed detention ponds. The remaining off-site flows within the property not conveyed through the site will bypass the detention ponds and will not be detained or treated for water quality. To remain consistent with the 2003 OSP, future land use conditions were selected for developing design peak flows and were based on future land use information found within the OSP. The Land Use Map from the 2003 OSP is included in Appendix B.

B. Minor Drainage Basins:

The basins delineated within this report reflect the historical drainage patterns. In general, proposed drainage basins will follow historical drainage patterns with minor rerouting for roadways. Extended Detention Basins (EDB) will be constructed to control discharge into existing channels at historic, or below historic, rates to comply with water quality and detention requirements of Douglas County. Off-site flows will be conveyed through the existing channels, storm sewer, and swales to avoid run-on to the proposed development.

The Pre-Development and Post-Development Drainage Maps included in Appendix F show drainage boundaries, areas, and percent impervious values. The basins for the site are described below:

Basin 1

Basin 1 is located on the southern portion of the site. The existing drainage generally sheet flows west, collecting in existing unnamed minor drainageways, ultimately draining under US Highway 85 via an existing 7’x5’ RCBC. Proposed land uses will be primarily non-urban with a small portion being urban. Additionally, one of the main public access roads to the site will bisect this basin. Developed and some undeveloped flows from this basin will be routed to proposed Detention Ponds 1B and 1D located within Basin 1. The proposed detention pond and bypassed off-site flows combined will discharge at historic flow rates.

Basin 4

Basin 4 is located on the southwestern portion of the site. The existing drainage generally sheet flows west, collecting in existing unnamed minor drainageways, ultimately draining under US Highway 85 via an existing 42" RCP. Proposed land uses will be primarily urban with a small portion being non-urban. Developed flows from this basin will be routed west via proposed grading and/or storm sewer to proposed Detention Pond 4 located within Basin 4. The proposed detention pond will discharge at historic flow rates.

Basin 5

Basin 5 is located on the eastern portion of the site, south of Daniels Park Drain. The existing drainage generally sheet flows north, collecting in existing unnamed minor drainageways, ultimately draining to Daniels Park Drain. Proposed land uses will be primarily urban with a portion being non-urban. Runoff from this basin will be routed via proposed grading and/or storm sewer to proposed Detention Pond 5 located within Basin 5. The proposed detention pond will discharge at historic flow rates.

Basin 6

Basin 6 is located on the southern and central portion of the site, south of Daniels Park Drain. The existing drainage generally sheet flows north, collecting in existing unnamed minor drainageways, ultimately draining to Daniels Park Drain. Proposed land uses will be primarily urban with a portion being non-urban. Runoff from this basin will be routed via proposed grading and/or storm sewer to proposed Detention Pond 6 located within Basin 6. The proposed detention pond will discharge at historic flow rates.

Basin 8

Basin 8 is located on the northeastern portion of the site. The existing drainage generally sheet flows south, collecting in existing unnamed minor drainageways, ultimately draining to Daniels Park Drain. Proposed land uses will be primarily urban with a portion being non-urban. Runoff from this basin will be routed via proposed grading and/or storm sewer to proposed Detention Pond 8 located within Basin 8. The proposed detention pond will discharge at historic flow rates.

Basin 9A

Basin 9A is located on the northern and central portion of the site. The existing drainage generally sheet flows south, collecting in existing unnamed minor drainageways, ultimately draining to Daniels Park Drain. Proposed land uses will be primarily urban with a portion being non-urban. Runoff from this basin will be routed via proposed grading and/or storm sewer to proposed Detention Pond 9A located within Basin 9A. The proposed detention pond will discharge at historic flow rates.

Basin 9B

Basin 9B is located on the northern and central portion of the site. The existing drainage generally sheet flows south, collecting in existing unnamed minor drainageways, ultimately draining to Daniels Park Drain. Proposed land uses will be primarily non-urban with a portion being urban. Runoff from this basin will be routed via proposed grading and/or storm sewer to proposed Detention Pond 9B located within Basin 9B. The proposed detention pond will discharge at historic flow rates.

Basin 12

Basin 12 is located on the northwestern portion of the site. The existing drainage generally sheet flows south and west, collecting in existing unnamed minor drainageways, ultimately draining under US Highway 85 via an existing 48" RCP. Proposed land uses will be primarily urban with a portion being non-urban. Runoff from this basin will be routed via proposed grading and/or storm sewer to proposed Detention Pond 12 located within Basin 12. The proposed detention pond will discharge at historic flow rates.

Basin 15

Basin 15 is located on the northern portion of the site. The existing drainage generally sheet flows north, collecting in existing unnamed minor drainageways, ultimately draining under US Highway 85 via an existing 10'x6' RCBC. Proposed land uses will be primarily urban with a portion being non-urban. Runoff from this basin will be routed via proposed grading and/or storm sewer to proposed Detention Pond 15 located within Basin 15. The proposed detention pond will discharge at historic flow rates.

III. DRAINAGE DESIGN CRITERIA

A. Regulations:

- Storm Drainage Design and Technical Criteria Manual – Douglas County, Colorado, June 2022.
- Roadway Design and Construction Standards – Douglas County, Colorado, May 2013.
- Standard Operating Procedure (SOP) for Extended Detention Basin (EDB) Inspection and Maintenance – Douglas County, Colorado, September 2014.
- Urban Storm Drainage Criteria Manual (USDCM) – Urban Drainage and Flood Control District (UDFCD), March 2024.

No deviation in criteria is requested from any criteria listed above.

B. Development Criteria Reference and Constraints:

- "Phase I Drainage Report for Range", CORE Consultants, Inc, July 16, 2021.

C. Hydrology:

a. Runoff Calculation Methods

This drainage study is prepared in accordance with the current Douglas County standards, presently the "Storm Drainage Design and Technical Criteria Manual, Douglas County, Colorado", June 2022, and the USDCM, UDFCD, March 2024. Instances where criteria conflict, the more stringent criteria is used.

Rational Method:

In accordance with the Storm Drainage Design and Technical Criteria Manual, Douglas County, June 2022 (herein referred to as the "Douglas County Drainage Criteria Manual"), Rational Method is used to calculate runoff for basins with area less than 160 acres and Colorado Urban Hydrograph Procedure (CUHP) is used to calculate runoff for basins more than 160 acres. The rational method was used to calculate the peak discharge for storm sewer, culvert, swale, inlet sizing and street capacity checks. The rational method equation is as follows,

$$Q = CIA$$

Where,
Q = Runoff in cubic feet/sec
C = Composite Runoff Coefficient for either 5 year or 100-year storm
I = Intensity of rainfall at calculated time of concentration
A= Area of basin in acres

The time of concentration is calculated by the following equation (equation 6-2 per USDCM, Jan 2016 edition):

$$t_c = t_i + t_t$$

Where,
t_c – Computed time of concentration (minutes)
t_i – Overland (initial) flow time (minutes)
t_t – Channelized flow time (minutes)

Initial or Overland Flow time is calculated by the following equation (equation 6-3 per USDCM, Jan 2016 edition):

$$t_i = \frac{0.395(1.1-C_5)\sqrt{L}}{S_0^{0.33}}$$

Where,
t_i – Overland (initial) flow time (minutes)
C_5 – Runoff coefficient for 5-year frequency
L - Length of overland flow
S_0 - Average slope along the overland path (ft/ft)

Channelized Flow time is calculated by the following equation (equation 6-4 per USDCM, Jan 2016 edition):

$$t_t = \frac{L_t}{60K\sqrt{S_0}}$$

Where,
t_t– Channelized flow time (travel time, min.)
L_t – Waterway Length (ft)
S_0 – Waterway Slope (ft/ft)
V_i – Travel time velocity (ft/s) = $K\sqrt{S_0}$
K – NRCS Conveyance factor

Time of concentration is also calculated based on the following equation (equation 6-5 per USDCM, Jan 2016 edition):

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_0}}$$

Where,

t_c – Minimum time of concentration for first design point when less than t_c from equation 6-2

L_t – Length of flow path

i – Imperviousness (expressed as decimal)

S_0 – Slope of flow path

The 5-year and 100-year storms are the minor and major storm events for this property in accordance with the Douglas County Drainage Criteria Manual. The intensity of the rainfall is determined from the Douglas County Drainage Criteria Manual and since the project lies within Zone 1, the following values of precipitation are used:

1-Hour Point Rainfall Values for Douglas County (inches)					
Event	2-Year	5-Year	10-Year	50-Year	100-Year
Zone 1	1.06	1.43	1.66	2.26	2.60

Colorado Urban Hydrograph Procedure:

In accordance with the Storm Drainage Design and Technical Criteria Manual, Douglas County, June 2022 (herein referred to as the "Douglas County Drainage Criteria Manual), Colorado Urban Hydrograph Procedure (CUHP) is used to calculate runoff for all detention basins and large off-site areas. CUHP is used to show compliance with the 100-year storm peak runoff rates on the site. Urban hydrograph calculations were done using ***CUHP 2005 Version 2.0.1 | Nov-2019***. This spreadsheet is available on mhfd.org. CUHP requires a rain gauge, subcatchment parameters, and infiltration parameters to compute peak runoff. A routing time step of 5 mins was used for subcatchments larger than 10 acres and 1 min was used for those less than 10 acres.

Subcatchment Parameters	
Area (ac)	Basin area measured in acres using AutoCAD
Length to Centroid (ft)	Length from the outfall point to the geometric center of the basin, measured using AutoCAD
Length (ft)	Length of longest flow path in the Basin. Also measured using AutoCAD
Slope (ft/ft)	Effective Slope within the basin. This was found by subdividing the longest flow path within the basin into separate reaches of approximately constant slope and calculating a weighted average according to Eqn. 6-7 of MHFD – Volume 1.
Percent Impervious (%)	Determined according to an area weighted average of proposed land use within the basin.
DCIA Level	Refers to the type of impervious area dispersion that is occurring within the watershed. May be level 0,1, or 2 according to chapter 3 in MHFD-V3. Typically, this parameter was not used
DCIA (%)	Percentage of the impervious area within the watershed that is directly connected via hardened conveyance to the outlet point
RPA(%)	The percentage of pervious area within the basin that receives flow from impervious areas. This includes buffer strips and swales.

Note: Unconnected Impervious areas flowing over pervious buffer strips and swales reduce the overall effective imperviousness of the basin.

Infiltration Parameters	
Watershed Depression Storage (in)	According to recommended values in Table 6-6 of MHFD-Volume 1, 0.1” was used for impervious areas and 0.35” was used for pervious areas.
Initial Rate (in/hr)	Dry soil infiltration rate determined using table 6-7 of MHFD-V1. In cases where multiple soil types were present, the soil type that underlies the majority of the basin was used. Areas with proposed fill assume type D soils due to compaction.
Final Rate (in/hr)	Saturated soil infiltration rate. See table 6-7.
Decay Coefficient	Exponential Decay Coefficient. See Table 6-7.

D. Hydromodification Management Plan (HMP)

Hydromodification refers to changes in the magnitude and frequency of stream flows as a result of urbanization and the resulting impacts on receiving channels in terms of erosion, sedimentation, and degradation of geomorphic stream characteristics. The degree to which a channel will erode is a function of the increase in driving force (shear stress), the resistance of the channel (critical shear stress), the change in sediment delivery, and the geomorphic condition of the channel. Critical shear stress is the stress threshold above which erosion occurs. Not all flows cause erosion -- only those that generate shear stress in excess of the critical shear stress of the bank and bed materials. Urbanization has the potential to increase the shear stress exerted on the channel by stream flows and can trigger erosion in the form of incision (channel downcutting), widening (bank erosion), or both. Increases in flow below critical shear stress levels have little or no effect on the channel. The purpose of hydromodification management is to minimize the potential of storm water discharges from the development from causing altered flow regimes and excessive downstream erosion in receiving waters. Hydromodification mitigation can provide:

- Demonstration of no post-project increase in impervious area and resultant peak flow rates as compared to pre-project conditions.
- Installation of SCMs, such as extended detention basins, rain gardens, to control runoff flows and durations from new impervious areas;
- Mitigation of flow and durations through implementation of extended detention flow duration control basins;
- Preparation of continuous simulation hydrologic models and comparison of the pre-project and mitigated post-project runoff peaks and durations (with hydromodification flow controls) until compliance is achieved; and
- Implementation of in-stream rehabilitation controls to demonstrate that projected increases in runoff peaks and/or durations do not accelerate erosion to the rehabilitated receiving stream reach.

A series of continuous simulation hydrologic model, using EPA SWMM (SWMM), were developed for the pre and post project conditions for the site at each discharge location or Point of

Compliance (POC). The project site drains to nine (9) Points of Compliance (POC) as shown in Pre- and Post-Project Hydromodification Management Plan Exhibits provided in Appendix F. In SWMM, rainfall loss parameters (parameters that describe processes occurring when rainfall lands on pervious lands and impervious lands) are entered in the "subcatchment" module. The subcatchment inputs used within the SWMM models include total area, width, percent slope and imperviousness, and the watershed's soil characteristics. In proposed conditions, the model inputs include a stage-storage discharge and stage-discharge curve for the proposed SCMs. The SWMM models are set up using the kinematic wave routing model and Green-Ampt infiltration model. Additionally, both pre- and post- project condition models utilize the hourly precipitation data from 1948 to 2013 at the Stapleton Rain Gauge. The SWMM inputs used for each basin have been provided within Appendix D.

a. HMP Modeling – Pre-Project Sub-Basins

In existing conditions, the project area is mostly undeveloped, with minor impervious surfaces due to existing residences within sub-basin 6. For the purpose of HMP modeling, the project is assuming all sub-basins are 5% impervious, based on the open space, undisturbed native grasses land use, per MHFD Vol 1 Chapter 6 Table 6-2. Please see Appendix F for the drainage basin delineation in pre-project conditions at each POC.

b. HMP Modeling – Post-Project Sub-Basins

In post-project, the major basin delineations have been dictated by the proposed grading, street layout, and storm drain network. The project proposes to maintain the same discharge locations as existing conditions and with this approach, diversion of areas between pre-project and post-project have been minimized to the maximum extent practicable. The project is proposing 10 SCMs to provide WQCV, mitigate the minor storm events, from 10% of the 2-year flow (0.1Q2) to the 10-year event, and provide detention for the 100-year storm. Care has been taken to maintain the outfall locations at all POCs and in proposed conditions, each SCM outfall has been designed to outlet at well-defined low points to reduce erosion at the storm drain outfall. Please see Appendix C for a complete table showing the percent impervious breakdown by land use.

POC-1 is located near the southwest corner of the project site and discharges to an existing swale that runs parallel to US Highway 85. In post-project conditions, Sub-Basin 1A is mainly open space area, Sub-Basin 1B is roadway area, and Sub-Basin 1D includes a small portion of roadway and is mainly single family residential area.

POC-4 is located near the intersection of Airport Road and US Highway 85 and is also located along an existing swale that ultimately discharges to Daniels Park Drain. In the proposed conditions, Sub-Basin 4 is comprised of landscape and single-family residential areas.

POC-5 and POC-6 are located on the central portion of the project area and both discharges directly to Daniels Park Drain. Sub-Basin 5A, 5B, 6 are located within the southern portion of the site and include mainly park areas, open space, landscaped areas, and single-family residences.

POC-7, 8-, and 9 are located on the central portion of the project area and discharge directly to Daniels Park Drain. POC 8 and 9 utilize SCMs to control peak flows into Daniels Park Drain, and the sub-basins to these POCs are inclusive of open space, landscaped areas, and single-family residences.

POC-12 is located along the western site boundary and discharges to an existing drainageway that eventually discharges to an existing swale along US Highway 85. In the proposed conditions, Sub-Basin 12 is comprised of landscape and single-family residential areas.

POC-15 is located along the northern site boundary and discharges to an existing drainageway that eventually discharges to an existing swale along US Highway 85. In the proposed conditions, Sub-Basin 15B is comprised of landscape and single-family residential areas. Sub-Basin 15A has been included in the model as undeveloped open space.

c. HMP Results

The continuous simulation model will generate a flow record corresponding to the frequency of the rainfall data input as its output. This flow record must then be processed to determine pre-development and post-project flow rates and durations. Compliance with hydromodification management requirements for this project is achieved when results for flow duration meet the performance standards. The performance standard is as follows:

- For flow rates ranging from 10 percent of the pre-development 2-year runoff event (0.1Q2) to the 10-year runoff event (Q10), the post-project discharge rates and durations must not exceed the pre-development rates and durations by more than 10 percent.

To demonstrate that a flow control facility meets the hydromodification management performance standard, first pre-development flows from Q2 through Q10 must be identified, then a flow duration summary is generated and compared for pre-development and post-project conditions between the appropriate fraction of Q2 to Q10. The range from a fraction of Q2 to Q10 represents the range of geomorphically significant flows for hydromodification management, based on our prior experience for similar streams. The upper bound of the range of flows to control is pre-development Q10 for all projects. The lower bound of the range of flows to control, or "lower flow threshold" is a fraction (10% or 0.1Q2) of pre-development Q2 that is based on the erosion susceptibility of the stream and depends on the specific natural system (stream) that a project will discharge to. The values for the upper limit and the low flow threshold have been selected based on extensive prior experience developing HMP models for projects discharging to similar streams. While these values may be revised in subsequent submittals based on coordination with the project geomorphologist, significant departures from these values are not anticipated. If additional background information is needed for the determination of these values, the following sources can be referred to:

1. Section 5 of the San Diego Final Hydromodification Plan
2. Appendix I of the Santa Margarita Region Hydromodification Plan
3. SCCWRP Hydromod Field Screening Tool (excel file) and its manual (pdf) with instructions on how to use the excel tool – this to evaluate channel susceptibility

d. Flow Frequency Determination

Flow rates for hydromodification management studies must be based on partial duration series analysis of the continuous hourly flow output. Partial duration series frequency calculations consider multiple storm events in a given year. To construct the partial duration series:

- Parse the continuous hourly flow data into discrete runoff events. The following separation criteria may be used for separation of flow events: a new discrete event is designated when the flow falls below an artificially low flow value based on a fraction of the contributing watershed area (e.g., 0.002 cfs/acre) for a time period of 24 hours.

- Rank the peak flows from each discrete flow event, and compute the return interval or plotting position for each event.

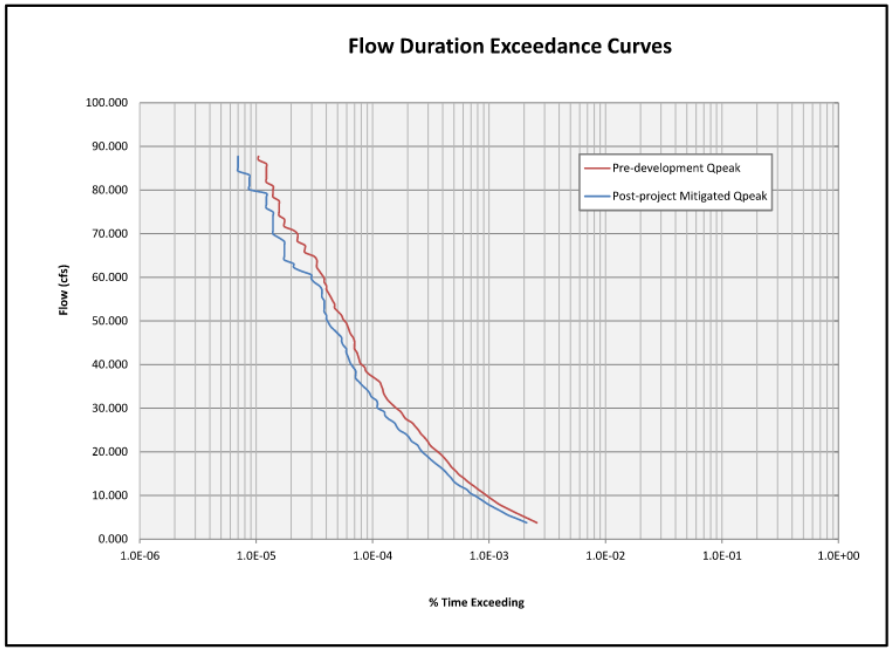
Pre-development Q2 and Q10 were determined from the partial duration analysis for the pre-development hourly flow record. Pre-development Q10 is the upper threshold of flow rates to be controlled in the post-project condition. The lower flow threshold is a fraction of the pre-development Q2 determined based on the erosion susceptibility of the receiving stream.

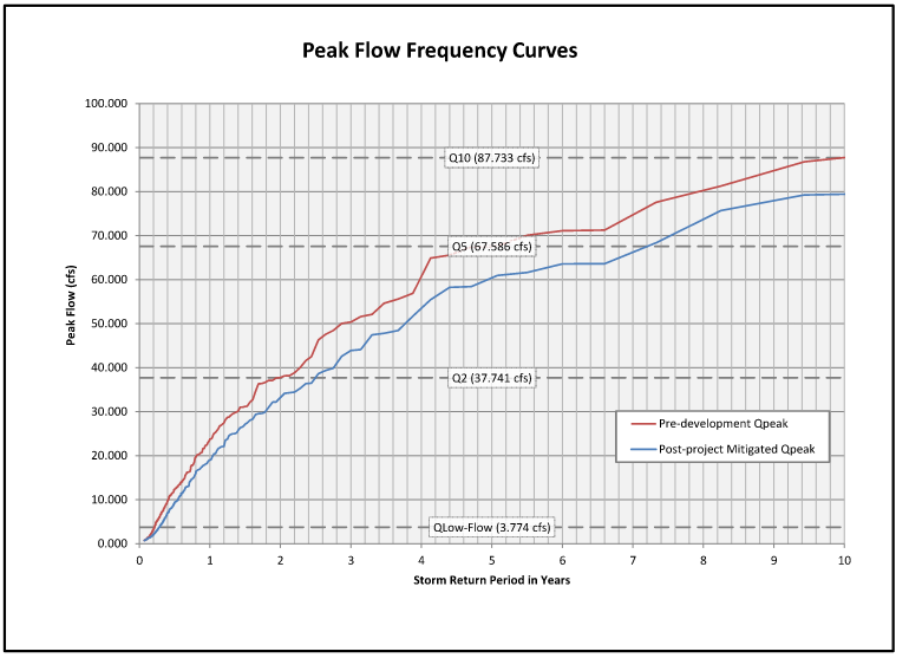
e. Flow Duration Determination

Flow durations are also summarized within the range of flows to control. Flow duration statistics provide a simple summary of how often a particular flow rate is exceeded. To prepare this summary:

- Rank the entire hourly runoff time series output.
- Extract the portion of the ranked hourly time series output from the lower flow threshold to the upper flow threshold – this is the portion of the record to be summarized.
- Divide the applicable portion of the record into 100 equal flow bins (compute the difference between the upper flow threshold (cfs) and lower flow threshold (cfs) and divide this value by 99 to establish the flow bin size).

Pre- and Post- Project Flow Frequency and Flow Duration long-term simulation results showing flow control compliance has been met at each POC have been provided within Appendix D. Flow Duration Curves and Flow Frequency Curve examples showing the post-project mitigated Q_{peak} is less than the pre-development Q_{peak} has been provided for one POC below:





E. Hydraulics:

Allowable use of streets/roads for minor (5-year) storm runoff:

Street Classification	Allowable Flow Depth in Gutter Flowline*	Maximum Roadway Encroachment
Urban Local Type I (Type A)	No curb overtopping.	Flow may spread to crown of street.
Entry Street (Type A)	No curb overtopping.	Flow may spread to crown of street.
Collector Street (Type B)	No curb overtopping.	Flow spread must leave at least one 10-foot lane free of water (5-feet either side of the crown of street.)

*If a 4-inch curb with an attached sidewalk is used (i.e., combination or rollover curb), the flow may spread to the back of sidewalk

Allowable use of streets/roads for major (100-year) storm runoff:

Street Classification	Allowable Flow Depth
Type A, B and C	The depth of water at the gutter flowline shall not exceed 12-inches.

Standard CDOT Type R curb-opening and Type C grate inlets have been used for the proposed inlets. Per the Douglas County Drainage Criteria Manual, storm sewers are sized to convey the minor design storm in a "just full" condition, generally without surcharging for the most part. The major storm event hydraulic grade lines are allowed to rise above the top of the storm sewer pipe and surcharge the system. However, a minimum clearance of 1-foot below the manhole lid, inlet grate or inlet curb opening elevation has been maintained.

The minimum pipe size for storm sewers located within the County Right-of-Way and public easements is 18-inches per the standard. Also, outlets into detention basins and connections to the public storm sewer system are designed with Reinforced Concrete Pipes (RCP).

Storm sewer easement widths have been maintained at 25-feet for storm sewers less than 36-inch in diameter and at 30-feet for 36-inch diameter and larger per the standard. Maximum manhole spacing is as follows:

Pipe Diameter	Maximum Distance Between Manholes
18-inch to 36-inch	400 feet
>36-inch	500 feet

Following criteria is used for sizing manholes:

Pipe Diameter	Minimum Manhole Diameter	Manhole Types
<42-inch	5 feet	Cast-in-place Slab Base
48-inch to 54-inch	6 feet	Cast-in-place Slab Base
60-inch to 72-inch	5 feet (Riser)	Box Base, Denver Type "P"
72-inch to 78-inch	5 feet (Riser)	Box Base, Denver Type "P", T-Base
78-inch to 96-inch	5 feet (Riser)	Box Base, T-Base
>96-inch	5 feet (Riser)	T-Base

Detailed storm sewer sizing, confluence analysis, hydraulic grade lines and energy grade line analyses will be performed using Hydraflow Storm Sewers Extension for Autodesk Civil 3D as part of the Phase III drainage report. Applicable storm sewer losses will be calculated, and hydraulic grade lines will be computed for the proposed storm sewer per criteria set forth in the USDCM Volume 1, March 2024 condition. Tailwater conditions will also be accounted for when applicable.

F. Water Quality Enhancements:

Best Management Practices (BMPs) for the project are implemented using a four-step process as defined in Chapter 14 of the Douglas County Drainage Criteria Manual as follows:

- Step 1: Reduce runoff volume to the maximum extent practicable.
- Step 2: Provide WQCV and flood control detention via full-spectrum detention.
- Step 3: Utilize stream channel stabilization techniques.
- Step 4: Undertake source control.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities:

General Concept: The project site has been designed to convey runoff from the proposed site in accordance with the design criteria described in Section III. Stormwater runoff from basins flows onto streets with curb and gutter before being intercepted by inlets located on the street. Inlets are provided where street capacity is exceeded for depth or spread criteria for either minor or major storm. The storm sewer system will be designed to ensure the hydraulic grade line of the system is below the ground elevation during the major storm. The proposed storm sewer systems drain to Extended Detention Basins, where the flow is detained and released at allowable rates.

Street Capacity and Inlets: Street capacity and CDOT Type R inlets along the proposed streets have been designed utilizing the UDFCD Street and Inlet Hydraulics spreadsheet (MHFD-Inlet Version 5.01) based on Chapter 7 of the Douglas County Storm Drainage Design and Technical Criteria Manual (DCSDTC). Type C inlets have been designed utilizing the weir equation and assuming 50% clogging to account for the grate and debris build up. The inlet calculations include the interception rates for both the minor and major storm events. Typical inlet calculations have been included in Appendix C. Detailed inlet calculations for each individual proposed inlet will be included with the Phase III drainage report.

Storm Sewer System: Storm sewers have been sized preliminarily using normal depth methods using the rational method post-project peak flow rate. Detailed storm sewer using the Hydraflow Storm Sewers Extension for Autodesk Civil3D will be included with the Phase III drainage report.

Swales: Swales for conveying flows through the site were sized based on the Urban Storm Drainage Criteria Manual Volume 2, Chapter 8, Section 6, Swales. Where feasible, swales will have a trapezoidal geometry with a maximum side slope of 5:1 and adequately convey the 100-year storm. Swale calculations will be included with the Phase III drainage report.

Riprap: Riprap at pipe outlets will be designed per USDCM Volume 1, Chapter 9, Section 3. The detention basin emergency spillways have been designed per USDCM Volume 2, Chapter 12, Section 5. Calculations for the proposed riprap pads and emergency spillways will be included with the Phase III drainage report.

B. Stormwater Storage Facilities:

The project proposes ten (10) extended detention basins, namely EDB 1B, 1D, 4, 5, 6, 8, 9A, 9B, 12, and 15. The detention basins are designed at 4:1 side slope and a micropool is provided at the bottom. Per Douglas County Drainage Criteria Manual, freeboard of 1 foot is provided. The emergency spillway for the proposed detention basins have been designed to convey the post-project un-detained 100-year runoff while maintaining the minimum freeboard.

In accordance with the Detention Criteria for Douglas County, the EDBs will provide detention of the Water Quality Capture Volume (WQCV), 100-Year storm event and hydromodification flow control using continuous simulation modeling for flow rates ranging from 10 percent of the pre-development 2-year runoff event (0.1Q2) to the 10-year runoff event (Q10). The post-project flow rates for the 100-year storm event will be detained back to 90% of the pre-development peak flow rates.

EDBs were designed using the Environmental Protection Agency (EPA) Storm Water Management Model 5.0 (SWMM) to provide detention and mitigate for the additional impervious area in the proposed condition. The design maximum allowable release rate for these detention basins will match the overall pre-project historic flow rate for the 100-year storm, as stipulated by Douglas County Drainage Criteria Manual. Please refer to Appendix B for supporting detention calculations.

An emergency overflow structure will be sized for the EDB-9A and 15 to convey the un-detained Q100 safely through the proposed outfall pipes without flooding or impacting the adjacent roads or pads. The remainder of the proposed EDBs will be designed with a trapezoidal weir spillway.

In addition to HMP modeling, the project has provided SWMM calculations for the 100-year detention calculations.

Separate SWMM Models have been provided in pre- and post- project conditions using CUHP to calculate the peak 100-year storm and the results are summarized below:

Q100 Peak Flow Summary					
POC ID	Area (ac)			Q100 (cfs)	
	Pre	Post	Δ	Pre	Mitigated Post
POC-1	74.77	76.78	2.01	98.7	86.4
POC-4	64.52	64.18	-0.34	79.8	69.4
POC-5	46.70	45.64	-1.06	94.8	69.8
POC-6	44.37	54.65	10.28	46.9	19.5
POC-8	152.09	153.14	1.05	174.4	164.7
POC-9	21.76	23.70	1.94	30.7	28.2
POC-12	22.16	22.81	0.65	38.5	32.5
POC-15	78.35	78.58	0.23	104.1	88.1

Maintenance of these detention basins will be required as defined by the Standard Operating Procedure (SOP) for Extended Detention Basin (EDB) Inspection and Maintenance – Douglas County, Colorado, September 2014. This will be facilitated via the future homeowner's association and/or maintenance district that may be established. A separate Operation and Maintenance (O&M) report titled: "Stormwater Management Facility Operation and Maintenance Manual for Range" will be prepared during Phase III.

C. Water Quality Enhancement BMPs:

Non-Structural Stormwater Control Measures (SCMs) focus on preserving open space, protecting natural systems, and incorporating existing landscape into the site plan to manage stormwater at its source. The development minimizes impervious areas where applicable and incorporates preventative maintenance measures during construction to minimize storm water contamination.

Structural SCMs are incorporated to improve water quality and runoff leaving the site. Structural SCMs include ditches and EDBs with low flow channels, micropools, forebays and outlet control systems to control sediment in the stormwater and attenuate the peak flows. Ten (10) EDBs are proposed as part of the project.

D. Floodplain Modifications:

This project proposes to modify the Daniels Park Drain floodplain to add two road crossings which connect the North and South portions of the project site. The proposed improvements associated with this project will provide full conveyance of the 100-year storm event. The post-project channel geometry reflects the two proposed road crossings over Daniels Park Drain. The western road crossing is approximately 2130 feet upstream of the US Highway 85 crossing and the eastern road crossing is approximately 4275 feet upstream of the US Highway 85 crossing. Currently, the proposed design for both roadway crossings over Daniels Park Drain includes a series of about 15 box culverts spread throughout the floodplain, each 14'-16' wide and 2'-6' tall, although the design is subject to change with the final drainage study. The intent of this design is to bypass flows across the entire span of the floodplain. Both proposed roadway crossings have been designed such that the 100-year flow rates do not overtop the roadway and allow for the low flows to meander, mimicking the pre-project condition. Because a large portion of roadway will be in the floodplain/floodway, a CLOMR/LOMR application will be required.

E. Additional Permitting Requirements:

- Douglas County Grading, Erosion and Sediment Control (GESC) Permit
- Colorado Department of Public Health & Environment – General Permit for Stormwater Discharges Associated with Construction Activity (NPDES)
- Conditional Letter of Map Revision (CLOMR)/Letter of Map Revision (LOMR)

V. CONCLUSIONS

A. Compliance with Standards:

This *Phase II Drainage Report for Range* meets criteria set forth by the Storm Drainage Design and Technical Criteria Manual – Douglas County, Colorado, June 2022 and the Urban Storm Drainage Criteria Manual (USDCM) – Urban Drainage and Flood Control District (UDFCD), March 2024.

B. Variances:

No variances from design criteria are requested at this time.

C. Drainage Concept:

The Range development will provide full conveyance of stormwater flow from the project site during the minor and major storm events. Stormwater flow from the project site will be treated for water quality, hydromodification flow control and detention of the minor and major storm events. By providing hydromodification flow control, the project is ensuring the low flow storm events ranging from the 0.1Q2 to the 10-year storm have been evaluated and release rates and durations are mitigated to less than pre-project conditions. The extended detention basins designed for the project account for a range of storm events and impacts to Daniels Park Drain are not anticipated. The improvements associated with this project are not anticipated to have any adverse impacts on wetlands/floodplains, downstream drainage facilities or adjacent properties at this time.

VI. REFERENCES

Storm Drainage Design and Technical Criteria Manual – Douglas County, Colorado, June 2022.

Roadway Design and Construction Standards – Douglas County, Colorado, May 2013.

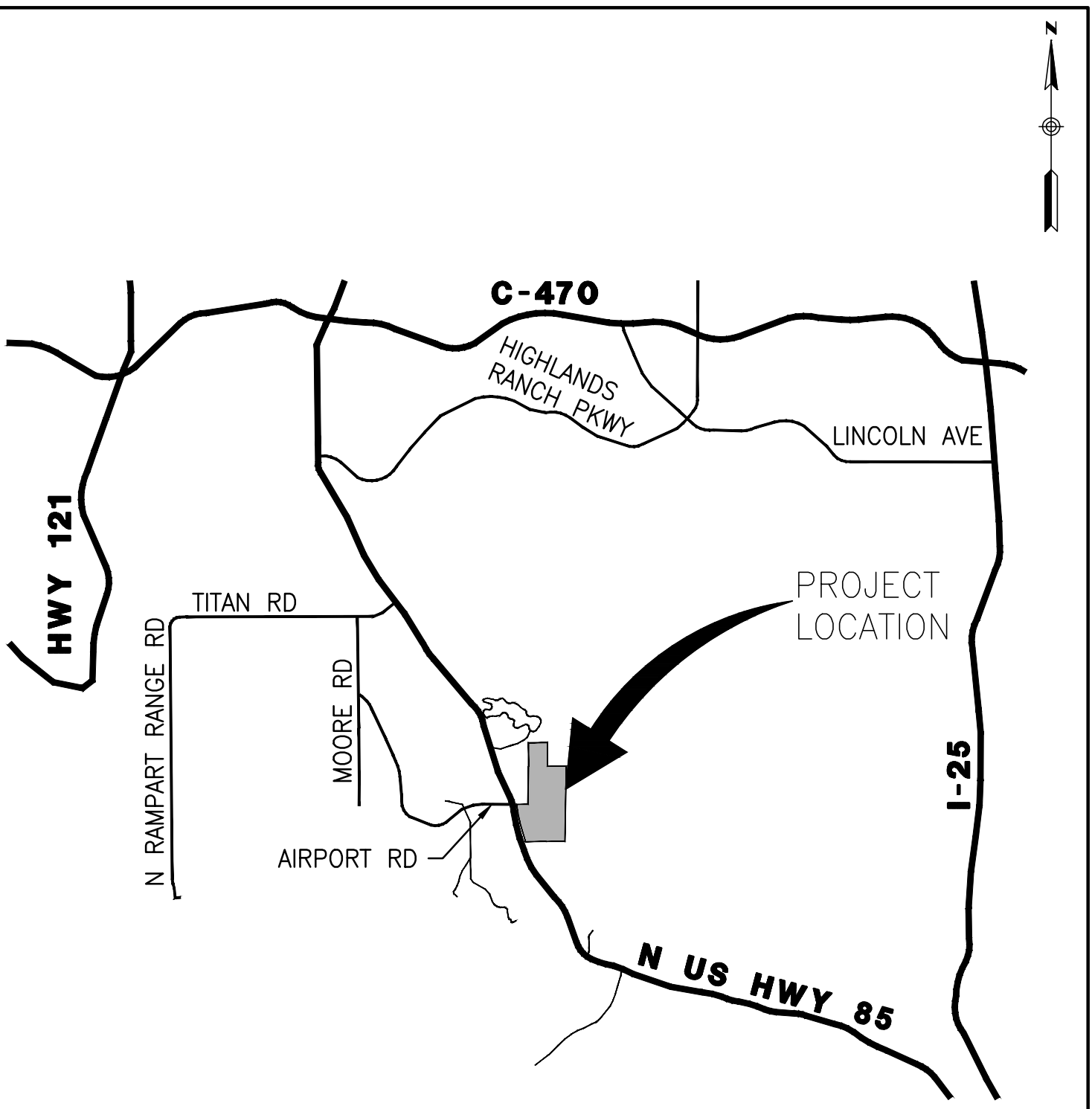
Standard Operating Procedure (SOP) for Extended Detention Basin (EDB) Inspection and Maintenance – Douglas County, Colorado, September 2014.

Urban Storm Drainage Criteria Manual (USDCM) – Urban Drainage and Flood Control District (UDFCD), March 2024.

"Phase I Drainage Report for Range", CORE Consultants, Inc, July 16, 2021.

APPENDIX A

General Information



LEGEND:

PROPERTY BOUNDARY

10,000 5,000 0 10,000

GRAPHIC SCALE: 1"=10,000'

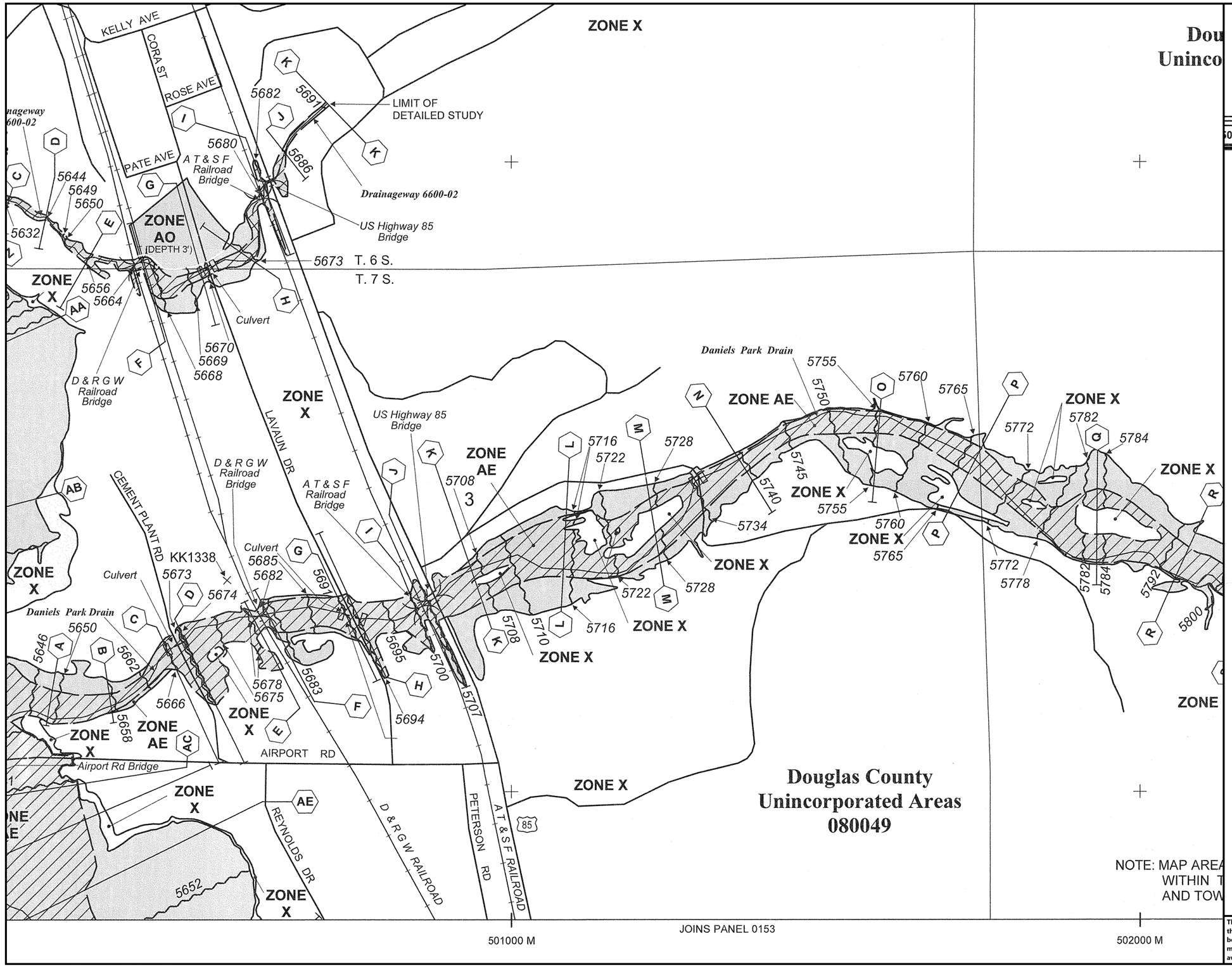
RICK
SAN DIEGO ORANGE RIVERSIDE SACRAMENTO SAN LUIS OBISPO
PHOENIX TUCSON LAS VEGAS DENVER
303-537-8020
rickengineering.com
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112

RANGE

VICINITY MAP

PROJECT NO:	02215
DRAWN BY:	NAS
CHECKED BY:	TWB
SCALE:	1"=10,000'
DATE:	8/9/2024

\\cp.rickeng.com\projects\D02000\2215_Range\WaterRes\2215-VicinityMap.dwg



MAP SCALE 1" = 500'

250 0 500 1000 FEET

50 0 150 300 METE

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0151F

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 151 OF 495

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0151	F

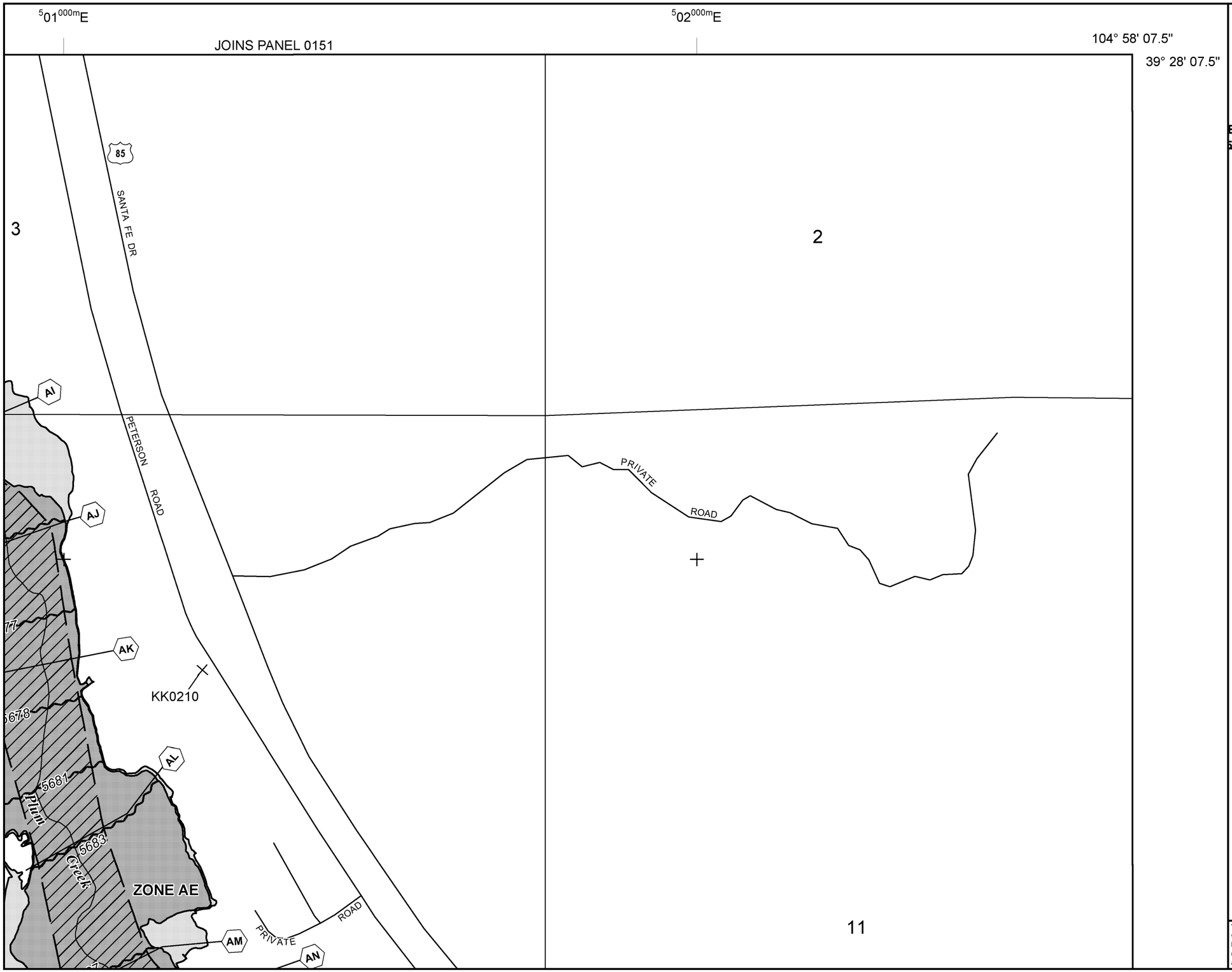
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08035C0151F

EFFECTIVE DATE
SEPTEMBER 30, 2005

Federal Emergency Management Agency

This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at https://msc.fema.gov.



MAP SCALE 1" = 500'

250 0 500 1000 FEET

50 0 150 300 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0153G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 153 OF 495

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0153	G

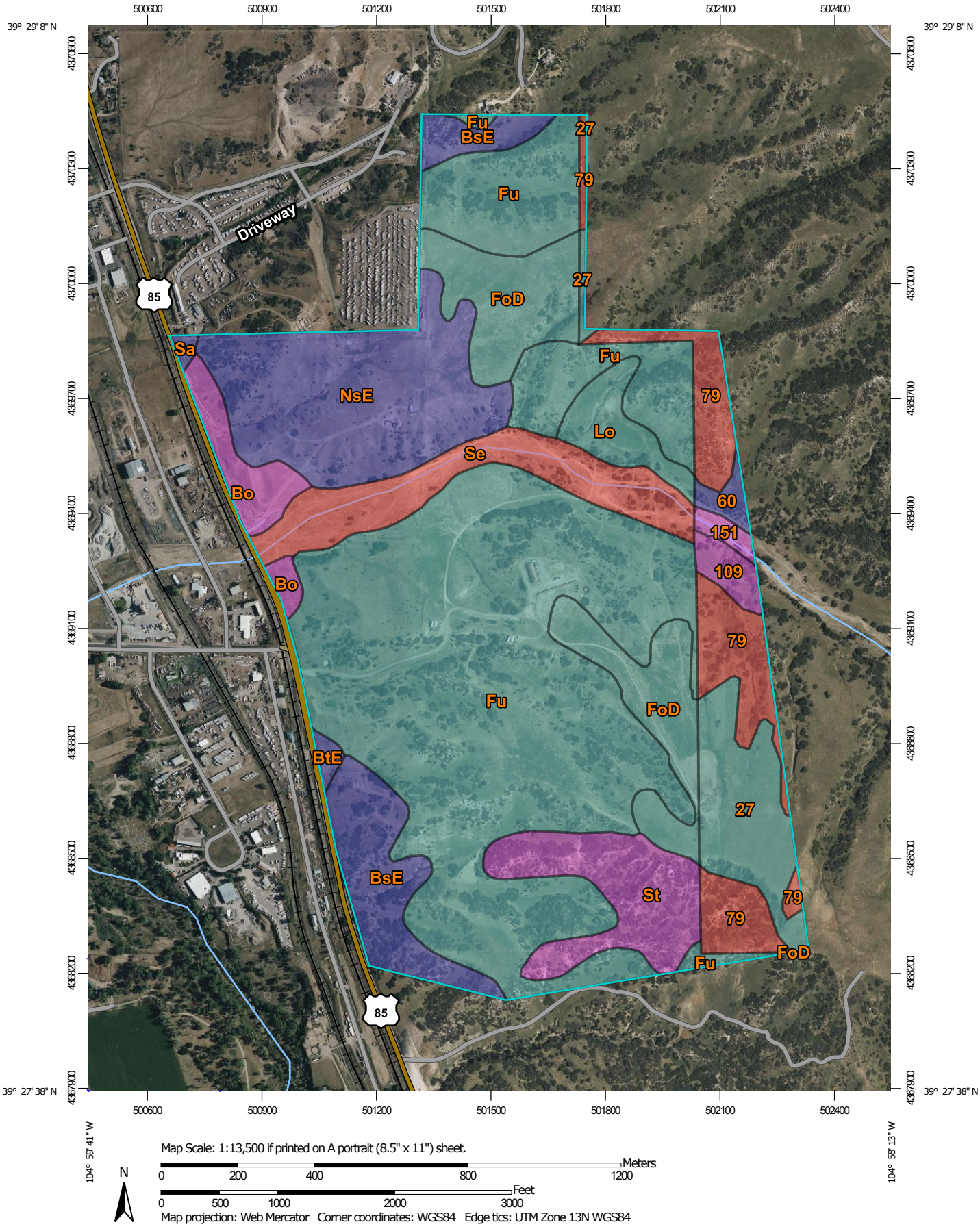
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08035C0153G

MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at https://msc.fema.gov.


104° 59' 41" W
104° 58' 13" W
39° 29' 8" N
39° 27' 38" N
500600
500900
501200
501500
501800
502100
502400
4370600
4370300
4370000
4369700
4369400
4369100
4368800
4368500
4368200
4367900
Fu
BsE
27
79
Fu
Driveway
85
FoD
27
Sa
Fu
NsE
79
Lo
Se
Bo
60
151
109
Bo
79
Fu
FoD
BtE
27
BsE
St
79
79
Fu
FoD
85
Map Scale: 1:13,500 if printed on A portrait (8.5" x 11") sheet.
N
Meters
0
200
400
800
1200
Feet
0
500
1000
2000
3000
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 scales ranging from 1:20,000 to 1:24,000.

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 Survey Area: Golden Area, Colorado, Parts of Denver, Douglas, Jefferson, and Park Counties
Survey Area Data: Version 18, Aug 24, 2023

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 1, 2020—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
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	A	13.8	2.3%
BsE	Bresser-Louviers complex, 7 to 30 percent slopes	B	32.9	5.6%
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	B	1.7	0.3%
FoD	Fondis clay loam, 3 to 9 percent slopes	C	49.3	8.3%
Fu	Fondis-Kutch association	C	274.0	46.2%
Lo	Loamy alluvial land	C	12.4	2.1%
NsE	Newlin-Satanta complex, 5 to 20 percent slopes	B	65.9	11.1%
Sa	Sampson loam	B	1.1	0.2%
Se	Sandy wet alluvial land	D	33.5	5.7%
St	Stapleton-Bresser association	A	30.7	5.2%
Subtotals for Soil Survey Area			**515.4**	**87.0%**
Totals for Area of Interest			**592.7**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
27	Denver clay loam, 5 to 9 percent slopes	C	28.8	4.9%
60	Haverson loam, 0 to 3 percent slopes	B	3.2	0.5%
79	Leyden-Nunn-Rooney complex, 9 to 30 percent slopes	D	37.5	6.3%
109	Paymaster sandy loam, 0 to 3 percent slopes	A	5.2	0.9%
151	Torrifluvents, very gravelly, 0 to 3 percent slope	A	2.5	0.4%
Subtotals for Soil Survey Area			**77.3**	**13.0%**
Totals for Area of Interest			**592.7**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

FOR REFERENCE ONLY

Referenced Material

COMPREHENSIVE MASTER PLAN
LAND USE MAP

DOUGLAS COUNTY, COLORADO
MAY 2006 MAP UPDATE

COMPREHENSIVE MASTER PLAN AREAS

- PRIMARY URBAN AREA
- SEPARATED URBAN AREA
- NORTHERN US HIGHWAY 85 CORRIDOR
- NON-DOUGLAS COUNTY BASED MUNICIPALITIES
- NON-URBAN AREA
- RURAL VILLAGES
- RURAL VILLAGE INFLUENCE AREA
- SUBAREAS
- CENTENNIAL AIRPORT REVIEW AREA

MUNICIPAL PLANNING AREAS

- MUNICIPAL PLANNING AREA INCLUSIVE OF COUNTY PUA
- PRIMARY URBAN SERVICE AREA (INCORPORATED)
- SECONDARY URBAN SERVICE AREA
- CASTLE ROCK IGA BOUNDARY & BUFFER AREA
- PARKER IGA BOUNDARY & BUFFER AREA

(Note: Refer to section 2.11 for detailed Municipal Planning Area Designations.)

SIGNIFICANT OPEN SPACE

- PIKE NATIONAL FOREST
- SIGNIFICANT PARKS & OPEN SPACE
- COUNTY OPEN SPACE WITHIN TOWN BOUNDARIES

(Note: Refer to Department of Open Space Maps for more information on all Open Space.)

DISCLAIMER:
All data and information ("Products") contained herein are for informational purposes only. Although such Products are believed to be accurate at the time of printing, Douglas County does not warrant that such Products are error free. Douglas County provides these Products on an "as is" basis without warranties of any kind, either express or implied, including, but not limited to, warranties of title or implied warranties of merchantability or fitness for a particular purpose. Douglas County shall not be liable for any direct, indirect, incidental, special or consequential damages arising out of the use of such Products, or the inability to use such Products or out of any breach of any warranty. The user acknowledges and agrees that the use of such Products is at the sole risk of the user.

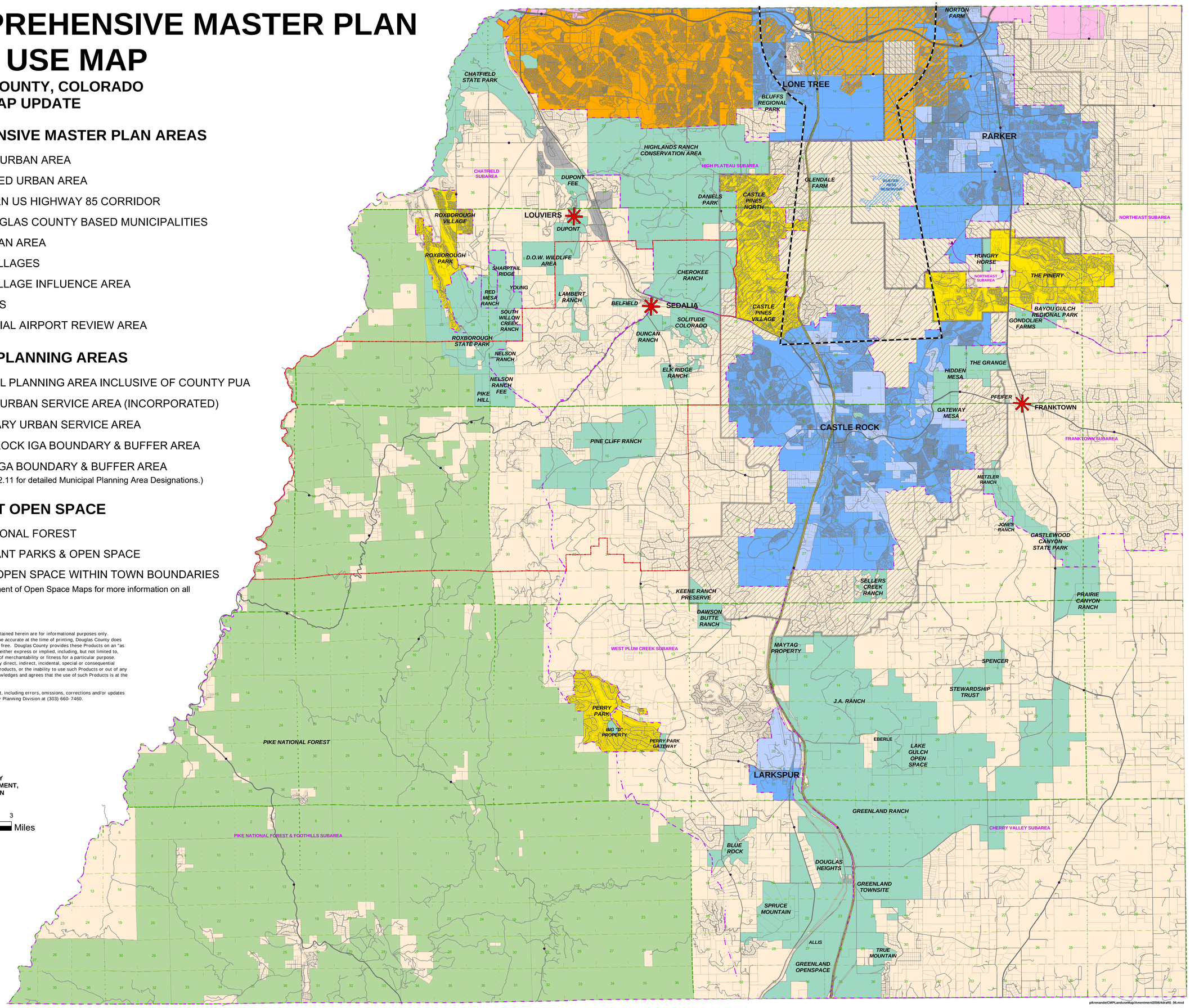
General questions about this map product, including errors, omissions, corrections and/or updates should be directed to the Douglas County Planning Division at (303) 660- 7460.

N

MAY 2006
DOUGLAS COUNTY
COMMUNITY DEVELOPMENT,
PLANNING DIVISION

0 0.5 1 2 3 Miles

fraction 1:63360



plkrenande/CMPLanduseMap/Amentment2006/4draft5_06.mxd

FLOOD HAZARD AREA DELINEATION
PLUM CREEK WATERSHED

Prepared For:

DOUGLAS COUNTY
URBAN DRAINAGE & FLOOD CONTROL DISTRICT

Prepared By:

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET, SUITE 404
DENVER, COLORADO 80246
(303) 757-8513

NOVEMBER, 2001

WRC File: 2048/21

FLOOD HAZARD AREA DELINEATION
PLUM CREEK WATERSHED

DOUGLAS COUNTY
URBAN DRAINAGE & FLOOD CONTROL DISTRICT
NOVEMBER 2001

PLUM CREEK
HIGHLINE CANAL
W. TITAN RD.
HIGHLANDS GULCH (6603)
US 85
AT&SF RR
D&RGW RR
OXIDE DRAW (6603-5)
PLUM CREEK (6600)
STERLING GULCH (6602)
PLUM CREEK (6600)
LOUVIERS GULCH (6604)
DRAINAGEWAY 6600-02
DRAINAGEWAY 6604-01
LOUVIERS
DANIELS PARK DRAIN (6608)
T 6 S
T 7 S
R 68 W
R 67 W
STUDY AREA
PLUM CREEK (6600)
LOUVIERS GULCH (6604)
DRAINAGEWAY 6605-01
INDIAN CREEK (6605)
LEHIGH GULCH (6606)
INDIAN CREEK (6605)
SEDALIA
US 85
JARRE CREEK (6610)
WEST PLUM CREEK (6611)
EAST PLUM CREEK (6630)
AT&SF RR
US 85
D&RGW RR
HWY 105
HWY 67
RAINBOW CREEK (6607)
DOUGLAS COUNTY

2000 1000 0 2000 4000
ORIGINAL SCALE: 1"=2000'

LEGEND

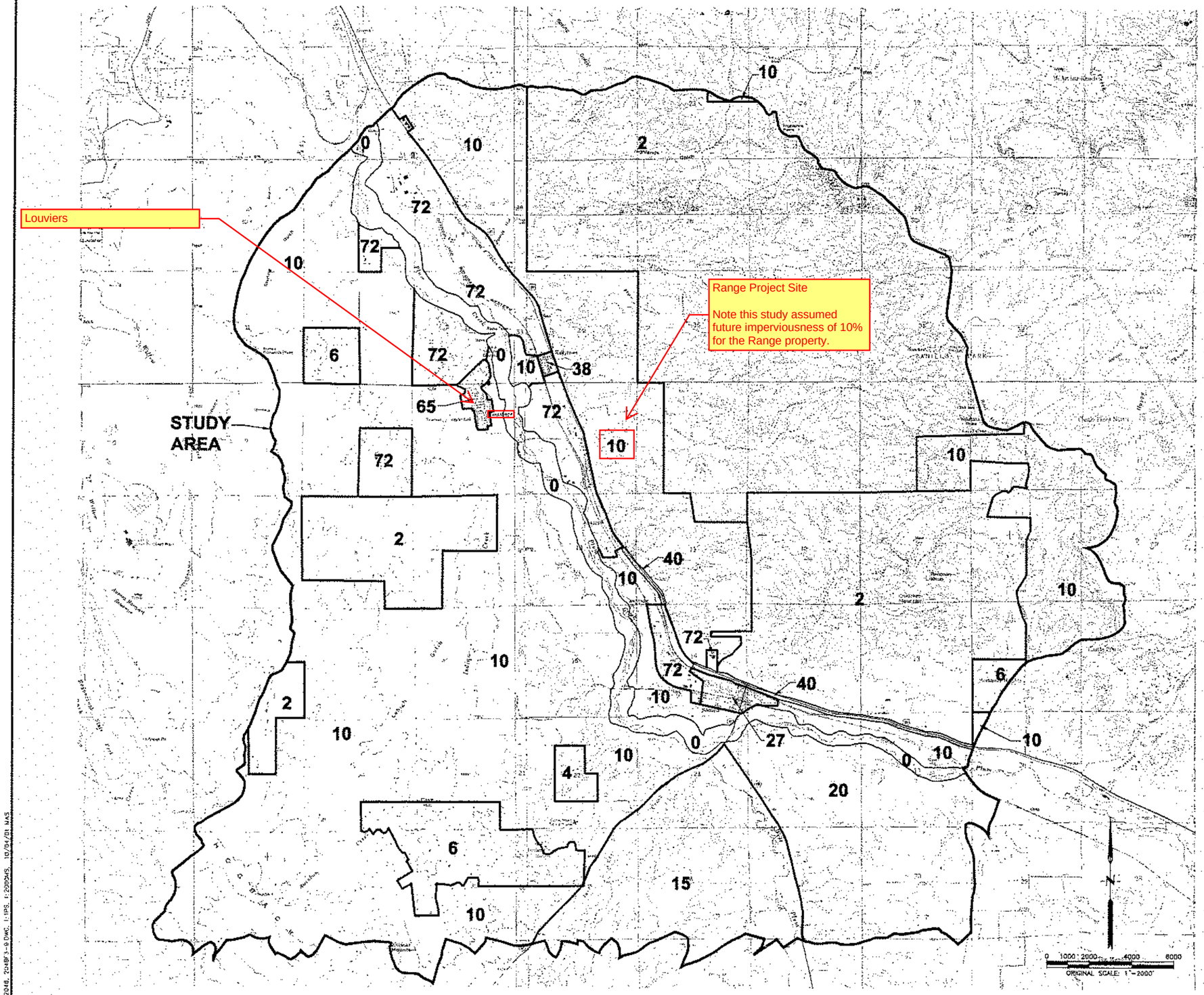
- STUDIED STREAM SEGMENTS
- RAILROAD
- SECTION LINE

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET SUITE 404
DENVER, COLORADO 80246
PHONE NO. (303) 757-8513
FAX NO. (303) 758-3208

2048_20480021.DWG, R14, 1:1PS, 1:2000-MS, RECOR-HALF FCS, 06/12/01, MAS

LIST OF DRAWINGS

SHEET NUMBER	DESCRIPTION	STATIONS
–	TITLE SHEET AND SHEET INDEX	–
1.	PLUM CREEK PLAN & PROFILE	1+00 TO 30+00
1A.	PLUM CREEK PLAN	1+00 TO 30+00
2.	PLUM CREEK PLAN & PROFILE	30+00 TO 60+00
2A.	PLUM CREEK PLAN	30+00 TO 60+00
3	PLUM CREEK PLAN & PROFILE	60+00 TO 90+00
3A.	PLUM CREEK PLAN	60+00 TO 90+00
4.	PLUM CREEK PLAN & PROFILE	90+00 TO 120+00
4A.	PLUM CREEK PLAN	90+00 TO 120+00
5.	PLUM CREEK PLAN & PROFILE	120+00 TO 150+00
5A.	PLUM CREEK PLAN	120+00 TO 150+00
6.	PLUM CREEK PLAN & PROFILE	150+00 TO 180+00
6A.	PLUM CREEK PLAN	150+00 TO 180+00
7	PLUM CREEK PLAN & PROFILE	180+00 TO 210+00
7A.	PLUM CREEK PLAN	180+00 TO 210+00
8.	PLUM CREEK PLAN & PROFILE	210+00 TO 233+34
8A.	PLUM CREEK PLAN	210+00 TO 233+34
9.	WEST PLUM CREEK PLAN & PROFILE	250+00 TO 280+00
9A.	WEST PLUM CREEK PLAN	250+00 TO 280+00
10.	WEST PLUM CREEK PLAN & PROFILE	280+00 TO 310+00
10A.	WEST PLUM CREEK PLAN	280+00 TO 310+00
11.	WEST PLUM CREEK PLAN & PROFILE	310+00 TO 340+00
11A.	WEST PLUM CREEK PLAN	310+00 TO 340+00
12.	WEST PLUM CREEK PLAN & PROFILE	340+00 TO 370+00
12A.	WEST PLUM CREEK PLAN	340+00 TO 370+00
13.	WEST PLUM CREEK PLAN & PROFILE	370+00 TO 400+00
13A.	WEST PLUM CREEK PLAN	370+00 TO 400+00
14.	WEST PLUM CREEK PLAN & PROFILE	400+00 TO 413+48
14A.	WEST PLUM CREEK PLAN	400+00 TO 413.48
15.	STERLING GULCH PLAN & PROFILE	500+00 TO 529+00
16.	STERLING GULCH PLAN & PROFILE	529+00 TO 558+00
17.	STERLING GULCH PLAN & PROFILE	558+00 TO 587+00
18.	STERLING GULCH PLAN & PROFILE	587+00 TO 591+63
19.	HIGHLANDS GULCH PLAN & PROFILE	600+00 TO 629+00
20.	HIGHLANDS GULCH PLAN & PROFILE	629+00 TO 658+00
21.	HIGHLANDS GULCH PLAN & PROFILE	658+00 TO 679+35
22.	LOUVIERS GULCH PLAN & PROFILE	700+00 TO 730+00
23.	LOUVIERS GULCH PLAN & PROFILE	730+00 TO 760+00
24.	LOUVIERS GULCH PLAN & PROFILE	760+00 TO 790+00
25.	LOUVIERS GULCH PLAN & PROFILE	790+00 TO 802.04
26.	DRAINAGEWAY 6604-01	850+00 TO 879+00
27.	DRAINAGEWAY 6604-01	879+00 TO 885+30
28.	OXIDE DRAW PLAN & PROFILE	900+00 TO 920+00
29.	OXIDE DRAW PLAN & PROFILE	920+00 TO 938+86
30.	DRAINAGEWAY 6600-02	950+00 TO 977+00
31.	DRAINAGEWAY 6600-02	977+00 TO 991.18
32.	DANIELS PARK DRAIN	1000+00 TO 1029+00
33.	DANIELS PARK DRAIN	1029+00 TO 1058+00
34.	DANIELS PARK DRAIN	1058+00 TO 1083+85
35.	INDIAN CREEK PLAN & PROFILE	2000+00 TO 2029+00
36.	INDIAN CREEK PLAN & PROFILE	2029+00 TO 2058+00
37.	INDIAN CREEK PLAN & PROFILE	2058+00 TO 2087+00
38.	INDIAN CREEK PLAN & PROFILE	2087+00 TO 2116+00
39.	INDIAN CREEK PLAN & PROFILE	2116+00 TO 2145+00
40.	INDIAN CREEK PLAN & PROFILE	2145+00 TO 2174+00
41.	INDIAN CREEK PLAN & PROFILE	2174+00 TO 2203+00
42.	INDIAN CREEK PLAN & PROFILE	2203+00 TO 2232+00
43.	INDIAN CREEK PLAN & PROFILE	2232+00 TO 2261+00
44.	INDIAN CREEK PLAN & PROFILE	2261+00 TO 2290+00
45.	INDIAN CREEK PLAN & PROFILE	2290+00 TO 2320+00
46.	INDIAN CREEK PLAN & PROFILE	2320+00 TO 2350+00
47.	INDIAN CREEK PLAN & PROFILE	2350+00 TO 2378+87
48.	DRAINAGEWAY 6605-01	2500+00 TO 2525+00
49.	DRAINAGEWAY 6605-01	2525+10 TO 2543+85
50.	LEHIGH GULCH PLAN & PROFILE	4000+00 TO 4029+00
51.	LEHIGH GULCH PLAN & PROFILE	4029+00 TO 4058+00
52.	LEHIGH GULCH PLAN & PROFILE	4058+00 TO 4087+00
53.	LEHIGH GULCH PLAN & PROFILE	4087+00 TO 4115+97
54.	RAINBOW CREEK PLAN & PROFILE	3000+00 TO 3029+00
55.	RAINBOW CREEK PLAN & PROFILE	3029+00 TO 3058+00
56.	RAINBOW CREEK PLAN & PROFILE	3058+00 TO 3080+96
57.	JARRE CREEK PLAN & PROFILE	5000+00 TO 5029+00
58.	JARRE CREEK PLAN & PROFILE	`029+00 TO 5058+00
59.	JARRE CREEK PLAN & PROFILE	5058+00 TO 5087+00
60.	JARRE CREEK PLAN & PROFILE	5087+00 TO 5116+00
61.	JARRE CREEK PLAN & PROFILE	5116+00 TO 5144+17

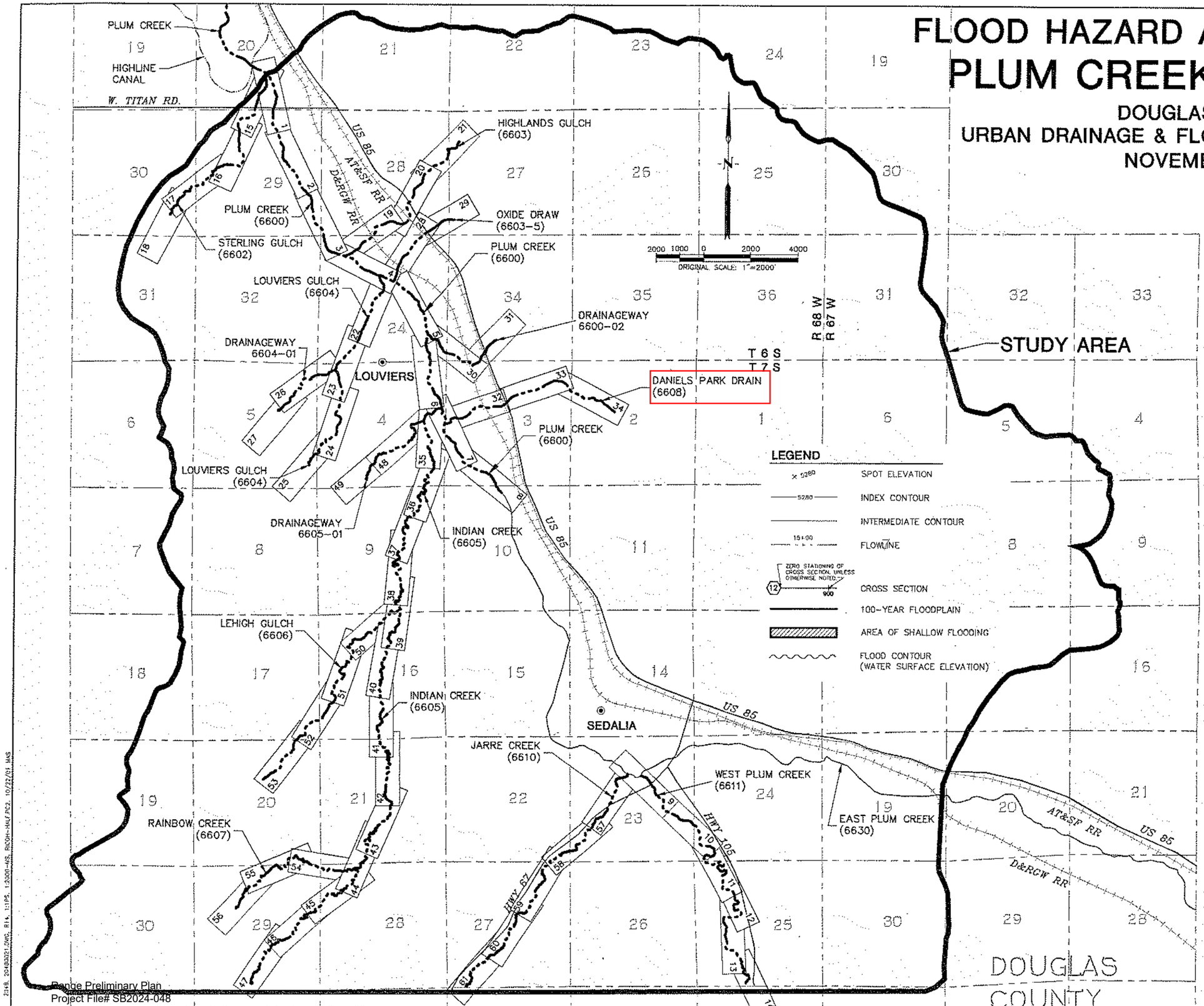


WRC ENGINEERING, INC. 950 SOUTH CHERRY STREET, SUITE 404 DENVER, COLORADO 80246 PHONE NO: (303) 757-8513 FAX NO: (303) 758-3208	DESIGNED BAC DRAWN JLH CHECKED AJL REVISED ——— AS-BUILT ———	DATE 03-00 DATE 03-00 DATE 03-01 DATE ——— DATE ———	URBAN DRAINAGE & FLOOD CONTROL DISTRICT DOUGLAS COUNTY	PLUM CREEK FLOOD HAZARD AREA DELINEATION	FUTURE WATERSHED IMPERVIOUSNESS STUDY AREA	FIGURE III-9

2048, 2048F3-9.DWG, 11"X17", 1:20000XS, 10/04/01, MAS

FLOOD HAZARD AREA DELINEATION
PLUM CREEK WATERSHED

DOUGLAS COUNTY
URBAN DRAINAGE & FLOOD CONTROL DISTRICT
NOVEMBER 2001



LEGEND

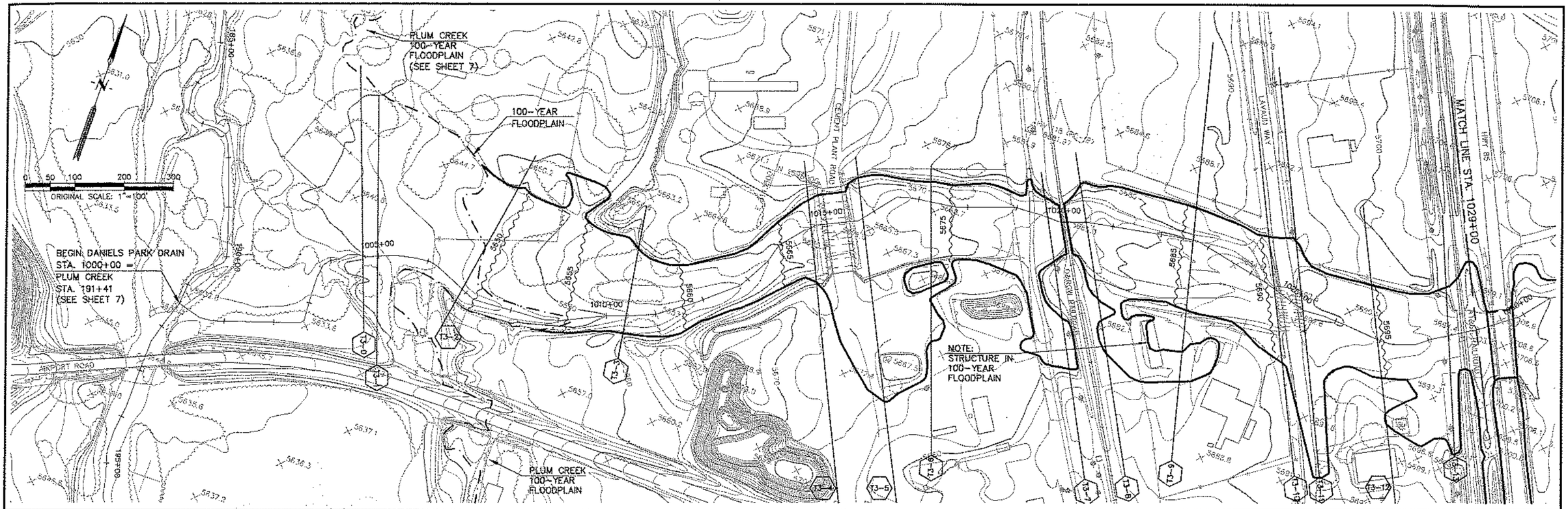
- SPOT ELEVATION
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- FLOWLINE
- ZERO STATIONING OF CROSS SECTION, UNLESS OTHERWISE NOTED — CROSS SECTION
- 100-YEAR FLOODPLAIN
- AREA OF SHALLOW FLOODING
- FLOOD CONTOUR (WATER SURFACE ELEVATION)

SHEET INDEX

SHT.No.	DESCRIPTION	STATIONS
1.	PLUM CREEK P & P	1+00 TO 30+00
1A.	PLUM CREEK PLAN	1+00 TO 30+00
2.	PLUM CREEK P & P	30+00 TO 60+00
2A.	PLUM CREEK PLAN	30+00 TO 60+00
3.	PLUM CREEK P & P	60+00 TO 90+00
3A.	PLUM CREEK PLAN	60+00 TO 90+00
4.	PLUM CREEK P & P	90+00 TO 120+00
4A.	PLUM CREEK PLAN	90+00 TO 120+00
5.	PLUM CREEK P & P	120+00 TO 150+00
5A.	PLUM CREEK PLAN	120+00 TO 150+00
6.	PLUM CREEK P & P	150+00 TO 180+00
6A.	PLUM CREEK PLAN	150+00 TO 180+00
7.	PLUM CREEK P & P	180+00 TO 210+00
7A.	PLUM CREEK PLAN	180+00 TO 210+00
8.	PLUM CREEK P & P	210+00 TO 233+34
8A.	PLUM CREEK PLAN	210+00 TO 233+34
9.	WEST PLUM CREEK P & P	260+00 TO 280+00
9A.	WEST PLUM CREEK PLAN	260+00 TO 280+00
10.	WEST PLUM CREEK P & P	280+00 TO 310+00
10A.	WEST PLUM CREEK PLAN	280+00 TO 310+00
11.	WEST PLUM CREEK P & P	310+00 TO 340+00
11A.	WEST PLUM CREEK PLAN	310+00 TO 340+00
12.	WEST PLUM CREEK P & P	340+00 TO 370+00
12A.	WEST PLUM CREEK PLAN	340+00 TO 370+00
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13A.	WEST PLUM CREEK PLAN	370+00 TO 400+00
14.	WEST PLUM CREEK P & P	400+00 TO 413+48
14A.	WEST PLUM CREEK PLAN	400+00 TO 413+48
15.	STERLING GULCH P & P	500+00 TO 529+00
16.	STERLING GULCH P & P	529+00 TO 558+00
17.	STERLING GULCH P & P	558+00 TO 587+00
18.	STERLING GULCH P & P	587+00 TO 591+63
19.	HIGHLANDS GULCH P & P	600+00 TO 629+00
20.	HIGHLANDS GULCH P & P	629+00 TO 658+00
21.	HIGHLANDS GULCH P & P	658+00 TO 679+36
22.	LOUVIERS GULCH P & P	700+00 TO 730+00
23.	LOUVIERS GULCH P & P	730+00 TO 760+00
24.	LOUVIERS GULCH P & P	760+00 TO 790+00
25.	LOUVIERS GULCH P & P	790+00 TO 801+85
26.	DRAINAGEWAY 6604-01 P & P	850+00 TO 879+00
27.	DRAINAGEWAY 6604-01 P & P	879+00 TO 885+30
28.	OXIDE DRAW P & P	900+00 TO 920+00
29.	OXIDE DRAW P & P	920+00 TO 938+86
30.	DRAINAGEWAY 6600-02 P & P	950+00 TO 977+00
31.	DRAINAGEWAY 6600-02 P & P	977+00 TO 992+57
32.	DANIELS PARK DRAIN P & P	1000+00 TO 1029+00
33.	DANIELS PARK DRAIN P & P	1029+00 TO 1058+00
34.	DANIELS PARK DRAIN P & P	1058+00 TO 1083+38
35.	INDIAN CREEK P & P	2000+00 TO 2029+00
36.	INDIAN CREEK P & P	2029+00 TO 2058+00
37.	INDIAN CREEK P & P	2058+00 TO 2087+00
38.	INDIAN CREEK P & P	2087+00 TO 2116+00
39.	INDIAN CREEK P & P	2116+00 TO 2145+00
40.	INDIAN CREEK P & P	2145+00 TO 2174+00
41.	INDIAN CREEK P & P	2174+00 TO 2203+00
42.	INDIAN CREEK P & P	2203+00 TO 2232+00
43.	INDIAN CREEK P & P	2232+00 TO 2261+00
44.	INDIAN CREEK P & P	2261+00 TO 2290+00
45.	INDIAN CREEK P & P	2290+00 TO 2320+00
46.	INDIAN CREEK P & P	2320+00 TO 2350+00
47.	INDIAN CREEK P & P	2350+00 TO 2378+98
48.	DRAINAGEWAY 6605-01 P & P	2500+00 TO 2525+00
49.	DRAINAGEWAY 6605-01 P & P	2525+00 TO 2543+86
50.	LEHIGH GULCH P & P	4000+00 TO 4029+00
51.	LEHIGH GULCH P & P	4029+00 TO 4058+00
52.	LEHIGH GULCH P & P	4058+00 TO 4087+00
53.	LEHIGH GULCH P & P	4087+00 TO 4115+98
54.	RAINBOW CREEK P & P	3000+00 TO 3029+00
55.	RAINBOW CREEK P & P	3029+00 TO 3058+00
56.	RAINBOW CREEK P & P	3058+00 TO 3080+96
57.	JARRE CREEK P & P	5000+00 TO 5029+00
58.	JARRE CREEK P & P	5029+00 TO 5058+00
59.	JARRE CREEK P & P	5058+00 TO 5087+00
60.	JARRE CREEK P & P	5087+00 TO 5116+00
61.	JARRE CREEK P & P	5116+00 TO 5144+17

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET SUITE 404
DENVER, COLORADO 80246
PHONE NO: (303) 757-8513
FAX NO: (303) 758-3208

2348_20480321.DWG, 81x, 1:1PS, 1:2000-HIS, RICOH-Half PG2, 10/22/01, WAS



GROUND CONTROL SURVEY BY: MOUNTAIN SURVEY & MAPPING
AERIAL PHOTOGRAPHY BY: LANDMARK MAPPING
TOPOGRAPHIC MAPPING BY: LANDMARK MAPPING
CONTROL FILE: SB2024-048 DATE FLOWN: 03/19/99

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET, SUITE 404
DENVER, COLORADO 80246
PHONE NO. (303) 757-8513
FAX NO. (303) 758-3208

DESIGNED	BAC	DATE 04-11-00
DRAWN	BH	DATE 04-11-00
CHECKED		DATE
REVISED		DATE
AS-BUILT		DATE

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
DOUGLAS COUNTY

PLUM CREEK
FLOOD HAZARD AREA DELINEATION

DANIELS PARK DRAIN
STA. 1000+00 TO 1029+00

SHEET
32 OF 61

100-YEAR FLOODPLAIN

MATCH LINE STA. 1060+00

MATCH LINE STA. 1058+00

END DANIELS PARK DRAIN STA. 1085+38

0 50 100 200 300
ORIGINAL SCALE: 1"=100'

SEC. T3-27

Q100=4,100 CFS
V100=7.8 FPS

5766.4

100-YEAR WATER SURFACE

10-YEAR WATER SURFACE

EXISTING CHANNEL THALWEG

0 200 400 600

1058+00 1063+00 1068+00 1073+00 1078+00 1083+00

5820 5810 5800 5790 5780 5770 5760 5750

GROUND CONTROL SURVEY BY: MOUNTAIN SURVEY & MAPPING
AERIAL PHOTOGRAPHY BY: LANDMARK MAPPING
TOPOGRAPHIC MAPPING BY: LANDMARK MAPPING
CONTOUR INTERVALS: 2' DATE FLOWN: 03/19/99

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET, SUITE 404
DENVER, COLORADO 80246
PHONE NO: (303) 757-8513
FAX NO: (303) 758-7208

DESIGNED	BAC	DATE	04-11-00
DRAWN	JLM	DATE	04-11-00
CHECKED		DATE	
REVISED		DATE	
AS-BUILT		DATE	

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
DOUGLAS COUNTY

PLUM CREEK
FLOOD HAZARD AREA DELINEATION

DANIELS PARK DRAIN
STA. 1058+00 TO 1085+38

SHEET
34 OF 61

20MF1A03 2043-34(2048-34P30) R14 RECH-HALFCEL 10/22/01 MAS

Range Preliminary Plan
Project File# SB2024-048

PLUM CREEK WATERSHED

OUTFALL SYSTEMS PLANNING

PRELIMINARY DESIGN REPORT

Prepared For:

DOUGLAS COUNTY
100 THIRD STREET
CASTLE ROCK, COLORADO 80104

and

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
2480 WEST 26TH AVENUE, SUITE 156-B
DENVER, COLORADO 80211

JULY 2003

Prepared By:

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET, SUITE 404
DENVER, COLORADO 80246
(303) 757-8513

WRC File: 2048/30

FIGURE ES-2
PROPOSED OUTFALL SYSTEM IMPROVEMENTS

PLUM CREEK
HIGHLINE CANAL
W. TITAN RD.
6600-00.5
NORTH HIGHLANDS GULCH (6602.5)
HIGHLANDS GULCH (6603)
6600-00.7
US 85
AT&SF RR
D&RGW RR
PLUM CREEK(6600)
6602-01
6602-02
OXIDE DRAW (6603-5)
6600-01
6600-00.8
6602-01
PLUM CREEK (6600)
6600-01.5
STERLING GULCH (6602)
LOUVIERS GULCH (6604)
6602-03
6604-01
6602-01
LOUVIERS
6600-02
6600-02.1
DANIELS PARK DRAIN (6608)
T 6 S
T 7 S
R 68 W
R 67 W
STUDY AREA
6600-02.8
6605-01
PLUM CREEK (6600)
6600-03.1
LOUVIERS GULCH (6604)
6600-03.2
INDIAN CREEK (6605)
6600-02.5
6605-01.5
6604-02
INGOT DRAW (6609)
6609-01
6600-04.1
6600-04.15
6605-02
6606
6606-02
6606-01
6600-03.9
6600-04
6600-04.1
DOUGLAS COUNTY
6606-01
6606
INDIAN CREEK (6605)
6600-05
6630-02
6630-02.1
6600-06
US 85
6630-04
6630-05
6630-06
COHEN'S DRAINAGE (6631)
SEDALIA
LEHIGH GULCH (6606)
6606-03
6605-03
6605
6600-08
6630-07.5
PLUM CREEK (6600)
6611-00.5
WEST PLUM CREEK (6611)
6606-05
6600-07
6630-07
6630-08
JARRE CREEK (6610)
6611-02.5
AT&SF RR
US 85
6606-04
6606
6610-01
6611-01
6611-02
6611-03
6630-09
EAST PLUM CREEK (6630)
HWY 105
6610-02
6611-05
6610-03
HWY 67
D&RGW RR
RAINBOW CREEK (6607)
6607-02
6605-05
6605-05.5
6610
6611-06.1
6611-06
6610-04
6610-05
6611-01
6611-07
6607
6607-03
6607-01
6605-06
6611-06.9
6611-08
6610-06
6611-06.95

PROPOSED OUTFALL SYSTEM IMPROVEMENTS

- PROPOSED OUTFALL CROSSINGS
- 5-YEAR EQUILIBRIUM CHANNEL CONTROLS
- 100-YEAR CHANNEL
- 100-YEAR STORM SEWER
- NO IMPROVEMENTS

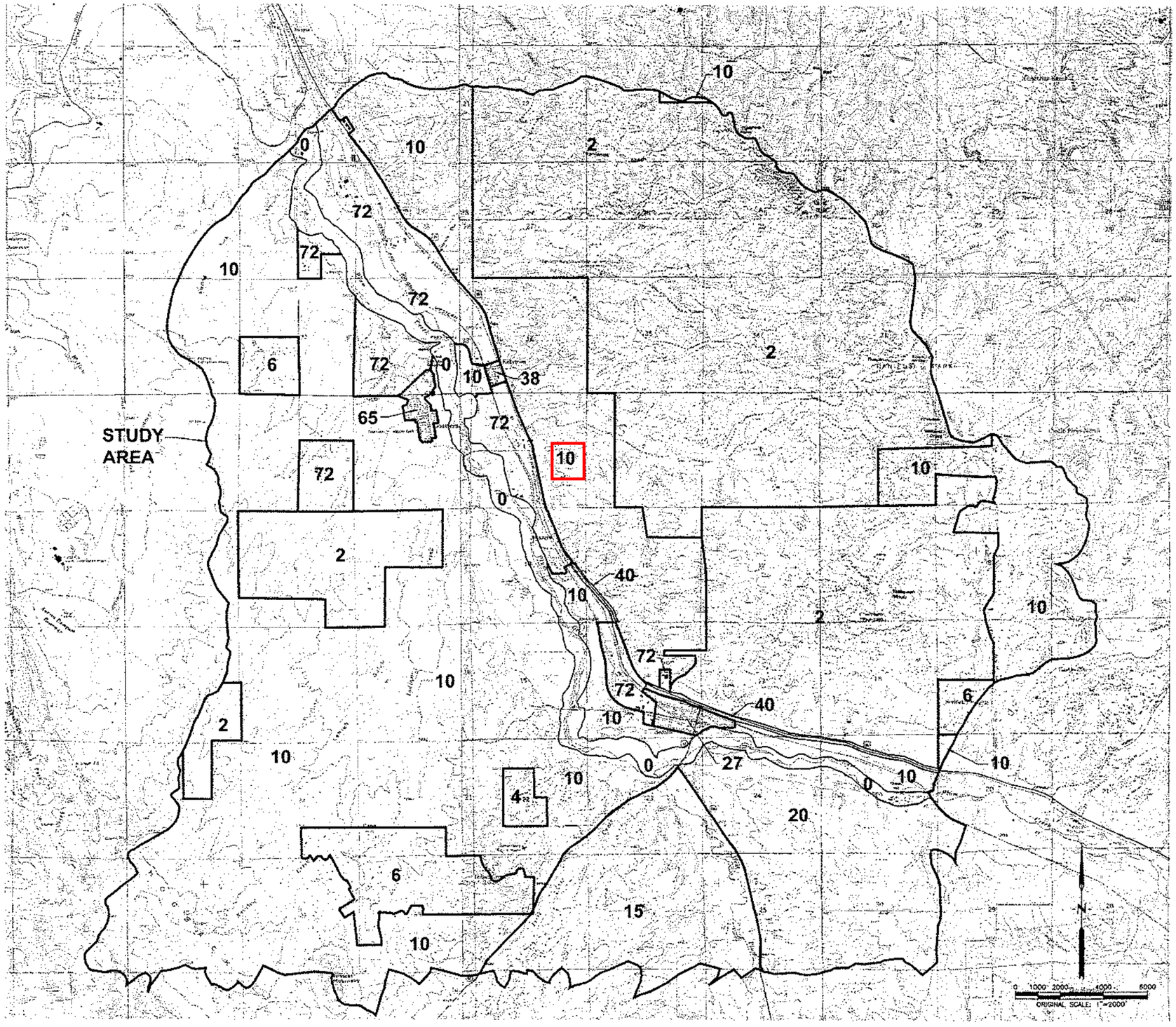
LEGEND

- DRAINAGEWAYS
- RAILROAD
- SECTION LINE
- ROADS

N

2000 1000 0 2000 4000
ORIGINAL SCALE: 1"=2000'

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET SUITE 404
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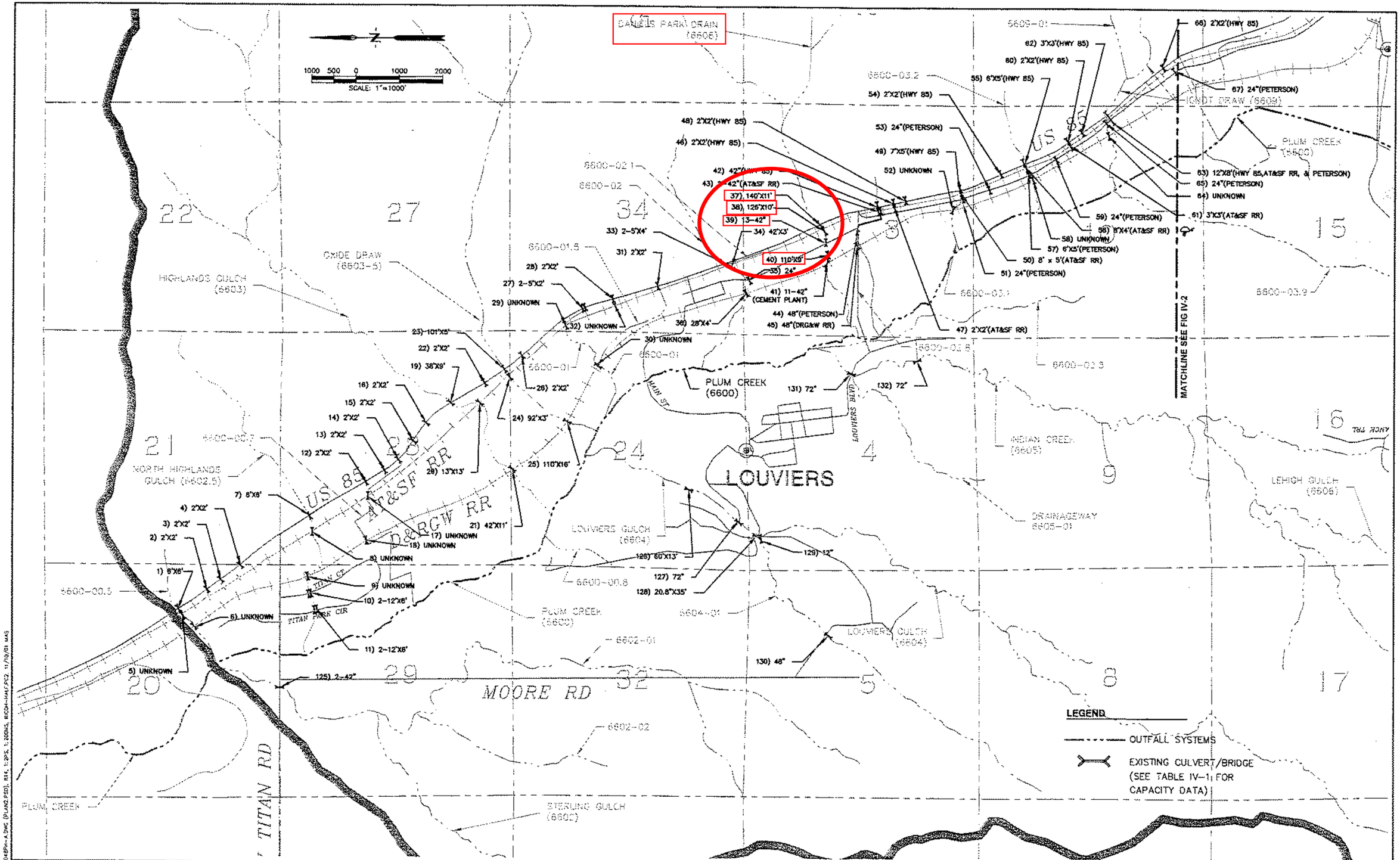


LEGEND:

72 – PERCENT IMPERVIOUS AREA

WRC ENGINEERING, INC. 950 SOUTH CHERRY STREET, SUITE 404 DENVER, COLORADO 80246 PHONE NO: (303) 757-8513 FAX NO: (303) 759-3208	DESIGNED BAC DATE 03-00 DRAWN BJH DATE 03-00 CHECKED AJR DATE 03-01 REVISED ____ DATE ____ AS-BUILT ____ DATE ____	URBAN DRAINAGE & FLOOD CONTROL DISTRICT DOUGLAS COUNTY	PLUM CREEK OUTFALL SYSTEMS PLANNING	FUTURE WATERSHED IMPERVIOUSNESS STUDY AREA	FIGURE A-9

w:\10459\RPT\2048F31-9.DWG - 4/8/03 - WMS



GROUND CONTROL SURVEY BY: MOUNTAIN SURVEY & MAPPING AERIAL PHOTOGRAPHY BY: LANDMARK MAPPING TOPOGRAPHIC MAPPING BY: LANDMARK MAPPING CONTOUR INTERVAL: 2 DATE FLOWN: 03/19/99	WRC ENGINEERING, INC. 950 SOUTH CHERRY STREET, SUITE 404 DENVER, COLORADO 80246 PHONE NO: (303) 757-8513 FAX NO: (303) 758-3208	DESIGNED BAC DATE 04-12-00 DRAWN BJH DATE 04-12-00 CHECKED ____ DATE ____ REVISED ____ DATE ____ AS-BUILT ____ DATE ____	URBAN DRAINAGE & FLOOD CONTROL DISTRICT DOUGLAS COUNTY	PLUM CREEK WATERSHED OUTFALL SYSTEM PLANNING	EXISTING FACILITIES MAP	FIGURE IV-1

TABLE V-2
CULVERT AND BRIDGE PROBLEM AREA IDENTIFICATION

No.	CROSSING	LOCATION	DRAINAGEWAY REFERENCE	CROSSING DESCRIPTION	ALLOWABLE CAPACITY (cfs)	TOTAL ALLOWABLE CAPACITY @ D. P. (cfs)	REQUIRED CAPACITY (cfs)	CROSSING ADEQUATE ?	
								PHYSICAL CAPACITY	ALLOWABLE CAPACITY
1	HWY - 85	DP 16 E	6600-00.5	(1) 6'Hx6'W-BOX CULVERT	115	220	400	Y	N
2	HWY - 85		-	(1)2'Hx2'W-BOX CULVERT	35				
3	HWY - 85		-	(1)2'Hx2'W-BOX CULVERT	35				
4	HWY - 85		-	(1)2'Hx2'W-BOX CULVERT	35				
5	AT&SF R. R.	DP 16 E	6600-00.5	-	-	-	400	-	-
6	D&RGW R.R.	DP 16 E	6600-00.5	-	-	-	400	-	-
7	HWY - 85	DP 18 E	6602.5	(1) 6'Hx6'W-BOX CULVERT	82	82	750	Y	N
8	AT&SF R. R.	DP 18 E	6602.5	-	-	-	750	-	-
9	D&RGW R.R.	DP 18 E	6602.5	-	-	-	750	-	-
10	TITAN CT.	DP 2 E	6602.5	(2) 6'Hx12'W-BOX CULVER	329	329	800	Y	N
11	TITAN CT.	DP 2 E	6602.5	(2) 6'Hx12'W-BOX CULVER	329	329	800	Y	N
12	HWY - 85	DP 23 E	6600-07	(1)2'Hx2'W-BOX CULVERT	35	113	115	Y	Y
13	HWY - 85		-	(1)2'Hx2'W-BOX CULVERT	43				
14	HWY - 85		-	(1)2'Hx2'W-BOX CULVERT	35				
15	HWY - 85	SW 24 E	-	(1)2'Hx2'W-BOX CULVERT	15	30	240	Y	N
16	HWY - 85		-	(1)2'Hx2'W-BOX CULVERT	15				
17	AT&SF R. R.	DP176E	6600-07	-	-	-	260	-	-
18	D&RGW R.R.	DP176E	6600-07	-	-	-	260	-	-
19	HWY - 85	DP 24 E	6603	(1)9'Hx38'W-BRIDGE	824	824	1700	Y	N
20	AT&SF R. R.	RE 224 E	6603	(2)13'Hx13'W-BRIDGE	857	857	1700	Y	N
21	D&RGW R.R.	DP 4 E	6603	(1)11'Hx43'W-BRIDGE	1202	1202	1730	Y	N
22	HWY - 85	SW 42 E	-	(1)2'Hx2'W-BOX CULVERT	52	52	135	N	N
23	HWY - 85	DP 42 E	6603-5	(1)5'Hx101'W-BRIDGE	971	971	3650	N	N
24	AT&SF R. R.	RE 242 E	6603-5	(1)3Hx92'W-BRIDGE	505	505	2590	N	N
25	D&RGW R.R.	DP 5 E	6603-5	(1)16'Hx110'W-BRIDGE	2597	2597	2590	Y	Y
26	HWY - 85	SW 42 E	-	(1)2'Hx2'W-BOX CULVERT	70	70	135	N	N
27	HWY - 85	DP 281 E	6600-01	(2)2'Hx5'W-BOX CULVERT	27	27	240	Y	N
28	HWY - 85		-	(1)2'Hx2'W-BOX CULVERT	28	28	240		
29	AT&SF R. R.	RE 281 E	6600-01	-	-	-	200	-	-
30	D&RGW R.R.	DP 6 E	6600-01	-	-	-	480	-	-
31	HWY - 85	DP 175 E	6600-01.5	(1)2'Hx2'W-BOX CULVERT	43	43	135	N	N
32	AT&SF R. R.	DP 175 E	6600-01.5	-	-	-	135	-	-
33	HWY - 85	DP 83 E	6600-02	(2)4'Hx5'W-BRIDGE	82	82	510	N	N
34	AT&SF R. R.	DP 83 E	6600-02	(1)3'Hx42'W-BRIDGE	173	173	510	N	N
35	LAVAUN WAY	RE 283 E	6600-02	(1)24"PIPE	15	15	500	N	N
36	D&RGW R.R.	DP 7 E	6600-02	(1)4'Hx28'W-BRIDGE	238	238	695	Y	N
37	HWY - 85	DP 88 E	6608	(1)11'Hx140'W-BRIDGE	3729	3729	4100	Y	N
38	AT&SF R. R.	DP 88 E	6608	(1)10'Hx126'W-BRIDGE	2941	2941	4100	Y	N
39	LAVAUN WAY	RE 288 E	6608	(13)42"PIPE-BRIDGE	631	631	4200	N	N
40	D&RGW R.R.	DP 8 E	6608	(1)9'Hx110'W-BRIDGE	2507	2507	4200	Y	N
41	CEMENT PLANT	RE 208 E	6608	(11)42"PIPE-BRIDGE	534	534	4150	Y	N
42	HWY - 85	DP 129 E	6600-02.8	(1)42"PIPE	49	49	120	Y	N

TABLE V-2 (cont.)
CULVERT AND BRIDGE PROBLEM AREA IDENTIFICATION

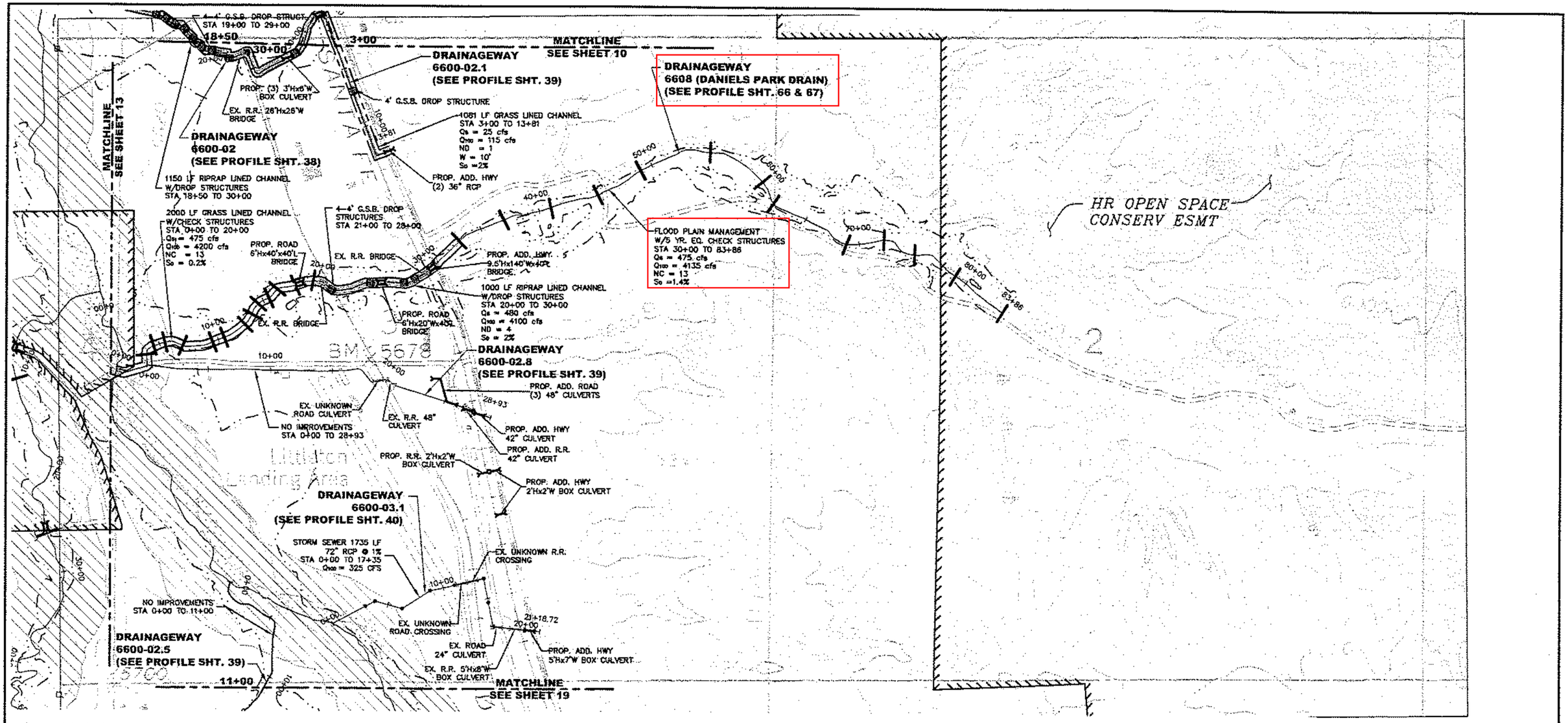
No.	CROSSING	LOCATION	DRAINAGEWAY REFERENCE	CROSSING DESCRIPTION	ALLOWABLE CAPACITY (cfs)	TOTAL ALLOWABLE CAPACITY @ D. P. (cfs)	REQUIRED CAPACITY (cfs)	CROSSING ADEQUATE ?	
								PHYSICAL CAPACITY	ALLOWABLE CAPACITY
43	AT&SF R. R.	DP 129 E	6600-02.8	(2)42"PIPE	97	97	120	Y	N
44	PETERSON	DP 9 E	6600-02.8	(1)48"PIPE	69	69	190	Y	N
45	D&RGW R.R.	DP 9 E	6600-02.8	(1)48"PIPE	69	69	190	Y	N
46	HWY - 85	DP 129 E	-	(1)2'Hx2'W-BOX CULVERT	122	122	120	Y	Y
47	AT&SF R. R.	DP 129 E	-	(1)2'Hx2'W-BOX CULVERT	197	197	120	Y	Y
48	HWY - 85	DP 130 E	-	(1)2'Hx2'W-BOX CULVERT	346	423	240	Y	Y
49	HWY - 85		6600-03.1	(1)5'Hx7'W-BOX CULVERT	77				
50	AT&SF R. R.	DP 130 E	6600-03.1	(1)5'Hx8'W-BOX CULVERT	88	88	240	Y	N
51	PETERSON	-	-	(1)24"PIPE	42	42	-	-	-
52	D&RGW R.R.	DP 10 E	6600-03.1	-	-	-	295	-	-
53	PETERSON	-	-	(1)24"PIPE	42	42	-	-	-
54	HWY - 85	DP 131 E	-	(1)2'Hx2'W-BOX CULVERT	15	163	340	Y	N
55	HWY - 85		6600-03.2	(1)5'Hx6'W-BOX CULVERT	66				
56	AT&SF R. R.	DP 131 E	6600-03.2	(1)4'Hx8'W-BOX CULVERT	66	66	340	Y	N
57	PETERSON	DP 131 E	6600-03.2	(1)5'Hx6'W-BOX CULVERT	66	66	340	Y	N
58	D&RGW R.R.	DP 11 E	6600-03.2	-	-	-	400	-	-
59	PETERSON	-	-	(1)24"PIPE	42	42	-	-	-
60	HWY - 85	DP 131 E	-	(1)2'Hx2'W-BOX CULVERT	28	28	340	Y	N
61	AT&SF R. R.	DP 131 E	-	(1)3'Hx3'W-BOX CULVERT	58	58	340	Y	N
62	HWY - 85	DP 131 E	-	(1)3'Hx3'W-BOX CULVERT	15	15	340	Y	N
63	HWY - 85	DP 133 E	6609	(1)8'Hx12'W-BOX CULVERT	231	231	1110	Y	N
64	D&RGW R.R.	DP 12 E	6609	-	-	-	1150	-	-
65	PETERSON	-	-	(1)24"PIPE	35	35	-	-	-
66	HWY - 85	DP 143 E	-	(1)2'Hx2'W-BOX CULVERT	28	28	50	Y	N
67	PETERSON	-	-	(1)24"PIPE	10	10	-	-	-
68	HWY - 85	DP 143 E	6600-04.15	(1)3'Hx3'W-BOX CULVERT	780	780	50	Y	Y
69	AT&SF R. R.	DP 143 E	6600-04.15	(1)24"PIPE	228	228	50	Y	Y
70	PETERSON	RE 344 E	6600-04.15	(1)60"PIPE	125	125	380	Y	Y
71	D&RGW R.R.	DP 13 E	6600-04.1	-	-	-	695	-	-
72	PETERSON	-	-	(1)24"PIPE	42	42	-	-	-
73	HWY - 85	DP 146 E	6600-04.1	(1)3'Hx3'W-BOX CULVERT	471	581	260	Y	Y
74	HWY - 85		6600-04.1	(1)6'Hx8'W-BOX CULVERT	110				
75	AT&SF R. R.	DP 144 E	6600-04.1	(1)5'Hx10'W-BOX CULVERT	110	110	390	N	N
76	PETERSON	-	-	(1)24"PIPE	35	35	-	-	-
77	HWY - 85	DP 148 E	-	(1)24"PIPE	55	197	210	N	N
78	HWY - 85		6600-05	(1)36"PIPE	141				
79	AT&SF R. R.	DP 148 E	6600-05	(1)5'Hx13'W-BOX CULVERT	143	143	210	N	N
80	PLATE A.V.	RE 348 E	6600-05	(1)3.5'Hx6'W-ELLIPS CULV	41	41	175	Y	N
81	D&RGW R.R.	DP 14 E	6600-05	(1)60"PIPE	125	125	270	Y	N
82	RIO GRANDE	DP 14 E	6600-05	(1)60"PIPE	125	125	270	Y	N
83	RIO GRANDE	SW 148 W	6600-03.9	(1)60"PIPE	125	125	0	Y	N

TABLE IV-1
ESTIMATED CAPACITY OF EXISTING DRAINAGE FACILITIES

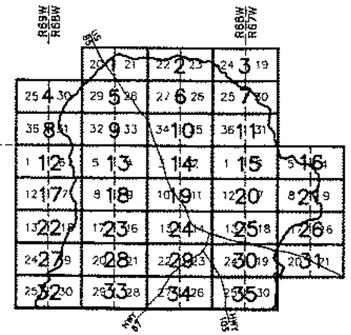
No. (1)	CROSSING REFERENCE	LOCATION REFERENCE	DRAINAGEWAY REFERENCE	CROSSING DESCRIPTION	STRUCTURE CAPACITY (2) (cfs)	TOTAL DESIGN POINT CAPACITY (cfs)	PEAK FLOWS (3) 5 YEAR (cfs)	10 YEAR (cfs)	100 YEAR (cfs)
1	HWY - 85	DP 16 E	6600-00.5	(1) 6'Hx6'W-BOX CULVERT	305	404	80	110	400
2			-	(1)2'Hx2'W-BOX CULVERT	35				
3			-	(1)2'Hx2'W-BOX CULVERT	35				
4			-	(1)2'Hx2'W-BOX CULVERT	28				
5	AT&SF R. R.	DP 16 E	6600-00.5	-	-	-	80	110	400
6	D&RGW R.R.	DP 16 E	6600-00.5	-	-	-	80	110	400
7	HWY - 85	DP 18 E	6602.5	(1) 6'Hx6'W-BOX CULVERT	771	771	115	165	750
8	AT&SF R. R.	DP 18 E	6602.5	-	-	-	115	165	750
9	D&RGW R.R.	DP 18 E	6602.5	-	-	-	115	165	750
10	TITAN CT.	DP 2 E	6602.5	(2) 6'Hx12'W-BOX CULVERT	1339	1339	190	220	800
11			6602.5	(2) 6'Hx12'W-BOX CULVERT	1339				
12	HWY - 85	DP 23 E	6600-07	(1)2'Hx2'W-BOX CULVERT	35	114	20	30	115
13			-	(1)2'Hx2'W-BOX CULVERT	43				
14			-	(1)2'Hx2'W-BOX CULVERT	35				
15	HWY - 85	SW 24 E	-	(1)2'Hx2'W-BOX CULVERT	15	31	50	70	240
16			-	(1)2'Hx2'W-BOX CULVERT	15				
17	AT&SF R. R.	DP 176 E	6600-07	-	-	-	70	80	260
18	D&RGW R.R.	DP 176 E	6600-07	-	-	-	70	80	260
19	HWY - 85	DP 24 E	6603	(1)9'Hx38'W-BRIDGE	1700	1700	170	290	1700
20	AT&SF R. R.	RE 224 E	6603	(2)13'Hx13'W-BRIDGE	2905	2905	160	270	1700
21	D&RGW R.R.	DP 4 E	6603	(1)11'Hx42'W-BRIDGE	2905	2905	220	295	1730
22	HWY - 85	SW 42 E	-	(1)2'Hx2'W-BOX CULVERT	52	121	30	35	135
23	HWY - 85	DP 42 E	6603-5	(1)5'Hx101'W-BRIDGE	2375	2375	370	625	3650
24	AT&SF R. R.	RE 242 E	6603-5	(1)3Hx92'W-BRIDGE	1385	1385	360	610	2590
25	D&RGW R.R.	DP 5 E	6603-5	(1)16'Hx110'W-BRIDGE	2342	2342	370	625	2590
26	HWY - 85	SW 42 E	-	(1)2'Hx2'W-BOX CULVERT	70	121	30	35	135
27	HWY - 85	DP 81 E	6600-01	(2)2'Hx5'W-BOX CULVERT	707	736	30	70	240
28			-	(1)2'Hx2'W-BOX CULVERT	28				
29	AT&SF R. R.	RE 281 E	6600-01	-	-	-	30	50	200
30	D&RGW R.R.	DP 6 E	6600-01	-	-	-	180	210	480
31	HWY - 85	DP 175 E	6600-01.5	(1)2'Hx2'W-BOX CULVERT	43	43	30	40	135
32	AT&SF R. R.	DP 175 E	6600-01.5	-	-	-	30	40	135
33	HWY - 85	DP 83 E	6600-02	(2)4'Hx5'W-BRIDGE	300	300	105	145	510
34	AT&SF R. R.	DP 83 E	6600-02	(1)3'Hx42'W-BRIDGE	174	174	105	145	510
35	LAVAUNN WAY	RE 283 E	6600-02	(1)24"PIPE	15	15	100	140	500
36	D&RGW R.R.	DP 7 E	6600-02	(1)4'Hx28'W-BRIDGE	695	695	200	250	695
37	HWY - 85	DP 88 E	6608	(1)11'Hx140'W-BRIDGE	4100	4100	400	820	4100
38	AT&SF R. R.	DP 88 E	6608	(1)10'Hx126'W-BRIDGE	4100	4100	400	820	4100
39	LAVAUNN WAY	RE 288 E	6608	(13)42"PIPE-BRIDGE	1409	1409	480	820	4200
40	D&RGW R.R.	DP 8 E	6608	(1)9'Hx110'W-BRIDGE	4200	4200	480	825	4200
41	CEMENT PLANT	RE 208 E	6608	(11)42"PIPE-BRIDGE	1481	1481	470	810	4150
42	HWY - 85	DP 129 E	6600-02.8	(1)42"PIPE	293	415	30	40	120
43	AT&SF R. R.	DP 129 E	6600-02.8	(2)42"PIPE	276	473	30	40	120
44	PETERSON	DP 9 E	6600-02.8	(1)48"PIPE	198	198	70	80	190
45	D&RGW R.R.	DP 9 E	6600-02.8	(1)48"PIPE	198	198	70	80	190
46	HWY - 85	DP 129 E	-	(1)2'Hx2'W-BOX CULVERT	122	415	30	40	120
47	AT&SF R. R.	DP 129 E	-	(1)2'Hx2'W-BOX CULVERT	197	473	30	40	120
48	HWY - 85	SW 130 E	-	(1)2'Hx2'W-BOX CULVERT	346	701	165	80	240

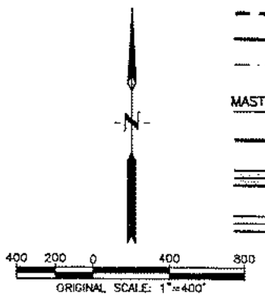
TABLE IV-1 (cont.)
ESTIMATED CAPACITY OF EXISTING DRAINAGE FACILITIES

No. (1)	CROSSING REFERENCE	LOCATION REFERENCE	DRAINAGEWAY REFERENCE	CROSSING DESCRIPTION	STRUCTURE CAPACITY (2) (cfs)	TOTAL DESIGN POINT CAPACITY (cfs)	PEAK FLOWS (3) 5 YEAR (cfs)	10 YEAR (cfs)	100 YEAR (cfs)
49	HWY - 85	DP 130 E	6600-03.1	(1)5'Hx7'W-BOX CULVERT	356	701	65	80	240
50	AT&SF R. R.	DP 130 E	6600-03.1	(1)5'Hx8'W-BOX CULVERT	345	245	65	80	240
51	PETERSON	-	-	(1)24"PIPE	42	42	-	-	-
52	D&RGW R.R.	DP 10 E	6600-03.1	-	-	-	85	105	295
53	PETERSON	-	-	(1)24"PIPE	42	42	-	-	-
54	HWY - 85	DP 131 E	-	(1)2'Hx2'W-BOX CULVERT	15	363	90	110	345
55			6600-03.2	(1)5'Hx6'W-BOX CULVERT	305				
56	AT&SF R. R.	DP 131 E	6600-03.2	(1)4'Hx8'W-BOX CULVERT	250	400	90	110	345
57	PETERSON	DP 131 E	6600-03.2	(1)5'Hx6'W-BOX CULVERT	444	444	90	110	345
58	D&RGW R.R.	DP 11 E	6600-03.2	-	-	-	110	140	400
59	PETERSON	-	-	(1)24"PIPE	42	42	0	0	0
60	HWY - 85	DP 131 E	-	(1)2'Hx2'W-BOX CULVERT	28	363	90	110	345
61	AT&SF R. R.	DP 131 E	-	(1)3'Hx3'W-BOX CULVERT	150	400	90	110	345
62	HWY - 85	DP 131 E	-	(1)3'Hx3'W-BOX CULVERT	15	363	90	110	345
63	HWY - 85	DP 133 E	6609	(1)8'Hx12'W-BOX CULVERT	4113	4113	200	285	1110
64	D&RGW R.R.	DP 12 E	6609	-	-	-	205	295	1150
65	PETERSON	-	-	(1)24"PIPE	35	35	-	-	-
66	HWY - 85	DP 143 E	-	(1)2'Hx2'W-BOX CULVERT	28	808	15	20	50
67	PETERSON	-	-	(1)24"PIPE	67	67	-	-	-
68	HWY - 85	DP 143 E	6600-04.15	(1)3'Hx3'W-BOX CULVERT	780	808	15	20	50
69	AT&SF R. R.	DP 143 E	6600-04.15	(1)24"PIPE	228	808	15	20	50
70	PETERSON	RE 344 E	6600-04.15	(1)60"PIPE	390	390	65	90	380
71	D&RGW R.R.	DP 13 E	6600-04.1	-	-	-	220	260	695
72	PETERSON	-	-	(1)24"PIPE	42	42	-	-	-
73	HWY - 85	DP 146 E	6600-04.1	(1)3'Hx3'W-BOX CULVERT	471	1165	45	65	265
74			6600-04.1	(1)6'Hx8'W-BOX CULVERT	694				
75	AT&SF R. R.	DP 144 E	6600-04.1	(1)5'Hx10'W-BOX CULVERT	313	313	70	100	390
76	PETERSON	-	-	(1)24"PIPE	35	35	-	-	-
77	HWY - 85	DP 148 E	-	(1)24"PIPE	55	197	50	60	210
78			6600-05	(1)36"PIPE	141				
79	AT&SF R. R.	DP 148 E	6600-05	(1)5'Hx13'W-BOX CULVERT	185	185	50	60	210
80	PLATE A.V.	RE 348 E	6600-05	(1)3.5'Hx6'W-ELLIPS CULVERT	199	199	30	40	175
81	D&RGW R.R.	DP 14 E	6600-05	(1)60"PIPE	419	419	70	85	270
82	RIO GRANDE	DP 14 E	6600-05	(1)60"PIPE	419	419	70	85	270
83	RIO GRANDE	SW 148 W	6600-03.9	(1)60"PIPE	298	298	0	0	0
84	HWY - 85	DP 75 SE	6630-02	(1)2'Hx2'W-BOX CULVERT	43	71	30	50	220
85			-	(1)2'Hx2'W-BOX CULVERT	28				
86	HWY - 85	DP 78 SE	-	(1)4'Hx4'W-BOX CULVERT	88	116	40	60	215
87			6630-02.1	(1)2'Hx2'W-BOX CULVERT	28				
88	AT&SF R. R.	DP 78 SE	6630-02	(1)36"PIPE	127	127	70	60	215
89	HWY - 85	DP79 SE	6630-04	(1)8'Hx8'W-BOX CULVERT	544	601	70	130	520
90	AT&SF R. R.	DP79 SE	6630-04	(1)14'Hx(4)12'W-BRIDGE	895	895	70	130	520
91	D&RGW R.R.	DP79 SE	6630-04	(3)66"PIPE	827	827	70	130	520
92	HWY - 85	DP79 SE	-	(1)4'Hx4'W-BOX CULVERT	57	601	70	130	520
93	HWY - 85	DP82 SE	6630-05	(1)36"PIPE	47	47	15	25	85
94	AT&SF R. R.	DP82 SE	6630-05	-	-	-	15	25	85
95	D&RGW R.R.	DP82 SE	6630-05	-	-	-	15	25	85
96	HWY - 85	DP83 SE	6630-06	(1)2'Hx2'W-BOX CULVERT	28	107	30	60	250



SHEET INDEX





LEGEND

- WATERSHED BOUNDARY
- SUB WATERSHED BOUNDARY
- MATCHLINE
- 100-YR FLOODPLAIN

MASTER PLAN FACILITIES

- STORM SEWER
- RIPRAP LINED CHANNEL W/R.O.W.
- GRASS LINED CHANNEL W/R.O.W.
- OPEN SPACE BOUNDARY
- PARK BOUNDARY
- PREBLE MOUSE HABITAT
- EXISTING BRIDGE
- PROPOSED BRIDGE
- EXISTING CULVERT
- PROPOSED CULVERT
- CHECK STRUCTURES
- DROP STRUCTURES

NOTES:

1. THIS DRAWING IS FOR MASTER PLANNING PURPOSES AND REPRESENTS PRELIMINARY AND CONCEPTUAL ENGINEERING. ALTERNATIVES TO THIS OUTFALL SYSTEM WILL BE CONSIDERED BY LOCAL REVIEWING AGENCIES AND THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT PROVIDED THE ALTERNATIVE OFFERS EQUAL HYDRAULIC CAPACITY AND STREAM STABILITY. THE ALTERNATIVE MUST COMPLY WITH ALL REQUIREMENTS OF THE LOCAL JURISDICTION AND THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT. THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES.
2. THIS PLAN REQUIRES THAT THE DOUGLAS COUNTY ZONE, MANAGE, AND REGULATE DEVELOPMENT IN THIS WATERSHED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THIS PLAN IN ORDER TO PREVENT FLOOD DAMAGES RELATED TO FUTURE DEVELOPMENT.
3. ANY PROPOSED CHANGES MUST BE APPROVED BY THE DOUGLAS COUNTY AND THE UD&FCD. ANY POTENTIAL USER SHOULD CONTACT THE LOCAL REVIEWING AGENCY FOR ANY REVISIONS OF THE PLAN IN THE NEARBY VICINITY.
4. DATUM: VERTICAL = NAVD 1929
   HORIZONTAL = NAD 1927
   THE HORIZONTAL DATUM SHIFT FROM THE PROJECT MAPPING TO NAD 27 IS 944.65 WEST AND 527.26 SOUTH.
5. ABBREVATIONS:
   So = DESIGN SLOPE
   Q5 = 5YR FLOOD FLOW
   Q100 = 100YR FLOOD FLOW
   NC = NUMBER OF CHECK STRUCTURES
   ND = NUMBER OF DROP STRUCTURES
   W = WIDTH OF BOTTOM OF CHANNEL
   ROW = RIGHT-OF-WAY

PLAN SHEETS FROM U.S.G.S. 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAPS
TOWNSHIP 7 S.
RANGE 68 W.
SECTION 32

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET, SUITE 404
DENVER, COLORADO 80246
PHONE NO: (303) 757-8513
FAX NO: (303) 758-3268

DESIGNED	AJL	DATE
DRAWN	JLM	DATE 10-12-01
CHECKED		DATE
REVISED	JCP	DATE 6-13-03
AS-BUILT		DATE

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
DOUGLAS COUNTY

OUTFALL SYSTEMS PLANNING
PLUM CREEK WATERSHED

PRELIMINARY DESIGN PLAN

SHEET 14 OF 79

Range Preliminary Plan
Project File# SB2024-048
Planning Commission Staff Report Attachment D - Page 121 of 486

APPENDIX C

Hydrologic Calculations

Post- Project Conditions - Onsite Basins Only
Runoff Coefficient Calculations and Land Use Breakdown

RICK

Job Name: Range
Job Number: 2215
Date: February 27, 2025

Post-Project Onsite Basins

Sub-Basin	Hydrologic Soil Group	Total Area		On-Site/Developed				Historic / Undeveloped				Composite				
		sq-ft	acres	%LU	sq-ft	acres	% Impervious	%LU	sq-ft	acres	% Impervious	Sub-Basin	Total Area acres	% Impervious	C5	C100
1A	C/D	180,086	4.13	44%	80,000	1.84	65%	56%	100,086	2.30	5%	1A	4.13	31.7%	0.29	0.61
1B	C/D	6,342	0.15	100%	6,342	0.15	65%	0%	0	0.00	5%	1B	0.15	65.0%	0.56	0.75
1C	C/D	7,396	0.17	100%	7,396	0.17	65%	0%	0	0.00	5%	1C	0.17	65.0%	0.56	0.75
1D	C/D	103,646	2.38	67%	69,157	1.59	65%	33%	34,488	0.79	5%	1D	2.38	45.0%	0.40	0.67
1E	C/D	3,182,614	73.06	0%	0	0.00	65%	100%	3,182,614	73.06	5%	1E	73.06	5.0%	0.08	0.50
1F	C/D	32,856	0.75	100%	32,856	0.75	65%	0%	0	0.00	5%	1F	0.75	65.0%	0.56	0.75
1G	C/D	33,234	0.76	100%	33,234	0.76	65%	0%	0	0.00	5%	1G	0.76	65.0%	0.56	0.75
1H	C/D	264,123	6.06	0%	0	0.00	65%	100%	264,123	6.06	5%	1H	6.06	5.0%	0.08	0.50
1 TOTAL	**C/D**	**3,810,297**	**87.47**	**6%**	**228,985**	**5.26**	**65%**	**94%**	**3,581,311**	**82.22**	**5%**	**1 TOTAL**	**87.47**	**8.6%**	**0.11**	**0.52**
4A	C/D	201,039	4.62	20%	40,403	0.93	65%	80%	160,635	3.69	5%	4A	4.62	17.1%	0.17	0.55
4B	C/D	78,517	1.80	100%	78,517	1.80	65%	0%	0	0.00	5%	4B	1.80	65.0%	0.56	0.75
4C	C/D	51,377	1.18	100%	51,377	1.18	65%	0%	0	0.00	5%	4C	1.18	65.0%	0.56	0.75
4D	C/D	84,522	1.94	100%	84,522	1.94	65%	0%	0	0.00	5%	4D	1.94	65.0%	0.56	0.75
4E	C/D	49,152	1.13	100%	49,152	1.13	65%	0%	0	0.00	5%	4E	1.13	65.0%	0.56	0.75
4F	C/D	49,793	1.14	100%	49,793	1.14	65%	0%	0	0.00	5%	4F	1.14	65.0%	0.56	0.75
4G	C/D	27,621	0.63	100%	27,621	0.63	65%	0%	0	0.00	5%	4G	0.63	65.0%	0.56	0.75
4H	C/D	117,534	2.70	100%	117,534	2.70	65%	0%	0	0.00	5%	4H	2.70	65.0%	0.56	0.75
4I	C/D	95,938	2.20	100%	95,938	2.20	65%	0%	0	0.00	5%	4I	2.20	65.0%	0.56	0.75
4J	C/D	171,047	3.93	100%	171,047	3.93	65%	0%	0	0.00	5%	4J	3.93	65.0%	0.56	0.75
4K	C/D	186,031	4.27	100%	186,031	4.27	65%	0%	0	0.00	5%	4K	4.27	65.0%	0.56	0.75
4L	C/D	46,281	1.06	100%	46,281	1.06	65%	0%	0	0.00	5%	4L	1.06	65.0%	0.56	0.75
4M	C/D	33,079	0.76	100%	33,079	0.76	65%	0%	0	0.00	5%	4M	0.76	65.0%	0.56	0.75
4N	C/D	39,362	0.90	100%	39,362	0.90	65%	0%	0	0.00	5%	4N	0.90	65.0%	0.56	0.75
4O	C/D	73,586	1.69	100%	73,586	1.69	65%	0%	0	0.00	5%	4O	1.69	65.0%	0.56	0.75
4P	C/D	30,521	0.70	100%	30,521	0.70	65%	0%	0	0.00	5%	4P	0.70	65.0%	0.56	0.75
4Q	C/D	123,066	2.83	100%	123,066	2.83	65%	0%	0	0.00	5%	4Q	2.83	65.0%	0.56	0.75
4R	C/D	103,690	2.38	100%	103,690	2.38	65%	0%	0	0.00	5%	4R	2.38	65.0%	0.56	0.75
4S	C/D	132,793	3.05	100%	132,793	3.05	65%	0%	0	0.00	5%	4S	3.05	65.0%	0.56	0.75
4T	C/D	11,255	0.26	100%	11,255	0.26	65%	0%	0	0.00	5%	4T	0.26	65.0%	0.56	0.75
4U	C/D	91,570	2.10	100%	91,570	2.10	65%	0%	0	0.00	5%	4U	2.10	65.0%	0.56	0.75
4V	C/D	52,412	1.20	100%	52,412	1.20	65%	0%	0	0.00	5%	4V	1.20	65.0%	0.56	0.75
4W	C/D	36,262	0.83	100%	36,262	0.83	65%	0%	0	0.00	5%	4W	0.83	65.0%	0.56	0.75
4X	C/D	1,092,896	25.09	100%	1,092,896	25.09	65%	0%	0	0.00	5%	4X	25.09	65.0%	0.56	0.75
4 TOTAL	**C/D**	**2,979,342**	**68.40**	**95%**	**2,818,707**	**64.71**	**65%**	**5%**	**160,635**	**3.69**	**5%**	**4 TOTAL**	**68.40**	**61.8%**	**0.54**	**0.74**
5A	C/D	118,251	2.71	100%	118,251	2.71	65%	0%	0	0.00	5%	5A	2.71	65.0%	0.56	0.75
5B	C/D	79,845	1.83	100%	79,845	1.83	65%	0%	0	0.00	5%	5B	1.83	65.0%	0.56	0.75
5C	C/D	331,007	7.60	100%	331,007	7.60	65%	0%	0	0.00	5%	5C	7.60	65.0%	0.56	0.75
5D	C/D	90,624	2.08	100%	90,624	2.08	65%	0%	0	0.00	5%	5D	2.08	65.0%	0.56	0.75
5E	C/D	117,073	2.69	100%	117,073	2.69	65%	0%	0	0.00	5%	5E	2.69	65.0%	0.56	0.75
5 TOTAL	**C/D**	**736,801**	**16.91**	**100%**	**736,801**	**16.91**	**65%**	**0%**	**0**	**0.00**	**5%**	**5 TOTAL**	**16.91**	**65.0%**	**0.56**	**0.75**
6A	C/D	25,071	0.58	100%	25,071	0.58	65%	0%	0	0.00	5%	6A	0.58	65.0%	0.56	0.75

Post- Project Conditions - Onsite Basins Only
Runoff Coefficient Calculations and Land Use Breakdown

RICK

Job Name: Range
Job Number: 2215
Date: February 27, 2025

Post-Project Onsite Basins

Sub-Basin	Hydrologic Soil Group	Total Area		On-Site/Developed				Historic / Undeveloped				Composite				
		sq-ft	acres	%LU	sq-ft	acres	% Impervious	%LU	sq-ft	acres	% Impervious	Sub-Basin	Total Area acres	% Impervious	C5	C100
6B	C/D	59,326	1.36	100%	59,326	1.36	65%	0%	0	0.00	5%	6B	1.36	65.0%	0.56	0.75
6C	C/D	27,741	0.64	100%	27,741	0.64	65%	0%	0	0.00	5%	6C	0.64	65.0%	0.56	0.75
6D	C/D	79,191	1.82	100%	79,191	1.82	65%	0%	0	0.00	5%	6D	1.82	65.0%	0.56	0.75
6E	C/D	55,194	1.27	100%	55,194	1.27	65%	0%	0	0.00	5%	6E	1.27	65.0%	0.56	0.75
6F	C/D	31,087	0.71	100%	31,087	0.71	65%	0%	0	0.00	5%	6F	0.71	65.0%	0.56	0.75
6G	C/D	10,178	0.23	100%	10,178	0.23	65%	0%	0	0.00	5%	6G	0.23	65.0%	0.56	0.75
6H	C/D	28,188	0.65	100%	28,188	0.65	65%	0%	0	0.00	5%	6H	0.65	65.0%	0.56	0.75
6I	C/D	52,713	1.21	100%	52,713	1.21	65%	0%	0	0.00	5%	6I	1.21	65.0%	0.56	0.75
6J	C/D	22,278	0.51	100%	22,278	0.51	65%	0%	0	0.00	5%	6J	0.51	65.0%	0.56	0.75
6K	C/D	41,109	0.94	100%	41,109	0.94	65%	0%	0	0.00	5%	6K	0.94	65.0%	0.56	0.75
6L	C/D	95,859	2.20	100%	95,859	2.20	65%	0%	0	0.00	5%	6L	2.20	65.0%	0.56	0.75
6M	C/D	28,652	0.66	100%	28,652	0.66	65%	0%	0	0.00	5%	6M	0.66	65.0%	0.56	0.75
6N	C/D	56,201	1.29	100%	56,201	1.29	65%	0%	0	0.00	5%	6N	1.29	65.0%	0.56	0.75
6O	C/D	33,369	0.77	100%	33,369	0.77	65%	0%	0	0.00	5%	6O	0.77	65.0%	0.56	0.75
6P	C/D	114,677	2.63	100%	114,677	2.63	65%	0%	0	0.00	5%	6P	2.63	65.0%	0.56	0.75
6Q	C/D	58,660	1.35	100%	58,660	1.35	65%	0%	0	0.00	5%	6Q	1.35	65.0%	0.56	0.75
6R	C/D	102,384	2.35	100%	102,384	2.35	65%	0%	0	0.00	5%	6R	2.35	65.0%	0.56	0.75
6S	C/D	50,306	1.15	100%	50,306	1.15	65%	0%	0	0.00	5%	6S	1.15	65.0%	0.56	0.75
6T	C/D	69,826	1.60	100%	69,826	1.60	65%	0%	0	0.00	5%	6T	1.60	65.0%	0.56	0.75
6U	C/D	52,361	1.20	100%	52,361	1.20	65%	0%	0	0.00	5%	6U	1.20	65.0%	0.56	0.75
6V	C/D	33,580	0.77	100%	33,580	0.77	65%	0%	0	0.00	5%	6V	0.77	65.0%	0.56	0.75
6W	C/D	23,517	0.54	100%	23,517	0.54	65%	0%	0	0.00	5%	6W	0.54	65.0%	0.56	0.75
6X	C/D	24,738	0.57	100%	24,738	0.57	65%	0%	0	0.00	5%	6X	0.57	65.0%	0.56	0.75
6Y	C/D	34,296	0.79	100%	34,296	0.79	65%	0%	0	0.00	5%	6Y	0.79	65.0%	0.56	0.75
6Z	C/D	709,447	16.29	31%	217,965	5.00	65%	69%	491,483	11.28	5%	6Z	16.29	23.4%	0.23	0.58
6A2	C/D	92,521	2.12	100%	92,521	2.12	65%	0%	0	0.00	5%	6A2	2.12	65.0%	0.56	0.75
6B2	C/D	152,717	3.51	100%	152,717	3.51	65%	0%	0	0.00	5%	6B2	3.51	65.0%	0.56	0.75
6 TOTAL	**C/D**	**2,165,188**	**49.71**	**77%**	**1,673,706**	**38.42**	**65%**	**23%**	**491,483**	**11.28**	**5%**	**6 TOTAL**	**49.71**	**51.4%**	**0.45**	**0.69**
8A	C/D	78,592	1.80	81%	63,450	1.46	65%	19%	15,142	0.35	5%	8A	1.80	53.4%	0.47	0.70
8B	C/D	29,700	0.68	100%	29,700	0.68	65%	0%	0	0.00	5%	8B	0.68	65.0%	0.56	0.75
8C	C/D	41,150	0.94	100%	41,150	0.94	65%	0%	0	0.00	5%	8C	0.94	65.0%	0.56	0.75
8D	C/D	41,253	0.95	100%	41,253	0.95	65%	0%	0	0.00	5%	8D	0.95	65.0%	0.56	0.75
8E	C/D	25,072	0.58	100%	25,072	0.58	65%	0%	0	0.00	5%	8E	0.58	65.0%	0.56	0.75
8F	C/D	52,079	1.20	100%	52,079	1.20	65%	0%	0	0.00	5%	8F	1.20	65.0%	0.56	0.75
8G	C/D	46,613	1.07	68%	31,755	0.73	65%	32%	14,858	0.34	5%	8G	1.07	45.9%	0.41	0.67
8H	C/D	56,376	1.29	100%	56,376	1.29	65%	0%	0	0.00	5%	8H	1.29	65.0%	0.56	0.75
8I	C/D	34,745	0.80	100%	34,745	0.80	65%	0%	0	0.00	5%	8I	0.80	65.0%	0.56	0.75
8J	C/D	36,806	0.84	100%	36,806	0.84	65%	0%	0	0.00	5%	8J	0.84	65.0%	0.56	0.75
8K	C/D	23,586	0.54	100%	23,586	0.54	65%	0%	0	0.00	5%	8K	0.54	65.0%	0.56	0.75
8L	C/D	52,381	1.20	100%	52,381	1.20	65%	0%	0	0.00	5%	8L	1.20	65.0%	0.56	0.75
8M	C/D	17,745	0.41	100%	17,745	0.41	65%	0%	0	0.00	5%	8M	0.41	65.0%	0.56	0.75
8N	C/D	17,567	0.40	100%	17,567	0.40	65%	0%	0	0.00	5%	8N	0.40	65.0%	0.56	0.75

Post- Project Conditions - Onsite Basins Only
Runoff Coefficient Calculations and Land Use Breakdown

RICK

Job Name: Range
Job Number: 2215
Date: February 27, 2025

Post-Project Onsite Basins

Sub-Basin	Hydrologic Soil Group	Total Area		On-Site/Developed				Historic / Undeveloped				Composite				
		sq-ft	acres	%LU	sq-ft	acres	% Impervious	%LU	sq-ft	acres	% Impervious	Sub-Basin	Total Area acres	% Impervious	C5	C100
8O	C/D	5,443	0.12	100%	5,443	0.12	65%	0%	0	0.00	5%	8O	0.12	65.0%	0.56	0.75
8P	C/D	70,137	1.61	100%	70,137	1.61	65%	0%	0	0.00	5%	8P	1.61	65.0%	0.56	0.75
8Q	C/D	88,483	2.03	100%	88,483	2.03	65%	0%	0	0.00	5%	8Q	2.03	65.0%	0.56	0.75
8R	C/D	46,984	1.08	100%	46,984	1.08	65%	0%	0	0.00	5%	8R	1.08	65.0%	0.56	0.75
8S	C/D	31,989	0.73	100%	31,989	0.73	65%	0%	0	0.00	5%	8S	0.73	65.0%	0.56	0.75
8T	C/D	26,104	0.60	100%	26,104	0.60	65%	0%	0	0.00	5%	8T	0.60	65.0%	0.56	0.75
8U	C/D	91,181	2.09	100%	91,181	2.09	65%	0%	0	0.00	5%	8U	2.09	65.0%	0.56	0.75
8V	C/D	61,449	1.41	100%	61,449	1.41	65%	0%	0	0.00	5%	8V	1.41	65.0%	0.56	0.75
8W	C/D	36,317	0.83	100%	36,317	0.83	65%	0%	0	0.00	5%	8W	0.83	65.0%	0.56	0.75
8X	C/D	153,817	3.53	100%	153,817	3.53	65%	0%	0	0.00	5%	8X	3.53	65.0%	0.56	0.75
8 TOTAL	**C/D**	**1,165,572**	**26.76**	**97%**	**1,135,571**	**26.07**	**65%**	**3%**	**30,000**	**0.69**	**5%**	**8 TOTAL**	**26.76**	**63.5%**	**0.55**	**0.74**
9A	C/D	441,603	10.14	15%	68,056	1.56	65%	85%	373,547	8.58	5%	9A	10.14	14.2%	0.15	0.54
9B	C/D	46,459	1.07	100%	46,459	1.07	65%	0%	0	0.00	5%	9B	1.07	65.0%	0.56	0.75
9C	C/D	10,156	0.23	100%	10,156	0.23	65%	0%	0	0.00	5%	9C	0.23	65.0%	0.56	0.75
9D	C/D	43,405	1.00	100%	43,405	1.00	65%	0%	0	0.00	5%	9D	1.00	65.0%	0.56	0.75
9E	C/D	14,102	0.32	100%	14,102	0.32	65%	0%	0	0.00	5%	9E	0.32	65.0%	0.56	0.75
9F	C/D	36,026	0.83	100%	36,026	0.83	65%	0%	0	0.00	5%	9F	0.83	65.0%	0.56	0.75
9G	C/D	10,103	0.23	100%	10,103	0.23	65%	0%	0	0.00	5%	9G	0.23	65.0%	0.56	0.75
9H	C/D	45,971	1.06	100%	45,971	1.06	65%	0%	0	0.00	5%	9H	1.06	65.0%	0.56	0.75
9I	C/D	51,334	1.18	100%	51,334	1.18	65%	0%	0	0.00	5%	9I	1.18	65.0%	0.56	0.75
9J	C/D	141,873	3.26	100%	141,873	3.26	65%	0%	0	0.00	5%	9J	3.26	65.0%	0.56	0.75
9ATOTAL	**C/D**	**841,03**	**19.3**	**56%**	**467,48**	**10.7**	**65%**	**44%**	**373,54**	**8.5**	**5%**	**9 TOTA**	**19.3**	**38.4%**	**0.3**	**0.6**
9B TOTAL	**C/D**	**193,048**	**4.43**	**100%**	**193,048**	**4.43**	**65%**	**0%**	**0**	**0.00**	**5%**	**10 TOTAL**	**4.43**	**65.0%**	**0.56**	**0.75**
12A	C/D	107,264	2.46	100%	107,264	2.46	65%	0%	0	0.00	5%	12A	2.46	65.0%	0.56	0.75
12B	C/D	25,719	0.59	100%	25,719	0.59	65%	0%	0	0.00	5%	12B	0.59	65.0%	0.56	0.75
12C	C/D	65,601	1.51	100%	65,601	1.51	65%	0%	0	0.00	5%	12C	1.51	65.0%	0.56	0.75
12D	C/D	23,287	0.53	100%	23,287	0.53	65%	0%	0	0.00	5%	12D	0.53	65.0%	0.56	0.75
12E	C/D	26,633	0.61	100%	26,633	0.61	65%	0%	0	0.00	5%	12E	0.61	65.0%	0.56	0.75
12F	C/D	63,877	1.47	100%	63,877	1.47	65%	0%	0	0.00	5%	12F	1.47	65.0%	0.56	0.75
12G	C/D	78,689	1.81	100%	78,689	1.81	65%	0%	0	0.00	5%	12G	1.81	65.0%	0.56	0.75
12H	C/D	22,883	0.53	100%	22,883	0.53	65%	0%	0	0.00	5%	12H	0.53	65.0%	0.56	0.75
12I	C/D	77,464	1.78	100%	77,464	1.78	65%	0%	0	0.00	5%	12I	1.78	65.0%	0.56	0.75
12J	B	17,915	0.41	100%	17,915	0.41	65%	0%	0	0.00	5%	12J	0.41	65.0%	0.54	0.73
12K	C/D	71,343	1.64	100%	71,343	1.64	65%	0%	0	0.00	5%	12K	1.64	65.0%	0.56	0.75
12L	C/D	21,911	0.50	100%	21,911	0.50	65%	0%	0	0.00	5%	12L	0.50	65.0%	0.56	0.75
12M	B	56,876	1.31	100%	56,876	1.31	65%	0%	0	0.00	5%	12M	1.31	65.0%	0.54	0.73
12N	B	14,508	0.33	100%	14,508	0.33	65%	0%	0	0.00	5%	12N	0.33	65.0%	0.54	0.73
12O	C/D	68,841	1.58	100%	68,841	1.58	65%	0%	0	0.00	5%	12O	1.58	65.0%	0.56	0.75
12P	B	22,015	0.51	100%	22,015	0.51	65%	0%	0	0.00	5%	12P	0.51	65.0%	0.54	0.73
12Q	B	48,816	1.12	100%	48,816	1.12	65%	0%	0	0.00	5%	12Q	1.12	65.0%	0.54	0.73
12R	B	42,723	0.98	100%	42,723	0.98	65%	0%	0	0.00	5%	12R	0.98	65.0%	0.54	0.73
12S	B	100,068	2.30	100%	100,068	2.30	65%	0%	0	0.00	5%	12S	2.30	65.0%	0.54	0.73

Post- Project Conditions - Onsite Basins Only
Runoff Coefficient Calculations and Land Use Breakdown

RICK

Job Name: Range
Job Number: 2215
Date: February 27, 2025

Post-Project Onsite Basins																
Sub-Basin	Hydrologic Soil Group	Total Area		On-Site/Developed				Historic / Undeveloped				Composite				
		sq-ft	acres	%LU	sq-ft	acres	% Impervious	%LU	sq-ft	acres	% Impervious	Sub-Basin	Total Area acres	% Impervious	C5	C100
12 TOTAL	**C/D**	**956,432**	**21.96**	**100%**	**956,432**	**21.96**	**65%**	**0%**	**0**	**0.00**	**5%**	**12 TOTAL**	**21.96**	**65.0%**	**0.56**	**0.75**
15A	C/D	70,846	1.63	100%	70,846	1.63	65%	0%	0	0.00	5%	15A	1.63	65.0%	0.56	0.75
15B	C/D	42,292	0.97	100%	42,292	0.97	65%	0%	0	0.00	5%	15B	0.97	65.0%	0.56	0.75
15C	C/D	26,878	0.62	100%	26,878	0.62	65%	0%	0	0.00	5%	15C	0.62	65.0%	0.56	0.75
15D	C/D	71,209	1.63	100%	71,209	1.63	65%	0%	0	0.00	5%	15D	1.63	65.0%	0.56	0.75
15E	C/D	62,920	1.44	100%	62,920	1.44	65%	0%	0	0.00	5%	15E	1.44	65.0%	0.56	0.75
15F	C/D	150,339	3.45	100%	150,339	3.45	65%	0%	0	0.00	5%	15F	3.45	65.0%	0.56	0.75
15 TOTAL	**C/D**	**424,483**	**9.74**	**100%**	**424,483**	**9.74**	**65%**	**0%**	**0**	**0.00**	**5%**	**15 TOTAL**	**9.74**	**65.0%**	**0.56**	**0.75**
TOTAL AREA	**C/D**	**13,272,195**	**304.7**	**65.1%**	**8,635,218**	**198.2**	**65%**	**34.9%**	**4,636,976**	**106.5**	**5%**	**Total**	**304.69**	**44.0%**	**0.39**	**0.66**

Calculation of Peak Runoff using Rational Method

Designer: NAS
Company: Rick Engineering Company
Date: 12/18/2024
Project: Range - North
Location: Douglas County, Colorado

Version 2.00 released May 2017

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

$t_i = \frac{0.3}{}$ Computed $t_c = t_i + t_t$

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

$t_t = \frac{}{}$ Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i+9)\sqrt{S}}$ Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

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

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.06	1.43	1.66	1.91	2.26	2.60	3.03

Rainfall Intensity Equation Coefficients =	a	b	c
	28.50	10.00	0.786

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

$Q(cfs) = CIA$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time			Channelized (Travel) Flow Time					Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
8A	1.80	C	53.4	0.41	0.47	0.52	0.62	0.66	0.70	0.76	270.00	0.250	6.46	280.00	0.053	20	4.60	1.01	7.47	18.15	7.47	3.19	4.30	4.99	5.75	6.80	7.82	9.12	2.37	3.64	4.71	6.39	8.04	9.89	12.41
8B	0.68	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	55.00	0.020	5.70	280.00	0.053	20	4.60	1.01	6.72	16.07	6.72	3.30	4.45	5.17	5.95	7.04	8.10	9.44	1.15	1.71	2.14	2.76	3.42	4.13	5.09
8C	0.94	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	80.00	0.250	2.99	365.00	0.040	7	1.40	4.35	7.33	16.63	7.33	3.21	4.33	5.03	5.78	6.84	7.87	9.17	1.55	2.30	2.88	3.71	4.59	5.55	6.84
8D	0.95	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	105.00	0.020	7.88	300.00	0.060	20	4.90	1.02	8.90	16.08	8.90	3.00	4.04	4.70	5.40	6.39	7.35	8.57	1.47	2.17	2.72	3.51	4.34	5.24	6.45
8E	0.58	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	50.00	0.020	5.44	300.00	0.060	20	4.90	1.02	6.46	16.08	6.46	3.34	4.51	5.23	6.02	7.13	8.20	9.56	1.00	1.48	1.85	2.39	2.95	3.57	4.39
8F	1.20	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	80.00	0.250	2.99	350.00	0.040	7	1.40	4.17	7.15	16.56	7.15	3.24	4.36	5.07	5.83	6.90	7.94	9.25	2.00	2.96	3.71	4.78	5.91	7.14	8.80
8G	1.07	C	45.9	0.35	0.41	0.47	0.58	0.62	0.67	0.73	100.00	0.250	4.31	280.00	0.080	7	1.98	2.36	6.67	19.27	6.67	3.31	4.46	5.18	5.96	7.06	8.12	9.46	1.23	1.95	2.60	3.68	4.68	5.83	7.41
8H	1.29	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	130.00	0.020	8.77	420.00	0.060	20	4.90	1.43	10.19	16.53	10.19	2.85	3.84	4.46	5.13	6.07	6.98	8.14	1.89	2.80	3.51	4.52	5.59	6.75	8.32
8I	0.80	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	90.00	0.020	7.29	420.00	0.060	20	4.90	1.43	8.72	16.53	8.72	3.02	4.07	4.73	5.44	6.44	7.41	8.63	1.24	1.84	2.31	2.97	3.68	4.44	5.48
8J	0.84	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	130.00	0.020	8.77	300.00	0.050	20	4.47	1.12	9.88	16.19	9.88	2.88	3.89	4.51	5.19	6.14	7.07	8.24	1.24	1.84	2.31	2.98	3.68	4.45	5.48
8K	0.54	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	50.00	0.020	5.44	300.00	0.050	20	4.47	1.12	6.55	16.19	6.55	3.33	4.49	5.21	6.00	7.09	8.16	9.51	0.92	1.37	1.72	2.21	2.74	3.30	4.07
8L	1.20	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	130.00	0.020	8.77	290.00	0.060	20	4.90	0.99	9.75	16.04	9.75	2.90	3.91	4.54	5.22	6.17	7.10	8.28	1.79	2.65	3.32	4.28	5.29	6.39	7.87
8M	0.41	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.020	5.16	290.00	0.060	20	4.90	0.99	6.14	16.04	6.14	3.39	4.58	5.31	6.11	7.24	8.32	9.70	0.72	1.06	1.33	1.71	2.12	2.56	3.15
8N	0.40	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	130.00	0.020	8.77	200.00	0.060	20	4.90	0.68	9.45	15.70	9.45	2.93	3.96	4.59	5.28	6.25	7.19	8.38	0.60	0.89	1.12	1.44	1.79	2.16	2.66
8O	0.12	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	20.00	0.020	3.44	130.00	0.060	20	4.90	0.44	3.88	15.44	5.00	3.60	4.85	5.63	6.48	7.67	8.82	10.28	0.22	0.33	0.41	0.53	0.66	0.79	0.98
8P	1.61	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	250.00	0.020	12.16	380.00	0.040	20	4.00	1.58	13.74	16.70	13.74	2.51	3.38	3.92	4.52	5.34	6.15	7.16	2.08	3.07	3.85	4.97	6.14	7.42	9.14
8Q	2.03	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	300.00	0.020	13.32	275.00	0.055	20	4.69	0.98	14.29	16.03	14.29	2.46	3.32	3.85	4.43	5.25	6.04	7.04	2.57	3.81	4.77	6.15	7.61	9.19	11.32
8R	1.08	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.020	5.16	650.00	0.050	7	1.57	6.92	12.08	17.63	12.08	2.65	3.58	4.16	4.78	5.66	6.51	7.58	1.47	2.18	2.74	3.53	4.36	5.27	6.49
8S	0.73	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	100.00	0.020	7.69	350.00	0.060	20	4.90	1.19	8.88	16.27	8.88	3.00	4.05	4.70	5.41	6.40	7.36	8.58	1.13	1.67	2.09	2.70	3.34	4.03	4.96
8T	0.60	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	50.00	0.020	5.44	350.00	0.060	20	4.90	1.19	6.63	16.27	6.63	3.32	4.47	5.19	5.97	7.07	8.13	9.48	1.02	1.52	1.90	2.45	3.03	3.66	4.51
8U	2.09	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	130.00	0.250	3.81	400.00	0.040	7	1.40	4.76	8.57	16.79	8.57	3.04	4.10	4.76	5.48	6.48	7.46	8.69	3.27	4.84	6.07	7.82	9.67	11.69	14.40
8V	1.41	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	125.00	0.020	8.60	375.00	0.035	20	3.74	1.67	10.27	16.80	10.27	2.84	3.83	4.44	5.11	6.05	6.96	8.11	2.06	3.05	3.82	4.92	6.09	7.36	9.07
8W	0.83	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	40.00	0.020	4.86	375.00	0.035	20	3.74	1.67	6.53	16.80	6.53	3.33	4.49	5.22	6.00	7.10	8.17	9.52	1.42	2.11	2.64	3.40	4.21	5.08	6.26
8X	3.53	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	90.00	0.250	3.17	670.00	0.040	7	1.40	7.98	11.15	18.03	11.15	2.74	3.70	4.30	4.95	5.85	6.73	7.85	4.98	7.38	9.25	11.92	14.75	17.82	21.96
9A	10.14	C	14.2	0.09	0.15	0.24	0.40	0.46	0.54	0.63	300.00	0.200	11.05	1050.00	0.150	7	2.71	6.45	17.50	27.70	17.50	2.23	3.01	3.50	4.02	4.76	5.48	6.38	2.11	4.60	8.38	16.26	22.36	30.10	40.95
9B	1.07	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	65.00	0.020	6.20	560.00	0.060	20	4.90	1.91	8.10	17.06	8.10	3.10	4.18	4.86	5.59	6.61	7.61	8.87	1.71	2.53	3.17	4.08	5.05	6.10	7.52
9C	0.23	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	20.00	0.020	3.44	280.00	0.060	20	4.90	0.95	4.39	16.00	5.00	3.60	4.85	5.63	6.48	7.67	8.82	10.28	0.43	0.63	0.79	1.02	1.26	1.52	1.87
9D	1.00	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	140.00	0.020	9.10	400.00	0.040	20	4.00	1.67	10.76	16.79	10.76	2.78	3.76	4.36	5.02	5.94	6.83	7.96	1.43	2.12	2.66	3.43	4.24	5.12	6.31
9E	0.32	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	20.00	0.020	3.44	400.00	0.040	20	4.00	1.67	5.10	16.79	5.10	3.58	4.82	5.60	6.44	7.62	8.77	10.22	0.59	0.87	1.09	1.41	1.74	2.10	2.59
9F	0.83	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.020	5.16	560.00	0.060	20	4.90	1.91	7.06	17.06	7.06	3.25	4.38	5.09	5.85	6.93	7.97	9.29	1.39	2.05	2.58	3.32	4.11	4.96	6.11
9G	0.23	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	20.00	0.020	3.44	250.00	0.060	20	4.90	0.85	4.29	15.89	5.00	3.60	4.85	5.63	6.48	7.67	8.82	10.28	0.43	0.63	0.79	1.02	1.26	1.52	1.87
9H	1.06	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.020	5.16	530.00	0.025	20	3.16	2.79	7.95	18.04	7.95	3.12	4.21	4.89	5.63	6.66	7.66	8.92	1.70	2.52	3.16	4.07	5.04	6.09	7.50
9I	1.18	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.020	5.16	530.00	0.025	20	3.16	2.79	7.95	18.04	7.95	3.12	4.21	4.89	5.63	6.66	7.66	8.92	1.89	2.81	3.52	4.53	5.61	6.78	8.35
9J	3.26	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	150.00	0.250	4.09	300.00	0.040	7	1.40	3.57	7.66	16.33	7.66	3.16	4.27	4.95	5.70	6.74	7.76	9.04	5.30	7.85	9.84	12.69	15.69	18.96	23.36
10	4.43	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	175.00	0.250	4.42	830.00	0.020	7	0.99	13.97	18.39	20.35	18.39	2.18	2.94	3.41	3.92	4.64	5.34	6.22	4.96	7.35	9.21	11.87	14.69	17.74	21.86
12A	2.46	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	240.00	0.020	11.91	380.00	0.050	20	4.47	1.42	13.33	16.51	13.33	2.54	3.43	3.98	4.58	5.42	6.23	7.26	3.22	4.76	5.97	7.69	9.52	11.50	14.17
12B	0.59	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	50.00	0.020	5.44	380.00	0.050	20	4.47	1.42	6.85	16.51	6.85	3.28	4.43	5.14	5.91	7.00	8.05	9.38	1.00	1.47	1.85	2.38	2.95	3.56	4.39
12C	1.51	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	200.00	0.020	10.87	340.00	0.050	20	4.47	1.27	12.14	16.35	12.14	2.65	3.57	4.15	4.77	5.64	6.49	7.57	2.06	3.05	3.82	4.92	6.09	7.35	9.06
12D	0.53	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	50.00	0.020	5.44	340.00	0.050	20	4.47	1.27	6.70	16.35	6.70	3.30	4.46	5.17	5.95	7.04	8.10	9.44	0.90	1.33	1.67	2.16	2.67	3.22	3.97
12E	0.61	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.020	5.16	440.00	0.060	20	4.90	1.50	6.65	16.60	6.65	3.31	4.47	5.19	5.97	7.06	8.12	9.47	1.04	1.54	1.93	2.49	3.08	3.72	4.58
12F	1.47	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	120.00	0.020	8.42	440.00	0.060	20	4.90	1.50	9.92	16.60	9.92	2.88	3.88	4.51	5.18	6.13	7.06	8.22	2.18	3.22	4.04	5.20	6.44	7.78	9.58
12G	1.81	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	230.00	0.020	11.66	330.00	0.060	20	4.90	1.12	12.78	16.19	12.78	2.59	3.49	4.05	4.66	5.52	6.35	7.40	2.41	3.57	4.47	5.77	7.13	8.62	10.62
12H	0.53	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.020	5.16	330.00	0.060	20	4.90	1.12	6.28	16.19	6.28	3.37	4.55	5.28	6.07	7.19	8.27	9.64	0.92	1.36	1.71	2.20	2.72	3.29	4.05
12I	1.78	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	230.00	0.020	11.66	240.00	0.060	20	4.90	0.82	12.48	15.85	12.48	2.62	3.53	4.10	4.71	5.58	6.42	7.48	2.40	3.55	4.45	5.73	7.09	8.57	10.55
12J	0.41	B	65.0	0.50	0.54	0.58	0.66	0.69	0.73	0.77	45.00	0.020	5.43	240.00	0.060	20	4.90	0.82	6.25	15.85	6.25	3.38	4.56	5.29	6.08	7.20	8.28	9.65	0.70	1.00	1.26	1.64	2.04	2.47	3.06
12K	1.64	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	220.00	0.020	11.40	280.00	0.060	20	4.90	0.95	12.36	16.00	12.36	2.63	3.54	4.11	4.73	5.60	6.44	7.51	2.22	3.28	4.11	5.30	6.56	7.93	9.76
12L	0.50	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.020	5.16	280.00	0.060	20	4.90	0.95	6.11	16.00	6.11	3.40	4.59	5.32	6.12	7.25	8.34	9.72	0.87	1.29	1.62	2.09	2.59	3.13	3.85
12M	1.31	B	65.0	0.50	0.54	0.58	0.66	0.69	0.73	0.77	210.00	0.020	11.73	190.00	0.060	20	4.90	0.65	12.38	15.66	12.38	2.63	3.54	4.11	4.73	5.60	6.44	7.50	1.74	2.49	3.13	4.07	5.06	6.14	7.61
12N	0.33	B	65.0	0.50	0.54	0.58	0.66	0.69	0.73	0.77	45.00	0.020	5.43	190.00	0.060	20	4.90	0.65	6.08	15.66	6.08	3.40	4.59	5.33	6.13	7.26	8.35	9.73	0.57	0.81	1.02	1.33	1.65	2.01	2.49

12O	1.58	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	200.00	0.020	10.87	300.00	0.050	20	4.47	1.12	11.99	16.19	11.99	2.66	3.59	4.17	4.80	5.67	6.53	7.61	2.16	3.20	4.02	5.18	6.40	7.73	9.53
12P	0.51	B	65.0	0.50	0.54	0.58	0.66	0.69	0.73	0.77	70.00	0.020	6.77	300.00	0.050	20	4.47	1.12	7.89	16.19	7.89	3.13	4.22	4.90	5.64	6.67	7.68	8.95	0.81	1.16	1.45	1.89	2.35	2.85	3.53
12Q	1.12	B	65.0	0.50	0.54	0.58	0.66	0.69	0.73	0.77	115.00	0.020	8.68	520.00	0.060	20	4.90	1.77	10.45	16.90	10.45	2.82	3.80	4.41	5.08	6.01	6.91	8.05	1.59	2.28	2.87	3.74	4.65	5.64	6.98
12R	0.98	B	65.0	0.50	0.54	0.58	0.66	0.69	0.73	0.77	70.00	0.020	6.77	520.00	0.060	20	4.90	1.77	8.54	16.90	8.54	3.04	4.11	4.77	5.48	6.49	7.47	8.70	1.51	2.16	2.72	3.53	4.39	5.33	6.60
12S	2.30	B	65.0	0.50	0.54	0.58	0.66	0.69	0.73	0.77	90.00	0.080	4.86	430.00	0.040	7	1.40	5.12	9.98	16.93	9.98	2.87	3.87	4.49	5.17	6.12	7.04	8.20	3.33	4.78	6.01	7.82	9.72	11.79	14.60
15A	1.63	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	130.00	0.020	8.77	300.00	0.050	20	4.47	1.12	9.88	16.19	9.88	2.88	3.89	4.51	5.19	6.14	7.07	8.24	2.42	3.58	4.48	5.78	7.15	8.64	10.64
15B	0.97	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	80.00	0.020	6.88	375.00	0.060	20	4.90	1.28	8.15	16.36	8.15	3.09	4.18	4.85	5.58	6.60	7.59	8.85	1.54	2.29	2.87	3.69	4.57	5.52	6.80
15C	0.62	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	50.00	0.020	5.44	375.00	0.060	20	4.90	1.28	6.71	16.36	6.71	3.30	4.46	5.17	5.95	7.04	8.10	9.44	1.05	1.56	1.96	2.52	3.12	3.77	4.64
15D	1.63	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	140.00	0.020	9.10	390.00	0.060	20	4.90	1.33	10.42	16.42	10.42	2.82	3.81	4.42	5.08	6.01	6.92	8.06	2.37	3.50	4.39	5.66	7.00	8.46	10.42
15E	1.44	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	120.00	0.020	8.42	390.00	0.060	20	4.90	1.33	9.75	16.42	9.75	2.90	3.91	4.54	5.22	6.18	7.10	8.28	2.15	3.18	3.98	5.13	6.35	7.67	9.45
15F	3.45	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	95.00	0.250	3.26	1000.00	0.040	7	1.40	11.90	15.16	19.55	15.16	2.39	3.23	3.75	4.31	5.10	5.87	6.84	4.25	6.29	7.89	10.17	12.58	15.19	18.72

Calculation of Peak Runoff using Rational Method

Designer: NAS
Company: Rick Engineering Company
Date: 12/18/2024
Project: Range - South
Location: Douglas County, Colorado

Version 2.00 released May 2017

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

$t_i = \frac{0.3}{}$ Computed $t_c = t_i + t_t$

$t_t = \frac{}{}$ Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i+9)\sqrt{S}}$ Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

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

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

1-hour rainfall depth, P1 (in) =	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
	1.06	1.43	1.66	1.91	2.26	2.60	3.03

Rainfall Intensity Equation Coefficients =	a	b	c
	28.50	10.00	0.786

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

$Q(cfs) = CIA$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time			Channelized (Travel) Flow Time					Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1A	4.13	C	31.7	0.23	0.29	0.36	0.50	0.55	0.61	0.69	45.00	0.010	9.77	1650.00	0.068	7	1.83	15.07	24.84	28.46	24.84	1.85	2.50	2.90	3.34	3.95	4.55	5.30	1.76	3.03	4.38	6.85	8.97	11.53	15.06
1B	0.15	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	19.00	0.020	3.35	1400.00	0.060	20	4.90	4.76	8.11	20.21	8.11	3.10	4.18	4.85	5.59	6.61	7.60	8.86	0.24	0.35	0.44	0.57	0.71	0.86	1.05
1C	0.17	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	19.00	0.020	3.35	1400.00	0.060	20	4.90	4.76	8.11	20.21	8.11	3.10	4.18	4.85	5.59	6.61	7.60	8.86	0.27	0.40	0.50	0.65	0.80	0.97	1.19
1D	2.38	C	45.0	0.34	0.40	0.46	0.57	0.62	0.67	0.73	45.00	0.010	8.46	820.00	0.020	7	0.99	13.81	22.26	24.67	22.26	1.97	2.66	3.08	3.55	4.20	4.83	5.63	1.60	2.54	3.40	4.82	6.15	7.68	9.78
1E	73.06	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60	480.00	0.120	17.84	2200.00	0.060	7	1.71	21.38	39.23	40.58	39.23	1.41	1.91	2.21	2.55	3.01	3.47	4.04	2.99	10.55	27.28	64.54	91.92	127.71	178.13
1F	0.75	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	19.00	0.020	3.35	1100.00	0.060	20	4.90	3.74	7.09	19.09	7.09	3.24	4.38	5.08	5.85	6.92	7.96	9.27	1.25	1.85	2.32	2.99	3.70	4.48	5.51
1G	0.76	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	19.00	0.020	3.35	1100.00	0.060	20	4.90	3.74	7.09	19.09	7.09	3.24	4.38	5.08	5.85	6.92	7.96	9.27	1.27	1.88	2.35	3.03	3.75	4.54	5.59
1H	6.06	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60	420.00	0.120	16.69	1100.00	0.050	7	1.57	11.71	28.40	33.60	28.40	1.72	2.32	2.69	3.09	3.66	4.21	4.91	0.30	1.06	2.75	6.51	9.27	12.88	17.96
4A	4.62	C	17.1	0.11	0.17	0.26	0.41	0.48	0.55	0.64	110.00	0.130	7.52	500.00	0.100	7	2.21	3.76	11.28	25.41	11.28	2.73	3.68	4.28	4.92	5.82	6.70	7.81	1.45	2.97	5.09	9.43	12.84	17.14	23.15
4B	1.80	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	130.00	0.025	8.14	340.00	0.055	20	4.69	1.21	9.35	16.28	9.35	2.94	3.97	4.61	5.30	6.27	7.22	8.41	2.72	4.04	5.06	6.52	8.07	9.74	12.00
4C	1.18	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	130.00	0.025	8.14	340.00	0.055	20	4.69	1.21	9.35	16.28	9.35	2.94	3.97	4.61	5.30	6.27	7.22	8.41	1.79	2.65	3.32	4.27	5.29	6.39	7.87
4D	1.94	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	120.00	0.025	7.82	375.00	0.010	20	2.00	3.13	10.95	18.40	10.95	2.77	3.73	4.33	4.98	5.90	6.78	7.90	2.76	4.09	5.12	6.60	8.17	9.87	12.16
4E	1.13	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.010	6.48	375.00	0.010	20	2.00	3.13	9.61	18.40	9.61	2.91	3.93	4.56	5.25	6.21	7.14	8.33	1.69	2.51	3.14	4.05	5.01	6.05	7.46
4F	1.14	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.010	6.48	690.00	0.055	20	4.69	2.45	8.93	17.66	8.93	2.99	4.04	4.69	5.39	6.38	7.34	8.56	1.76	2.60	3.26	4.20	5.20	6.28	7.73
4G	0.63	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	20.00	0.020	3.44	690.00	0.055	20	4.69	2.45	5.89	17.66	5.89	3.44	4.64	5.38	6.19	7.33	8.43	9.82	1.11	1.65	2.07	2.66	3.30	3.98	4.91
4H	2.70	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	250.00	0.084	7.57	340.00	0.040	20	4.00	1.42	8.99	16.52	8.99	2.99	4.03	4.68	5.38	6.37	7.33	8.54	4.15	6.15	7.70	9.93	12.28	14.84	18.28
4I	2.20	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	300.00	0.090	8.11	360.00	0.019	20	2.76	2.18	10.28	17.35	10.28	2.84	3.83	4.44	5.11	6.05	6.96	8.11	3.21	4.75	5.96	7.68	9.50	11.48	14.14
4J	3.93	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	200.00	0.080	6.88	350.00	0.070	7	1.85	3.15	10.03	16.17	10.03	2.86	3.86	4.49	5.16	6.11	7.03	8.19	5.79	8.58	10.75	13.85	17.14	20.70	25.51
4K	4.27	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	260.00	0.025	11.52	435.00	0.032	20	3.58	2.03	13.54	17.19	13.54	2.52	3.40	3.95	4.55	5.38	6.19	7.21	5.54	8.21	10.29	13.26	16.40	19.81	24.41
4L	1.06	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.010	6.48	435.00	0.032	20	3.58	2.03	8.51	17.19	8.51	3.05	4.11	4.77	5.49	6.50	7.48	8.71	1.66	2.46	3.08	3.98	4.92	5.94	7.32
4M	0.76	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.010	6.48	550.00	0.055	20	4.69	1.95	8.44	17.11	8.44	3.06	4.12	4.79	5.51	6.52	7.50	8.74	1.20	1.77	2.22	2.86	3.54	4.27	5.27
4N	0.90	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	90.00	0.005	11.52	550.00	0.055	20	4.69	1.95	13.48	17.11	13.48	2.53	3.41	3.96	4.56	5.39	6.20	7.23	1.17	1.73	2.17	2.80	3.46	4.18	5.16
4O	1.69	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	200.00	0.083	6.80	520.00	0.011	20	2.10	4.13	10.93	19.52	10.93	2.77	3.73	4.33	4.99	5.90	6.79	7.91	2.41	3.56	4.47	5.76	7.12	8.60	10.60
4P	0.70	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	90.00	0.025	6.78	500.00	0.010	20	2.00	4.17	10.94	19.55	10.94	2.77	3.73	4.33	4.98	5.90	6.78	7.91	1.00	1.48	1.85	2.38	2.95	3.56	4.39
4Q	2.83	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	235.00	0.055	8.44	350.00	0.020	20	2.83	2.06	10.50	17.23	10.50	2.81	3.79	4.40	5.07	6.00	6.90	8.04	4.09	6.06	7.60	9.79	12.12	14.64	18.04
4R	2.38	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.010	6.48	350.00	0.020	20	2.83	2.06	8.55	17.23	8.55	3.04	4.11	4.77	5.48	6.49	7.46	8.70	3.73	5.52	6.92	8.91	11.03	13.32	16.41
4S	3.05	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	228.00	0.010	14.59	210.00	0.042	20	4.10	0.85	15.45	15.89	15.45	2.37	3.20	3.72	4.28	5.06	5.82	6.78	3.72	5.51	6.91	8.91	11.02	13.31	16.40
4T	0.26	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	19.00	0.020	3.35	210.00	0.042	20	4.10	0.85	4.21	15.89	5.00	3.60	4.85	5.63	6.48	7.67	8.82	10.28	0.48	0.71	0.89	1.15	1.42	1.72	2.12
4U	2.10	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	19.00	0.020	3.35	1850.00	0.042	20	4.10	7.52	10.87	23.26	10.87	2.77	3.74	4.34	5.00	5.91	6.80	7.93	3.00	4.44	5.56	7.17	8.87	10.71	13.20
4V	1.20	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	19.00	0.020	3.35	1180.00	0.063	20	5.02	3.92	7.27	19.28	7.27	3.22	4.34	5.04	5.80	6.86	7.89	9.20	1.99	2.94	3.69	4.75	5.88	7.10	8.75
4W	0.83	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	19.00	0.020	3.35	1180.00	0.063	20	5.02	3.92	7.27	19.28	7.27	3.22	4.34	5.04	5.80	6.86	7.89	9.20	1.37	2.04	2.55	3.29	4.07	4.91	6.05
4X	25.09	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	300.00	0.060	9.27	1600.00	0.053	7	1.61	16.55	25.81	21.35	21.35	2.01	2.72	3.15	3.63	4.29	4.94	5.76	25.99	38.50	48.26	62.20	76.94	92.95	114.52
5A	2.71	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	220.00	0.085	7.07	760.00	0.028	20	3.35	3.78	10.86	19.13	10.86	2.77	3.74	4.35	5.00	5.92	6.81	7.93	3.87	5.73	7.18	9.25	11.45	13.83	17.04
5B	1.83	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	50.00	0.010	6.83	760.00	0.028	20	3.35	3.78	10.62	19.13	10.62	2.80	3.78	4.38	5.05	5.97	6.87	8.00	2.64	3.90	4.89	6.31	7.80	9.42	11.61
5C	7.60	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	80.00	0.140	3.62	980.00	0.030	7	1.21	13.47	17.09	20.16	17.09	2.26	3.05	3.54	4.07	4.82	5.54	6.46	8.83	13.08	16.40	21.13	26.14	31.58	38.91
5D	2.08	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	220.00	0.150	5.86	2350.00	0.060	7	1.71	22.84	28.71	23.78	23.78	1.90	2.56	2.97	3.42	4.05	4.66	5.43	2.03	3.01	3.77	4.86	6.01	7.27	8.95
5E	2.69	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	115.00	0.130	4.45	340.00	0.060	7	1.71	3.30	7.75	16.23	7.75	3.15	4.25	4.93	5.68	6.72	7.73	9.00	4.36	6.46	8.09	10.43	12.90	15.58	19.20
6A	0.58	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	90.00	0.010	9.17	280.00	0.055	20	4.69	0.99	10.16	16.05	10.16	2.85	3.84	4.46	5.13	6.08	6.99	8.15	0.85	1.26	1.58	2.03	2.52	3.04	3.75
6B	1.36	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	120.00	0.025	7.82	280.00	0.055	20	4.69	0.99	8.82	16.05	8.82	3.01	4.06	4.71	5.42	6.41	7.38	8.60	2.10	3.12	3.91	5.04	6.23	7.52	9.27
6C	0.64	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.010	6.48	600.00	0.055	20	4.69	2.13	8.61	17.31	8.61	3.03	4.09	4.75	5.47	6.47	7.44	8.67	1.00	1.48	1.85	2.39	2.96	3.57	4.40
6D	1.82	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	120.00	0.025	7.82	600.00	0.055	20	4.69	2.13	9.96	17.31	9.96	2.87	3.88	4.50	5.18	6.12	7.05	8.21	2.69	3.98	4.99	6.43	7.96	9.62	11.85
6E	1.27	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	140.00	0.025	8.45	300.00	0.020	20	2.83	1.77	10.22	16.90	10.22	2.84	3.84	4.45	5.12	6.06	6.97	8.13	1.86	2.75	3.45	4.44	5.50	6.64	8.18
6F	0.71	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	45.00	0.010	6.48	300.00	0.020	20	2.83	1.77	8.25	16.90	8.25	3.08	4.16	4.83	5.55	6.57	7.56	8.81	1.13	1.67	2.09	2.69	3.33	4.02	4.96
6G	0.23	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	6.00	0.020	1.88	400.00	0.055	20	4.69	1.42	3.30	16.52	5.00	3.60	4.85	5.63	6.48	7.67	8.82	10.28	0.43	0.63	0.79	1.02	1.26	1.52	1.87
6H	0.65	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	35.00	0.100	2.67	400.00	0.055	20	4.69	1.42	4.10	16.52	5.00	3.60	4.85	5.63	6.48	7.67	8.82	10.28	1.20	1.78	2.23	2.88	3.56	4.30	5.30
6I	1.21	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	300.00	0.075	8.61	320.00	0.022	20	2.97	1.80	10.41	16.94	10.41	2.82	3.81	4.42	5.09	6.02	6.92	8.07	1.76	2.60	3.26	4.20	5.20	6.28	7.74
6J	0.51	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	120.00	0.025	7.82	320.00	0.022	20	2.97	1.80	9.62	16.94	9.62	2.91	3.93	4.56	5.25	6.21	7.14	8.32	0.76	1.13	1.42	1.83	2.26	2.73	3.36
6K	0.94	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	90.00	0.010	9.17	320.00	0.022	20	2.97	1.80	10.97	16.94	10.97	2.76	3.73	4.33	4.98	5.89	6.78	7.90	1.34	1.98	2.48	3.20	3.95	4.78	5.89
6L	2.20	C	65.0	0.51	0.56	0.61	0.68	0.71	0.75	0.79	250.00	0.065	8.24	375.00	0.008	20	1.82	3.43	11.67	18.74	11.67	2.69	3.63	4.22	4.85	5.74	6.60	7.70	3.05	4.51	5.66	7.29	9.02	10.90	13.42

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APPENDIX D

Hydromodification

RICK

Job Name: Range
Job Number: 2215
Date: March 18, 2025

Pre-Project Areas					
Sub-Basin	Total Area		Historic / Undeveloped		
	sq-ft	acres	sq-ft	acres	% Impervious
1	3,256,959	74.77	3,256,959	74.8	5%
4	2,810,348	64.52	2,810,348	64.5	5%
5	2,034,259	46.70	2,034,259	46.7	5%
6	1,932,658	44.37	1,932,658	44.4	5%
8	6,624,953	152.09	6,624,953	152.1	5%
9	947,814	21.76	947,814	21.8	5%
12	965,333	22.16	965,333	22.2	5%
15	3,412,921	78.35	3,412,921	78.3	5%
20	1,381,127	31.71	1,381,127	31.7	5%
O1	123,087,249	2825.69	123,087,249	2825.7	5%
O2	3,115,908	71.53	3,115,908	71.5	5%

Pre-Project SWMM Inputs						
Subcatchment Name	Area	Longest Flow Path	Elev Up	Elev Down	Slope	Imp
	(ac)	(ft)	(ft)	(ft)	%	%
1	74.8	3,876	5,990	5,743	6%	5%
4	64.5	4,094	5,973	5,721	6%	5%
5	46.7	2,066	5,951	5,734	11%	5%
6	44.4	3,879	5,949	5,771	5%	5%
8	152.1	6,142	6,107	5,763	6%	5%
9	21.8	2,138	5,902	5,758	7%	5%
12	22.2	1,466	5,873	5,785	6%	5%
15	78.3	4,188	6,027	5,779	6%	5%
20	31.7	1,996	5,794	5,748	2%	5%
O1	2,825.7	19,507	6,548	5,793	4%	5%
O2	71.5	2,239	5,799	5,706	4%	5%

Sum Total 3,434 AC

RICK

Job Name: Range
Job Number: 2215
Date: March 18, 2025

Post-Project Onsite Basins

Sub-Basin	Total Area		Single Family				Streets (Paved)				Disturbed Soils (Pervious/Landscape)				Historic / Undeveloped						Composite
	sq-ft	acres	%LU	sq-ft	acres	% Impervious	%LU	sq-ft	acres	% Impervious	%LU	sq-ft	acres	% Impervious	%LU	sq-ft	acres	% Impervious	Sub-Basin	Total Area acres	% Impervious
1A	2,940,935	67.5	0%	0	0.0	65%	0%	0	0.00	95%	2%	58,819	1.4	20%	98%	2,882,117	66.2	5%	1A	67.5	5%
1B	98,928	2.3	0%	0	0.0	65%	52%	51,443	1.18	95%	48%	47,486	1.1	20%	0%	0	0.0	5%	1B	2.3	59%
1D	304,847	7.0	58%	175,851	4.0	65%	3%	8,531	0.20	95%	40%	120,465	2.8	20%	0%		0.0	5%	1D	7.0	48%
4	2,795,696	64.2	66%	1,856,423	42.6	65%	3%	83,684	1.92	95%	26%	727,080	16.7	20%	5%	128,509	3.0	5%	4	64.2	51%
5A	905,426	20.8	0%	0	0.0	65%	0%	0	0.00	95%	0%	0	0.0	20%	100%	905,426	20.8	5%	5A	20.8	5%
5B	1,082,515	24.9	39%	424,313	9.7	65%	7%	75,830	1.74	95%	53%	570,685	13.1	20%	100%	1,080,106	24.8	5%	5B	24.9	48%
6	2,380,359	54.6	52%	1,228,189	28.2	65%	5%	122,415	2.81	95%	13%	314,948	7.2	20%	30%	715,674	16.4	5%	6	54.6	43%
8A	5,332,568	122.4	0%	0	0.0	65%	0%	0	0.00	95%	0%	0	0.0	20%	100%	5,332,568	122.4	5%	8A	122.4	5%
8B	1,338,166	30.7	83%	1,112,980	25.6	65%	0%		0.00	95%	10%	130,730	3.0	20%	7%	94,456	2.2	5%	8B	30.7	56%
9A	842,948	19.4	55%	464,972	10.7	65%	0%		0.00	95%	0%	0	0.0	20%	45%	377,976	8.7	5%	9A	19.4	38%
9B	189,208	4.3	43%	82,050	1.9	65%	0%		0.00	95%	57%	107,158	2.5	20%	0%	0	0.0	5%	9B	4.3	40%
12	993,598	22.8	88%	877,586	20.1	65%	0%		0.00	95%	5%	46,792	1.1	20%	5%	53,584	1.2	5%	12	22.8	59%
15A	2,991,095	68.7	0%	0	0.0	65%	0%		0.00	95%	0%		0.0	20%	100%	2,991,095	68.7	5%	15A	68.7	5%
15B	431,846	9.9	100%	431,846	9.9	65%	0%		0.00	95%	0%		0.0	20%	0%	0	0.0	5%	15B	9.9	65%
20	1,307,970	30.0	0%	0	0.0	65%	0%		0.00	95%	0%		0.0	20%	100%	1,307,970	30.0	5%	20	30.0	5%
O1	123,024,939	2,824.3	0%	0	0.0	65%	0%		0.00	95%	0%		0.0	20%	100%	123,024,939	2,824.3	5%	O1	2824.3	5%
O2	2,852,912	65.5	0%	431,846	9.9	65%	0%		0.00	95%	0%		0.0	20%	100%	2,852,912	65.5	5%	O2	65.5	5%

Post- Project SWMM Inputs						
	Area	Longest Flow Path	Elev Up	Elev Down	Slope	Imp
Subcatchment Name	(ac)	(ft)	(ft)	(ft)	%	%
1A	67.5	5,990	5,990	5,743	4%	5%
1B	2.3	5,836	5,836	5,752	1%	59%
1D	7.0	5,938	5,938	5,817	2%	48%
4	64.2	5,973	5,973	5,721	4%	51%
5A	20.8	5,949	5,951	5,734	4%	5%
5B	24.9	5,949	5,949	5,771	3%	48%
6	54.6	4,959	5,949	5,771	4%	43%
8A	122.4	6,107	6,107	5,801	5%	5%
8B	30.7	5,832	5,832	5,771	1%	56%
9A	19.4	5,873	5,873	5,796	1%	38%
9B	4.3	5,800	5,800	5,756	1%	40%
12	22.8	6,027	6,027	5,779	4%	59%
15A	68.7	6,027	6,027	5,779	4%	5%
15B	9.9	5,868	5,868	5,822	1%	65%
20	30.0	1,996	5,794	5,748	2%	5%
O1	2,824.3	19,507	6,548	5,793	4%	5%
O2	65.5	2,239	5,799	5,706	4%	5%
Sum Total	3,374 AC					

Job Name: Range
Job Number: 2215
Date: March 19, 2025

Q100 Peak Flow Summary					
POC ID	Area (ac)			Q100 (cfs)	
	Pre	Post	Δ	Pre	Mitigated Post
POC-1	74.77	76.78	2.01	98.7	86.4
POC-4	64.52	64.18	-0.34	79.8	69.4
POC-5	46.70	45.64	-1.06	94.8	69.8
POC-6	44.37	54.65	10.28	46.9	19.5
POC-8	152.09	153.14	1.05	174.4	164.7
POC-9	21.76	23.70	1.94	30.7	28.2
POC-12	22.16	22.81	0.65	38.5	32.5
POC-15	78.35	78.58	0.23	104.1	88.1
Sum	*505 AC*	*519 AC*			

Job Name: Range
Job Number: 2215
Date: March 18, 2025

Area Comparison at DP 88								
Pre-Project Area ID	Pre-Project Area (ac)	Pre-Project Imp %	Pre-Project Imp Ac Area (ac)	Post-Project Area ID	Post-Project Area (ac)	Post-Project Imp %	Post Project Imp Area Area (ac)	Increase/Decrease in Area Δ (AC)
5	46.7	5%	2.3	5A	20.8	5%	1.0	-1.1
				5B	24.9	48%	11.8	
6	44.4	5%	2.2	6	54.6	43%	23.3	10.3
8	152.1	5%	7.6	8A	122.4	5%	6.1	1.1
				8B	30.7	56%	17.3	
9	21.8	5%	1.1	9A	19.4	38%	7.4	1.9
				9B	4.3	40%	1.7	
20	31.7	5%	1.6	20	30.0	5%	1.5	-1.7
O1	2825.7	5%	141.3	O1	2824.3	5%	141.2	-1.4
O2	71.5	5%	3.6	O2	65.5	5%	3.3	-6.0
Total	**3193.8**		**159.7**		**3196.9**		**214.7**	3.1

Notes:

1) Existing impervious area at DP 88= 160 ac, or 5% of watershed area
2) Proposed Impervous area at DP 88 = 215 ac , or 7% of watershed area
3) Net increase in impervious area due to project at DP 88 is ≈ 2% of watershed area

SWMM Parameter	Unit	Rangeof Parameters	Parameter Used in Model
Name X- , Y- Coordinate Description Tag Rain Gauge Oultet	N/A	N/A - Project Specific	Project Specific
Area	area (ac)	Project Specific	Project Specific
Width	ft	Project Specific	Project Specific
% Slope	percent (%)	Project Specific	Project Specific
% Impervious	percent (%)	Project Specific	Project Specific
N-Imp	-	0.011 – 0.024 presented in Table A.6 of SWMM Manual	0.013, Range (Natural); otherwise provide documentation of other surface consistent with Table A.6 of SWMM Manual
N-Perv	-	0.05 – 0.80 presented in Table A.6 of SWMM Manual	0.10
Dstore-Imp	inches	0.05 – 0.10 inches presented in Table A.5 of SWMM Manual	0.05
Dstore-Perv	inches	0.10 – 0.30 inches presented in Table A.5 of SWMM Manual	0.20
%Zero-Imperv	percent (%)	0% – 100%	25%
Subarea Routing	-	OUTLET IMPERVIOUS PERVIOUS	Project-specific, typically OUTLET
Percent Routed	percent (%)	0% – 100%	Project-specific, typically 100%
Infiltration	Method	HORTON GREEN_AMPT CURVE_NUMBER	GREEN_AMPT
Suction Head	inches	1.93 – 12.60 presented in Table A.2 of SWMM Manual	Hydrologic Soil Group A: 1.5 Hydrologic Soil Group B: 3.0 Hydrologic Soil Group C: 6.0 Hydrologic Soil Group D: 9.0
Conductivity	Inches/Hour	0.01 – 4.74 presented in Table A.2 of SWMM Manual by soil texture class 0.00 – ≥0.45 presented in Table A.3 of SWMM Manual by hydrologic soil group	Hydrologic Soil Group A: 0.3 Hydrologic Soil Group B: 0.2 Hydrologic Soil Group C: 0.1 Hydrologic Soil Group D: 0.025 Note: reduce conductivity by 25% in the post-project condition when native soils will be compacted. Conductivity may also be reduced by 25% in the pre-development condition model for redevelopment areas that are currently concrete or asphalt but must be modeled according to their underlying soil characteristics.
Initial Defecit	-	The difference between soil porosity and initial moisture content. Based on the values provided in Table A.2 of SWMM Manual, the range for completely dry soil would be 0.097 to 0.375	Hydrologic Soil Group A: 0.33 Hydrologic Soil Group B: 0.32 Hydrologic Soil Group C: 0.31 Hydrologic Soil Group D: 0.30 Note: in long-term continuous simulation, this value is not important as the soil will reach equilibrium after a few storm events regardless of the initial moisture content specified.
Groundwater	yes/no	yes/no	No
LID Controls			Project Specific
Snowpack Land Uses Initial Buildup	N/A	N/A	N/A

Infiltration

Infiltration is the process of rainfall penetrating the ground surface into the unsaturated soil zone of pervious subcatchments areas. SWMM offers four choices for modeling infiltration:

Classical Horton Method
This method is based on empirical observations showing that infiltration decreases exponentially from an initial maximum rate to some minimum rate over the course of a long rainfall event. Input parameters required by this method include the maximum and minimum infiltration rates, a decay coefficient that describes how fast the rate decreases over time, and the time it takes a fully saturated soil to completely dry (used to compute the recovery of infiltration rate during dry periods).

Modified Horton Method
This is a modified version of the classical Horton Method that uses the cumulative infiltration in excess of the minimum rate as its state variable (instead of time along the Horton curve), providing a more accurate infiltration estimate when low rainfall intensities occur. It uses the same input parameters as does the traditional Horton Method.

Green-Ampt Method
This method for modeling infiltration assumes that a sharp wetting front exists in the soil column, separating soil with some initial moisture content below from saturated soil above. The input parameters required are the initial moisture deficit of the soil, the soil's hydraulic conductivity, and the suction head at the wetting front. The recovery rate of moisture deficit during dry periods is empirically related to the hydraulic conductivity.

Modified Green-Ampt Method
This method modifies the original Green-Ampt procedure by not depleting moisture deficit in the top surface layer of soil during initial periods of low rainfall as was done in the original method. This change can produce more realistic infiltration behavior for storms with long initial periods where the rainfall intensity is below the soil's saturated hydraulic conductivity.

Curve Number Method
This approach is adopted from the NRCS (SCS) Curve Number method for estimating runoff. It assumes that the total infiltration capacity of a soil can be found from the soil's tabulated Curve Number. During a rain event this capacity is depleted as a function of cumulative rainfall and remaining capacity. The input parameters for this method are the curve number and the time it takes a fully saturated soil to completely dry (used to compute the recovery of infiltration capacity during dry periods).

SWMM also allows the infiltration recovery rate to be adjusted by a fixed amount on a monthly basis to account for seasonal variation in such factors as evaporation rates and groundwater levels. This optional monthly soil recovery pattern is specified as part of a project's Evaporation data.

Green-Ampt Infiltration Parameters

Parameter	Description
Suction Head	Average value of soil capillary suction along the wetting front (inches or mm)
Conductivity	Soil saturated hydraulic conductivity (in/hr or mm/hr)
Initial Deficit	Fraction of soil volume that is initially dry (i.e., difference between soil porosity and initial moisture content)

The initial deficit for a completely drained soil is the difference between the soil's porosity and its field capacity. Typical values for all of these parameters can be found in the Soil Characteristics Table.

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Soil Characteristics

Soil Texture Class	K	Ψ	ϕ	FC	WP
Sand	4.74	1.93	0.437	0.062	0.024
Loamy Sand	1.18	2.40	0.437	0.105	0.047
Sandy Loam	0.43	4.33	0.453	0.190	0.085
Loam	0.13	3.50	0.463	0.232	0.116
Silt Loam	0.26	6.69	0.501	0.284	0.135
Sandy Clay Loam	0.06	8.66	0.398	0.244	0.136
Clay Loam	0.04	8.27	0.464	0.310	0.187
Silty Clay Loam	0.04	10.63	0.471	0.342	0.210
Sandy Clay	0.02	9.45	0.430	0.321	0.221
Silty Clay	0.02	11.42	0.479	0.371	0.251
Clay	0.01	12.60	0.475	0.378	0.265

K = hydraulic conductivity, in/hr
Ψ = suction head, in.
ϕ = porosity, fraction
FC = field capacity, fraction
WP= wilting point, fraction

Source: Rawls, W.J. et al., (1983). *J. Hyd. Engr.*, 109:1316.

Note: The following relation between **Ψ** and **K** can be derived from this table:
$\Psi = 3.237K^{-0.328}$ ($R^2 = 0.9$)

	Value Used for D soils	Value Used for C soils
Suction Head	9	6.00
Conductivity	0.025	0.10
Initial Defecit	0.3	0.3

Subcatchment Properties

Name	User-assigned subcatchment name.
X-Coordinate	Horizontal location of the subcatchment's centroid on the Study Area Map. If left blank then the subcatchment will not appear on the map.
Y-Coordinate	Vertical location of the subcatchment's centroid on the Study Area Map. If left blank then the subcatchment will not appear on the map.
Description	Click the ellipsis button (or press Enter) to edit an optional description of the subcatchment.
Tag	Optional label used to categorize or classify the subcatchment.
Rain Gage	Name of the rain gage associated with the subcatchment.
Outlet	Name of the node or subcatchment that recieves the subcatchment's runoff.
Area	Area of the subcatchment, including any LID controls (acres or hectares).
Width	Characteristic width of the overland flow path for sheet flow runoff (feet or meters). (More...)
% Slope	Average percent slope of the subcatchment.
% Imperv	Percent of the land area (not including any LIDs) which is impervious.
N-Imperv	Manning's n for overland flow over the impervious portion of the subcatchment (Typical Values).
N-Perv	Manning's n for overland flow over the pervious portion of the subcatchment (Typical Values).
Dstore-Imperv	Depth of depression storage on the impervious portion of the subcatchment (inches or millimeters) (Typical Values).
Dstore-Perv	Depth of depression storage on the pervious portion of the subcatchment (inches or millimeters) (Typical Values).
% Zero-Imperv	Percent of the impervious area with no depression storage.
Subarea Routing	Choice of internal routing of runoff between pervious and impervious areas: ***IMPERV:*** runoff from pervious area flows to impervious area ***PERV:*** runoff from impervious flows to pervious area ***OUTLET:*** runoff from both areas flows directly to outlet
Percent Routed	Percent of runoff routed between subareas.
Infiltration	Click the ellipsis button (or press Enter) to edit infiltration parameters for the subcatchment.
LID Controls	Click the ellipsis button (or press Enter) to edit the use of low impact development controls in the subcatchment.
Groundwater	Click the ellipsis button (or press Enter) to edit groundwater flow parameters for the subcatchment.
Snow Pack	Name of snow pack parameter set (if any) assigned to the subcatchment.
Land Uses	Click the ellipsis button (or press Enter) to assign land uses to the subcatchment. Only needed if pollutant buildup/washoff modeled.

Manning's n - Overland Flow

Surface	n
Smooth asphalt	0.011
Smooth concrete	0.012
Ordinary concrete lining	0.013
Good wood	0.014
Brick with cement mortar	0.014
Vitrified clay	0.015
Cast iron	0.015
Corrugated metal pipes	0.024
Cement rubble surface	0.024
Fallow soils (no residue)	0.05
Cultivated soils	
Residue cover < 20%	0.06
Residue cover > 20%	0.17
Range (natural)	0.13
Grass	
Short, prarie	0.15
Dense	0.24
Bermuda grass	0.41
Woods	
Light underbrush	0.40
Dense underbrush	0.80

Source: McCuen, R. et al. (1996), *Hydrology*, FHWA-SA-96-067, Federal Highway Administration, Washington, DC

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Depression Storage

Typical Depression Storage Values

Impervious surfaces	0.05 - 0.10 inches
Lawns	0.10 - 0.20 inches
Pasture	0.20 inches
Forest litter	0.30 inches

(Source: ASCE,(1992), *Design & Construction of Urban Stormwater Management Systems*, New York, NY)

Appendix D Table of Contents per POC:

1. SWMM Schematics
    a. Pre-Project
    b. Post-Project

2. SWMM Inputs & Results for HMP Run:
    a. Pre-Project Input file (Ex: POC1_RANGE_PRE.inp – Notepad.pdf)
    b. Pre-Project Report File (Ex: POC1_RANGE_PRE.rpt - Notepad.pdf)
    c. Post-Project Input file (Ex: POC1_RANGE_POST.inp – Notepad.pdf)
    d. Post-Project Report File (Ex: POC1_RANGE_POST.rpt - Notepad.pdf)

3. HMP Post-Processing Spreadsheet
    a. Peak Flow Frequency Summary Table
    b. Peak Flow Frequency Curve
    c. Flow Duration Exceedance Table
    d. Flow Duration Exceedance Curve

4. CUHP Inputs & Outputs for the 100Yr Storm Event *(Q25 & Q50 to be provided with Final Drainage Report)*
    a. CUHP Inputs Spreadsheet
    b. SWMM Results using CUHP input file:
        i. Pre-Project Report File (Ex: 6_Ex_100yr_0mi^2_POC1_RANGE_PRE.rpt)
        ii. Multiple Run Post-Project Input File: (POC1_RANGE_POST.inp - Notepad.pdf)
        iii. 100-Yr Storm Post-Project Reports file (Ex: 6_Fut_100yr_0mi^2_POC1_RANGE_POST.rpt - Notepad.pdf)
        iv. WQ Storm Post-Project Reports file: (Ex: 1_Fut_WQ_0mi^2_POC1_RANGE_POST.rpt - Notepad.pdf
5. EDB Cross Section
6. EDB Stage Storage Discharge Table
7. MHFD-Detention – Stage-Storage Table

1. POC -1 SWMM Schematics

Pre-Project DMA 1

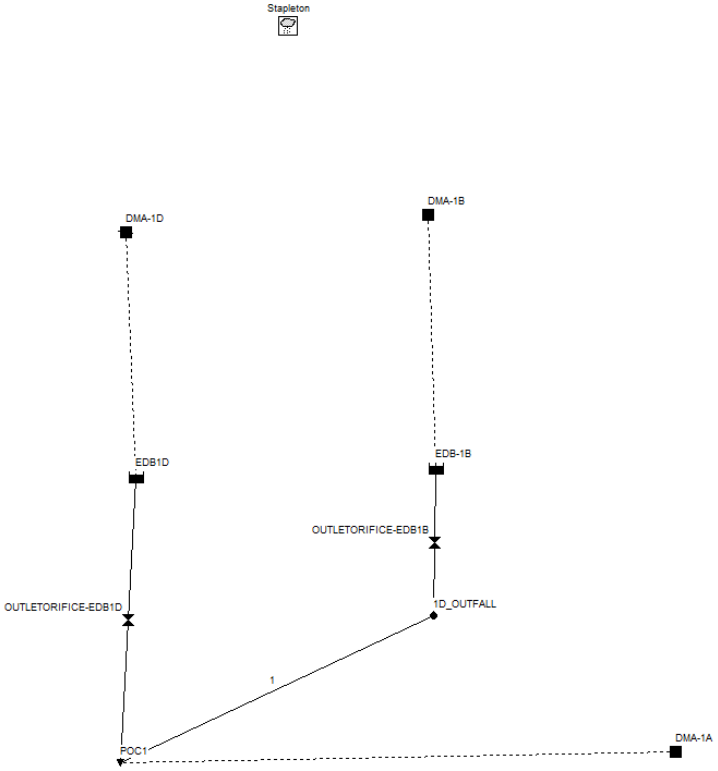


Subcatchment DMA-1

Property	Value
Name	DMA-1
X-Coordinate	4021.330
Y-Coordinate	7804.266
Description	Pre-Project Condition
Tag	
Rain Gage	Stapleton
Outlet	POC1
Area	75
Width	841
% Slope	6
% Imperv	5
N-Imperv	.013
N-Perv	.10
Dstore-Imperv	.05
Dstore-Perv	0.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

Post Project DMA 1A, 1B, and 1D



Subcatchment DMA-1A

Property	Value
Name	DMA-1A
X-Coordinate	6585.928
Y-Coordinate	3944.637
Description	
Tag	
Rain Gage	Stapleton
Outlet	POC1
Area	67.5
Width	841
% Slope	6
% Imperv	5
N-Imperv	0.013
N-Perv	0.10
Dstore-Imperv	0.05
Dstore-Perv	0.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

Subcatchment DMA-1B

Property	Value
Name	DMA-1B
X-Coordinate	4959.631
Y-Coordinate	7485.582
Description	
Tag	
Rain Gage	Stapleton
Outlet	EDB-1B
Area	2.3
Width	600
% Slope	7
% Imperv	51
N-Imperv	0.013
N-Perv	0.10
Dstore-Imperv	0.05
Dstore-Perv	0.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

Subcatchment DMA-1D

Property	Value
Name	DMA-1D
X-Coordinate	2964.245
Y-Coordinate	7370.242
Description	
Tag	
Rain Gage	Stapleton
Outlet	EDB1D
Area	7.0
Width	600
% Slope	8
% Imperv	50
N-Imperv	0.013
N-Perv	0.10
Dstore-Imperv	0.05
Dstore-Perv	0.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

2. POC -1 SWMM Inputs & Results for HMP Run

```
[TITLE]
;;Project Title/Notes
2215 Range
Pre-Project Condition POC 1

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
;Pre-Project Condition
DMA-1            Stapleton        POC1             75       5        841      6        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1            .013       .10        .05        0.20       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-1            9          0.01875    0.3

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
```

```
POC1             0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC1             4021.330           5821.832

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1            4021.330           7804.266

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition POC 1


***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      6004.500       960.720
Evaporation Loss .........       412.320        65.971
Infiltration Loss ........      4832.921       773.267
Surface Runoff ...........       854.605       136.737
Final Storage ............         0.008         0.001
Continuity Error (%) .....        -1.588


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------      ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       854.605       278.486
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       854.605       278.486
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


**************************
Subcatchment Runoff Summary
**************************

-----------------------------------------------------------------------------------------------------
                         Total      Total      Total      Total      Total       Total     Peak  Runoff
                        Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------
DMA-1                   960.72       0.00      65.97     773.27     136.74      278.47    64.21   0.142
```

```
Analysis begun on:  Wed Jul 31 14:13:36 2024
Analysis ended on:  Wed Jul 31 14:13:52 2024
Total elapsed time: 00:00:16
```

```
[TITLE]
;;Project Title/Notes
2215 Range - POC 1
Post-Project Condition

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
DMA-1D           Stapleton        EDB1D            7.0      50       600      8        0
DMA-1B           Stapleton        EDB-1B           2.3      51       600      7        0
DMA-1A           Stapleton        POC1             67.5     5        841      6        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1D           0.013      0.10       0.05       0.20       25         OUTLET
DMA-1B           0.013      0.10       0.05       0.20       25         OUTLET
DMA-1A           0.013      0.10       0.05       0.20       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-1D           9          0.01875    0.3
DMA-1B           9          0.01875    0.3
```

```
DMA-1A          9          .01875     0.3

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
1D_OUTFALL       0          0          0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC1             0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat
   IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------
-------- --------
EDB1D            0        9.5        0          TABULAR    EDB1D                        0        0
EDB-1B           0        7          0          TABULAR    EDB1B                        0        0

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
1                1D_OUTFALL       POC1             400        0.01       0          0          0          0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type            QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- --------
OUTLETORIFICE-EDB1D EDB1D            POC1             0          TABULAR/DEPTH   RC_EDB_1D                   NO
OUTLETORIFICE-EDB1B EDB-1B           1D_OUTFALL       0          TABULAR/DEPTH   RC_EDB_1B                   NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
1                DUMMY        0                0          0          0          1

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
RC_EDB_1D        Rating     0.00       0.000
RC_EDB_1D                   0.25       0.043
RC_EDB_1D                   0.50       0.068
RC_EDB_1D                   0.75       0.086
RC_EDB_1D                   1.00       0.101
RC_EDB_1D                   1.25       0.156
RC_EDB_1D                   1.50       0.193
RC_EDB_1D                   1.75       0.221
RC_EDB_1D                   2.00       0.246
RC_EDB_1D                   2.25       0.432
RC_EDB_1D                   2.50       0.547
RC_EDB_1D                   2.75       0.635
RC_EDB_1D                   3.00       0.709
RC_EDB_1D                   3.25       0.775
RC_EDB_1D                   3.50       0.835
RC_EDB_1D                   3.75       0.891
RC_EDB_1D                   4.00       0.943
RC_EDB_1D                   4.25       1.779
RC_EDB_1D                   4.50       3.266
RC_EDB_1D                   4.75       5.175
RC_EDB_1D                   5.00       7.426
RC_EDB_1D                   5.25       9.972
RC_EDB_1D                   5.50       12.781
RC_EDB_1D                   5.75       15.830
RC_EDB_1D                   6.00       19.102
RC_EDB_1D                   6.25       22.581
RC_EDB_1D                   6.50       26.257
;
RC_EDB_1B        Rating     0.00       0.000
RC_EDB_1B                   0.25       0.007
RC_EDB_1B                   0.50       0.010
RC_EDB_1B                   0.75       0.018
RC_EDB_1B                   1.00       0.024
```

```
RC_EDB_1B                   1.25       0.028
RC_EDB_1B                   1.50       0.129
RC_EDB_1B                   1.75       0.184
RC_EDB_1B                   2.00       0.225
RC_EDB_1B                   2.25       0.259
RC_EDB_1B                   2.50       0.289
RC_EDB_1B                   2.75       0.316
RC_EDB_1B                   3.00       0.341
RC_EDB_1B                   3.25       0.365
RC_EDB_1B                   3.50       0.386
RC_EDB_1B                   3.75       0.932
RC_EDB_1B                   4.00       1.911
RC_EDB_1B                   4.25       3.173
RC_EDB_1B                   4.50       4.663
RC_EDB_1B                   4.75       6.350
RC_EDB_1B                   5.00       8.213
RC_EDB_1B                   5.25       10.236
RC_EDB_1B                   5.50       12.408
RC_EDB_1B                   5.75       14.719
RC_EDB_1B                   6.00       17.161
RC_EDB_1B                   6.25       19.727
RC_EDB_1B                   6.50       22.411
RC_EDB_1B                   6.75       25.209
RC_EDB_1B                   7.00       28.116
;
EDB1B             Storage   0.00       350
EDB1B                       0.50       1600.2
EDB1B                       1.00       3767.4
EDB1B                       1.50       4722.2
EDB1B                       2.00       5366.2
EDB1B                       2.50       6046.6
EDB1B                       3.00       6762
EDB1B                       3.50       7512.4
EDB1B                       4.00       8296.4
EDB1B                       4.50       9115.4
EDB1B                       5.00       9968
EDB1B                       5.50       10854.2
EDB1B                       6.00       11775.4
EDB1B                       6.50       12731.6
EDB1B                       7.00       13225.8
;
EDB1D             Storage   0.00       538.496
EDB1D                       0.50       3232.824
EDB1D                       1.00       5645.472
EDB1D                       1.50       6847.876
EDB1D                       2.00       7657.23
EDB1D                       2.50       8504.93
EDB1D                       3.00       9391.116
EDB1D                       3.50       10315.914
EDB1D                       4.00       11279.352
EDB1D                       4.50       12281.458
EDB1D                       5.00       13322.316
EDB1D                       5.50       14402.29
EDB1D                       6.00       15521.478
EDB1D                       6.50       16679.908

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
```

```
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
1D_OUTFALL       4994.233           4844.291
POC1             2929.642           3875.433
EDB1D            3033.449           5743.945
EDB-1B           5005.767           5801.615

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1D           3009.837           7360.110
DMA-1D           2918.652           7380.374
DMA-1B           4959.631           7485.582
DMA-1A           6585.928           3944.637

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range - POC 1
Post-Project Condition

WARNING 04: minimum elevation drop used for Conduit 1

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      6148.608       960.720
Evaporation Loss .........       476.128        74.395
Infiltration Loss ........      4640.584       725.091
Surface Runoff ...........      1130.841       176.694
Final Storage ............         0.017         0.003
Continuity Error (%) .....        -1.609


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......      1130.841       368.501
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........      1130.727       368.464
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.010


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.
```

****
Routing Time Step Summary
****
Minimum Time Step : 60.00 sec
Average Time Step : 60.00 sec
Maximum Time Step : 60.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 1.00
Percent Not Converging : 0.00

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA-1D	960.72	0.00	139.20	391.50	447.89	85.13	11.64	0.466
DMA-1B	960.72	0.00	137.95	381.26	462.50	28.88	3.83	0.481
DMA-1A	960.72	0.00	65.51	771.40	138.83	254.46	61.32	0.145

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
1D_OUTFALL	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC1	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
EDB1D	STORAGE	0.04	4.76	4.76	23722 19:04	4.75
EDB-1B	STORAGE	0.06	3.56	3.56	20471 23:05	3.56

HMP Ponding Depth

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1D_OUTFALL	JUNCTION	0.00	0.52	20471 23:05	0	28.9	0.000
POC1	OUTFALL	61.32	64.02	20471 19:01	254	368	0.000
EDB1D	STORAGE	11.64	11.64	20471 19:01	85.1	85.1	0.037
EDB-1B	STORAGE	3.83	3.83	20471 19:01	28.9	28.9	0.020

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS

EDB1D	0.121	0	0	0	37.918	31	23722	19:03	5.26
EDB-1B	0.088	0	0	0	16.572	31	20471	23:05	0.52

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC1	16.16	0.15	64.02	368.437
System	16.16	0.15	64.02	368.437

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	DUMMY	0.52	20471 23:05			
OUTLETORIFICE-EDB1D	DUMMY	5.26	23722 19:04			
OUTLETORIFICE-EDB1B	DUMMY	0.52	20471 23:05			

****
Conduit Surcharge Summary
****

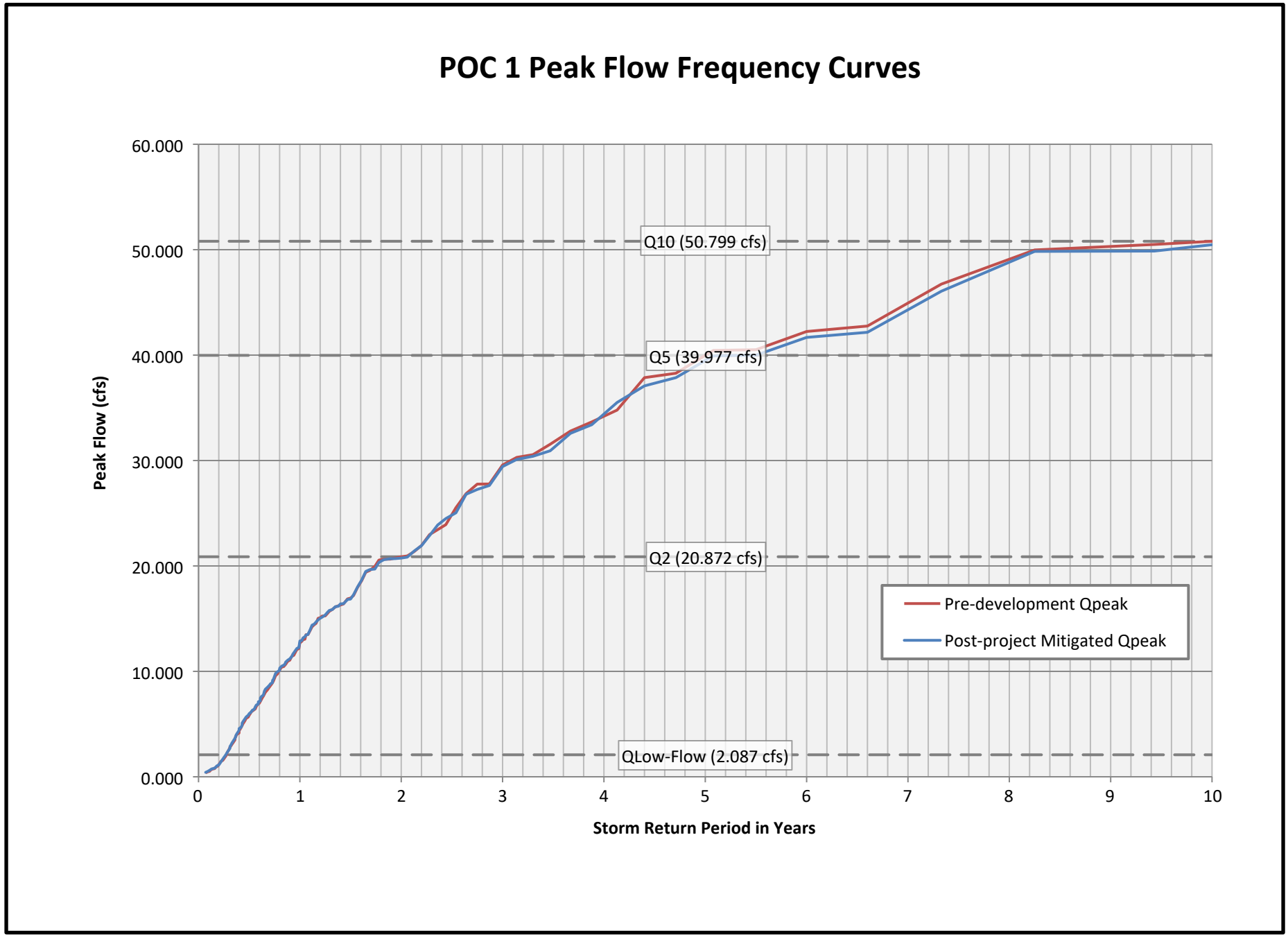
No conduits were surcharged.

Analysis begun on: Tue Dec 17 16:15:42 2024
Analysis ended on: Tue Dec 17 16:16:12 2024
Total elapsed time: 00:00:30

3. POC -1 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

	HMP Flow Frequency Range Based on:	SWMM - Weibull	
Return Period	**Pre-development Qpeak (cfs)**	**Post-project - Mitigated Q (cfs)**	*Check*
Low-Flow = 0.1*Q2	2.087	2.075	*Okay! -> Decreased by 0.013 cfs*
2-year	20.872	20.745	*Okay! -> Decreased by 0.127 cfs*
3-year	29.578	29.427	*Okay! -> Decreased by 0.151 cfs*
4-year	34.201	34.409	*Okay! -> Decreased by -0.209 cfs*
5-year	39.977	39.476	*Okay! -> Decreased by 0.5 cfs*
6-year	42.239	41.678	*Okay! -> Decreased by 0.561 cfs*
7-year	44.937	44.300	*Okay! -> Decreased by 0.636 cfs*
8-year	49.094	48.811	*Okay! -> Decreased by 0.283 cfs*
9-year	50.305	49.856	*Okay! -> Decreased by 0.449 cfs*
10-year	50.799	50.470	*Okay! -> Decreased by 0.329 cfs*


POC 1 Peak Flow Frequency Curves
60.000
50.000
40.000
30.000
20.000
10.000
0.000
Peak Flow (cfs)
Q10 (50.799 cfs)
Q5 (39.977 cfs)
Q2 (20.872 cfs)
QLow-Flow (2.087 cfs)
Pre-development Qpeak
Post-project Mitigated Qpeak
0
1
2
3
4
5
6
7
8
9
10
Storm Return Period in Years

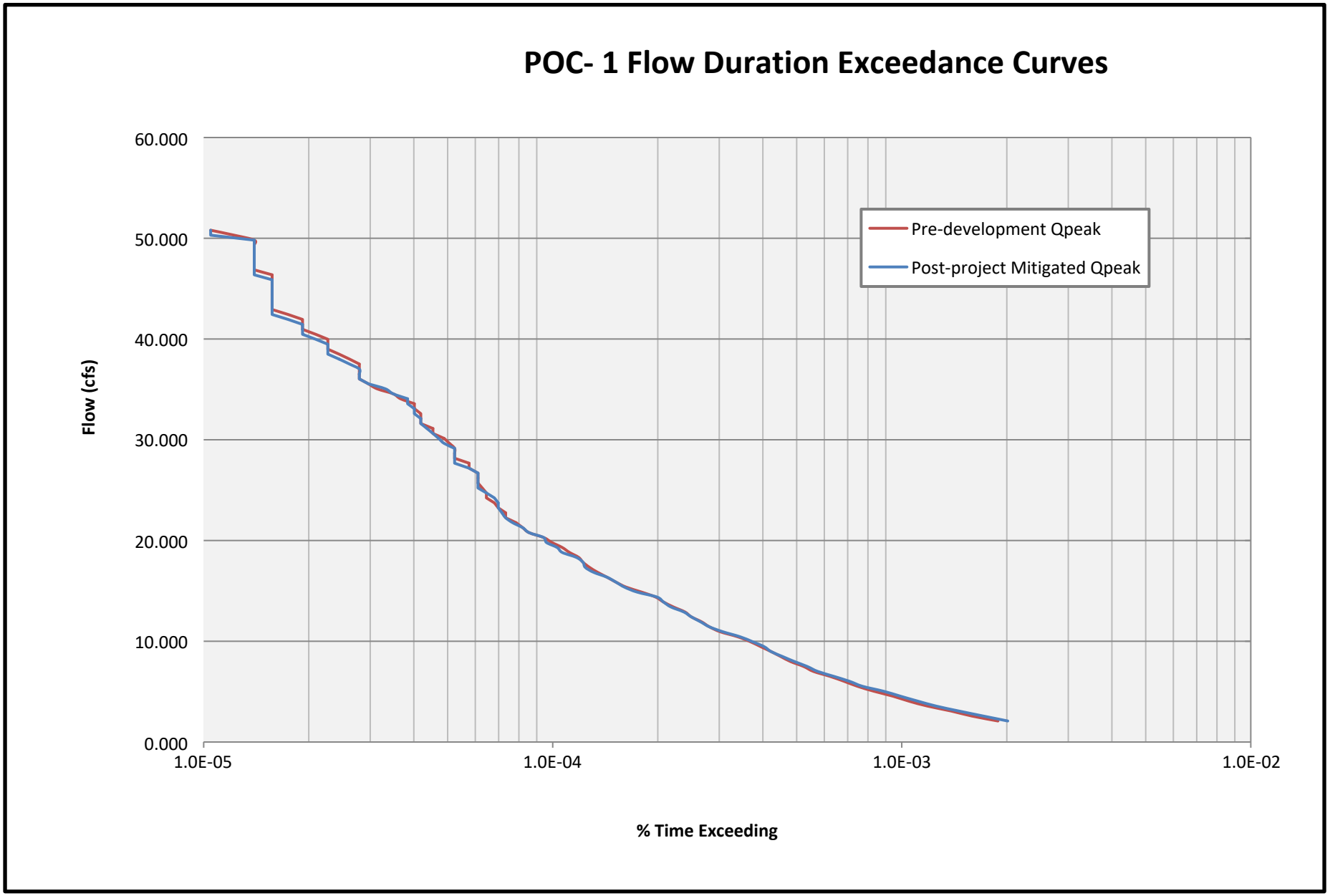
Low-flow Threshold:	10%	
0.1xQ2 (Pre):	2.0872	cfs
Q10 (Pre):	50.799	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	0.49204	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	2.087	1081	1.89E-03	1153	2.01E-03	*107%*	*Pass^*
2	2.579	910	1.59E-03	980	1.71E-03	*108%*	*Pass^*
3	3.071	795	1.39E-03	836	1.46E-03	*105%*	*Pass^*
4	3.563	680	1.19E-03	719	1.25E-03	*106%*	*Pass^*
5	4.055	601	1.05E-03	637	1.11E-03	*106%*	*Pass^*
6	4.547	541	9.44E-04	568	9.91E-04	*105%*	*Pass^*
7	5.039	477	8.32E-04	508	8.86E-04	*106%*	*Pass^*
8	5.531	428	7.47E-04	442	7.71E-04	*103%*	*Pass^*
9	6.023	392	6.84E-04	406	7.08E-04	*104%*	*Pass^*
10	6.516	357	6.23E-04	366	6.39E-04	*103%*	*Pass^*
11	7.008	320	5.58E-04	329	5.74E-04	*103%*	*Pass^*
12	7.500	300	5.24E-04	307	5.36E-04	*102%*	*Pass^*
13	7.992	275	4.80E-04	282	4.92E-04	*103%*	*Pass^*
14	8.484	258	4.50E-04	261	4.55E-04	*101%*	*Pass^*
15	8.976	242	4.22E-04	242	4.22E-04	*100%*	*Pass^*
16	9.468	226	3.94E-04	231	4.03E-04	*102%*	*Pass^*
17	9.960	211	3.68E-04	214	3.73E-04	*101%*	*Pass^*
18	10.452	194	3.39E-04	197	3.44E-04	*102%*	*Pass^*
19	10.944	173	3.02E-04	176	3.07E-04	*102%*	*Pass^*
20	11.436	161	2.81E-04	161	2.81E-04	*100%*	*Pass^*
21	11.928	153	2.67E-04	152	2.65E-04	99%	Pass
22	12.420	143	2.50E-04	143	2.50E-04	*100%*	*Pass^*
23	12.912	137	2.39E-04	136	2.37E-04	99%	Pass
24	13.404	127	2.22E-04	125	2.18E-04	98%	Pass
25	13.896	119	2.08E-04	119	2.08E-04	*100%*	*Pass^*
26	14.388	113	1.97E-04	114	1.99E-04	*101%*	*Pass^*
27	14.880	103	1.80E-04	100	1.75E-04	97%	Pass
28	15.372	93	1.62E-04	92	1.61E-04	99%	Pass
29	15.864	87	1.52E-04	87	1.52E-04	*100%*	*Pass^*
30	16.356	82	1.43E-04	82	1.43E-04	*100%*	*Pass^*
31	16.848	77	1.34E-04	75	1.31E-04	97%	Pass
32	17.340	73	1.27E-04	71	1.24E-04	97%	Pass
33	17.832	70	1.22E-04	70	1.22E-04	*100%*	*Pass^*
34	18.324	68	1.19E-04	67	1.17E-04	99%	Pass
35	18.816	64	1.12E-04	61	1.06E-04	95%	Pass
36	19.309	61	1.06E-04	59	1.03E-04	97%	Pass
37	19.801	57	9.95E-05	55	9.60E-05	96%	Pass
38	20.293	54	9.42E-05	54	9.42E-05	*100%*	*Pass^*
39	20.785	49	8.55E-05	49	8.55E-05	*100%*	*Pass^*
40	21.277	47	8.20E-05	47	8.20E-05	*100%*	*Pass^*
41	21.769	45	7.85E-05	44	7.68E-05	98%	Pass
42	22.261	42	7.33E-05	42	7.33E-05	*100%*	*Pass^*
43	22.753	42	7.33E-05	41	7.15E-05	98%	Pass
44	23.245	40	6.98E-05	40	6.98E-05	*100%*	*Pass^*
45	23.737	39	6.81E-05	40	6.98E-05	*103%*	*Pass^*
46	24.229	37	6.46E-05	39	6.81E-05	*105%*	*Pass^*
47	24.721	37	6.46E-05	37	6.46E-05	*100%*	*Pass^*
48	25.213	36	6.28E-05	35	6.11E-05	97%	Pass
49	25.705	35	6.11E-05	35	6.11E-05	*100%*	*Pass^*
50	26.197	35	6.11E-05	35	6.11E-05	*100%*	*Pass^*
51	26.689	35	6.11E-05	35	6.11E-05	*100%*	*Pass^*

Flow Frequency Range Based on: **SWMM - Weibull**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
52	27.181	33	5.76E-05	33	5.76E-05	*100%*	*Pass^*
53	27.673	33	5.76E-05	30	5.24E-05	91%	Pass
54	28.165	30	5.24E-05	30	5.24E-05	*100%*	*Pass^*
55	28.657	30	5.24E-05	30	5.24E-05	*100%*	*Pass^*
56	29.149	30	5.24E-05	30	5.24E-05	*100%*	*Pass^*
57	29.641	29	5.06E-05	28	4.89E-05	97%	Pass
58	30.133	28	4.89E-05	27	4.71E-05	96%	Pass
59	30.625	26	4.54E-05	26	4.54E-05	*100%*	*Pass^*
60	31.117	26	4.54E-05	25	4.36E-05	96%	Pass
61	31.609	24	4.19E-05	24	4.19E-05	*100%*	*Pass^*
62	32.101	24	4.19E-05	24	4.19E-05	*100%*	*Pass^*
63	32.594	24	4.19E-05	23	4.01E-05	96%	Pass
64	33.086	23	4.01E-05	23	4.01E-05	*100%*	*Pass^*
65	33.578	23	4.01E-05	22	3.84E-05	96%	Pass
66	34.070	21	3.66E-05	22	3.84E-05	*105%*	*Pass^*
67	34.562	20	3.49E-05	20	3.49E-05	*100%*	*Pass^*
68	35.054	18	3.14E-05	19	3.32E-05	*106%*	*Pass^*
69	35.546	17	2.97E-05	17	2.97E-05	*100%*	*Pass^*
70	36.038	16	2.79E-05	16	2.79E-05	*100%*	*Pass^*
71	36.530	16	2.79E-05	16	2.79E-05	*100%*	*Pass^*
72	37.022	16	2.79E-05	16	2.79E-05	*100%*	*Pass^*
73	37.514	16	2.79E-05	15	2.62E-05	94%	Pass
74	38.006	15	2.62E-05	14	2.44E-05	93%	Pass
75	38.498	14	2.44E-05	13	2.27E-05	93%	Pass
76	38.990	13	2.27E-05	13	2.27E-05	*100%*	*Pass^*
77	39.482	13	2.27E-05	13	2.27E-05	*100%*	*Pass^*
78	39.974	13	2.27E-05	12	2.09E-05	92%	Pass
79	40.466	12	2.09E-05	11	1.92E-05	92%	Pass
80	40.958	11	1.92E-05	11	1.92E-05	*100%*	*Pass^*
81	41.450	11	1.92E-05	11	1.92E-05	*100%*	*Pass^*
82	41.942	11	1.92E-05	10	1.75E-05	91%	Pass
83	42.434	10	1.75E-05	9	1.57E-05	90%	Pass
84	42.926	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
85	43.418	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
86	43.910	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
87	44.402	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
88	44.894	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
89	45.386	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
90	45.879	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
91	46.371	9	1.57E-05	8	1.40E-05	89%	Pass
92	46.863	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
93	47.355	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
94	47.847	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
95	48.339	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
96	48.831	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
97	49.323	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
98	49.815	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
99	50.307	7	1.22E-05	6	1.05E-05	86%	Pass
100	50.799	6	1.05E-05	6	1.05E-05	*100%*	*Pass^*


POC- 1 Flow Duration Exceedance Curves
60.000
50.000
40.000
30.000
20.000
10.000
0.000
Flow (cfs)
1.0E-05
1.0E-04
1.0E-03
1.0E-02
% Time Exceeding
Pre-development Qpeak
Post-project Mitigated Qpeak

4. POC -1 CUHP Inputs & Outputs for the 100Yr Storm Event

(Q25 & Q50 to be provided with Final Drainage Report)

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (acre)	Length to Centroid (ft)	Length (ft)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
DMA-1	DMA-1	100	75	2100	3876	0.06	5	0.35	0.1	3	0.0018	0.5	0

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (acre)	Length to Centroid (ft)	Length (ft)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
DMA-1A	DMA-1A	100	67.5	2100	3876	0.06	5	0.35	0.1	3	0.0018	0.5	0
DMA-1B	DMA-1B	100	2.3	2100	1220	0.07	51	0.35	0.1	3	0.0018	0.5	0
DMA-1D	DMA-1D	100	7	2100	1500	0.08	50	0.35	0.1	3	0.0018	0.5	0

RUN MULTIPLE CUHP AND SWMM SCENARIOS

Columns with this color heading are for required user-input
Columns with this color heading are for program-calculated values

SWMM Run Wait Time (sec)
5

(Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)
RP

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
DMA-1A	5	5
DMA-1B	5	51
DMA-1D	5	50

Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
2	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
5	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
10	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
50	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
100	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
WQ	WQ	0.6	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40

Enter "X" to Run Scenario	Scenario ID	Land Use (E or F)	Return Period (yr)	Correction Area (Sq.Mi.)	(Optional) SWMM Time Series Inflow Table "NAME"
X	1	F	WQ	0	1_Fut_WQ_0mi^2_POST1_OUT
X	2	F	2	0	2_Fut_2yr_0mi^2_POST1_OUT
X	3	F	5	0	3_Fut_5yr_0mi^2_POST1_OUT
X	4	F	10	0	4_Fut_10yr_0mi^2_POST1_OUT
X	5	F	50	0	5_Fut_50yr_0mi^2_POST1_OUT
X	6	F	100	0	6_Fut_100yr_0mi^2_POST1_OUT

5. POC – 1 SWMM Results using CUHP Input File for the 100Yr Storm

(Q25 & Q50 to be provided with Final Drainage Report)

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition
Scenario ID = 6_Ex_100yr_0mi^2_POC1_RANGE_PRE

WARNING 04: minimum elevation drop used for Conduit 1

*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        10.295         3.355
External Outflow .........        10.295         3.355
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000

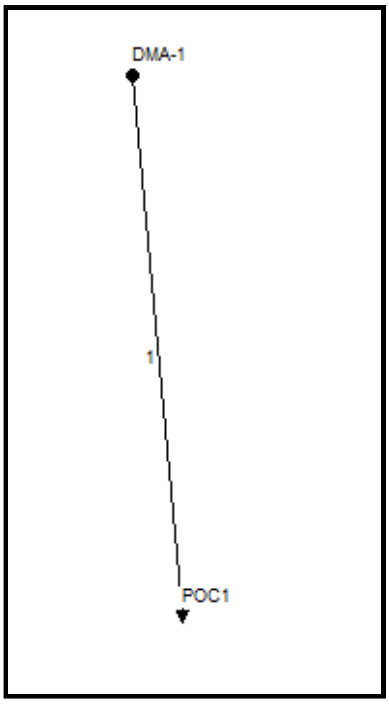

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


*****************
Node Depth Summary
*****************

-------------------------------------------------------------------------------
                                 Average  Maximum  Maximum  Time of Max    Reported
                                   Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type          Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
DMA-1                JUNCTION      0.00     0.00     0.00     0  00:00         0.00
POC1                 OUTFALL       0.00     0.00     0.00     0  00:00         0.00
```


SWMM Model Input Schematic using CUHP input file



****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
DMA-1	JUNCTION	98.67	98.67	0 00:51	3.35	3.35	0.000
POC1	OUTFALL	0.00	98.67	0 00:51	0	3.35	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC1	74.72	27.79	98.67	3.355
System	74.72	27.79	98.67	3.355

Pre-Project Q100 per CUHP run

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	DUMMY	98.67	0 00:51			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Mar 19 11:01:02 2025
Analysis ended on: Wed Mar 19 11:01:02 2025
Total elapsed time: < 1 sec

```
[TITLE]
;;Project Title/Notes
2215 Range
POST-Project Condition CUHP RUN

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           01/01/2024
START_TIME           00:00:00
REPORT_START_DATE    01/01/2024
REPORT_START_TIME    00:00:00
END_DATE             01/01/2024
END_TIME             06:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[FILES]
;;Interfacing Files
USE INFLOWS "POC1_CUHP_POST.txt"

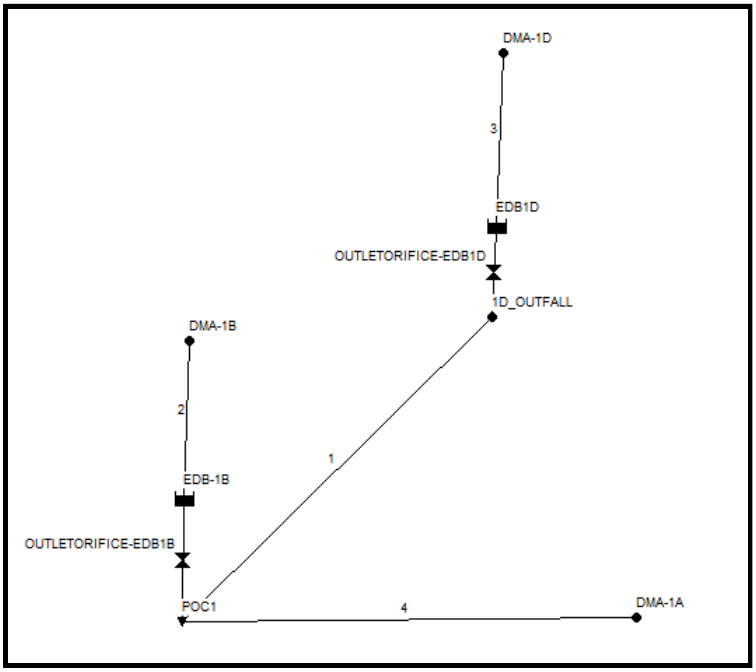
[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
1D_OUTFALL       0          0          0          0          0
DMA-1B           0          0          0          0          0
DMA-1D           0          0          0          0          0
DMA-1A           0          0          0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC1             0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat
   IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------
-------- --------
EDB1D            0        9.5        0          TABULAR    EDB1D                        0        0
EDB-1B           0        7.0        0          TABULAR    EDB1B                        0        0
```

SWMM Model Input Schematic using CUHP input file



```
[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
1                1D_OUTFALL       POC1             400        0.01       0          0          0          0
2                DMA-1B           EDB-1B           400        0.01       0          0          0          0
3                DMA-1D           EDB1D            400        0.01       0          0          0          0
4                DMA-1A           POC1             400        0.01       0          0          0          0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type            QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- --------
OUTLETORIFICE-EDB1D EDB1D            1D_OUTFALL       0          TABULAR/DEPTH   EDB_1D_rc                   NO
OUTLETORIFICE-EDB1B EDB-1B           POC1             0          TABULAR/DEPTH   EDB_1B_RC                   NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
1                DUMMY        0                0          0          0          1
2                DUMMY        0                0          0          0          1
3                DUMMY        0                0          0          0          1
4                DUMMY        0                0          0          0          1

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
EDB_1D_rc        Rating     0.00       0.000
EDB_1D_rc                   0.25       0.043
EDB_1D_rc                   0.50       0.068
EDB_1D_rc                   0.75       0.086
EDB_1D_rc                   1.00       0.101
EDB_1D_rc                   1.25       0.156
EDB_1D_rc                   1.50       0.193
EDB_1D_rc                   1.75       0.221
EDB_1D_rc                   2.00       0.246
EDB_1D_rc                   2.25       0.432
EDB_1D_rc                   2.50       0.547
EDB_1D_rc                   2.75       0.635
EDB_1D_rc                   3.00       0.709
EDB_1D_rc                   3.25       0.775
EDB_1D_rc                   3.50       0.835
EDB_1D_rc                   3.75       0.891
EDB_1D_rc                   4.00       0.943
EDB_1D_rc                   4.25       1.779
EDB_1D_rc                   4.50       3.266
EDB_1D_rc                   4.75       5.175
EDB_1D_rc                   5.00       7.426
EDB_1D_rc                   5.25       9.972
EDB_1D_rc                   5.50       12.781
EDB_1D_rc                   5.75       15.830
EDB_1D_rc                   6.00       19.102
EDB_1D_rc                   6.25       22.581
EDB_1D_rc                   6.50       26.257
;
EDB_1B_RC        Rating     0.00       0.000
EDB_1B_RC                   0.25       0.007
EDB_1B_RC                   0.50       0.010
EDB_1B_RC                   0.75       0.018
EDB_1B_RC                   1.00       0.024
EDB_1B_RC                   1.25       0.028
EDB_1B_RC                   1.50       0.129
EDB_1B_RC                   1.75       0.184
EDB_1B_RC                   2.00       0.225
EDB_1B_RC                   2.25       0.259
EDB_1B_RC                   2.50       0.289
EDB_1B_RC                   2.75       0.316
EDB_1B_RC                   3.00       0.341
EDB_1B_RC                   3.25       0.365
EDB_1B_RC                   3.50       0.386
EDB_1B_RC                   3.75       0.932
EDB_1B_RC                   4.00       1.911
EDB_1B_RC                   4.25       3.173
```

```
EDB_1B_RC                   4.50       4.663
EDB_1B_RC                   4.75       6.350
EDB_1B_RC                   5.00       8.213
EDB_1B_RC                   5.25       10.236
EDB_1B_RC                   5.50       12.408
EDB_1B_RC                   5.75       14.719
EDB_1B_RC                   6.00       17.161
EDB_1B_RC                   6.25       19.727
EDB_1B_RC                   6.50       22.411
EDB_1B_RC                   6.75       25.209
EDB_1B_RC                   7.00       28.116
;
EDB1D             Storage   0.00       538.496
EDB1D                       0.50       3232.824
EDB1D                       1.00       5645.472
EDB1D                       1.50       6847.876
EDB1D                       2.00       7657.23
EDB1D                       2.50       8504.93
EDB1D                       3.00       9391.116
EDB1D                       3.50       10315.914
EDB1D                       4.00       11279.352
EDB1D                       4.50       12281.458
EDB1D                       5.00       13322.316
EDB1D                       5.50       14402.29
EDB1D                       6.00       15521.478
EDB1D                       6.50       16679.908
;
EDB1B             Storage   0.00       350
EDB1B                       0.50       1600.2
EDB1B                       1.00       3767.4
EDB1B                       1.50       4722.2
EDB1B                       2.00       5366.2
EDB1B                       2.50       6046.6
EDB1B                       3.00       6762
EDB1B                       3.50       7512.4
EDB1B                       4.00       8296.4
EDB1B                       4.50       9115.4
EDB1B                       5.00       9968
EDB1B                       5.50       10854.2
EDB1B                       6.00       11775.4
EDB1B                       6.50       12731.6
EDB1B                       7.00       13225.8

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
1D_OUTFALL       3483.276           6297.578
DMA-1B           991.926            6101.499
DMA-1D           3575.548           8477.509
DMA-1A           4671.280           3817.762
POC1             934.256            3783.160
EDB1D            3517.878           7035.755
EDB-1B           945.790            4786.621

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition
Scenario ID = 6_Fut_100yr_0mi^2_POC1_RANGE_POST

WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2
WARNING 04: minimum elevation drop used for Conduit 3
WARNING 04: minimum elevation drop used for Conduit 4

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        10.949         3.568
External Outflow .........        10.180         3.317
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.768         0.250
Continuity Error (%) .....         0.007


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
1D_OUTFALL	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DMA-1B	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DMA-1D	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DMA-1A	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC1	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
EDB1D	STORAGE	3.55	4.65	4.65	0 01:53	4.64
EDB-1B	STORAGE	2.62	3.28	3.28	0 03:29	3.26

100-YR Ponding Depth

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1D_OUTFALL	JUNCTION	0.00	4.42	0 01:53	0	0.249	0.000
DMA-1B	JUNCTION	2.92	2.92	0 00:51	0.136	0.136	0.000
DMA-1D	JUNCTION	12.02	12.02	0 00:46	0.41	0.41	0.000
DMA-1A	JUNCTION	85.67	85.67	0 00:51	3.02	3.02	0.000
POC1	OUTFALL	0.00	86.39	0 00:51	0	3.32	0.000
EDB1D	STORAGE	0.00	12.02	0 00:46	0	0.41	0.062
EDB-1B	STORAGE	0.00	2.92	0 00:51	0	0.136	-0.005

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB1D	25.302	20	0	0	36.534	29	0 01:52	4.42
EDB-1B	10.785	20	0	0	14.515	28	0 03:28	0.37

Detained Q100 out of EDB

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC1	97.22	21.12	86.39	3.317
System	97.22	21.12	86.39	3.317

Mitigated Q100 at POC

```
********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                                |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
1                    DUMMY        4.42     0  01:53
2                    DUMMY        2.92     0  00:51
3                    DUMMY       12.02     0  00:46
4                    DUMMY       85.67     0  00:51
OUTLETORIFICE-EDB1D  DUMMY        4.42     0  01:53
OUTLETORIFICE-EDB1B  DUMMY        0.37     0  03:29


************************
Conduit Surcharge Summary
************************

No conduits were surcharged.


Analysis begun on:  Tue Dec 17 17:19:40 2024
Analysis ended on:  Tue Dec 17 17:19:40 2024
Total elapsed time: < 1 sec
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Post-Project Condition
Scenario ID = 1_Fut_WQ_0mi^2_POC1_RANGE_POST

WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2
WARNING 04: minimum elevation drop used for Conduit 3
WARNING 04: minimum elevation drop used for Conduit 4

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.233         0.076
External Outflow .........         0.115         0.038
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.117         0.038
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
1D_OUTFALL	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DMA-1B	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DMA-1D	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DMA-1A	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC1	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
EDB1D	STORAGE	1.02	1.28	1.28	0 02:45	1.28
EDB-1B	STORAGE	0.79	0.99	0.99	0 03:59	0.99

WQ Ponding Depth

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1D_OUTFALL	JUNCTION	0.00	0.16	0 02:45	0	0.0196	0.000
DMA-1B	JUNCTION	0.27	0.27	0 00:46	0.0153	0.0153	0.000
DMA-1D	JUNCTION	1.12	1.12	0 00:41	0.0456	0.0456	0.000
DMA-1A	JUNCTION	0.46	0.46	0 00:46	0.0149	0.0149	0.000
POC1	OUTFALL	0.00	0.55	0 00:46	0	0.0376	0.000
EDB1D	STORAGE	0.00	1.12	0 00:41	0	0.0456	-0.010
EDB-1B	STORAGE	0.00	0.27	0 00:46	0	0.0153	-0.018

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB1D	3.557	3	0	0	4.867	4	0 02:44	0.16
EDB-1B	1.308	2	0	0	1.776	3	0 03:58	0.02

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC1	95.56	0.24	0.55	0.038
System	95.56	0.24	0.55	0.038

```
********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                                |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
1                    DUMMY        0.16     0  02:45
2                    DUMMY        0.27     0  00:46
3                    DUMMY        1.12     0  00:41
4                    DUMMY        0.46     0  00:46
OUTLETORIFICE-EDB1D  DUMMY        0.16     0  02:45
OUTLETORIFICE-EDB1B  DUMMY        0.02     0  03:59


************************
Conduit Surcharge Summary
************************

No conduits were surcharged.

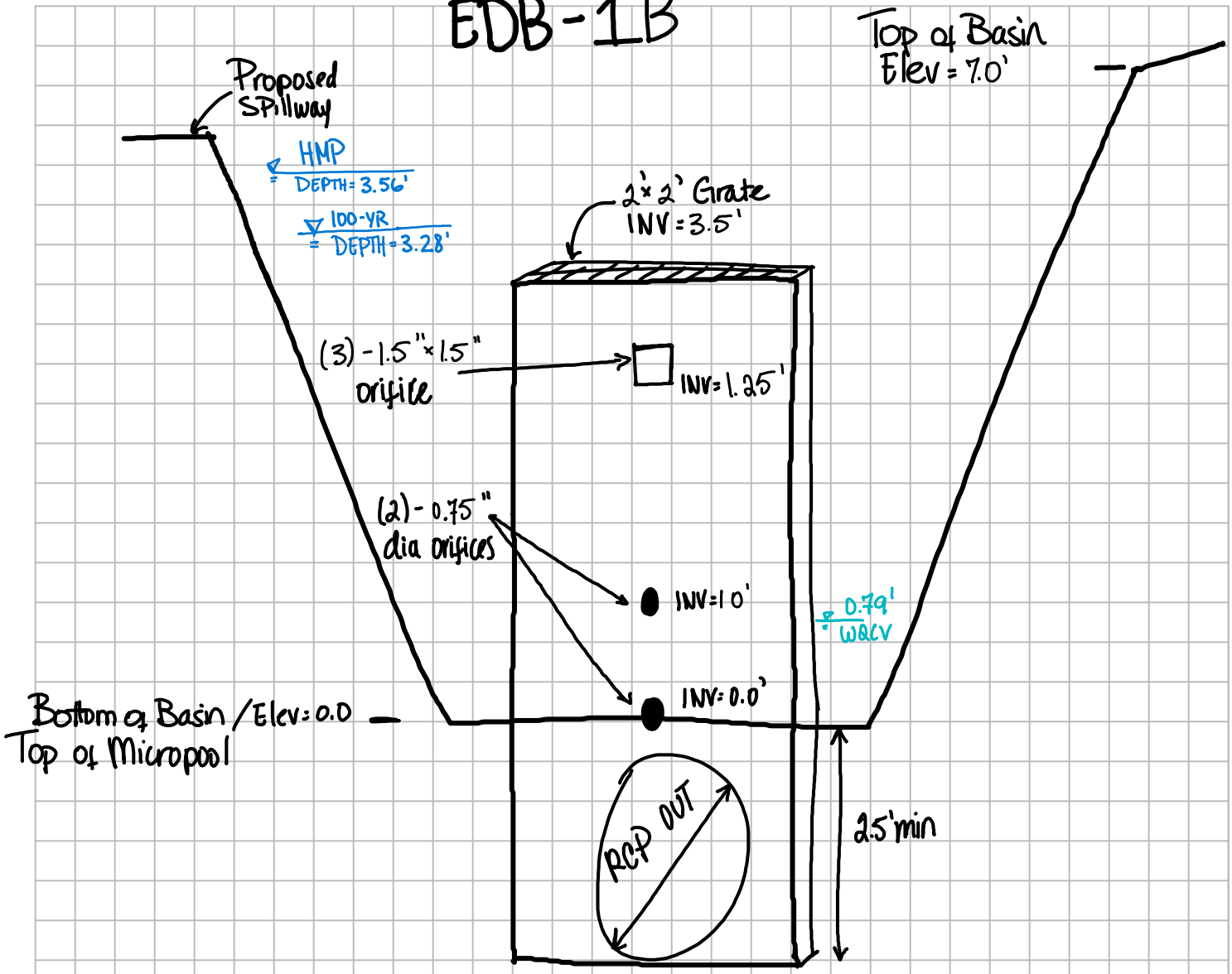

Analysis begun on:  Tue Dec 17 17:18:38 2024
Analysis ended on:  Tue Dec 17 17:18:38 2024
Total elapsed time: < 1 sec
```

6. EDB Cross Section

RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE: 12-18-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

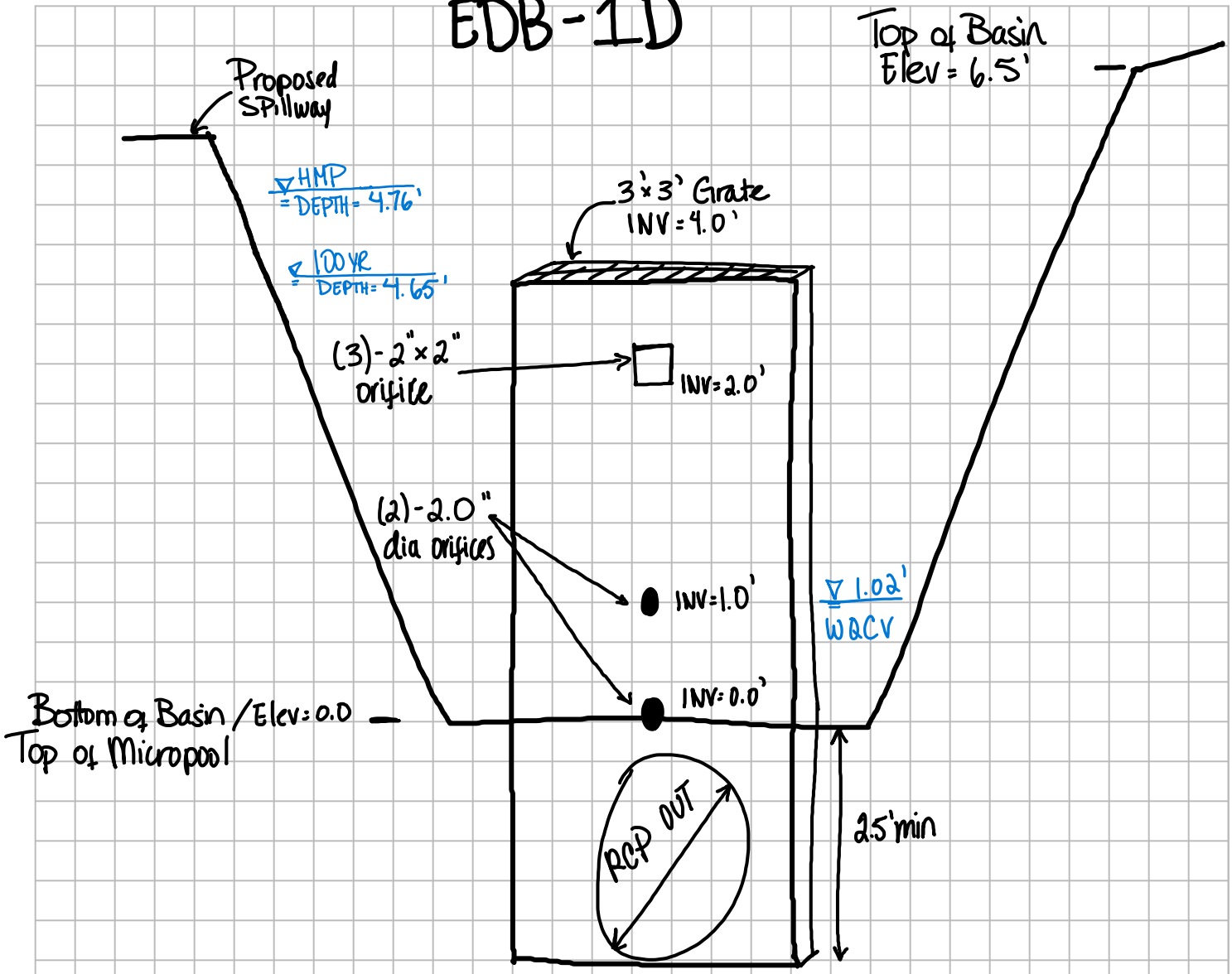
EDB-1B



RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE: 12-18-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

EDB-1D



7. EDB Stage Storage Discharge Table

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 0.75" dia.	1 x 0.75" dia.
# of openings	1	1
Orifice Size (inches)	0.75	0.75
Area Orifice (ft2)	*0.00*	*0.00*
Flowline of Orifice (ft)	0	0.600

RECTANGULAR OPENINGS	3 x 1.5"H by 1.5"W	1 x 16.8"H by 16.8"W
# of openings	3	1
Height (inches)	1.5	16.8
Width (inches)	1.5	16.8
Area Orifice (ft2)	*0.015625*	*1.96*
Flowline of Weir (ft)	1.25	3.5

2-ft x 2-ft Grate
(assumed 70% Open Area reduction)

Flowline (ft)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	**0.000**
0.25	0.007	-	**0.007**
0.50	0.010	-	**0.010**
0.75	0.013	0.005	**0.018**
1.00	0.015	0.009	**0.024**
1.25	0.016	0.012	**0.028**
1.50	0.018	0.014	**0.032**
1.75	0.019	0.016	**0.035**
2.00	0.021	0.017	**0.038**
2.25	0.022	0.019	**0.041**
2.50	0.023	0.020	**0.043**
2.75	0.024	0.022	**0.046**
3.00	0.025	0.023	**0.048**
3.25	0.027	0.024	**0.050**
3.50	0.028	0.025	**0.053**
3.75	0.028	0.026	**0.055**
4.00	0.029	0.027	**0.057**
4.25	0.030	0.028	**0.058**
4.50	0.031	0.029	**0.060**
4.75	0.032	0.030	**0.062**
5.00	0.033	0.031	**0.064**
5.25	0.034	0.032	**0.065**
5.50	0.035	0.033	**0.067**
5.75	0.035	0.033	**0.069**
6.00	0.036	0.034	**0.070**
6.25	0.037	0.035	**0.072**
6.50	0.038	0.036	**0.073**
6.75	0.038	0.037	**0.075**
7.00	0.039	0.037	**0.076**

Flowline (ft)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	TOTAL
0.00	-	-	-	-	**0.0**
0.25	-	-	-	-	**0.0**
0.50	-	-	-	-	**0.0**
0.75	-	-	-	-	**0.0**
1.00	-	-	-	-	**0.0**
1.25	-	-	-	-	**0.0**
1.50	0.141	0.098	0.098	-	**0.1**
1.75	0.398	0.149	0.149	-	**0.1**
2.00	0.731	0.187	0.187	-	**0.2**
2.25	1.125	0.219	0.219	-	**0.2**
2.50	1.572	0.246	0.246	-	**0.2**
2.75	2.067	0.271	0.271	-	**0.3**
3.00	2.604	0.293	0.293	-	**0.3**
3.25	3.182	0.314	0.314	-	**0.3**
3.50	3.797	0.334	0.334	-	**0.3**
3.75	4.447	0.352	0.352	0.525	**0.9**
4.00	5.130	0.370	0.370	1.485	**1.9**
4.25	5.846	0.387	0.387	2.728	**3.1**
4.50	6.591	0.403	0.403	4.200	**4.6**
4.75	7.366	0.418	0.418	5.870	**6.3**
5.00	8.170	0.433	0.433	7.716	**8.1**
5.25	9.000	0.448	0.448	9.723	**10.2**
5.50	9.857	0.462	0.462	11.879	**12.3**
5.75	10.739	0.475	0.475	14.175	**14.7**
6.00	11.646	0.489	0.489	16.602	**17.1**
6.25	12.578	0.502	0.502	19.154	**19.7**
6.50	13.533	0.514	0.514	21.824	**22.3**
6.75	14.511	0.526	0.526	24.608	**25.1**
7.00	15.512	0.538	0.538	27.501	**28.0**

Total Rating Curve for SWMM Analysis

Stage (ft)	Discharge (cfs)
0.00	0.000
0.25	0.007
0.50	0.010
0.75	0.018
1.00	0.024
1.25	0.028
1.50	0.129
1.75	0.184
2.00	0.225
2.25	0.259
2.50	0.289
2.75	0.316
3.00	0.341
3.25	0.365
3.50	0.386
3.75	0.932
4.00	1.911
4.25	3.173
4.50	4.663
4.75	6.350
5.00	8.213
5.25	10.236
5.50	12.408
5.75	14.719
6.00	17.161
6.25	19.727
6.50	22.411
6.75	25.209
7.00	28.116

Stage-Storage Curve

Elevation (ft)	Stage (ft)	Area (sf)
5,750.0	0.00	350
5,750.5	0.50	1600.2
5,751.0	1.00	3767.4
5,751.5	1.50	4722.2
5,752.0	2.00	5366.2
5,752.5	2.50	6046.6
5,753.0	3.00	6762
5,753.5	3.50	7512.4
5,754.0	4.00	8296.4
5,754.5	4.50	9115.4
5,755.0	5.00	9968
5,755.5	5.50	10854.2
5,756.0	6.00	11775.4
5,756.5	6.50	12731.6
5,757.0	7.00	13225.8

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 2" dia.	1 x 2" dia.
# of openings	1	1
Orifice Size (inches)	2	2
Area Orifice (ft2)	*0.022*	*0.022*
Flowline of Orifice (ft)	0	1.000

RECTANGULAR OPENINGS	3 x 2"H by 2"W	None	None	1 x 25.2"H by 25.2"W
# of openings	3	0	0	1
Height (inches)	2	0	0	25.2
Width (inches)	2	0	0	25.2
Area Orifice (ft2)	*0.027778*	*0*	*0*	*4.41*
Flowline of Weir (ft)	2.00	0	0	4

3-ft x 3-ft Grate
(assumed 70% Open Area reduction)

Flowline (ft)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	**0.000**
0.25	0.043	-	**0.043**
0.50	0.068	-	**0.068**
0.75	0.086	-	**0.086**
1.00	0.101	No Value	**0.101**
1.25	0.113	0.043	**0.156**
1.50	0.125	0.068	**0.193**
1.75	0.136	0.086	**0.221**
2.00	0.145	0.101	**0.246**
2.25	0.155	0.113	**0.268**
2.50	0.163	0.125	**0.288**
2.75	0.172	0.136	**0.307**
3.00	0.179	0.145	**0.325**
3.25	0.187	0.155	**0.342**
3.50	0.194	0.163	**0.357**
3.75	0.201	0.172	**0.373**
4.00	0.208	0.179	**0.387**
4.25	0.214	0.187	**0.401**
4.50	0.221	0.194	**0.415**
4.75	0.227	0.201	**0.428**
5.00	0.233	0.208	**0.441**
5.25	0.239	0.214	**0.453**
5.50	0.244	0.221	**0.465**
5.75	0.250	0.227	**0.477**
6.00	0.256	0.233	**0.488**
6.25	0.261	0.239	**0.500**
6.50	0.266	0.244	**0.511**

Flowline (ft)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	0.188	0.164	0.164	-	-	-	-	-	-	-	**0.2**
2.50	0.530	0.259	0.259	-	-	-	-	-	-	-	**0.3**
2.75	0.974	0.328	0.328	-	-	-	-	-	-	-	**0.3**
3.00	1.500	0.384	0.384	-	-	-	-	-	-	-	**0.4**
3.25	2.096	0.433	0.433	-	-	-	-	-	-	-	**0.4**
3.50	2.756	0.478	0.478	-	-	-	-	-	-	-	**0.5**
3.75	3.473	0.518	0.518	-	-	-	-	-	-	-	**0.5**
4.00	4.243	0.556	0.556	-	-	-	-	-	-	-	**0.6**
4.25	5.063	0.591	0.591	-	-	-	-	-	-	0.788	**1.4**
4.50	5.929	0.624	0.624	-	-	-	-	-	-	2.227	**2.9**
4.75	6.841	0.655	0.655	-	-	-	-	-	-	4.092	**4.7**
5.00	7.794	0.685	0.685	-	-	-	-	-	-	6.300	**7.0**
5.25	8.789	0.714	0.714	-	-	-	-	-	-	8.805	**9.5**
5.50	9.822	0.742	0.742	-	-	-	-	-	-	11.574	**12.3**
5.75	10.893	0.768	0.768	-	-	-	-	-	-	14.585	**15.4**
6.00	12.000	0.794	0.794	-	-	-	-	-	-	17.819	**18.6**
6.25	13.142	0.819	0.819	-	-	-	-	-	-	21.263	**22.1**
6.50	14.319	0.843	0.843	-	-	-	-	-	-	24.903	**25.7**

Total Rating Curve for SWMM Analysis	
Stage (ft)	**Discharge (cfs)**
0.00	0.000
0.25	0.043
0.50	0.068
0.75	0.086
1.00	0.101
1.25	0.156
1.50	0.193
1.75	0.221
2.00	0.246
2.25	0.432
2.50	0.547
2.75	0.635
3.00	0.709
3.25	0.775
3.50	0.835
3.75	0.891
4.00	0.943
4.25	1.779
4.50	3.266
4.75	5.175
5.00	7.426
5.25	9.972
5.50	12.781
5.75	15.830
6.00	19.102
6.25	22.581
6.50	26.257

Stage-Storage Curve		
Elevation (ft)	**Stage (ft)**	**Area (sf)**
5,810.5	0.00	538.5
5,811.0	0.50	3232.8
5,811.5	1.00	5645.5
5,812.0	1.50	6847.9
5,812.5	2.00	7657.2
5,813.0	2.50	8504.9
5,813.5	3.00	9391.1
5,814.0	3.50	10315.9
5,814.5	4.00	11279.4
5,815.0	4.50	12281.5
5,815.5	5.00	13322.3
5,816.0	5.50	14402.3
5,816.5	6.00	15521.5
5,817.0	6.50	16679.9

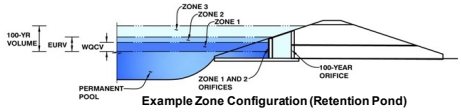
8. MHFD-Detention – Stage-Storage Table

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Range - POC 1

Basin ID: EDB 1B - Street Only area



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB		**Note: L / W Ratio > 8**
Watershed Area =	2.20	acres	**L / W Ratio = 15.53**
Watershed Length =	1,220	ft	
Watershed Length to Centroid =	600	ft	
Watershed Slope =	0.070	ft/ft	**Steep Slope > 0.06 ft/ft**
Watershed Imperviousness =	51.00%	percent	
Percentage Hydrologic Soil Group A =	30.0%	percent	
Percentage Hydrologic Soil Group B =	0.0%	percent	
Percentage Hydrologic Soil Groups C/D =	70.0%	percent	
Target WQCV Drain Time =	40.0	hours	
Location for 1-hr Rainfall Depths =	Sedalia		

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) =	0.038	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.113	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	0.067	acre-feet		inches
5-yr Runoff Volume (P1 = 1.43 in.) =	0.144	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.52 in.) =	0.157	acre-feet	1.52	inches
25-yr Runoff Volume (P1 = 1.71 in.) =	0.200	acre-feet		inches
50-yr Runoff Volume (P1 = 2 in.) =	0.252	acre-feet		inches
100-yr Runoff Volume (P1 = 2.6 in.) =	0.369	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.03 in.) =	0.449	acre-feet		inches
Approximate 2-yr Detention Volume =	0.063	acre-feet		
Approximate 5-yr Detention Volume =	0.125	acre-feet		
Approximate 10-yr Detention Volume =	0.132	acre-feet		
Approximate 25-yr Detention Volume =	0.145	acre-feet		
Approximate 50-yr Detention Volume =	0.159	acre-feet		
Approximate 100-yr Detention Volume =	0.209	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.038	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.075	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.096	acre-feet
Total Detention Basin Volume =	0.209	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 = 0.50 ft

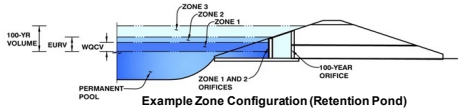
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	350	0.008		
	--	0.50	--	--	--	1,600	0.037	488	0.011
	--	1.00	--	--	--	3,767	0.086	1,829	0.042
	--	1.50	--	--	--	4,722	0.108	3,952	0.091
	--	2.00	--	--	--	5,366	0.123	6,474	0.149
	--	2.50	--	--	--	6,047	0.139	9,327	0.214
	--	3.00	--	--	--	6,762	0.155	12,529	0.288
	--	3.50	--	--	--	7,512	0.172	16,098	0.370
	--	4.00	--	--	--	8,296	0.190	20,050	0.460
	--	4.50	--	--	--	9,115	0.209	24,403	0.560
	--	5.00	--	--	--	9,968	0.229	29,174	0.670
	--	5.50	--	--	--	10,854	0.249	34,379	0.789
	--	6.00	--	--	--	11,775	0.270	40,037	0.919
	--	6.50	--	--	--	12,732	0.292	46,164	1.060
	--	7.00	--	--	--	13,226	0.304	52,653	1.209

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Range - POC 1**

Basin ID: **EDB 1D - Lots only**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	6.70	acres
Watershed Length =	1,500	ft
Watershed Length to Centroid =	600	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	50.00%	percent
Percentage Hydrologic Soil Group A =	30.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	70.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Sedalia	

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) =	0.115	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.338	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	0.197	acre-feet		inches
5-yr Runoff Volume (P1 = 1.43 in.) =	0.430	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.52 in.) =	0.468	acre-feet	1.52	inches
25-yr Runoff Volume (P1 = 1.71 in.) =	0.599	acre-feet		inches
50-yr Runoff Volume (P1 = 2 in.) =	0.755	acre-feet		inches
100-yr Runoff Volume (P1 = 2.6 in.) =	1.111	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.03 in.) =	1.354	acre-feet		inches
Approximate 2-yr Detention Volume =	0.188	acre-feet		
Approximate 5-yr Detention Volume =	0.372	acre-feet		
Approximate 10-yr Detention Volume =	0.393	acre-feet		
Approximate 25-yr Detention Volume =	0.433	acre-feet		
Approximate 50-yr Detention Volume =	0.477	acre-feet		
Approximate 100-yr Detention Volume =	0.628	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.115	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.223	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.290	acre-feet
Total Detention Basin Volume =	0.628	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 = 0.50 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	--	--	--	539	0.012		
5,811.00	--	0.50	--	--	--	3,233	0.074	943	0.022
5,811.50	--	1.00	--	--	--	5,646	0.130	3,162	0.073
5,812.00	--	1.50	--	--	--	6,848	0.157	6,286	0.144
5,812.50	--	2.00	--	--	--	7,657	0.176	9,912	0.228
5,813.00	--	2.50	--	--	--	8,505	0.195	13,952	0.320
5,813.50	--	3.00	--	--	--	9,391	0.216	18,426	0.423
5,814.00	--	3.50	--	--	--	10,316	0.237	23,353	0.536
5,814.50	--	4.00	--	--	--	11,279	0.259	28,752	0.660
5,815.00	--	4.50	--	--	--	12,282	0.282	34,642	0.795
5,815.50	--	5.00	--	--	--	13,322	0.306	41,043	0.942
5,816.00	--	5.50	--	--	--	14,402	0.331	47,974	1.101
5,816.50	--	6.00	--	--	--	15,522	0.356	55,455	1.273
5,817.00	--	6.50	--	--	--	16,680	0.383	63,506	1.458

1. POC - 4 SWMM Schematics

Pre-Project DMA 4

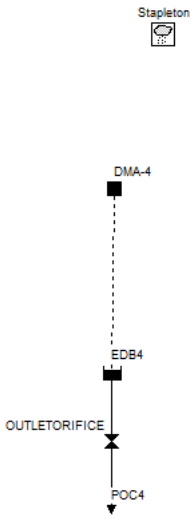


Subcatchment DMA-4

Property	Value
Name	DMA-4
X-Coordinate	4021.330
Y-Coordinate	7804.266
Description	Pre-Project Condition
Tag	
Rain Gage	Stapleton
Outlet	POC4
Area	65
Width	687
% Slope	6
% Imperv	5
N-Imperv	.013
N-Perv	.10
Dstore-Imperv	.05
Dstore-Perv	.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

Post Project DMA 4



Subcatchment DMA-4

Property	Value
Name	DMA-4
X-Coordinate	3611.956
Y-Coordinate	7406.282
Description	
Tag	
Rain Gage	Stapleton
Outlet	EDB4
Area	64.2
Width	687
% Slope	6
% Imperv	51
N-Imperv	0.013
N-Perv	0.10
Dstore-Imperv	0.05
Dstore-Perv	0.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

```
[TITLE]
;;Project Title/Notes
2215 Range
Pre-Project Condition

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
;Pre-Project Condition
DMA-4            Stapleton        POC4             65       5        687      6        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-4            .013       .10        .05        .20        25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-4            9          0.01875    0.3

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
```

```
POC4             0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC4             4021.330           5821.832

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-4            4021.330           7804.266

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition


**********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
**********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      5203.900       960.720
Evaporation Loss .........       357.728        66.042
Infiltration Loss ........      4189.324       773.414
Surface Runoff ...........       737.976       136.242
Final Storage ............         0.007         0.001
Continuity Error (%) .....        -1.559


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------      ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       737.976       240.480
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       737.976       240.480
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************

-----------------------------------------------------------------------------------------------------
                         Total      Total      Total      Total      Total       Total     Peak  Runoff
                        Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------
DMA-4                   960.72       0.00      66.04     773.41     136.24      240.46    53.77   0.142
```

```
Analysis begun on:  Thu Aug 08 12:13:06 2024
Analysis ended on:  Thu Aug 08 12:13:22 2024
Total elapsed time: 00:00:16
```

```
[TITLE]
;;Project Title/Notes
2215 Range POC4
Post-Project Condition

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
DMA-4            Stapleton        EDB4             64.2     51       687      6        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-4            0.013      0.10       0.05       0.20       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-4            9          .01875     0.3

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC4             0          FREE                        NO
```

```
[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat
   IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------
-------- --------
EDB4             0        8.5        0          TABULAR    EDB4                         0        0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type            QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- --------
OUTLETORIFICE    EDB4             POC4             0          TABULAR/DEPTH   EDB4_ratingcurve            NO

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
EDB4_ratingcurve Rating     0.00       0.000
EDB4_ratingcurve            0.25       0.084
EDB4_ratingcurve            0.50       0.145
EDB4_ratingcurve            0.75       0.187
EDB4_ratingcurve            1.00       0.221
EDB4_ratingcurve            1.25       0.334
EDB4_ratingcurve            1.50       0.422
EDB4_ratingcurve            1.75       0.488
EDB4_ratingcurve            2.00       0.545
EDB4_ratingcurve            2.25       0.762
EDB4_ratingcurve            2.50       0.931
EDB4_ratingcurve            2.75       1.058
EDB4_ratingcurve            3.00       1.167
EDB4_ratingcurve            3.25       1.264
EDB4_ratingcurve            3.50       1.353
EDB4_ratingcurve            3.75       1.436
EDB4_ratingcurve            4.00       3.104
EDB4_ratingcurve            4.25       4.140
EDB4_ratingcurve            4.50       6.375
EDB4_ratingcurve            4.75       7.889
EDB4_ratingcurve            5.00       8.954
EDB4_ratingcurve            5.25       11.985
EDB4_ratingcurve            5.50       16.665
EDB4_ratingcurve            5.75       17.988
EDB4_ratingcurve            6.00       29.019
EDB4_ratingcurve            6.25       36.376
EDB4_ratingcurve            6.50       44.402
EDB4_ratingcurve            6.75       53.043
EDB4_ratingcurve            7.00       62.253
EDB4_ratingcurve            7.25       71.997
EDB4_ratingcurve            7.50       82.246
EDB4_ratingcurve            7.75       92.975
EDB4_ratingcurve            8.00       104.162
EDB4_ratingcurve            8.25       115.789
EDB4_ratingcurve            8.50       127.839
;
EDB4             Storage    0.00       264
EDB4                        0.50       2137.3
EDB4                        1.00       6503.2
EDB4                        1.50       13030.6
EDB4                        2.00       23456.4
EDB4                        2.50       31069.5
EDB4                        3.00       44539
EDB4                        3.50       51242.4
EDB4                        4.00       53585.4
EDB4                        4.50       55603.9
EDB4                        5.00       57651
EDB4                        5.50       59724.5
EDB4                        6.00       61825.5
EDB4                        6.50       63955.1
EDB4                        7.00       66111.1
EDB4                        7.50       68295.7
EDB4                        8.00       70506.7
EDB4                        8.50       72747.4

[TIMESERIES]
```

```
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC4             3581.560           4640.324
EDB4             3581.560           5805.471

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-4            3662.614           7436.677
DMA-4            3561.297           7375.887

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range POC4
Post-Project Condition


***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      5139.852       960.720
Evaporation Loss .........       832.018       155.517
Infiltration Loss ........      2095.680       391.716
Surface Runoff ...........      2253.682       421.249
Final Storage ............         0.078         0.015
Continuity Error (%) .....        -0.809


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......      2253.682       734.396
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........      2252.782       734.103
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.040


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
```

```
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


**************************
Subcatchment Runoff Summary
**************************

-----------------------------------------------------------------------------------------------------------
                        Total      Total      Total      Total      Total       Total     Peak  Runoff
                       Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment              in         in         in         in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------------
DMA-4                  960.72       0.00     155.52     391.72     421.25      734.34    91.64   0.438


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type        Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
POC4                 OUTFALL     0.00     0.00     0.00     0  00:00        0.00
EDB4                 STORAGE     0.13     6.51     6.51  23722  19:06        6.48


******************
Node Inflow Summary
******************

-------------------------------------------------------------------------------------------------
                              Maximum  Maximum                  Lateral       Total        Flow
                              Lateral    Total  Time of Max      Inflow      Inflow     Balance
                               Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type         CFS      CFS  days hr:min    10^6 gal    10^6 gal     Percent
-------------------------------------------------------------------------------------------------
POC4                 OUTFALL     0.00    44.85  23722  19:06           0         734       0.000
EDB4                 STORAGE    91.64    91.64  20471  19:01         734         734       0.040


**********************
Node Flooding Summary
**********************

No nodes were flooded.


**********************
Storage Volume Summary
**********************

-----------------------------------------------------------------------------------------------
                      Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                       Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit         1000 ft3    Full  Loss  Loss      1000 ft3    Full    days hr:min        CFS
-----------------------------------------------------------------------------------------------
EDB4                    1.273       0     0     0       247.133      65    23722  19:05      44.85


**********************
Outfall Loading Summary
**********************
```

HMP Ponding Depth

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC4	11.05	0.43	44.85	734.048
System	11.05	0.43	44.85	734.048

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
OUTLETORIFICE	DUMMY	44.85	23722 19:06			

****
Conduit Surcharge Summary
****

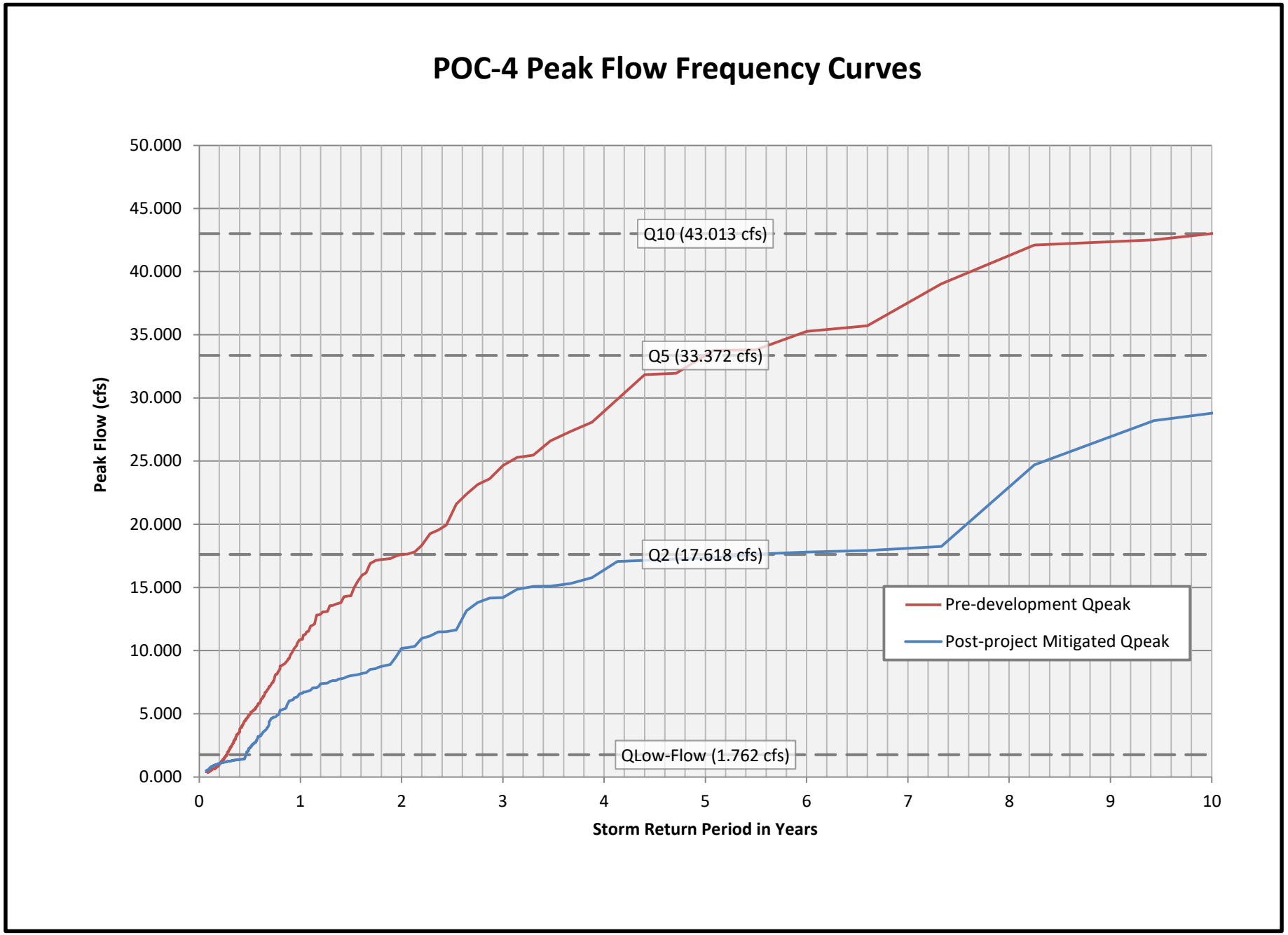
No conduits were surcharged.

Analysis begun on: Wed Dec 18 11:34:11 2024
Analysis ended on: Wed Dec 18 11:34:35 2024
Total elapsed time: 00:00:24

3. POC -4 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

	HMP Flow Frequency Range Based on:	SWMM - Weibull	
Return Period	**Pre-development Qpeak (cfs)**	**Post-project - Mitigated Q (cfs)**	*Check*
Low-Flow = 0.1*Q2	1.762	1.018	*Okay! -> Decreased by 0.744 cfs*
2-year	17.618	10.182	*Okay! -> Decreased by 7.436 cfs*
3-year	24.659	14.190	*Okay! -> Decreased by 10.469 cfs*
4-year	28.940	16.388	*Okay! -> Decreased by 12.552 cfs*
5-year	33.372	17.310	*Okay! -> Decreased by 16.062 cfs*
6-year	35.261	17.794	*Okay! -> Decreased by 17.467 cfs*
7-year	37.523	18.095	*Okay! -> Decreased by 19.428 cfs*
8-year	41.269	22.949	*Okay! -> Decreased by 18.319 cfs*
9-year	42.366	26.927	*Okay! -> Decreased by 15.439 cfs*
10-year	43.013	28.790	*Okay! -> Decreased by 14.224 cfs*


POC-4 Peak Flow Frequency Curves
Peak Flow (cfs)
50.000
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
Q10 (43.013 cfs)
Q5 (33.372 cfs)
Q2 (17.618 cfs)
QLow-Flow (1.762 cfs)
Pre-development Qpeak
Post-project Mitigated Qpeak
0
1
2
3
4
5
6
7
8
9
10
Storm Return Period in Years

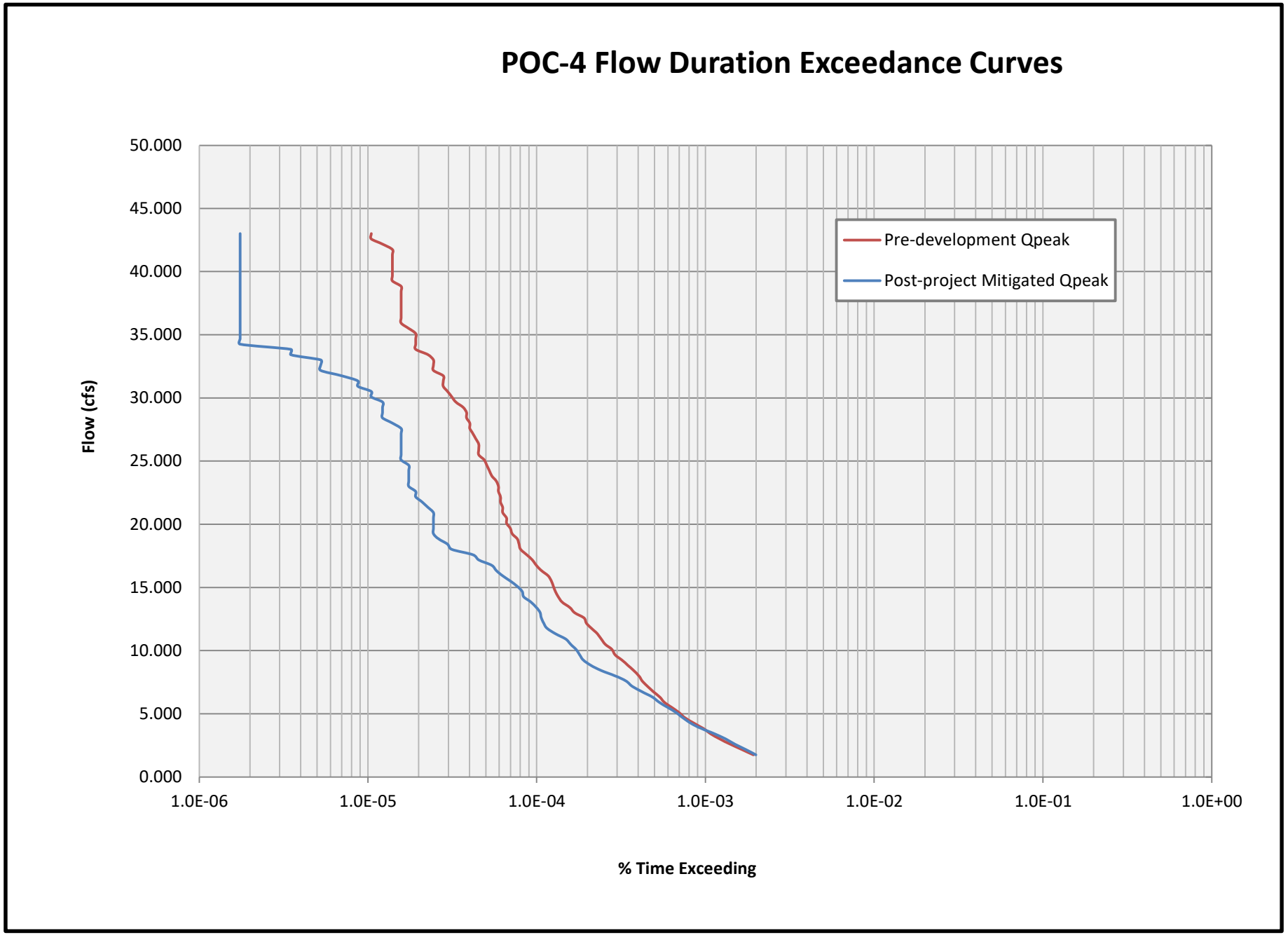
Low-flow Threshold:	10%	
0.1xQ2 (Pre):	1.7618	cfs
Q10 (Pre):	43.013	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	0.41668	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	1.762	1101	1.92E-03	1140	1.99E-03	*104%*	*Pass^*
2	2.178	941	1.64E-03	991	1.73E-03	*105%*	*Pass^*
3	2.595	806	1.41E-03	857	1.50E-03	*106%*	*Pass^*
4	3.012	696	1.21E-03	754	1.32E-03	*108%*	*Pass^*
5	3.429	615	1.07E-03	647	1.13E-03	*105%*	*Pass^*
6	3.845	556	9.70E-04	540	9.42E-04	97%	Pass
7	4.262	490	8.55E-04	469	8.18E-04	96%	Pass
8	4.679	434	7.57E-04	422	7.36E-04	97%	Pass
9	5.095	401	7.00E-04	385	6.72E-04	96%	Pass
10	5.512	361	6.30E-04	342	5.97E-04	95%	Pass
11	5.929	326	5.69E-04	304	5.30E-04	93%	Pass
12	6.345	307	5.36E-04	277	4.83E-04	90%	Pass
13	6.762	281	4.90E-04	240	4.19E-04	85%	Pass
14	7.179	260	4.54E-04	211	3.68E-04	81%	Pass
15	7.595	242	4.22E-04	194	3.39E-04	80%	Pass
16	8.012	231	4.03E-04	167	2.91E-04	72%	Pass
17	8.429	215	3.75E-04	138	2.41E-04	64%	Pass
18	8.845	199	3.47E-04	120	2.09E-04	60%	Pass
19	9.262	183	3.19E-04	108	1.88E-04	59%	Pass
20	9.679	167	2.91E-04	103	1.80E-04	62%	Pass
21	10.095	160	2.79E-04	98	1.71E-04	61%	Pass
22	10.512	146	2.55E-04	91	1.59E-04	62%	Pass
23	10.929	138	2.41E-04	85	1.48E-04	62%	Pass
24	11.346	131	2.29E-04	74	1.29E-04	56%	Pass
25	11.762	121	2.11E-04	66	1.15E-04	55%	Pass
26	12.179	113	1.97E-04	63	1.10E-04	56%	Pass
27	12.596	109	1.90E-04	61	1.06E-04	56%	Pass
28	13.012	96	1.68E-04	60	1.05E-04	63%	Pass
29	13.429	90	1.57E-04	57	9.95E-05	63%	Pass
30	13.846	81	1.41E-04	53	9.25E-05	65%	Pass
31	14.262	77	1.34E-04	48	8.38E-05	62%	Pass
32	14.679	74	1.29E-04	47	8.20E-05	64%	Pass
33	15.096	72	1.26E-04	44	7.68E-05	61%	Pass
34	15.512	70	1.22E-04	40	6.98E-05	57%	Pass
35	15.929	67	1.17E-04	36	6.28E-05	54%	Pass
36	16.346	61	1.06E-04	33	5.76E-05	54%	Pass
37	16.762	57	9.95E-05	31	5.41E-05	54%	Pass
38	17.179	54	9.42E-05	26	4.54E-05	48%	Pass
39	17.596	50	8.73E-05	24	4.19E-05	48%	Pass
40	18.012	46	8.03E-05	18	3.14E-05	39%	Pass
41	18.429	45	7.85E-05	17	2.97E-05	38%	Pass
42	18.846	44	7.68E-05	15	2.62E-05	34%	Pass
43	19.263	41	7.15E-05	14	2.44E-05	34%	Pass
44	19.679	40	6.98E-05	14	2.44E-05	35%	Pass
45	20.096	38	6.63E-05	14	2.44E-05	37%	Pass
46	20.513	38	6.63E-05	14	2.44E-05	37%	Pass
47	20.929	36	6.28E-05	14	2.44E-05	39%	Pass
48	21.346	36	6.28E-05	13	2.27E-05	36%	Pass
49	21.763	35	6.11E-05	12	2.09E-05	34%	Pass
50	22.179	35	6.11E-05	11	1.92E-05	31%	Pass
51	22.596	34	5.93E-05	11	1.92E-05	32%	Pass
52	23.013	34	5.93E-05	10	1.75E-05	29%	Pass
53	23.429	33	5.76E-05	10	1.75E-05	30%	Pass

Flow Frequency Range Based on: SWMM - Weibull

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
54	23.846	31	5.41E-05	10	1.75E-05	32%	Pass
55	24.263	30	5.24E-05	10	1.75E-05	33%	Pass
56	24.679	29	5.06E-05	10	1.75E-05	34%	Pass
57	25.096	28	4.89E-05	9	1.57E-05	32%	Pass
58	25.513	26	4.54E-05	9	1.57E-05	35%	Pass
59	25.929	26	4.54E-05	9	1.57E-05	35%	Pass
60	26.346	26	4.54E-05	9	1.57E-05	35%	Pass
61	26.763	25	4.36E-05	9	1.57E-05	36%	Pass
62	27.180	24	4.19E-05	9	1.57E-05	38%	Pass
63	27.596	23	4.01E-05	9	1.57E-05	39%	Pass
64	28.013	23	4.01E-05	8	1.40E-05	35%	Pass
65	28.430	22	3.84E-05	7	1.22E-05	32%	Pass
66	28.846	22	3.84E-05	7	1.22E-05	32%	Pass
67	29.263	21	3.66E-05	7	1.22E-05	33%	Pass
68	29.680	19	3.32E-05	7	1.22E-05	37%	Pass
69	30.096	18	3.14E-05	6	1.05E-05	33%	Pass
70	30.513	17	2.97E-05	6	1.05E-05	35%	Pass
71	30.930	16	2.79E-05	5	8.73E-06	31%	Pass
72	31.346	16	2.79E-05	5	8.73E-06	31%	Pass
73	31.763	16	2.79E-05	4	6.98E-06	25%	Pass
74	32.180	14	2.44E-05	3	5.24E-06	21%	Pass
75	32.596	14	2.44E-05	3	5.24E-06	21%	Pass
76	33.013	14	2.44E-05	3	5.24E-06	21%	Pass
77	33.430	13	2.27E-05	2	3.49E-06	15%	Pass
78	33.846	11	1.92E-05	2	3.49E-06	18%	Pass
79	34.263	11	1.92E-05	1	1.75E-06	9%	Pass
80	34.680	11	1.92E-05	1	1.75E-06	9%	Pass
81	35.096	11	1.92E-05	1	1.75E-06	9%	Pass
82	35.513	10	1.75E-05	1	1.75E-06	10%	Pass
83	35.930	9	1.57E-05	1	1.75E-06	11%	Pass
84	36.347	9	1.57E-05	1	1.75E-06	11%	Pass
85	36.763	9	1.57E-05	1	1.75E-06	11%	Pass
86	37.180	9	1.57E-05	1	1.75E-06	11%	Pass
87	37.597	9	1.57E-05	1	1.75E-06	11%	Pass
88	38.013	9	1.57E-05	1	1.75E-06	11%	Pass
89	38.430	9	1.57E-05	1	1.75E-06	11%	Pass
90	38.847	9	1.57E-05	1	1.75E-06	11%	Pass
91	39.263	8	1.40E-05	1	1.75E-06	13%	Pass
92	39.680	8	1.40E-05	1	1.75E-06	13%	Pass
93	40.097	8	1.40E-05	1	1.75E-06	13%	Pass
94	40.513	8	1.40E-05	1	1.75E-06	13%	Pass
95	40.930	8	1.40E-05	1	1.75E-06	13%	Pass
96	41.347	8	1.40E-05	1	1.75E-06	13%	Pass
97	41.763	8	1.40E-05	1	1.75E-06	13%	Pass
98	42.180	7	1.22E-05	1	1.75E-06	14%	Pass
99	42.597	6	1.05E-05	1	1.75E-06	17%	Pass
100	43.013	6	1.05E-05	1	1.75E-06	17%	Pass


POC-4 Flow Duration Exceedance Curves
50.000
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
Flow (cfs)
1.0E-06
1.0E-05
1.0E-04
1.0E-03
1.0E-02
1.0E-01
1.0E+00
% Time Exceeding
Pre-development Qpeak
Post-project Mitigated Qpeak

4. POC -4 CUHP Inputs

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (acre)	Length to Centroid (ft)	Length (ft)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
DMA-4	DMA-4	100	65	2100	4094	0.06	5	0.35	0.1	3	0.0018	0.5	0

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (mi^2)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
DMA-4	DMA-4	100	0.1003125	0.397727273	0.7753788	0.06	51	0.35	0.1	3	0.0018	0.5	0

RUN MULTIPLE CUHP AND SWMM SCENARIOS

Columns with this color heading are for required user-input
Columns with this color heading are for program-calculated values

SWMM Run Wait Time (sec)
5

(Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)
RP

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
DMA-4	5	51

Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
2	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
5	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
10	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
50	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
100	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
WQ	WQ	0.6	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40

Enter "X" to Run Scenario	Scenario ID	Land Use (E or F)	Return Period (yr)	Correction Area (Sq.Mi.)	(Optional) SWMM Time Series Inflow Table "NAME"
X	1	F	WQ	0	1_Fut_WQ_0mi^2_POC4_CUHP_POST
X	2	F	2	0	2_Fut_2yr_0mi^2_POC4_CUHP_POST
X	3	F	5	0	3_Fut_5yr_0mi^2_POC4_CUHP_POST
X	4	F	10	0	4_Fut_10yr_0mi^2_POC4_CUHP_POST
X	5	F	50	0	5_Fut_50yr_0mi^2_POC4_CUHP_POST
X	6	F	100	0	6_Fut_100yr_0mi^2_POC4_CUHP_POST

5. POC – 4 SWMM Results using CUHP Input File for the 100Yr Storm

(Q25 & Q50 to be provided with Final Drainage Report)

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition
Scenario ID = 6_Ex_100yr_0mi^2_POC4_RANGE_PRE

WARNING 04: minimum elevation drop used for Conduit 1

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         8.929         2.910
External Outflow .........         8.929         2.910
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000

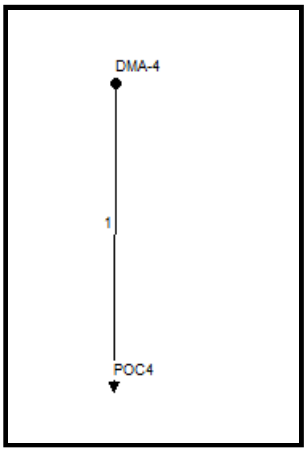

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


*****************
Node Depth Summary
*****************

--------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type          Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
DMA-4                JUNCTION      0.00     0.00     0.00     0  00:00        0.00
POC4                 OUTFALL       0.00     0.00     0.00     0  00:00        0.00
                                                                    Page 1
```

SWMM Model Input Schematic using CUHP input file



****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
DMA-4	JUNCTION	79.77	79.77	0 00:51	2.91	2.91	0.000
POC4	OUTFALL	0.00	79.77	0 00:51	0	2.91	0.000

****
Node Flooding Summary
****

No nodes were flooded.

Pre-Project Q100 per CUHP run

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC4	78.61	22.91	79.77	2.910
System	78.61	22.91	79.77	2.910

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	DUMMY	79.77	0 00:51			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Mar 19 12:01:11 2025
Analysis ended on: Wed Mar 19 12:01:11 2025
Total elapsed time: < 1 sec

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range POC4
Post-Project Condition
Scenario ID = 6_Fut_100yr_0mi^2_POC4_RANGE_POST

WARNING 04: minimum elevation drop used for Conduit 1

*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec

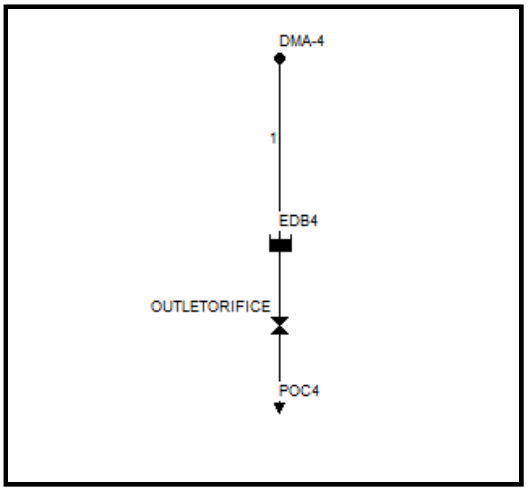

*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        11.629         3.789
External Outflow .........         9.256         3.016
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         2.366         0.771
Continuity Error (%) .....         0.057


******************************
Highest Flow Instability Indexes
******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


*****************
Node Depth Summary
```

SWMM Model Input Schematic using CUHP input file



****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
DMA-4	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC4	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
EDB4	STORAGE	4.88	7.18	7.18	0 01:22	6.54

100-YR Ponding Depth per CUHP run

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
DMA-4	JUNCTION	155.81	155.81	0 00:41	3.79	3.79	0.000
POC4	OUTFALL	0.00	69.39	0 01:22	0	3.02	0.000
EDB4	STORAGE	0.00	155.81	0 00:41	0	3.79	0.057

****
Node Flooding Summary
****

No nodes were flooded.

Undetained Q100 into EDB-4=155.81 cfs per CUHP run

Detained Q100out of EDB4=69.4 cfs

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB4	158.355	41	0	0	291.023	76	0 01:21	69.39

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC4	98.06	19.04	69.39	3.016
System	98.06	19.04	69.39	3.016

Q100 per CUHP run at POC 4

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	DUMMY	155.81	0 00:41			
OUTLETORIFICE	DUMMY	69.39	0 01:22			

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range POC4
Post-Project Condition
Scenario ID = 1_Fut_WQ_0mi^2_POC4_RANGE_POST

WARNING 04: minimum elevation drop used for Conduit 1

*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         1.314         0.428
External Outflow .........         0.482         0.157
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.833         0.271
Continuity Error (%) .....        -0.003


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


*****************
Node Depth Summary
```

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
DMA-4	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC4	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
EDB4	STORAGE	2.56	2.99	2.99	0 02:28	2.97

WQ Ponding Depth

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
DMA-4	JUNCTION	15.18	15.18	0 00:36	0.428	0.428	0.000
POC4	OUTFALL	0.00	1.16	0 02:28	0	0.157	0.000
EDB4	STORAGE	0.00	15.18	0 00:36	0	0.428	-0.003

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB4	37.236	10	0	0	49.063	13	0 02:27	1.16

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC4	95.56	1.02	1.16	0.157
System	95.56	1.02	1.16	0.157

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	DUMMY	15.18	0 00:36			
OUTLETORIFICE	DUMMY	1.16	0 02:28			

```
************************
Conduit Surcharge Summary
************************

No conduits were surcharged.


Analysis begun on:  Wed Dec 18 11:31:18 2024
Analysis ended on:  Wed Dec 18 11:31:18 2024
Total elapsed time: < 1 sec
```

```
************************
Conduit Surcharge Summary
************************

No conduits were surcharged.

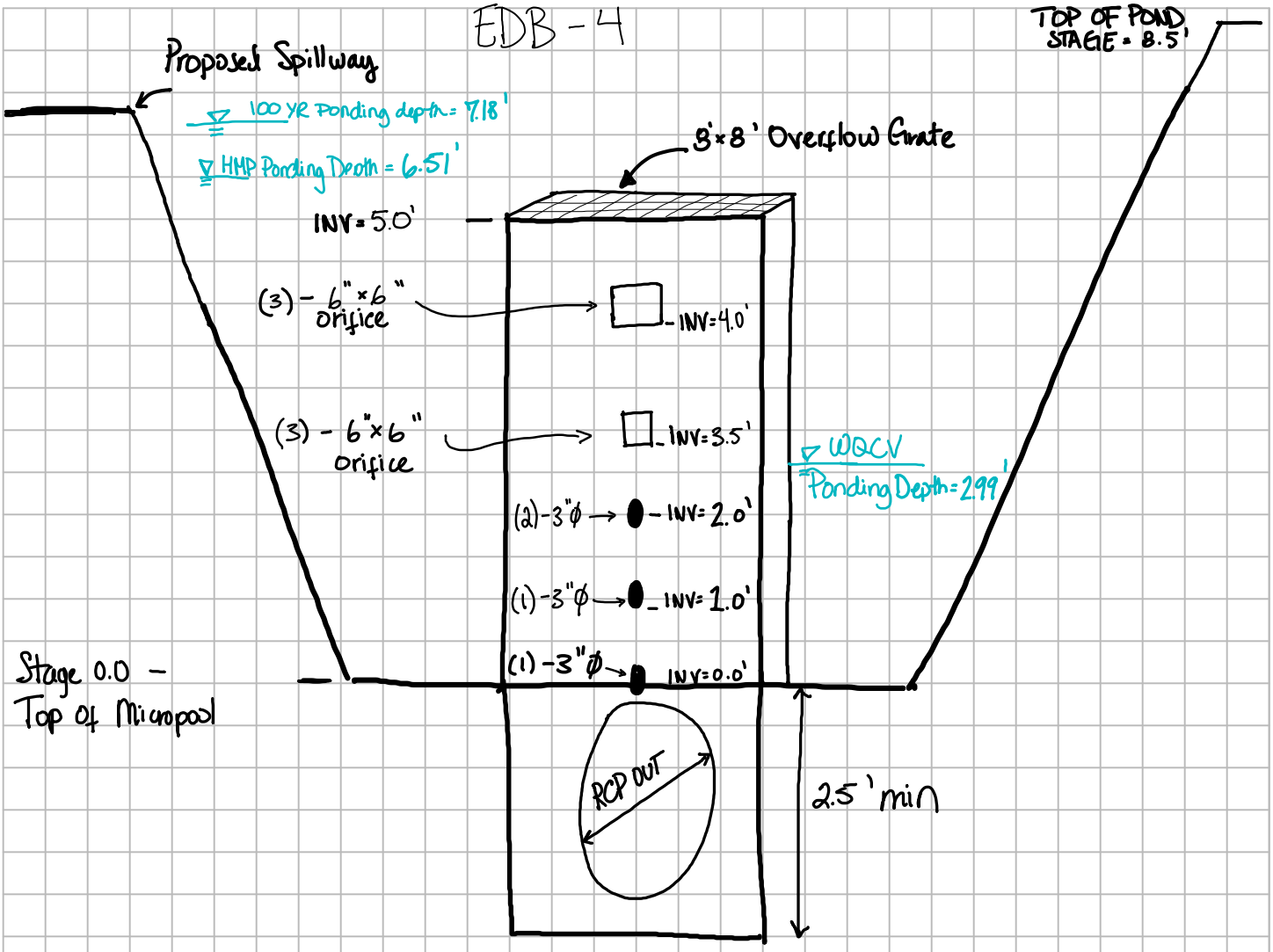

Analysis begun on:  Wed Dec 18 11:31:44 2024
Analysis ended on:  Wed Dec 18 11:31:45 2024
Total elapsed time: 00:00:01
```

6. EDB Cross Section

RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE: 12-18-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

EDB-4



7. EDB Stage Storage Discharge Table

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 3" dia.	1 x 3" dia.	2 x 3" dia.	None	None	None
# of openings	1	1	2			
Orifice Size (inches)	3	3	3			
Area Orifice (ft2)	*0.05*	*0.05*	*0.05*	*0.00*	*0.00*	*0.00*
	7.068583					
Flowline of Orifice (ft)	0	1.0	2			

RECTANGULAR OPENINGS	3 x 6"H by 6"W	3 x 6"H by 6"W	None	1 x 67.2"H by 67.2"W
# of openings	3	3	0	1
Height (inches)	6	6	0	67.2
Width (inches)	6	6	0	67.2
Area Orifice (ft2)	*0.25*	*0.25*	*0*	*31.36*
Flowline of Weir (ft)	3.50	4	0	5

8-ft x 8-ft Grate
(assumed 70% Open Area reduction)

Flowline (ft)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	-	0.000	0.000	0.000	**0.000**
0.25	0.084	-	-	0.000	0.000	0.000	**0.084**
0.50	0.145	-	-	0.000	0.000	0.000	**0.145**
0.75	0.187	-	-	0.000	0.000	0.000	**0.187**
1.00	0.221	No Value	-	0.000	0.000	0.000	**0.221**
1.25	0.251	0.084	-	0.000	0.000	0.000	**0.334**
1.50	0.277	0.145	-	0.000	0.000	0.000	**0.422**
1.75	0.301	0.187	-	0.000	0.000	0.000	**0.488**
2.00	0.324	0.221	No Value	0.000	0.000	0.000	**0.545**
2.25	0.345	0.251	0.167	0.000	0.000	0.000	**0.762**
2.50	0.364	0.277	0.289	0.000	0.000	0.000	**0.931**
2.75	0.383	0.301	0.374	0.000	0.000	0.000	**1.058**
3.00	0.401	0.324	0.442	0.000	0.000	0.000	**1.167**
3.25	0.418	0.345	0.501	0.000	0.000	0.000	**1.264**
3.50	0.434	0.364	0.554	0.000	0.000	0.000	**1.353**
3.75	0.450	0.383	0.603	0.000	0.000	0.000	**1.436**
4.00	0.465	0.401	0.647	0.000	0.000	0.000	**1.513**
4.25	0.480	0.418	0.689	0.000	0.000	0.000	**1.587**
4.50	0.494	0.434	0.728	0.000	0.000	0.000	**1.657**
4.75	0.508	0.450	0.766	0.000	0.000	0.000	**1.724**
5.00	0.522	0.465	0.802	0.000	0.000	0.000	**1.789**
5.25	0.535	0.480	0.836	0.000	0.000	0.000	**1.851**
5.50	0.548	0.494	0.868	0.000	0.000	0.000	**1.911**
5.75	0.561	0.508	0.900	0.000	0.000	0.000	**1.969**
6.00	0.573	0.522	0.931	0.000	0.000	0.000	**2.025**
6.25	0.585	0.535	0.960	0.000	0.000	0.000	**2.080**
6.50	0.597	0.548	0.989	0.000	0.000	0.000	**2.133**
6.75	0.608	0.561	1.017	0.000	0.000	0.000	**2.186**
7.00	0.620	0.573	1.044	0.000	0.000	0.000	**2.236**
7.25	0.631	0.585	1.070	0.000	0.000	0.000	**2.286**
7.50	0.642	0.597	1.096	0.000	0.000	0.000	**2.335**
7.75	0.653	0.608	1.121	0.000	0.000	0.000	**2.382**
8.00	0.663	0.620	1.146	0.000	0.000	0.000	**2.429**
8.25	0.674	0.631	1.170	0.000	0.000	0.000	**2.475**
8.50	0.684	0.642	1.194	0.000	0.000	0.000	**2.519**

Flowline (ft)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	-	-	-	-	-	-	-	-	-	-	**0.0**
2.50	-	-	-	-	-	-	-	-	-	-	**0.0**
2.75	-	-	-	-	-	-	-	-	-	-	**0.0**
3.00	-	-	-	-	-	-	-	-	-	-	**0.0**
3.25	-	-	-	-	-	-	-	-	-	-	**0.0**
3.50	-	-	-	-	-	-	-	-	-	-	**0.0**
3.75	0.563	0.000	0.000	-	-	-	-	-	-	-	**0.0**
4.00	1.591	1.806	1.591	-	-	-	-	-	-	-	**1.6**
4.25	2.923	2.554	2.554	0.563	0.000	0.000	-	-	-	-	**2.6**
4.50	4.500	3.127	3.127	1.591	1.806	1.591	-	-	-	-	**4.7**
4.75	6.289	3.611	3.611	2.923	2.554	2.554	-	-	-	-	**6.2**
5.00	8.267	4.037	4.037	4.500	3.127	3.127	-	-	-	-	**7.2**
5.25	10.418	4.423	4.423	6.289	3.611	3.611	-	-	-	2.100	**10.1**
5.50	12.728	4.777	4.777	8.267	4.037	4.037	-	-	-	5.940	**14.8**
5.75	15.188	5.107	5.107	10.418	0.000	0.000	-	-	-	10.912	**16.0**
6.00	17.788	5.417	5.417	12.728	4.777	4.777	-	-	-	16.800	**27.0**
6.25	20.522	5.710	5.710	15.188	5.107	5.107	-	-	-	23.479	**34.3**
6.50	23.383	5.989	5.989	17.788	5.417	5.417	-	-	-	30.864	**42.3**
6.75	26.366	6.255	6.255	20.522	5.710	5.710	-	-	-	38.893	**50.9**
7.00	29.466	6.510	6.510	23.383	5.989	5.989	-	-	-	47.518	**60.0**
7.25	32.678	6.756	6.756	26.366	6.255	6.255	-	-	-	56.700	**69.7**
7.50	36.000	6.993	6.993	29.466	6.510	6.510	-	-	-	66.408	**79.9**
7.75	39.427	7.222	7.222	32.678	6.756	6.756	-	-	-	76.614	**90.6**
8.00	42.957	7.445	7.445	36.000	6.993	6.993	-	-	-	87.295	**101.7**
8.25	46.586	7.661	7.661	39.427	7.222	7.222	-	-	-	98.432	**113.3**
8.50	50.312	7.870	7.870	42.957	7.445	7.445	-	-	-	110.005	**125.3**

Total Rating Curve for SWMM Analysis	
Stage (ft)	**Discharge (cfs)**
0.00	0.000
0.25	0.084
0.50	0.145
0.75	0.187
1.00	0.221
1.25	0.334
1.50	0.422
1.75	0.488
2.00	0.545
2.25	0.762
2.50	0.931
2.75	1.058
3.00	1.167
3.25	1.264
3.50	1.353
3.75	1.436
4.00	3.104
4.25	4.140
4.50	6.375
4.75	7.889
5.00	8.954
5.25	11.985
5.50	16.665
5.75	17.988
6.00	29.019
6.25	36.376
6.50	44.402
6.75	53.043
7.00	62.253
7.25	71.997
7.50	82.246
7.75	92.975
8.00	104.162
8.25	115.789
8.50	127.839

Stage Storage for SWMM		
Stage (ft)	**Elevation (ft)**	**Area (sf)**
0.0	5,736.5	264
0.5	5,737.0	2,137
1.0	5,737.5	6,503
1.5	5,738.0	13,031
2.0	5,738.5	23,456
2.5	5,739.0	31,070
3.0	5,739.5	44,539
3.5	5,740.0	51,242
4.0	5,740.5	53,585
4.5	5,741.0	55,604
5.0	5,741.5	57,651
5.5	5,742.0	59,725
6.0	5,742.5	61,826
6.5	5,743.0	63,955
7.0	5,743.5	66,111
7.5	5,744.0	68,296
8.0	5,744.5	70,507
8.5	5,745.0	72,747

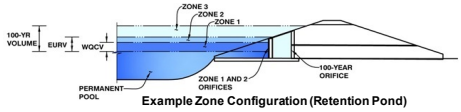
8. MHFD-Detention – Stage-Storage Table

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: RANGE - POC 4

Basin ID: EDB 4



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	64.20	acres
Watershed Length =	3,600	ft
Watershed Length to Centroid =	1,700	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	51.00%	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 =	Sedalia	

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) =	1.118 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.102 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	2.038 acre-feet		inches
5-yr Runoff Volume (P1 = 1.43 in.) =	4.775 acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.52 in.) =	5.217 acre-feet	1.52	inches
25-yr Runoff Volume (P1 = 1.71 in.) =	6.448 acre-feet		inches
50-yr Runoff Volume (P1 = 2 in.) =	8.030 acre-feet		inches
100-yr Runoff Volume (P1 = 2.6 in.) =	11.573 acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.03 in.) =	14.002 acre-feet		inches
Approximate 2-yr Detention Volume =	1.903 acre-feet		
Approximate 5-yr Detention Volume =	3.878 acre-feet		
Approximate 10-yr Detention Volume =	4.028 acre-feet		
Approximate 25-yr Detention Volume =	4.285 acre-feet		
Approximate 50-yr Detention Volume =	4.613 acre-feet		
Approximate 100-yr Detention Volume =	6.073 acre-feet		

Define Zones and Basin Geometry

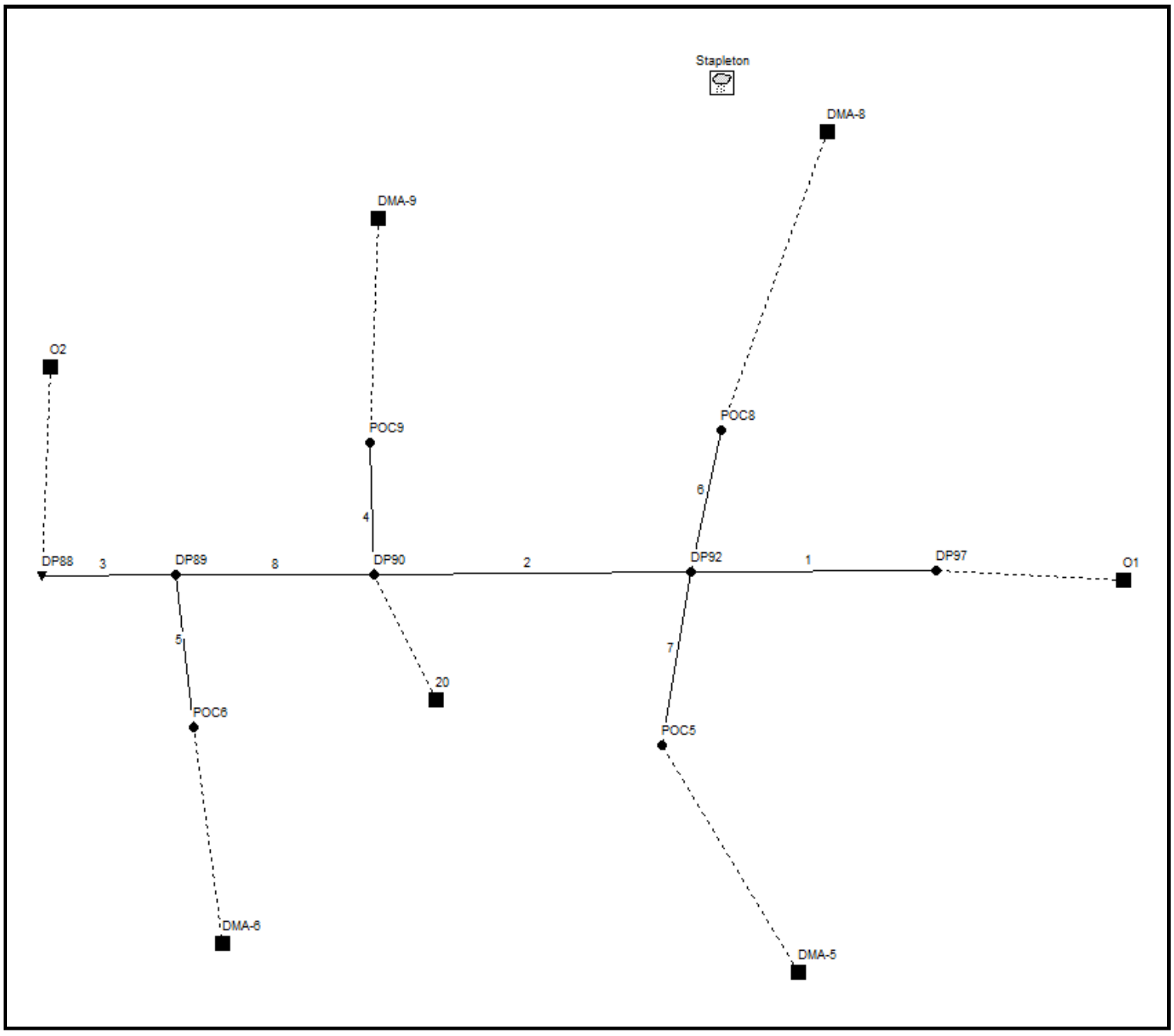
Zone 1 Volume (WQCV) =	1.118	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.984	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.971	acre-feet
Total Detention Basin Volume =	6.073	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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 = 0.50 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	--	--	--	264	0.006		
	--	0.50	--	--	--	2,137	0.049	600	0.014
	--	1.00	--	--	--	6,503	0.149	2,760	0.063
	--	1.50	--	--	--	13,031	0.299	7,644	0.175
	--	2.00	--	--	--	23,456	0.538	16,765	0.385
	--	2.50	--	--	--	31,070	0.713	30,397	0.698
	--	3.00	--	--	--	44,539	1.022	49,299	1.132
	--	3.50	--	--	--	51,242	1.176	73,244	1.681
	--	4.00	--	--	--	53,585	1.230	99,451	2.283
	--	4.50	--	--	--	55,604	1.276	126,748	2.910
	--	5.00	--	--	--	57,651	1.323	155,062	3.560
	--	5.50	--	--	--	59,725	1.371	184,406	4.233
	--	6.00	--	--	--	61,826	1.419	214,794	4.931
	--	6.50	--	--	--	63,955	1.468	246,239	5.653
	--	7.00	--	--	--	66,111	1.518	278,756	6.399
	--	7.50	--	--	--	68,296	1.568	312,357	7.171
	--	8.00	--	--	--	70,507	1.619	347,058	7.967
	--	8.50	--	--	--	72,747	1.670	382,872	8.790

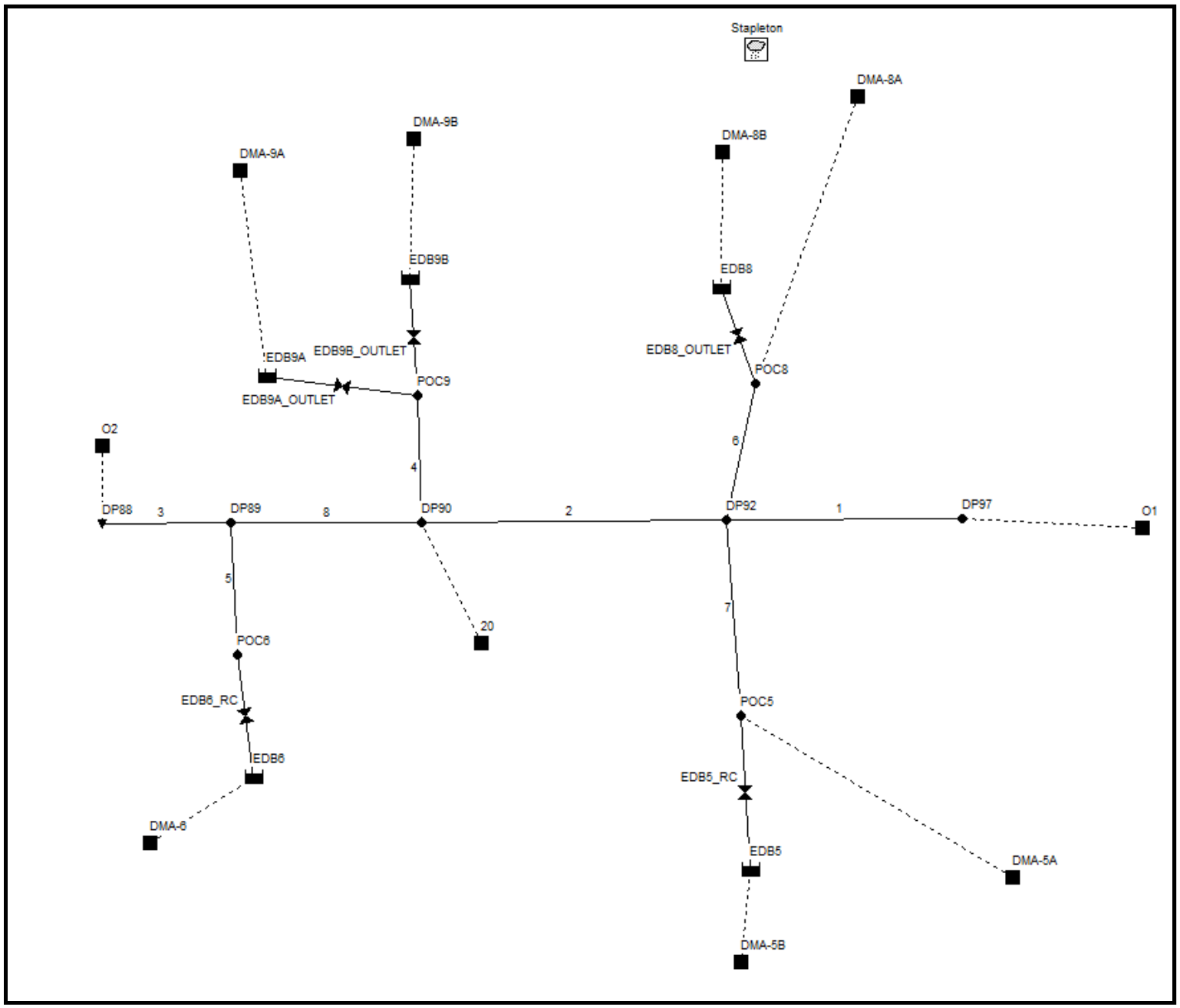
1. POC - 5, 6 , 8 , and 9 and DP88 SWMM Schematics

Pre-Project Schematic



1. POC - 5, 6 , 8 , and 9 and DP88 SWMM Schematics

Post-Project Schematic



2. POC 5, 6, 8 and 9 and DP 88 SWMM Inputs & Results for HMP Run

```
[TITLE]
;;Project Title/Notes
2215 Range
Pre-Project Condition

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;--------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
;Pre-Project Condition
DMA-5            Stapleton        POC5             46.7     5        2263     11       0
DMA-6            Stapleton        POC6             44.4     5        1831     5        0
DMA-8            Stapleton        POC8             152.1    5        6733     6        0
DMA-9            Stapleton        POC9             21.8     5        1881     7        0
O2               Stapleton        DP88             71.5     5        6232     4        0
O1               Stapleton        DP97             2826     5        62166    4        0
20               Stapleton        DP90             31.7     5        2763     2        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-5            0.013      0.1        0.05       0.20       25         OUTLET
DMA-6            0.013      0.1        0.05       0.20       25         OUTLET
DMA-8            0.013      0.1        0.05       0.20       25         OUTLET
DMA-9            0.013      0.1        0.05       0.20       25         OUTLET
O2               0.013      0.1        0.05       0.20       25         OUTLET
O1               0.013      0.1        0.05       0.20       25         OUTLET
20               0.013      0.1        0.05       0.20       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-5            6          0.010      0.31
DMA-6            6          0.010      0.31
DMA-8            9          0.025      0.30
DMA-9            9          0.025      0.30
```

```
O2              9          0.025      0.30
O1              9          0.025      0.30
20              9          0.025      0.30

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
DP90            0          0          0          0          0
DP92            0          0          0          0          0
DP97            0          0          0          0          0
POC9            0          0          0          0          0
POC8            0          0          0          0          0
POC5            0          0          0          0          0
POC6            0          0          0          0          0
DP89            0          0          0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
DP88            0          FREE                        NO

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
1               DP97             DP92             400        0.01       0          0          0          0
2               DP92             DP90             400        0.01       0          0          0          0
3               DP89             DP88             400        0.01       0          0          0          0
4               POC9             DP90             400        0.01       0          0          0          0
5               POC6             DP89             400        0.01       0          0          0          0
6               POC8             DP92             400        0.01       0          0          0          0
7               POC5             DP92             400        0.01       0          0          0          0
8               DP90             DP89             400        0.01       0          0          0          0

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
1               DUMMY        0                0          0          0          1
2               DUMMY        0                0          0          0          1
3               DUMMY        0                0          0          0          1
4               DUMMY        0                0          0          0          1
5               DUMMY        0                0          0          0          1
6               DUMMY        0                0          0          0          1
7               DUMMY        0                0          0          0          1
8               DUMMY        0                0          0          0          1

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton       FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DP90            1119.649           4610.318
DP92            3776.070           4632.272
DP97            5824.683           4648.212
POC9            1086.718           5718.990
POC8            4021.330           5821.832
POC5            3529.412           3183.391
POC6            -392.157           3333.333
DP89            -537.870           4610.318
DP88            -1657.519          4599.341

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
```

```
;;-------------- ------------------ ------------------
DMA-5            4671.280           1280.277
DMA-6            -118.216           1520.730
DMA-6            -189.138           1530.861
DMA-8            4913.495           8327.566
DMA-9            1188.041           7590.983
DMA-9            1117.119           7601.114
O2               -1591.696          6355.248
O1               7398.463           4566.411
20               1637.832           3564.014

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition

WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2
WARNING 04: minimum elevation drop used for Conduit 3
WARNING 04: minimum elevation drop used for Conduit 4
WARNING 04: minimum elevation drop used for Conduit 5
WARNING 04: minimum elevation drop used for Conduit 6
WARNING 04: minimum elevation drop used for Conduit 7
WARNING 04: minimum elevation drop used for Conduit 8

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......    255727.652       960.720
Evaporation Loss .........     14127.953        53.076
Infiltration Loss ........    210407.342       790.460
Surface Runoff ...........     34380.599       129.161
Final Storage ............         0.327         0.001
Continuity Error (%) .....        -1.247


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......     34380.599     11203.432
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........     34380.599     11203.432
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
```

```
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


**************************
Subcatchment Runoff Summary
**************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA-5	960.72	0.00	121.21	621.18	246.03	311.98	75.25	0.256
DMA-6	960.72	0.00	123.95	625.70	238.01	286.95	66.11	0.248
DMA-8	960.72	0.00	49.88	786.57	136.39	563.29	217.42	0.142
DMA-9	960.72	0.00	48.60	780.26	144.34	85.44	34.14	0.150
O2	960.72	0.00	48.93	782.54	141.49	274.70	109.72	0.147
O1	960.72	0.00	51.19	796.39	124.60	9561.62	2976.39	0.130
20	960.72	0.00	49.55	785.52	137.79	118.61	46.43	0.143

```
******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
DP90	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP92	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP97	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC9	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC8	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC5	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC6	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP89	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP88	OUTFALL	0.00	0.00	0.00	0 00:00	0.00

```
******************
Node Inflow Summary
******************
```

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
DP90	JUNCTION	46.43	3349.64	20471 19:01	119	1.06e+004	0.000
DP92	JUNCTION	0.00	3269.06	20471 19:01	0	1.04e+004	0.000
DP97	JUNCTION	2976.39	2976.39	20471 19:01	9.56e+003	9.56e+003	0.000
POC9	JUNCTION	34.14	34.14	20471 19:01	85.4	85.4	0.000
POC8	JUNCTION	217.42	217.42	20471 19:01	563	563	0.000
POC5	JUNCTION	75.25	75.25	20471 19:01	312	312	0.000
POC6	JUNCTION	66.11	66.11	20471 19:01	287	287	0.000
DP89	JUNCTION	0.00	3415.75	20471 19:01	0	1.09e+004	0.000
DP88	OUTFALL	109.72	3525.46	20471 19:01	275	1.12e+004	0.000

```
*********************
Node Flooding Summary
*********************

No nodes were flooded.


***********************
Outfall Loading Summary
***********************
```

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
DP88	4.49	16.18	3525.46	11202.600

```
-------------------------------------------------------------
System                4.49     16.18   3525.46   11202.600


*******************
Link Flow Summary
*******************

-------------------------------------------------------------------------------
                              Maximum  Time of Max   Maximum    Max/    Max/
                               |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
1                    DUMMY     2976.39  20471  19:01
2                    DUMMY     3269.06  20471  19:01
3                    DUMMY     3415.75  20471  19:01
4                    DUMMY       34.14  20471  19:01
5                    DUMMY       66.11  20471  19:01
6                    DUMMY      217.42  20471  19:01
7                    DUMMY       75.25  20471  19:01
8                    DUMMY     3349.64  20471  19:01


************************
Conduit Surcharge Summary
************************

No conduits were surcharged.


Analysis begun on:  Mon Mar 17 12:24:08 2025
Analysis ended on:  Mon Mar 17 12:24:58 2025
Total elapsed time: 00:00:50
```

```
[TITLE]
;;Project Title/Notes
2215 Range
Post-Project Condition

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
DMA-5A           Stapleton        POC5             20.8     5        2263     11       0
DMA-8A           Stapleton        POC8             122      5        5419     6        0
DMA-8B           Stapleton        EDB8             31       56       790      4        0
DMA-9B           Stapleton        EDB9B            4.3      40       1577     4        0
O2               Stapleton        DP88             65.5     5        5706     4        0
O1               Stapleton        DP97             2824     5        62134    4        0
20               Stapleton        DP90             30       5        2616     2        0
DMA-9A           Stapleton        EDB9A            19.4     38       1673     4        0
DMA-6            Stapleton        EDB6             54.6     43       1762     5        0
DMA-5B           Stapleton        EDB5             24.9     48       3018     7        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-5A           0.013      0.1        0.05       0.20       25         OUTLET
DMA-8A           0.013      0.1        0.05       0.20       25         OUTLET
DMA-8B           0.013      0.1        0.05       0.20       25         OUTLET
DMA-9B           0.013      0.1        0.05       0.20       25         OUTLET
O2               0.013      0.1        0.05       0.20       25         OUTLET
O1               0.013      0.1        0.05       0.20       25         OUTLET
20               0.013      0.1        0.05       0.20       25         OUTLET
DMA-9A           0.013      0.1        0.05       0.20       25         OUTLET
DMA-6            0.013      0.1        0.05       0.20       25         OUTLET
DMA-5B           0.013      0.1        0.05       0.20       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
```

```
;;-------------- ---------- ---------- ----------
DMA-5A          6          0.010      0.31
DMA-8A          9          0.025      0.30
DMA-8B          9          0.025      0.30
DMA-9B          9          0.025      0.30
O2              9          0.025      0.30
O1              9          0.025      0.30
20              9          0.025      0.30
DMA-9A          9          0.025      0.30
DMA-6           6          0.010      0.31
DMA-5B          9          0.025      0.30

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
DP90            0          0          0          0          0
DP92            0          0          0          0          0
DP97            0          0          0          0          0
POC9            0          0          0          0          0
POC8            0          0          0          0          0
POC5            0          0          0          0          0
POC6            0          0          0          0          0
DP89            0          0          0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
DP88            0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------          -------- --------
EDB5            0        9.5        0          TABULAR    EDB5                         0        0
EDB6            0        9.5        0          TABULAR    EDB6                         0        0
EDB8            0        9.5        0          TABULAR    EDB8                         0        0
EDB9A           0        9.5        0          TABULAR    EDB9A                        0        0
EDB9B           0        9.5        0          TABULAR    EDB9B                        0        0

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
1               DP97             DP92             400        0.01       0          0          0          0
2               DP92             DP90             400        0.01       0          0          0          0
3               DP89             DP88             400        0.01       0          0          0          0
4               POC9             DP90             400        0.01       0          0          0          0
5               POC6             DP89             400        0.01       0          0          0          0
6               POC8             DP92             400        0.01       0          0          0          0
7               POC5             DP92             400        0.01       0          0          0          0
8               DP90             DP89             400        0.01       0          0          0          0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type            QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- --------
EDB5_RC         EDB5             POC5             0          TABULAR/DEPTH   EDB5_RC                     NO
EDB6_RC         EDB6             POC6             0          TABULAR/DEPTH   EDB6_RatingCurve            NO
EDB8_OUTLET     EDB8             POC8             0          TABULAR/DEPTH   edb8RatingCurve             NO
EDB9A_OUTLET    EDB9A            POC9             0          TABULAR/DEPTH   EDB9A_RatCurve              NO
EDB9B_OUTLET    EDB9B            POC9             0          TABULAR/DEPTH   EDB9b_RatingCurve            NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
1               DUMMY        0                0          0          0          1
2               DUMMY        0                0          0          0          1
3               DUMMY        0                0          0          0          1
4               DUMMY        0                0          0          0          1
5               DUMMY        0                0          0          0          1
6               DUMMY        0                0          0          0          1
7               DUMMY        0                0          0          0          1
8               DUMMY        0                0          0          0          1

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
EDB5_RC         Rating     0.00       0.000
EDB5_RC                    0.25       0.026
EDB5_RC                    0.50       0.039
EDB5_RC                    0.75       0.049
EDB5_RC                    1.00       0.057
EDB5_RC                    1.25       0.064
EDB5_RC                    1.50       0.071
EDB5_RC                    1.75       0.102
EDB5_RC                    2.00       0.121
```

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EDB5_RC                    2.25       0.136
EDB5_RC                    2.50       0.149
EDB5_RC                    2.75       0.161
EDB5_RC                    3.00       0.172
EDB5_RC                    3.25       0.182
EDB5_RC                    3.50       0.722
EDB5_RC                    3.75       1.052
EDB5_RC                    4.00       1.252
EDB5_RC                    4.25       1.422
EDB5_RC                    4.50       1.572
EDB5_RC                    4.75       1.708
EDB5_RC                    5.00       1.833
EDB5_RC                    5.25       3.263
EDB5_RC                    5.50       5.773
EDB5_RC                    5.75       8.985
EDB5_RC                    6.00       12.765
EDB5_RC                    6.25       17.034
EDB5_RC                    6.50       21.741
EDB5_RC                    6.75       26.847
EDB5_RC                    7.00       32.323
EDB5_RC                    7.25       38.144
EDB5_RC                    7.50       44.292
EDB5_RC                    7.75       50.748
EDB5_RC                    8.00       57.499
EDB5_RC                    8.25       64.533
EDB5_RC                    8.50       71.838
;
EDB6_RatingCurve Rating    0.00       0.000
EDB6_RatingCurve           0.25       0.011
EDB6_RatingCurve           0.50       0.016
EDB6_RatingCurve           0.75       0.019
EDB6_RatingCurve           1.00       0.023
EDB6_RatingCurve           1.25       0.025
EDB6_RatingCurve           1.50       0.028
EDB6_RatingCurve           1.75       0.030
EDB6_RatingCurve           2.00       0.043
EDB6_RatingCurve           2.25       0.061
EDB6_RatingCurve           2.50       0.071
EDB6_RatingCurve           2.75       0.080
EDB6_RatingCurve           3.00       0.088
EDB6_RatingCurve           3.25       0.095
EDB6_RatingCurve           3.50       0.116
EDB6_RatingCurve           3.75       0.130
EDB6_RatingCurve           4.00       0.141
EDB6_RatingCurve           4.25       0.151
EDB6_RatingCurve           4.50       0.160
EDB6_RatingCurve           4.75       0.168
EDB6_RatingCurve           5.00       0.176
EDB6_RatingCurve           5.25       0.184
EDB6_RatingCurve           5.50       0.191
EDB6_RatingCurve           5.75       0.198
EDB6_RatingCurve           6.00       0.205
EDB6_RatingCurve           6.25       0.211
EDB6_RatingCurve           6.50       0.217
EDB6_RatingCurve           6.75       0.223
EDB6_RatingCurve           7.00       1.542
EDB6_RatingCurve           7.25       3.947
EDB6_RatingCurve           7.50       7.061
EDB6_RatingCurve           7.75       10.746
EDB6_RatingCurve           8.00       14.926
EDB6_RatingCurve           8.25       19.547
EDB6_RatingCurve           8.50       24.570
EDB6_RatingCurve           8.75       29.965
EDB6_RatingCurve           9.00       35.709
EDB6_RatingCurve           9.25       41.782
EDB6_RatingCurve           9.50       48.165
;
edb8RatingCurve  Rating    0.00       0.000
edb8RatingCurve            0.25       0.034
edb8RatingCurve            0.50       0.053
edb8RatingCurve            0.75       0.066
edb8RatingCurve            1.00       0.077
edb8RatingCurve            1.25       0.121
edb8RatingCurve            1.50       0.149
edb8RatingCurve            1.75       0.170
edb8RatingCurve            2.00       0.189
edb8RatingCurve            2.25       0.206
edb8RatingCurve            2.50       0.221
edb8RatingCurve            2.75       0.236
edb8RatingCurve            3.00       0.249
edb8RatingCurve            3.25       0.262
edb8RatingCurve            3.50       0.893
edb8RatingCurve            3.75       1.279
```

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edb8RatingCurve             4.00       1.513
edb8RatingCurve             4.25       1.712
edb8RatingCurve             4.50       1.888
edb8RatingCurve             4.75       2.048
edb8RatingCurve             5.00       2.250
edb8RatingCurve             5.25       2.420
edb8RatingCurve             5.50       2.572
edb8RatingCurve             5.75       2.714
edb8RatingCurve             6.00       2.848
edb8RatingCurve             6.25       2.975
edb8RatingCurve             6.50       3.096
edb8RatingCurve             6.75       3.212
edb8RatingCurve             7.00       3.324
edb8RatingCurve             7.25       4.745
edb8RatingCurve             7.50       7.249
edb8RatingCurve             7.75       10.458
edb8RatingCurve             8.00       14.237
edb8RatingCurve             8.25       18.507
edb8RatingCurve             8.50       23.216
edb8RatingCurve             8.75       28.326
edb8RatingCurve             9.00       33.806
edb8RatingCurve             9.25       39.632
edb8RatingCurve             9.50       45.785
;
EDB9A_RatCurve   Rating     0.00       0.000
EDB9A_RatCurve              0.25       0.007
EDB9A_RatCurve              0.50       0.010
EDB9A_RatCurve              0.75       0.013
EDB9A_RatCurve              1.00       0.015
EDB9A_RatCurve              1.25       0.016
EDB9A_RatCurve              1.50       0.018
EDB9A_RatCurve              1.75       0.026
EDB9A_RatCurve              2.00       0.031
EDB9A_RatCurve              2.25       0.035
EDB9A_RatCurve              2.50       0.038
EDB9A_RatCurve              2.75       0.041
EDB9A_RatCurve              3.00       0.043
EDB9A_RatCurve              3.25       0.046
EDB9A_RatCurve              3.50       0.103
EDB9A_RatCurve              3.75       0.137
EDB9A_RatCurve              4.00       0.162
EDB9A_RatCurve              4.25       0.183
EDB9A_RatCurve              4.50       0.201
EDB9A_RatCurve              4.75       0.218
EDB9A_RatCurve              5.00       0.233
EDB9A_RatCurve              5.25       0.247
EDB9A_RatCurve              5.50       0.261
EDB9A_RatCurve              5.75       0.274
EDB9A_RatCurve              6.00       0.286
EDB9A_RatCurve              6.25       1.872
EDB9A_RatCurve              6.50       4.763
EDB9A_RatCurve              6.75       8.503
EDB9A_RatCurve              7.00       12.930
EDB9A_RatCurve              7.25       17.949
EDB9A_RatCurve              7.50       23.497
EDB9A_RatCurve              7.75       29.528
EDB9A_RatCurve              8.00       36.006
EDB9A_RatCurve              8.25       42.902
EDB9A_RatCurve              8.50       50.192
EDB9A_RatCurve              8.75       57.855
EDB9A_RatCurve              9.00       65.875
EDB9A_RatCurve              9.25       74.235
EDB9A_RatCurve              9.50       82.923
;
EDB9b_RatingCurve Rating     0.00       0.000
EDB9b_RatingCurve            0.25       0.006
EDB9b_RatingCurve            0.50       0.009
EDB9b_RatingCurve            0.75       0.011
EDB9b_RatingCurve            1.00       0.012
EDB9b_RatingCurve            1.25       0.014
EDB9b_RatingCurve            1.50       0.018
EDB9b_RatingCurve            1.75       0.023
EDB9b_RatingCurve            2.00       0.027
EDB9b_RatingCurve            2.25       0.030
EDB9b_RatingCurve            2.50       0.032
EDB9b_RatingCurve            2.75       0.035
EDB9b_RatingCurve            3.00       0.043
EDB9b_RatingCurve            3.25       0.048
EDB9b_RatingCurve            3.50       0.052
EDB9b_RatingCurve            3.75       0.055
EDB9b_RatingCurve            4.00       0.058
EDB9b_RatingCurve            4.25       0.061
EDB9b_RatingCurve            4.50       0.064
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EDB9b_RatingCurve            4.75       0.855
EDB9b_RatingCurve            5.00       2.297
EDB9b_RatingCurve            5.25       4.164
EDB9b_RatingCurve            5.50       6.375
EDB9b_RatingCurve            5.75       8.881
EDB9b_RatingCurve            6.00       11.653
EDB9b_RatingCurve            6.25       14.666
EDB9b_RatingCurve            6.50       17.903
EDB9b_RatingCurve            6.75       21.348
EDB9b_RatingCurve            7.00       24.991
EDB9b_RatingCurve            7.25       28.820
EDB9b_RatingCurve            7.50       32.827
EDB9b_RatingCurve            7.75       37.005
EDB9b_RatingCurve            8.00       41.347
EDB9b_RatingCurve            8.25       45.847
EDB9b_RatingCurve            8.50       50.499
EDB9b_RatingCurve            8.75       55.299
;
EDB1             Storage     0.00       28.07
EDB1                         0.50       201.63
EDB1                         1.00       1110.67
EDB1                         1.50       2610.65
EDB1                         2.00       4637.61
EDB1                         2.50       6720.93
EDB1                         3.00       8938.02
EDB1                         3.50       11207.97
EDB1                         4.00       13054.50
EDB1                         4.50       14225.59
EDB1                         5.00       15279.74
EDB1                         5.50       16360.44
EDB1                         6.00       17467.68
EDB1                         6.50       18601.47
EDB1                         7.00       19761.82
EDB1                         7.50       20948.71
EDB1                         8.00       22255.97
EDB1                         8.50       23509.13
EDB1                         9.00       24784.47
EDB1                         9.50       26083.17
;
EDB6             Storage     0.00       49.00
EDB6                         0.50       472.199
EDB6                         1.00       3271.801
EDB6                         1.50       10019.178
EDB6                         2.00       19869.33
EDB6                         2.50       31626.439
EDB6                         3.00       42038.906
EDB6                         3.50       48902.62
EDB6                         4.00       51957.243
EDB6                         4.50       54010.762
EDB6                         5.00       56099.719
EDB6                         5.50       58224.127
EDB6                         6.00       60383.986
EDB6                         6.50       62579.296
EDB6                         7.00       64810.057
EDB6                         7.50       67076.256
EDB6                         8.00       68828.448
EDB6                         8.50       70583.084
EDB6                         9.00       72364.357
EDB6                         9.50       74172.241
;
EDB5             Storage     0.00       50
EDB5                         0.50       228.165
EDB5                         1.00       1438.99
EDB5                         1.50       4516.218
EDB5                         2.00       8285.158
EDB5                         2.50       11043.235
EDB5                         3.00       11862.053
EDB5                         3.50       12413.191
EDB5                         4.00       12975.515
EDB5                         4.50       13549.011
EDB5                         5.00       14133.679
EDB5                         5.50       14729.526
EDB5                         6.00       15336.552
EDB5                         6.50       15954.75
EDB5                         7.00       16584.127
EDB5                         7.50       17223.36
EDB5                         8.00       17871.126
EDB5                         8.50       18527.432
;
EDB8             Storage     0.00       106.00
EDB8                         0.25       234.69
EDB8                         0.50       609.46
EDB8                         0.75       1587.70
```

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EDB8                    1.00       3144.83
EDB8                    1.25       5271.05
EDB8                    1.50       8092.39
EDB8                    1.75       11101.12
EDB8                    2.00       13866.55
EDB8                    2.25       16563.98
EDB8                    2.50       19035.07
EDB8                    2.75       21132.76
EDB8                    3.00       22804.22
EDB8                    3.25       24079.54
EDB8                    3.50       24897.17
EDB8                    3.75       25604.42
EDB8                    4.00       26317.58
EDB8                    4.25       27036.67
EDB8                    4.50       27761.69
EDB8                    4.75       28492.62
EDB8                    5.00       29229.48
EDB8                    5.25       29972.27
EDB8                    5.50       30720.98
EDB8                    5.75       31475.61
EDB8                    6.00       32236.16
EDB8                    6.25       33002.64
EDB8                    6.50       33775.05
EDB8                    6.75       34553.37
EDB8                    7.00       35337.62
EDB8                    7.25       36127.80
EDB8                    7.50       36923.90
EDB8                    7.75       37725.92
EDB8                    8.00       38533.86
EDB8                    8.25       39347.73
EDB8                    8.50       40167.52
;
EDB9A          Storage  0.00       16.71
EDB9A                   0.25       130.75
EDB9A                   0.50       273.17
EDB9A                   0.75       765.78
EDB9A                   1.00       1834.41
EDB9A                   1.25       3377.24
EDB9A                   1.50       5361.33
EDB9A                   1.75       7458.61
EDB9A                   2.00       9226.71
EDB9A                   2.25       10607.94
EDB9A                   2.50       11558.10
EDB9A                   2.75       12126.63
EDB9A                   3.00       12575.61
EDB9A                   3.25       13032.10
EDB9A                   3.50       13496.06
EDB9A                   3.75       13967.50
EDB9A                   4.00       14446.54
EDB9A                   4.25       14933.34
EDB9A                   4.50       15427.86
EDB9A                   4.75       15930.12
EDB9A                   5.00       16440.11
EDB9A                   5.25       16957.81
EDB9A                   5.50       17483.24
EDB9A                   5.75       18016.39
EDB9A                   6.00       18557.26
EDB9A                   6.25       19105.86
EDB9A                   6.50       19662.17
EDB9A                   6.75       20225.42
EDB9A                   7.00       20795.15
EDB9A                   7.25       21371.34
EDB9A                   7.50       21954.01
;
EDB9B          Storage  0.00       91.99
EDB9B                   0.25       149.76
EDB9B                   0.50       336.56
EDB9B                   0.75       777.93
EDB9B                   1.00       1003.85
EDB9B                   1.25       1152.57
EDB9B                   1.50       1304.60
EDB9B                   1.75       1463.82
EDB9B                   2.00       1630.18
EDB9B                   2.25       1803.77
EDB9B                   2.50       1984.77
EDB9B                   2.75       2173.18
EDB9B                   3.00       2369.22
EDB9B                   3.25       2573.01
EDB9B                   3.50       2784.59
EDB9B                   3.75       3004.34
EDB9B                   4.00       3232.33
EDB9B                   4.25       3468.75
EDB9B                   4.50       3714.11
```

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EDB9B                    4.75       3968.44
EDB9B                    5.00       4232.03
EDB9B                    5.25       4505.05
EDB9B                    5.50       4787.65
EDB9B                    5.75       5080.65
EDB9B                    6.00       5384.14
EDB9B                    6.25       5698.41
EDB9B                    6.50       6023.73
EDB9B                    6.75       6360.10
EDB9B                    7.00       6707.54
EDB9B                    7.25       7066.03
EDB9B                    7.50       7437.89
EDB9B                    7.75       7787.04
EDB9B                    8.00       8128.17
EDB9B                    8.25       8472.71
EDB9B                    8.50       8839.01
EDB9B                    8.75       9258.24

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DP90             1119.649           4610.318
DP92             3776.070           4632.272
DP97             5824.683           4648.212
POC9             1086.718           5718.990
POC8             4021.330           5821.832
POC5             3898.501           2929.642
POC6             -484.429           3460.208
DP89             -537.870           4610.318
DP88             -1657.519          4599.341
EDB5             3979.239           1580.161
EDB6             -346.021           2387.543
EDB8             3725.490           6655.133
EDB9A            -230.681           5882.353
EDB9B            1014.994           6735.871

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-5A           6258.558           1518.589
DMA-8A           4913.495           8327.566
DMA-8B           3736.481           7844.539
DMA-9B           1044.791           7958.478
O2               -1660.900          5282.584
O1               7398.463           4566.411
20               1637.832           3564.014
DMA-9A           -461.361           7681.661
DMA-6            -1245.675          1822.376
DMA-5B           3898.501           784.314

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Post-Project Condition

WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2
WARNING 04: minimum elevation drop used for Conduit 3
WARNING 04: minimum elevation drop used for Conduit 4
WARNING 04: minimum elevation drop used for Conduit 5
WARNING 04: minimum elevation drop used for Conduit 6
WARNING 04: minimum elevation drop used for Conduit 7
WARNING 04: minimum elevation drop used for Conduit 8

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......    255911.790       960.720
Evaporation Loss .........     14271.695        53.577
Infiltration Loss ........    207224.074       777.941
Surface Runoff ...........     36883.770       138.466
Final Storage ............         0.448         0.002
Continuity Error (%) .....        -0.964


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......     36883.770     12019.127
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........     36882.568     12018.736
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.191         0.062
Continuity Error (%) .....         0.003


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
```

```
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


**************************
Subcatchment Runoff Summary
**************************

-----------------------------------------------------------------------------------------------------------
                         Total      Total      Total      Total      Total       Total     Peak    Runoff
                        Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff    Coeff
Subcatchment                in         in         in         in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------------
DMA-5A                  960.72       0.00     113.85     615.69     254.25      143.60    34.56    0.265
DMA-8A                  960.72       0.00      48.12     785.46     136.82      453.26   174.51    0.142
DMA-8B                  960.72       0.00     153.96     363.77     451.99      380.46    49.02    0.470
DMA-9B                  960.72       0.00     109.80     487.35     379.69       44.33     7.05    0.395
O2                      960.72       0.00      47.15     782.16     141.46      251.60   100.50    0.147
O1                      960.72       0.00      49.20     796.41     124.00     9508.45  2974.56    0.129
20                      960.72       0.00      47.68     784.75     138.05      112.46    43.95    0.144
DMA-9A                  960.72       0.00     109.61     507.86     355.98      187.52    31.48    0.371
DMA-6                   960.72       0.00     165.43     374.76     437.81      649.09    88.42    0.456
DMA-5B                  960.72       0.00     127.00     423.42     425.17      287.47    41.03    0.443


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                           Average  Maximum  Maximum  Time of Max    Reported
                             Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type     Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
DP90                 JUNCTION 0.00     0.00     0.00     0  00:00         0.00
DP92                 JUNCTION 0.00     0.00     0.00     0  00:00         0.00
DP97                 JUNCTION 0.00     0.00     0.00     0  00:00         0.00
POC9                 JUNCTION 0.00     0.00     0.00     0  00:00         0.00
POC8                 JUNCTION 0.00     0.00     0.00     0  00:00         0.00
POC5                 JUNCTION 0.00     0.00     0.00     0  00:00         0.00
POC6                 JUNCTION 0.00     0.00     0.00     0  00:00         0.00
DP89                 JUNCTION 0.00     0.00     0.00     0  00:00         0.00
DP88                 OUTFALL  0.00     0.00     0.00     0  00:00         0.00
EDB5                 STORAGE  0.22     7.22     7.22  20471  19:03         7.19
EDB6                 STORAGE  1.33     9.21     9.21  6202  18:16         8.90
EDB8                 STORAGE  0.21     8.12     8.12  23722  19:10         8.03
EDB9A                STORAGE  0.61     7.49     7.49  6202  18:07         7.40
EDB9B                STORAGE  0.18     5.55     5.55  20471  19:02         5.54


******************
Node Inflow Summary
******************

-------------------------------------------------------------------------------------------------
                           Maximum  Maximum                  Lateral       Total        Flow
                           Lateral    Total  Time of Max      Inflow      Inflow     Balance
                            Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type      CFS      CFS  days hr:min    10^6 gal    10^6 gal     Percent
-------------------------------------------------------------------------------------------------
DP90                 JUNCTION 43.95  3285.73  20471  19:01         112   1.11e+004       0.000
DP92                 JUNCTION  0.00  3223.82  20471  19:01           0   1.08e+004       0.000
DP97                 JUNCTION 2974.56 2974.56 20471  19:01   9.51e+003   9.51e+003       0.000
POC9                 JUNCTION  0.00    29.58  6202  18:05           0         232       0.000
POC8                 JUNCTION 174.51   177.60  20471  19:01         453         834       0.000
POC5                 JUNCTION 34.56    71.67  20471  19:01         144         431       0.000
POC6                 JUNCTION  0.00    40.82  6202  18:16           0         649       0.000
DP89                 JUNCTION  0.00  3285.95  20471  19:01           0   1.18e+004       0.000
DP88                 OUTFALL  100.50  3386.45  20471  19:01         252    1.2e+004       0.000
EDB5                 STORAGE  41.03    41.03  20471  19:01         287         287       0.039
EDB6                 STORAGE  88.42    88.42  20471  19:01         649         649       0.010
EDB8                 STORAGE  49.02    49.02  20471  19:01         380         380       0.025
EDB9A                STORAGE  31.48    31.48  20471  19:01         188         188       0.020
EDB9B                STORAGE   7.05     7.05  20471  19:01        44.3        44.3       0.039


*********************
Node Flooding Summary
*********************
```

HMP Ponding Depth

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB5	0.692	1	0	0	76.066	65	20471 19:03	37.40
EDB6	20.748	5	0	0	418.904	95	6202 18:15	40.82
EDB8	1.206	0	0	0	186.675	77	23722 19:10	16.27
EDB9A	2.299	2	0	0	93.815	66	6202 18:07	23.24
EDB9B	0.154	0	0	0	12.747	30	20471 19:02	6.84

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
DP88	54.06	1.44	3386.45	12017.843
System	54.06	1.44	3386.45	12017.843

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	DUMMY	2974.56	20471 19:01			
2	DUMMY	3223.82	20471 19:01			
3	DUMMY	3285.95	20471 19:01			
4	DUMMY	29.58	6202 18:05			
5	DUMMY	40.82	6202 18:16			
6	DUMMY	177.60	20471 19:01			
7	DUMMY	71.67	20471 19:01			
8	DUMMY	3285.73	20471 19:01			
EDB5_RC	DUMMY	37.40	20471 19:03			
EDB6_RC	DUMMY	40.82	6202 18:16			
EDB8_OUTLET	DUMMY	16.27	23722 19:10			
EDB9A_OUTLET	DUMMY	23.24	6202 18:07			
EDB9B_OUTLET	DUMMY	6.84	20471 19:02			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Mar 19 16:38:48 2025
Analysis ended on: Wed Mar 19 16:39:48 2025
Total elapsed time: 00:01:00

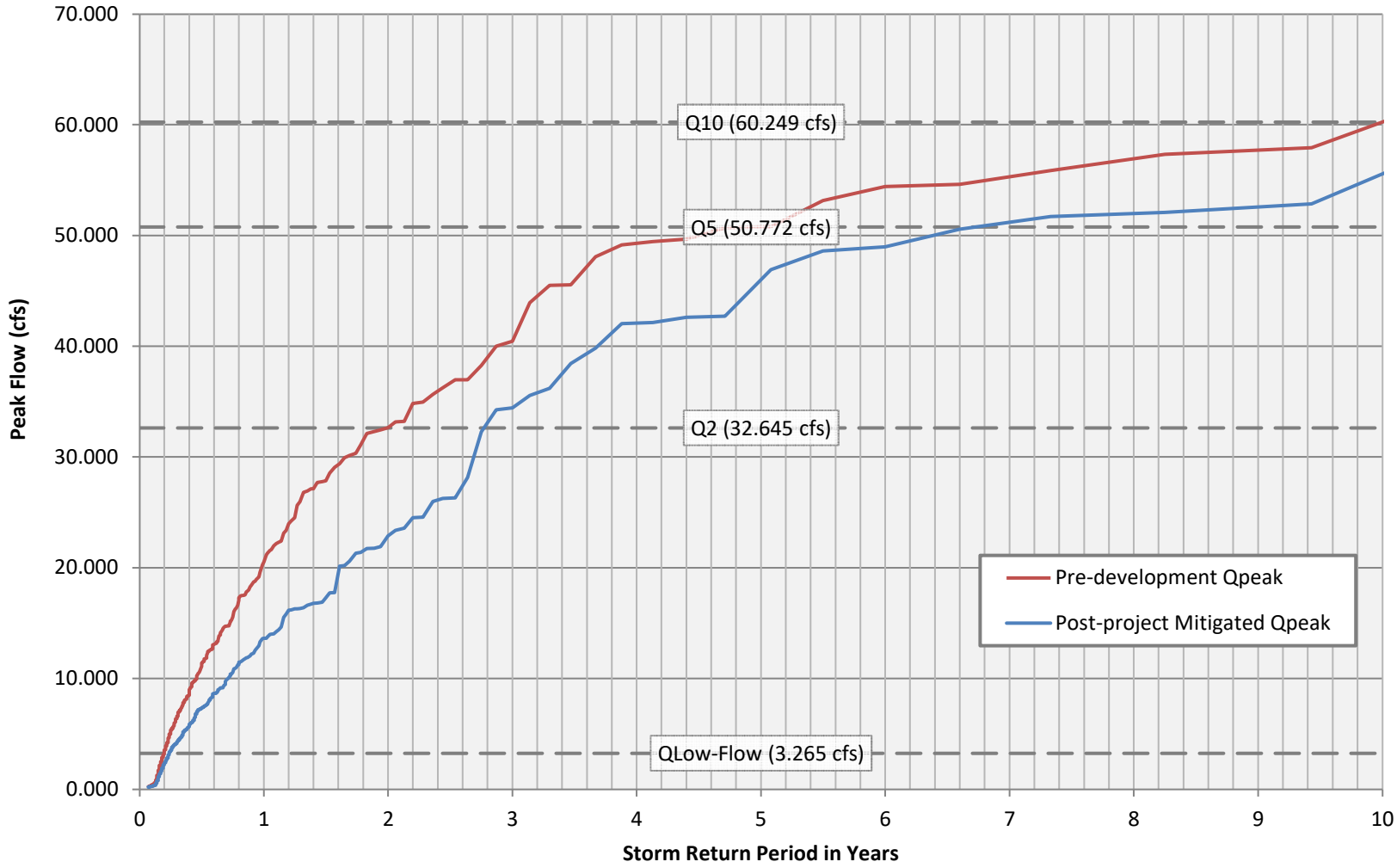
3. POC -5 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

HMP Flow Frequency Range Based on: **SWMM - Weibull**

Return Period	Pre-development Qpeak (cfs)	Post-project - Mitigated Q (cfs)	*Check*
Low-Flow = 0.1*Q2	3.265	2.287	*Okay! -> Decreased by 0.977 cfs*
2-year	32.645	22.872	*Okay! -> Decreased by 9.773 cfs*
3-year	40.446	34.443	*Okay! -> Decreased by 6.003 cfs*
4-year	49.283	42.100	*Okay! -> Decreased by 7.183 cfs*
5-year	50.772	46.006	*Okay! -> Decreased by 4.766 cfs*
6-year	54.421	48.986	*Okay! -> Decreased by 5.435 cfs*
7-year	55.304	51.193	*Okay! -> Decreased by 4.111 cfs*
8-year	56.936	51.986	*Okay! -> Decreased by 4.951 cfs*
9-year	57.713	52.573	*Okay! -> Decreased by 5.14 cfs*
10-year	60.249	55.564	*Okay! -> Decreased by 4.685 cfs*

POC-5 Peak Flow Frequency Curves



Low-flow Threshold:	10%	
0.1xQ2 (Pre):	3.2645	cfs
Q10 (Pre):	60.249	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	0.57560	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

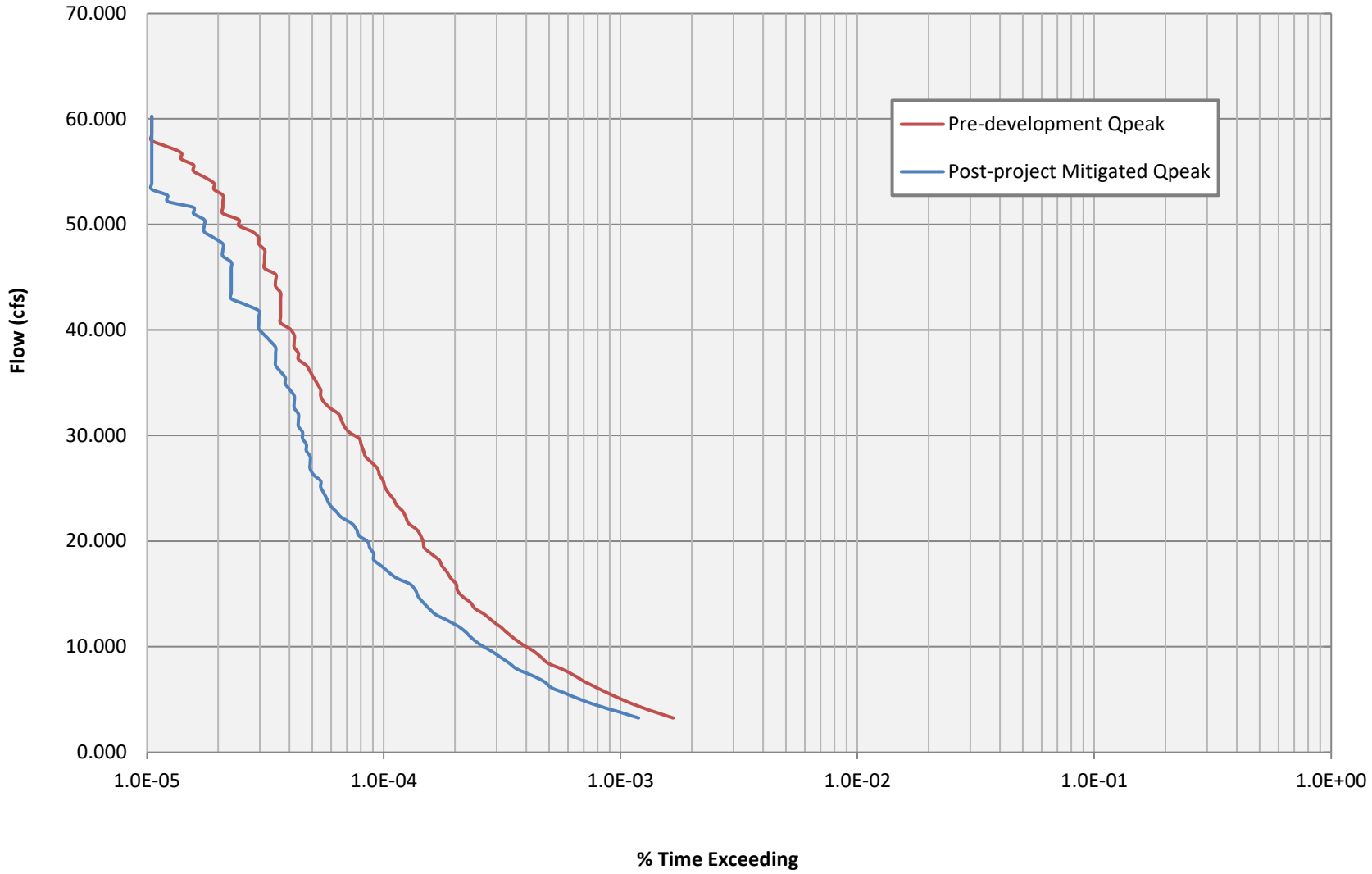
The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	3.265	955	1.67E-03	682	1.19E-03	71%	Pass
2	3.840	793	1.38E-03	560	9.77E-04	71%	Pass
3	4.416	673	1.17E-03	461	8.04E-04	68%	Pass
4	4.991	582	1.02E-03	389	6.79E-04	67%	Pass
5	5.567	512	8.93E-04	337	5.88E-04	66%	Pass
6	6.143	453	7.91E-04	292	5.10E-04	64%	Pass
7	6.718	402	7.02E-04	272	4.75E-04	68%	Pass
8	7.294	365	6.37E-04	242	4.22E-04	66%	Pass
9	7.869	325	5.67E-04	210	3.66E-04	65%	Pass
10	8.445	283	4.94E-04	194	3.39E-04	69%	Pass
11	9.021	264	4.61E-04	178	3.11E-04	67%	Pass
12	9.596	246	4.29E-04	163	2.84E-04	66%	Pass
13	10.172	222	3.87E-04	147	2.57E-04	66%	Pass
14	10.747	205	3.58E-04	136	2.37E-04	66%	Pass
15	11.323	190	3.32E-04	128	2.23E-04	67%	Pass
16	11.899	178	3.11E-04	119	2.08E-04	67%	Pass
17	12.474	164	2.86E-04	107	1.87E-04	65%	Pass
18	13.050	153	2.67E-04	95	1.66E-04	62%	Pass
19	13.625	139	2.43E-04	89	1.55E-04	64%	Pass
20	14.201	133	2.32E-04	84	1.47E-04	63%	Pass
21	14.777	123	2.15E-04	80	1.40E-04	65%	Pass
22	15.352	117	2.04E-04	78	1.36E-04	67%	Pass
23	15.928	116	2.02E-04	74	1.29E-04	64%	Pass
24	16.503	110	1.92E-04	65	1.13E-04	59%	Pass
25	17.079	106	1.85E-04	60	1.05E-04	57%	Pass
26	17.655	101	1.76E-04	56	9.77E-05	55%	Pass
27	18.230	98	1.71E-04	52	9.07E-05	53%	Pass
28	18.806	91	1.59E-04	52	9.07E-05	57%	Pass
29	19.381	85	1.48E-04	50	8.73E-05	59%	Pass
30	19.957	84	1.47E-04	49	8.55E-05	58%	Pass
31	20.533	82	1.43E-04	45	7.85E-05	55%	Pass
32	21.108	79	1.38E-04	44	7.68E-05	56%	Pass
33	21.684	73	1.27E-04	42	7.33E-05	58%	Pass
34	22.259	71	1.24E-04	38	6.63E-05	54%	Pass
35	22.835	69	1.20E-04	36	6.28E-05	52%	Pass
36	23.411	65	1.13E-04	34	5.93E-05	52%	Pass
37	23.986	63	1.10E-04	33	5.76E-05	52%	Pass
38	24.562	60	1.05E-04	32	5.58E-05	53%	Pass
39	25.137	58	1.01E-04	31	5.41E-05	53%	Pass
40	25.713	57	9.95E-05	31	5.41E-05	54%	Pass
41	26.289	55	9.60E-05	29	5.06E-05	53%	Pass
42	26.864	54	9.42E-05	28	4.89E-05	52%	Pass
43	27.440	51	8.90E-05	28	4.89E-05	55%	Pass
44	28.015	48	8.38E-05	28	4.89E-05	58%	Pass
45	28.591	47	8.20E-05	27	4.71E-05	57%	Pass
46	29.167	46	8.03E-05	27	4.71E-05	59%	Pass
47	29.742	45	7.85E-05	26	4.54E-05	58%	Pass
48	30.318	41	7.15E-05	26	4.54E-05	63%	Pass
49	30.893	39	6.81E-05	25	4.36E-05	64%	Pass
50	31.469	38	6.63E-05	25	4.36E-05	66%	Pass
51	32.045	37	6.46E-05	25	4.36E-05	68%	Pass
52	32.620	34	5.93E-05	24	4.19E-05	71%	Pass

Flow Frequency Range Based on: SWMM - Weibull

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
53	33.196	32	5.58E-05	24	4.19E-05	75%	Pass
54	33.772	31	5.41E-05	24	4.19E-05	77%	Pass
55	34.347	31	5.41E-05	23	4.01E-05	74%	Pass
56	34.923	30	5.24E-05	22	3.84E-05	73%	Pass
57	35.498	29	5.06E-05	22	3.84E-05	76%	Pass
58	36.074	28	4.89E-05	21	3.66E-05	75%	Pass
59	36.650	27	4.71E-05	20	3.49E-05	74%	Pass
60	37.225	25	4.36E-05	20	3.49E-05	80%	Pass
61	37.801	25	4.36E-05	20	3.49E-05	80%	Pass
62	38.376	24	4.19E-05	20	3.49E-05	83%	Pass
63	38.952	24	4.19E-05	19	3.32E-05	79%	Pass
64	39.528	24	4.19E-05	18	3.14E-05	75%	Pass
65	40.103	23	4.01E-05	17	2.97E-05	74%	Pass
66	40.679	21	3.66E-05	17	2.97E-05	81%	Pass
67	41.254	21	3.66E-05	17	2.97E-05	81%	Pass
68	41.830	21	3.66E-05	17	2.97E-05	81%	Pass
69	42.406	21	3.66E-05	15	2.62E-05	71%	Pass
70	42.981	21	3.66E-05	13	2.27E-05	62%	Pass
71	43.557	21	3.66E-05	13	2.27E-05	62%	Pass
72	44.132	20	3.49E-05	13	2.27E-05	65%	Pass
73	44.708	20	3.49E-05	13	2.27E-05	65%	Pass
74	45.284	20	3.49E-05	13	2.27E-05	65%	Pass
75	45.859	18	3.14E-05	13	2.27E-05	72%	Pass
76	46.435	18	3.14E-05	13	2.27E-05	72%	Pass
77	47.010	18	3.14E-05	12	2.09E-05	67%	Pass
78	47.586	18	3.14E-05	12	2.09E-05	67%	Pass
79	48.162	17	2.97E-05	12	2.09E-05	71%	Pass
80	48.737	17	2.97E-05	11	1.92E-05	65%	Pass
81	49.313	16	2.79E-05	10	1.75E-05	63%	Pass
82	49.888	14	2.44E-05	10	1.75E-05	71%	Pass
83	50.464	14	2.44E-05	10	1.75E-05	71%	Pass
84	51.040	12	2.09E-05	9	1.57E-05	75%	Pass
85	51.615	12	2.09E-05	9	1.57E-05	75%	Pass
86	52.191	12	2.09E-05	7	1.22E-05	58%	Pass
87	52.766	12	2.09E-05	7	1.22E-05	58%	Pass
88	53.342	11	1.92E-05	6	1.05E-05	55%	Pass
89	53.918	11	1.92E-05	6	1.05E-05	55%	Pass
90	54.493	10	1.75E-05	6	1.05E-05	60%	Pass
91	55.069	9	1.57E-05	6	1.05E-05	67%	Pass
92	55.644	9	1.57E-05	6	1.05E-05	67%	Pass
93	56.220	8	1.40E-05	6	1.05E-05	75%	Pass
94	56.796	8	1.40E-05	6	1.05E-05	75%	Pass
95	57.371	7	1.22E-05	6	1.05E-05	86%	Pass
96	57.947	6	1.05E-05	6	1.05E-05	*100%*	*Pass^*
97	58.522	6	1.05E-05	6	1.05E-05	*100%*	*Pass^*
98	59.098	6	1.05E-05	6	1.05E-05	*100%*	*Pass^*
99	59.674	6	1.05E-05	6	1.05E-05	*100%*	*Pass^*
100	60.249	6	1.05E-05	6	1.05E-05	*100%*	*Pass^*

POC- 5 Flow Duration Exceedance Curves

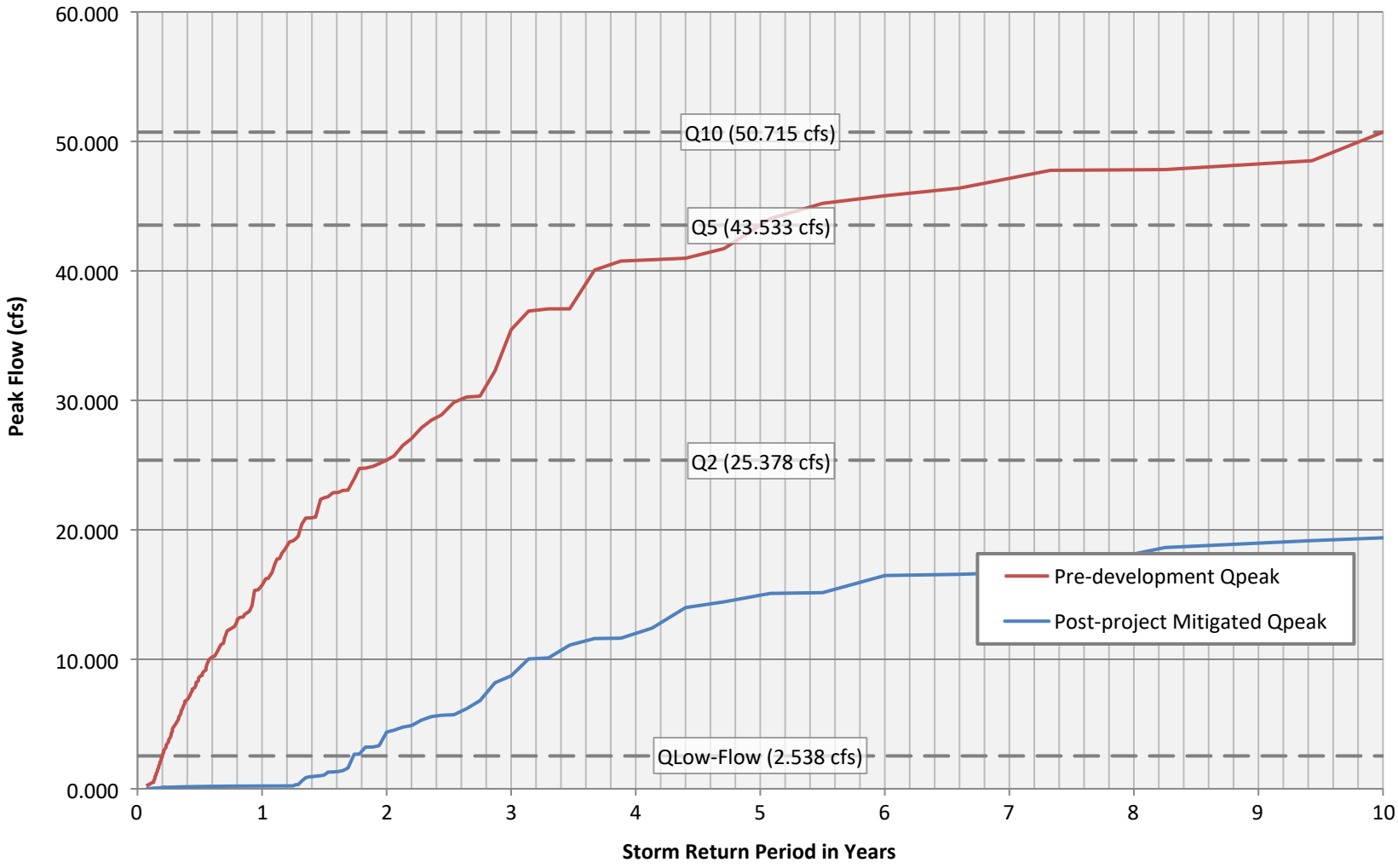


3. POC - 6 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

	HMP Flow Frequency Range Based on:	SWMM - Weibull	
Return Period	**Pre-development Qpeak (cfs)**	**Post-project - Mitigated Q (cfs)**	*Check*
Low-Flow = 0.1*Q2	2.538	0.438	*Okay! -> Decreased by 2.1 cfs*
2-year	25.378	4.377	*Okay! -> Decreased by 21.001 cfs*
3-year	35.457	8.724	*Okay! -> Decreased by 26.733 cfs*
4-year	40.805	12.000	*Okay! -> Decreased by 28.806 cfs*
5-year	43.533	14.949	*Okay! -> Decreased by 28.584 cfs*
6-year	45.799	16.470	*Okay! -> Decreased by 29.329 cfs*
7-year	47.144	16.694	*Okay! -> Decreased by 30.45 cfs*
8-year	47.808	18.135	*Okay! -> Decreased by 29.673 cfs*
9-year	48.259	18.972	*Okay! -> Decreased by 29.287 cfs*
10-year	50.715	19.383	*Okay! -> Decreased by 31.332 cfs*

POC-6 Peak Flow Frequency Curves



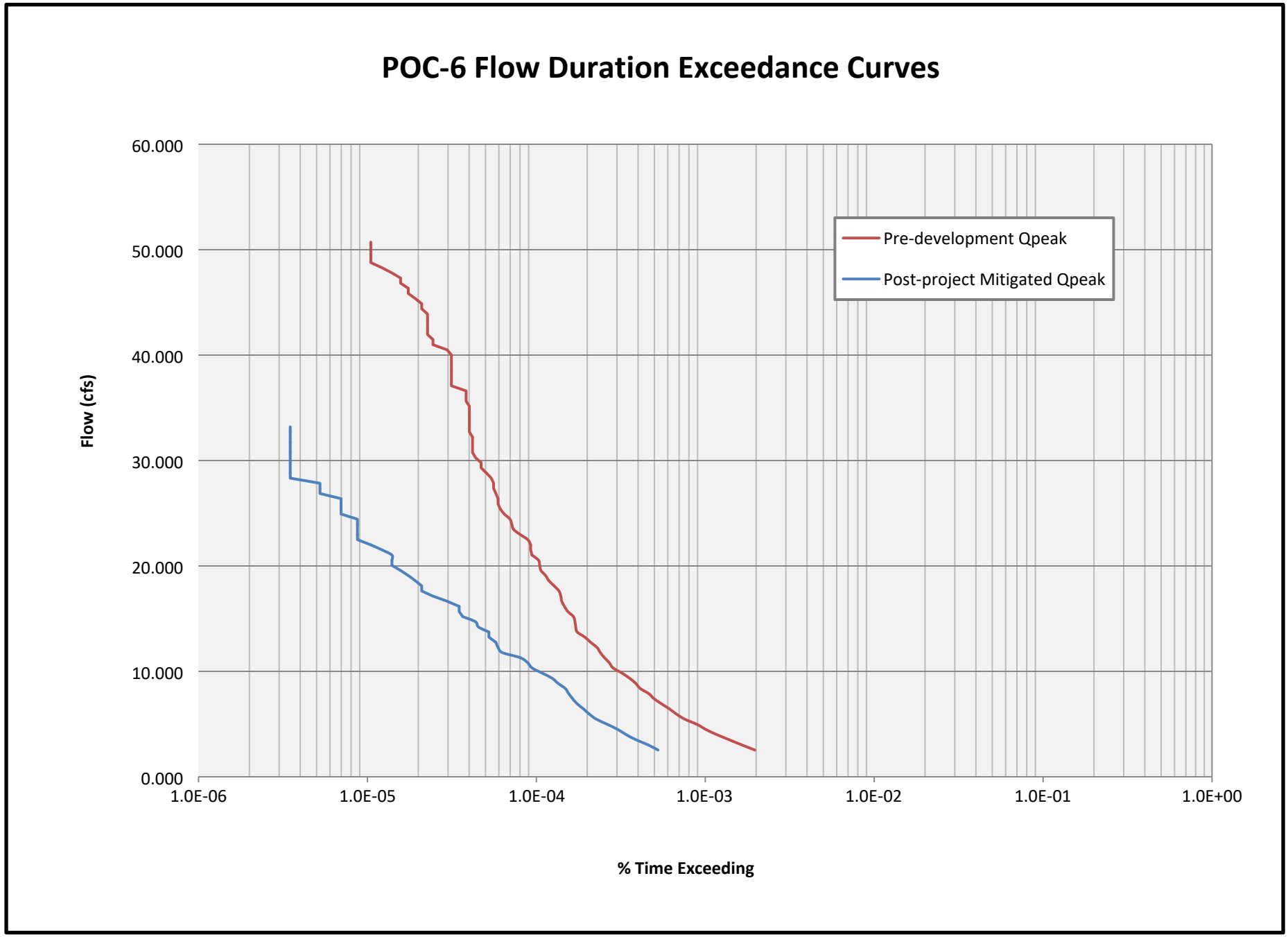
Low-flow Threshold:	10%	
0.1xQ2 (Pre):	2.5378	cfs
Q10 (Pre):	50.715	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	0.48664	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	2.538	1126	1.96E-03	301	5.25E-04	27%	Pass
2	3.024	942	1.64E-03	263	4.59E-04	28%	Pass
3	3.511	795	1.39E-03	223	3.89E-04	28%	Pass
4	3.998	671	1.17E-03	195	3.40E-04	29%	Pass
5	4.484	578	1.01E-03	174	3.04E-04	30%	Pass
6	4.971	512	8.93E-04	151	2.64E-04	29%	Pass
7	5.458	434	7.57E-04	130	2.27E-04	30%	Pass
8	5.944	387	6.75E-04	118	2.06E-04	30%	Pass
9	6.431	352	6.14E-04	109	1.90E-04	31%	Pass
10	6.918	316	5.51E-04	100	1.75E-04	32%	Pass
11	7.404	285	4.97E-04	94	1.64E-04	33%	Pass
12	7.891	265	4.62E-04	89	1.55E-04	34%	Pass
13	8.378	236	4.12E-04	85	1.48E-04	36%	Pass
14	8.864	222	3.87E-04	77	1.34E-04	35%	Pass
15	9.351	204	3.56E-04	71	1.24E-04	35%	Pass
16	9.837	184	3.21E-04	62	1.08E-04	34%	Pass
17	10.324	163	2.84E-04	54	9.42E-05	33%	Pass
18	10.811	155	2.70E-04	51	8.90E-05	33%	Pass
19	11.297	145	2.53E-04	46	8.03E-05	32%	Pass
20	11.784	137	2.39E-04	36	6.28E-05	26%	Pass
21	12.271	131	2.29E-04	34	5.93E-05	26%	Pass
22	12.757	120	2.09E-04	33	5.76E-05	28%	Pass
23	13.244	111	1.94E-04	30	5.24E-05	27%	Pass
24	13.731	100	1.75E-04	30	5.24E-05	30%	Pass
25	14.217	98	1.71E-04	26	4.54E-05	27%	Pass
26	14.704	97	1.69E-04	25	4.36E-05	26%	Pass
27	15.191	95	1.66E-04	21	3.66E-05	22%	Pass
28	15.677	88	1.54E-04	20	3.49E-05	23%	Pass
29	16.164	84	1.47E-04	20	3.49E-05	24%	Pass
30	16.650	81	1.41E-04	17	2.97E-05	21%	Pass
31	17.137	80	1.40E-04	14	2.44E-05	18%	Pass
32	17.624	78	1.36E-04	12	2.09E-05	15%	Pass
33	18.110	73	1.27E-04	12	2.09E-05	16%	Pass
34	18.597	68	1.19E-04	11	1.92E-05	16%	Pass
35	19.084	65	1.13E-04	10	1.75E-05	15%	Pass
36	19.570	61	1.06E-04	9	1.57E-05	15%	Pass
37	20.057	60	1.05E-04	8	1.40E-05	13%	Pass
38	20.544	59	1.03E-04	8	1.40E-05	14%	Pass
39	21.030	54	9.42E-05	8	1.40E-05	15%	Pass
40	21.517	53	9.25E-05	7	1.22E-05	13%	Pass
41	22.003	53	9.25E-05	6	1.05E-05	11%	Pass
42	22.490	51	8.90E-05	5	8.73E-06	10%	Pass
43	22.977	46	8.03E-05	5	8.73E-06	11%	Pass
44	23.463	42	7.33E-05	5	8.73E-06	12%	Pass
45	23.950	41	7.15E-05	5	8.73E-06	12%	Pass
46	24.437	40	6.98E-05	5	8.73E-06	13%	Pass
47	24.923	37	6.46E-05	4	6.98E-06	11%	Pass
48	25.410	35	6.11E-05	4	6.98E-06	11%	Pass
49	25.897	34	5.93E-05	4	6.98E-06	12%	Pass
50	26.383	34	5.93E-05	4	6.98E-06	12%	Pass
51	26.870	33	5.76E-05	3	5.24E-06	9%	Pass

Flow Frequency Range Based on: **SWMM - Weibull**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
52	27.357	32	5.58E-05	3	5.24E-06	9%	Pass
53	27.843	32	5.58E-05	3	5.24E-06	9%	Pass
54	28.330	31	5.41E-05	2	3.49E-06	6%	Pass
55	28.816	29	5.06E-05	2	3.49E-06	7%	Pass
56	29.303	27	4.71E-05	2	3.49E-06	7%	Pass
57	29.790	27	4.71E-05	2	3.49E-06	7%	Pass
58	30.276	25	4.36E-05	2	3.49E-06	8%	Pass
59	30.763	24	4.19E-05	2	3.49E-06	8%	Pass
60	31.250	24	4.19E-05	2	3.49E-06	8%	Pass
61	31.736	24	4.19E-05	2	3.49E-06	8%	Pass
62	32.223	24	4.19E-05	2	3.49E-06	8%	Pass
63	32.710	23	4.01E-05	2	3.49E-06	9%	Pass
64	33.196	23	4.01E-05	2	3.49E-06	9%	Pass
65	33.683	23	4.01E-05	0	0.00E+00	0%	Pass
66	34.170	23	4.01E-05	0	0.00E+00	0%	Pass
67	34.656	23	4.01E-05	0	0.00E+00	0%	Pass
68	35.143	23	4.01E-05	0	0.00E+00	0%	Pass
69	35.629	22	3.84E-05	0	0.00E+00	0%	Pass
70	36.116	22	3.84E-05	0	0.00E+00	0%	Pass
71	36.603	22	3.84E-05	0	0.00E+00	0%	Pass
72	37.089	18	3.14E-05	0	0.00E+00	0%	Pass
73	37.576	18	3.14E-05	0	0.00E+00	0%	Pass
74	38.063	18	3.14E-05	0	0.00E+00	0%	Pass
75	38.549	18	3.14E-05	0	0.00E+00	0%	Pass
76	39.036	18	3.14E-05	0	0.00E+00	0%	Pass
77	39.523	18	3.14E-05	0	0.00E+00	0%	Pass
78	40.009	18	3.14E-05	0	0.00E+00	0%	Pass
79	40.496	17	2.97E-05	0	0.00E+00	0%	Pass
80	40.983	14	2.44E-05	0	0.00E+00	0%	Pass
81	41.469	14	2.44E-05	0	0.00E+00	0%	Pass
82	41.956	13	2.27E-05	0	0.00E+00	0%	Pass
83	42.442	13	2.27E-05	0	0.00E+00	0%	Pass
84	42.929	13	2.27E-05	0	0.00E+00	0%	Pass
85	43.416	13	2.27E-05	0	0.00E+00	0%	Pass
86	43.902	13	2.27E-05	0	0.00E+00	0%	Pass
87	44.389	12	2.09E-05	0	0.00E+00	0%	Pass
88	44.876	12	2.09E-05	0	0.00E+00	0%	Pass
89	45.362	11	1.92E-05	0	0.00E+00	0%	Pass
90	45.849	10	1.75E-05	0	0.00E+00	0%	Pass
91	46.336	10	1.75E-05	0	0.00E+00	0%	Pass
92	46.822	9	1.57E-05	0	0.00E+00	0%	Pass
93	47.309	9	1.57E-05	0	0.00E+00	0%	Pass
94	47.796	8	1.40E-05	0	0.00E+00	0%	Pass
95	48.282	7	1.22E-05	0	0.00E+00	0%	Pass
96	48.769	6	1.05E-05	0	0.00E+00	0%	Pass
97	49.255	6	1.05E-05	0	0.00E+00	0%	Pass
98	49.742	6	1.05E-05	0	0.00E+00	0%	Pass
99	50.229	6	1.05E-05	0	0.00E+00	0%	Pass
100	50.715	6	1.05E-05	0	0.00E+00	0%	Pass

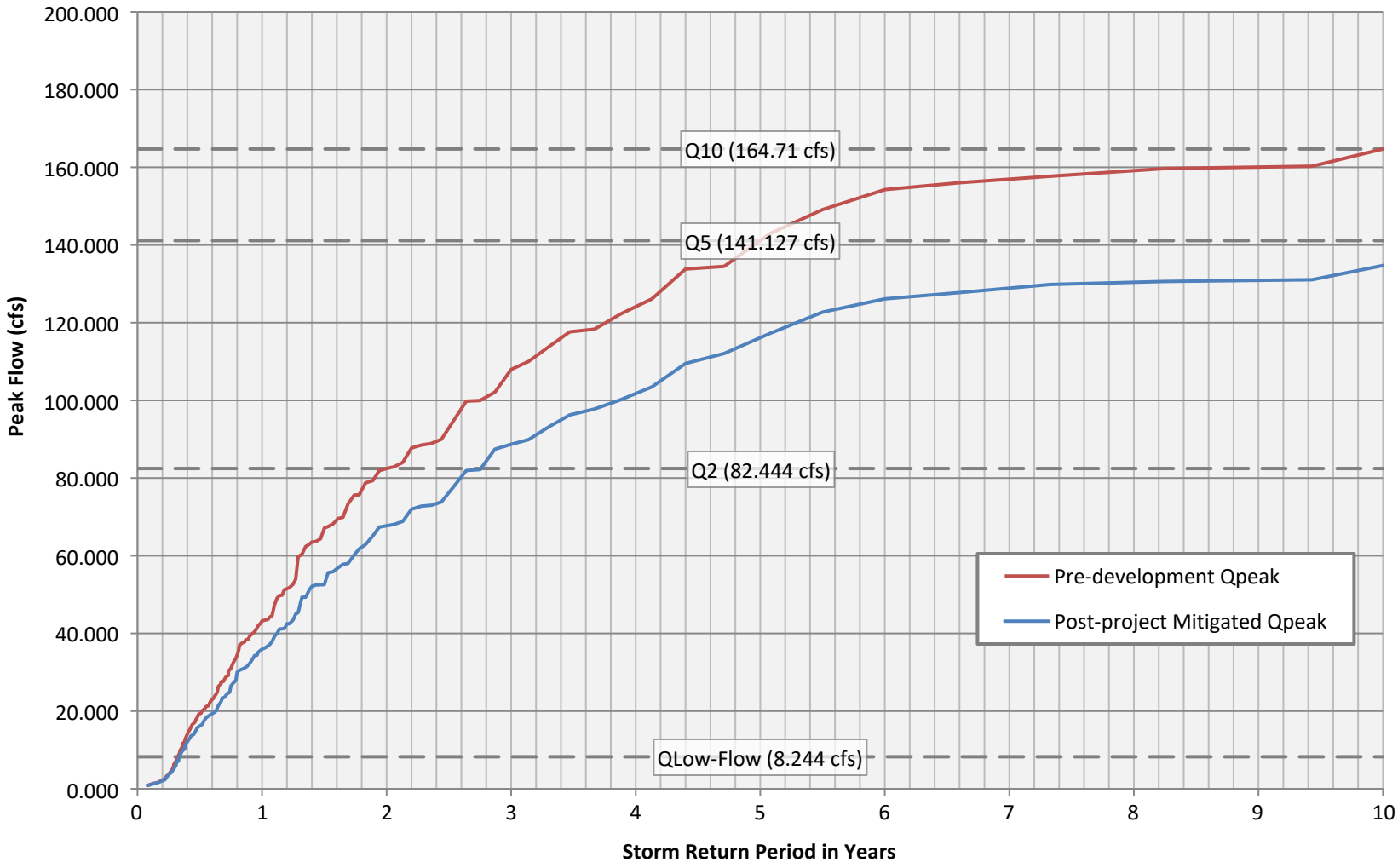

POC-6 Flow Duration Exceedance Curves
60.000
50.000
40.000
30.000
20.000
10.000
0.000
Flow (cfs)
1.0E-06
1.0E-05
1.0E-04
1.0E-03
1.0E-02
1.0E-01
1.0E+00
% Time Exceeding
Pre-development Qpeak
Post-project Mitigated Qpeak

3. POC - 8 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

	HMP Flow Frequency Range Based on:	SWMM - Weibull	
Return Period	**Pre-development Qpeak (cfs)**	**Post-project - Mitigated Q (cfs)**	*Check*
Low-Flow = 0.1*Q2	8.244	6.771	*Okay! -> Decreased by 1.474 cfs*
2-year	82.444	67.708	*Okay! -> Decreased by 14.736 cfs*
3-year	107.957	88.680	*Okay! -> Decreased by 19.277 cfs*
4-year	124.107	101.746	*Okay! -> Decreased by 22.361 cfs*
5-year	141.127	116.138	*Okay! -> Decreased by 24.989 cfs*
6-year	154.251	126.134	*Okay! -> Decreased by 28.117 cfs*
7-year	156.947	128.893	*Okay! -> Decreased by 28.054 cfs*
8-year	159.138	130.405	*Okay! -> Decreased by 28.733 cfs*
9-year	160.052	130.894	*Okay! -> Decreased by 29.158 cfs*
10-year	164.710	134.713	*Okay! -> Decreased by 29.997 cfs*

POC- 8 Peak Flow Frequency Curves



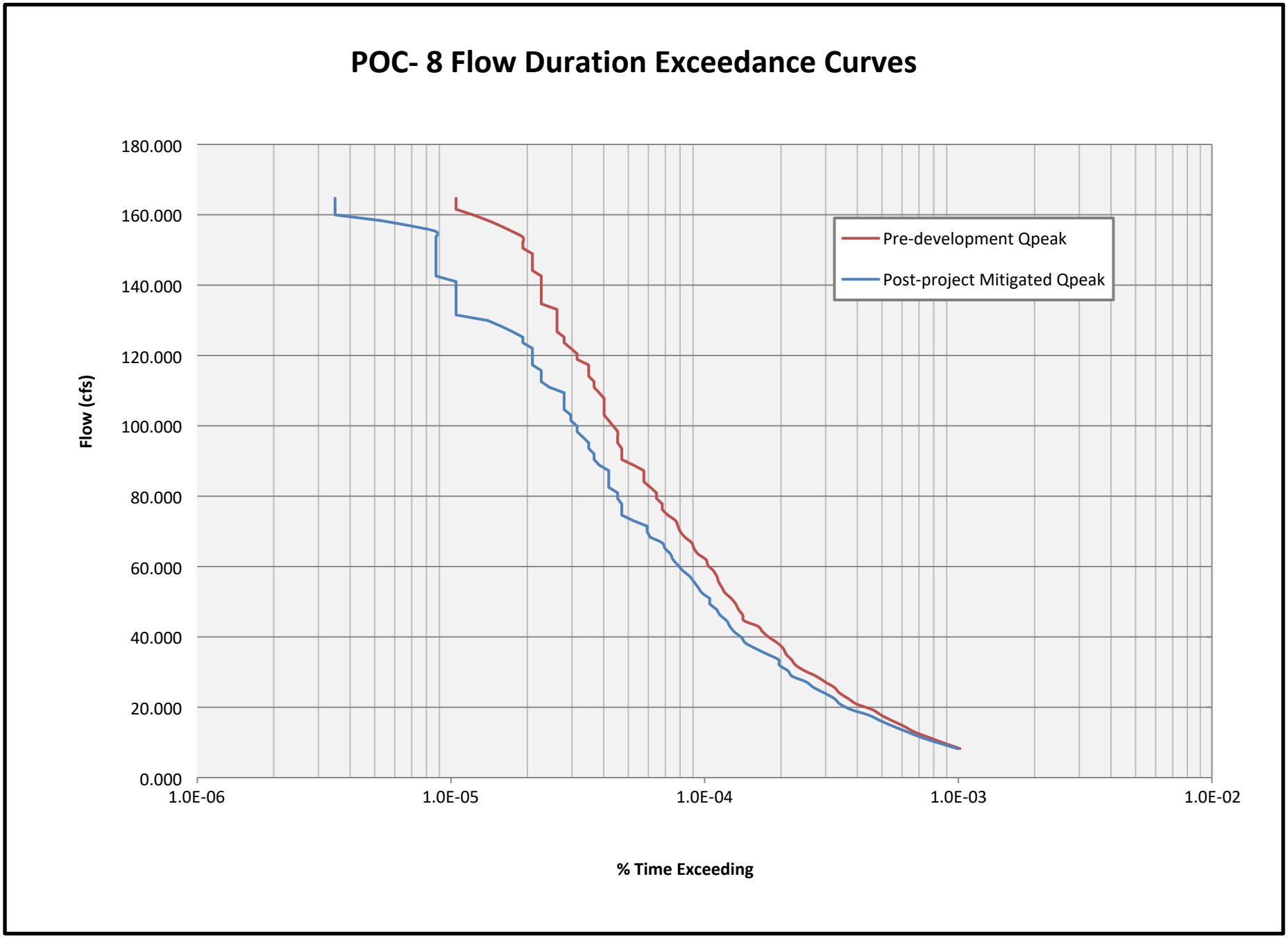
Low-flow Threshold:	10%	
0.1xQ2 (Pre):	8.2444	cfs
Q10 (Pre):	164.710	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	1.58046	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	8.244	582	1.02E-03	568	9.91E-04	98%	Pass
2	9.825	503	8.78E-04	481	8.39E-04	96%	Pass
3	11.405	440	7.68E-04	410	7.15E-04	93%	Pass
4	12.986	384	6.70E-04	361	6.30E-04	94%	Pass
5	14.566	351	6.13E-04	318	5.55E-04	91%	Pass
6	16.147	315	5.50E-04	283	4.94E-04	90%	Pass
7	17.727	285	4.97E-04	255	4.45E-04	89%	Pass
8	19.308	263	4.59E-04	217	3.79E-04	83%	Pass
9	20.888	228	3.98E-04	196	3.42E-04	86%	Pass
10	22.469	211	3.68E-04	186	3.25E-04	88%	Pass
11	24.049	195	3.40E-04	170	2.97E-04	87%	Pass
12	25.629	186	3.25E-04	154	2.69E-04	83%	Pass
13	27.210	171	2.98E-04	144	2.51E-04	84%	Pass
14	28.790	158	2.76E-04	127	2.22E-04	80%	Pass
15	30.371	142	2.48E-04	122	2.13E-04	86%	Pass
16	31.951	131	2.29E-04	113	1.97E-04	86%	Pass
17	33.532	126	2.20E-04	112	1.95E-04	89%	Pass
18	35.112	120	2.09E-04	101	1.76E-04	84%	Pass
19	36.693	117	2.04E-04	91	1.59E-04	78%	Pass
20	38.273	111	1.94E-04	83	1.45E-04	75%	Pass
21	39.854	103	1.80E-04	80	1.40E-04	78%	Pass
22	41.434	97	1.69E-04	75	1.31E-04	77%	Pass
23	43.015	93	1.62E-04	72	1.26E-04	77%	Pass
24	44.595	82	1.43E-04	70	1.22E-04	85%	Pass
25	46.175	81	1.41E-04	66	1.15E-04	81%	Pass
26	47.756	78	1.36E-04	64	1.12E-04	82%	Pass
27	49.336	76	1.33E-04	60	1.05E-04	79%	Pass
28	50.917	73	1.27E-04	60	1.05E-04	82%	Pass
29	52.497	69	1.20E-04	56	9.77E-05	81%	Pass
30	54.078	67	1.17E-04	54	9.42E-05	81%	Pass
31	55.658	65	1.13E-04	52	9.07E-05	80%	Pass
32	57.239	64	1.12E-04	50	8.73E-05	78%	Pass
33	58.819	62	1.08E-04	47	8.20E-05	76%	Pass
34	60.400	59	1.03E-04	45	7.85E-05	76%	Pass
35	61.980	58	1.01E-04	43	7.50E-05	74%	Pass
36	63.560	54	9.42E-05	42	7.33E-05	78%	Pass
37	65.141	52	9.07E-05	40	6.98E-05	77%	Pass
38	66.721	51	8.90E-05	39	6.81E-05	76%	Pass
39	68.302	48	8.38E-05	35	6.11E-05	73%	Pass
40	69.882	46	8.03E-05	34	5.93E-05	74%	Pass
41	71.463	45	7.85E-05	34	5.93E-05	76%	Pass
42	73.043	44	7.68E-05	30	5.24E-05	68%	Pass
43	74.624	41	7.15E-05	27	4.71E-05	66%	Pass
44	76.204	39	6.81E-05	27	4.71E-05	69%	Pass
45	77.785	39	6.81E-05	27	4.71E-05	69%	Pass
46	79.365	37	6.46E-05	26	4.54E-05	70%	Pass
47	80.946	37	6.46E-05	26	4.54E-05	70%	Pass
48	82.526	35	6.11E-05	24	4.19E-05	69%	Pass
49	84.106	33	5.76E-05	24	4.19E-05	73%	Pass
50	85.687	33	5.76E-05	24	4.19E-05	73%	Pass
51	87.267	33	5.76E-05	24	4.19E-05	73%	Pass

Flow Frequency Range Based on: **SWMM - Weibull**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
52	88.848	30	5.24E-05	22	3.84E-05	73%	Pass
53	90.428	27	4.71E-05	21	3.66E-05	78%	Pass
54	92.009	27	4.71E-05	21	3.66E-05	78%	Pass
55	93.589	27	4.71E-05	20	3.49E-05	74%	Pass
56	95.170	26	4.54E-05	20	3.49E-05	77%	Pass
57	96.750	26	4.54E-05	19	3.32E-05	73%	Pass
58	98.331	26	4.54E-05	18	3.14E-05	69%	Pass
59	99.911	25	4.36E-05	18	3.14E-05	72%	Pass
60	101.492	24	4.19E-05	17	2.97E-05	71%	Pass
61	103.072	23	4.01E-05	17	2.97E-05	74%	Pass
62	104.652	23	4.01E-05	16	2.79E-05	70%	Pass
63	106.233	23	4.01E-05	16	2.79E-05	70%	Pass
64	107.813	23	4.01E-05	16	2.79E-05	70%	Pass
65	109.394	22	3.84E-05	16	2.79E-05	73%	Pass
66	110.974	21	3.66E-05	14	2.44E-05	67%	Pass
67	112.555	21	3.66E-05	13	2.27E-05	62%	Pass
68	114.135	20	3.49E-05	13	2.27E-05	65%	Pass
69	115.716	20	3.49E-05	13	2.27E-05	65%	Pass
70	117.296	20	3.49E-05	12	2.09E-05	60%	Pass
71	118.877	18	3.14E-05	12	2.09E-05	67%	Pass
72	120.457	18	3.14E-05	12	2.09E-05	67%	Pass
73	122.038	17	2.97E-05	12	2.09E-05	71%	Pass
74	123.618	16	2.79E-05	11	1.92E-05	69%	Pass
75	125.198	16	2.79E-05	11	1.92E-05	69%	Pass
76	126.779	15	2.62E-05	10	1.75E-05	67%	Pass
77	128.359	15	2.62E-05	9	1.57E-05	60%	Pass
78	129.940	15	2.62E-05	8	1.40E-05	53%	Pass
79	131.520	15	2.62E-05	6	1.05E-05	40%	Pass
80	133.101	15	2.62E-05	6	1.05E-05	40%	Pass
81	134.681	13	2.27E-05	6	1.05E-05	46%	Pass
82	136.262	13	2.27E-05	6	1.05E-05	46%	Pass
83	137.842	13	2.27E-05	6	1.05E-05	46%	Pass
84	139.423	13	2.27E-05	6	1.05E-05	46%	Pass
85	141.003	13	2.27E-05	6	1.05E-05	46%	Pass
86	142.583	13	2.27E-05	5	8.73E-06	38%	Pass
87	144.164	12	2.09E-05	5	8.73E-06	42%	Pass
88	145.744	12	2.09E-05	5	8.73E-06	42%	Pass
89	147.325	12	2.09E-05	5	8.73E-06	42%	Pass
90	148.905	12	2.09E-05	5	8.73E-06	42%	Pass
91	150.486	11	1.92E-05	5	8.73E-06	45%	Pass
92	152.066	11	1.92E-05	5	8.73E-06	45%	Pass
93	153.647	11	1.92E-05	5	8.73E-06	45%	Pass
94	155.227	10	1.75E-05	5	8.73E-06	50%	Pass
95	156.808	9	1.57E-05	4	6.98E-06	44%	Pass
96	158.388	8	1.40E-05	3	5.24E-06	38%	Pass
97	159.969	7	1.22E-05	2	3.49E-06	29%	Pass
98	161.549	6	1.05E-05	2	3.49E-06	33%	Pass
99	163.129	6	1.05E-05	2	3.49E-06	33%	Pass
100	164.710	6	1.05E-05	2	3.49E-06	33%	Pass

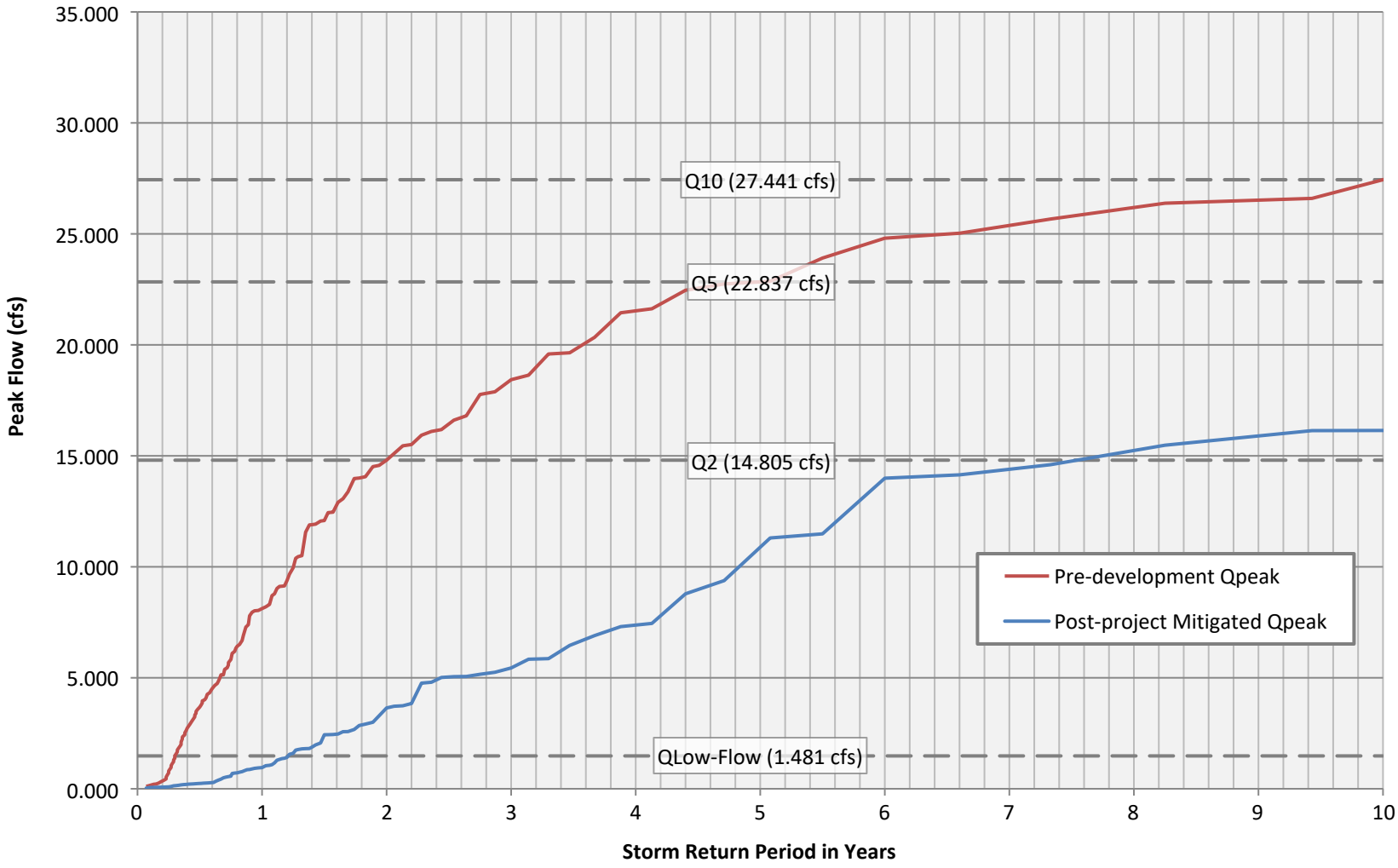

POC- 8 Flow Duration Exceedance Curves
180.000
160.000
140.000
120.000
100.000
80.000
60.000
40.000
20.000
0.000
Flow (cfs)
1.0E-06
1.0E-05
1.0E-04
1.0E-03
1.0E-02
% Time Exceeding
Pre-development Qpeak
Post-project Mitigated Qpeak

3. POC - 9 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

	HMP Flow Frequency Range Based on:	SWMM - Weibull	
Return Period	**Pre-development Qpeak (cfs)**	**Post-project - Mitigated Q (cfs)**	*Check*
Low-Flow = 0.1*Q2	1.481	0.364	*Okay! -> Decreased by 1.116 cfs*
2-year	14.805	3.642	*Okay! -> Decreased by 11.163 cfs*
3-year	18.431	5.444	*Okay! -> Decreased by 12.987 cfs*
4-year	21.532	7.375	*Okay! -> Decreased by 14.157 cfs*
5-year	22.837	10.884	*Okay! -> Decreased by 11.953 cfs*
6-year	24.805	13.993	*Okay! -> Decreased by 10.812 cfs*
7-year	25.380	14.394	*Okay! -> Decreased by 10.985 cfs*
8-year	26.188	15.240	*Okay! -> Decreased by 10.948 cfs*
9-year	26.520	15.897	*Okay! -> Decreased by 10.623 cfs*
10-year	27.441	16.143	*Okay! -> Decreased by 11.298 cfs*

POC-9 Peak Flow Frequency Curves



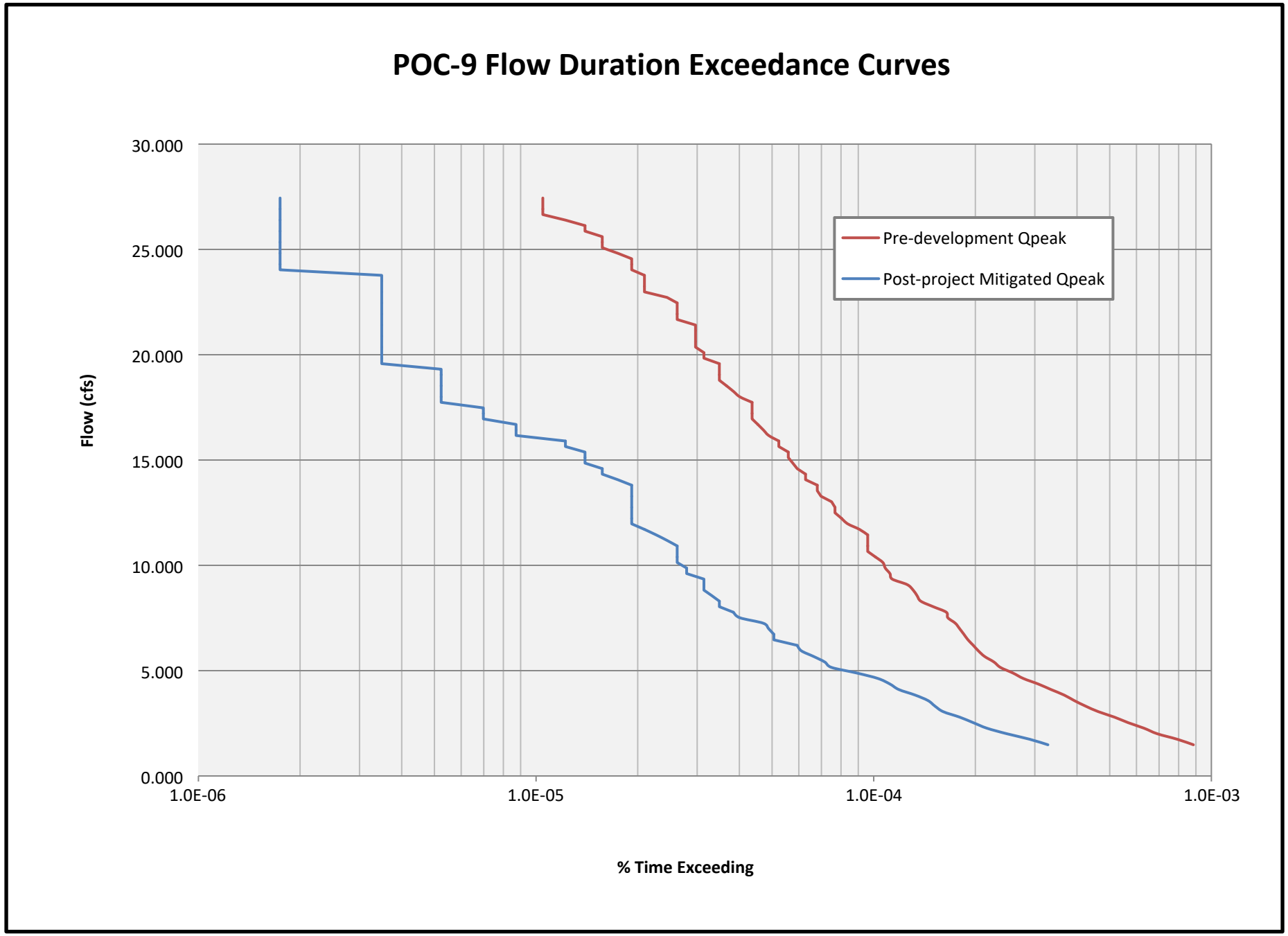
Low-flow Threshold:	10%	
0.1xQ2 (Pre):	1.4805	cfs
Q10 (Pre):	27.441	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	0.26222	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	1.481	507	8.85E-04	188	3.28E-04	37%	Pass
2	1.743	454	7.92E-04	166	2.90E-04	37%	Pass
3	2.005	396	6.91E-04	142	2.48E-04	36%	Pass
4	2.267	362	6.32E-04	124	2.16E-04	34%	Pass
5	2.529	325	5.67E-04	113	1.97E-04	35%	Pass
6	2.792	296	5.17E-04	103	1.80E-04	35%	Pass
7	3.054	265	4.62E-04	92	1.61E-04	35%	Pass
8	3.316	243	4.24E-04	87	1.52E-04	36%	Pass
9	3.578	225	3.93E-04	83	1.45E-04	37%	Pass
10	3.841	210	3.66E-04	76	1.33E-04	36%	Pass
11	4.103	192	3.35E-04	68	1.19E-04	35%	Pass
12	4.365	176	3.07E-04	64	1.12E-04	36%	Pass
13	4.627	159	2.77E-04	59	1.03E-04	37%	Pass
14	4.889	148	2.58E-04	51	8.90E-05	34%	Pass
15	5.152	136	2.37E-04	43	7.50E-05	32%	Pass
16	5.414	130	2.27E-04	41	7.15E-05	32%	Pass
17	5.676	122	2.13E-04	38	6.63E-05	31%	Pass
18	5.938	117	2.04E-04	35	6.11E-05	30%	Pass
19	6.201	113	1.97E-04	34	5.93E-05	30%	Pass
20	6.463	109	1.90E-04	29	5.06E-05	27%	Pass
21	6.725	106	1.85E-04	29	5.06E-05	27%	Pass
22	6.987	103	1.80E-04	28	4.89E-05	27%	Pass
23	7.249	100	1.75E-04	27	4.71E-05	27%	Pass
24	7.512	95	1.66E-04	23	4.01E-05	24%	Pass
25	7.774	94	1.64E-04	22	3.84E-05	23%	Pass
26	8.036	86	1.50E-04	20	3.49E-05	23%	Pass
27	8.298	79	1.38E-04	20	3.49E-05	25%	Pass
28	8.561	77	1.34E-04	19	3.32E-05	25%	Pass
29	8.823	75	1.31E-04	18	3.14E-05	24%	Pass
30	9.085	72	1.26E-04	18	3.14E-05	25%	Pass
31	9.347	65	1.13E-04	18	3.14E-05	28%	Pass
32	9.609	64	1.12E-04	16	2.79E-05	25%	Pass
33	9.872	62	1.08E-04	16	2.79E-05	26%	Pass
34	10.134	61	1.06E-04	15	2.62E-05	25%	Pass
35	10.396	58	1.01E-04	15	2.62E-05	26%	Pass
36	10.658	55	9.60E-05	15	2.62E-05	27%	Pass
37	10.921	55	9.60E-05	15	2.62E-05	27%	Pass
38	11.183	55	9.60E-05	14	2.44E-05	25%	Pass
39	11.445	55	9.60E-05	13	2.27E-05	24%	Pass
40	11.707	52	9.07E-05	12	2.09E-05	23%	Pass
41	11.969	48	8.38E-05	11	1.92E-05	23%	Pass
42	12.232	46	8.03E-05	11	1.92E-05	24%	Pass
43	12.494	44	7.68E-05	11	1.92E-05	25%	Pass
44	12.756	44	7.68E-05	11	1.92E-05	25%	Pass
45	13.018	43	7.50E-05	11	1.92E-05	26%	Pass
46	13.281	40	6.98E-05	11	1.92E-05	28%	Pass
47	13.543	39	6.81E-05	11	1.92E-05	28%	Pass
48	13.805	39	6.81E-05	11	1.92E-05	28%	Pass
49	14.067	36	6.28E-05	10	1.75E-05	28%	Pass
50	14.329	36	6.28E-05	9	1.57E-05	25%	Pass
51	14.592	34	5.93E-05	9	1.57E-05	26%	Pass

Flow Frequency Range Based on: **SWMM - Weibull**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
52	14.854	33	5.76E-05	8	1.40E-05	24%	Pass
53	15.116	32	5.58E-05	8	1.40E-05	25%	Pass
54	15.378	32	5.58E-05	8	1.40E-05	25%	Pass
55	15.641	30	5.24E-05	7	1.22E-05	23%	Pass
56	15.903	30	5.24E-05	7	1.22E-05	23%	Pass
57	16.165	28	4.89E-05	5	8.73E-06	18%	Pass
58	16.427	27	4.71E-05	5	8.73E-06	19%	Pass
59	16.689	26	4.54E-05	5	8.73E-06	19%	Pass
60	16.952	25	4.36E-05	4	6.98E-06	16%	Pass
61	17.214	25	4.36E-05	4	6.98E-06	16%	Pass
62	17.476	25	4.36E-05	4	6.98E-06	16%	Pass
63	17.738	25	4.36E-05	3	5.24E-06	12%	Pass
64	18.001	23	4.01E-05	3	5.24E-06	13%	Pass
65	18.263	22	3.84E-05	3	5.24E-06	14%	Pass
66	18.525	21	3.66E-05	3	5.24E-06	14%	Pass
67	18.787	20	3.49E-05	3	5.24E-06	15%	Pass
68	19.049	20	3.49E-05	3	5.24E-06	15%	Pass
69	19.312	20	3.49E-05	3	5.24E-06	15%	Pass
70	19.574	20	3.49E-05	2	3.49E-06	10%	Pass
71	19.836	18	3.14E-05	2	3.49E-06	11%	Pass
72	20.098	18	3.14E-05	2	3.49E-06	11%	Pass
73	20.361	17	2.97E-05	2	3.49E-06	12%	Pass
74	20.623	17	2.97E-05	2	3.49E-06	12%	Pass
75	20.885	17	2.97E-05	2	3.49E-06	12%	Pass
76	21.147	17	2.97E-05	2	3.49E-06	12%	Pass
77	21.409	17	2.97E-05	2	3.49E-06	12%	Pass
78	21.672	15	2.62E-05	2	3.49E-06	13%	Pass
79	21.934	15	2.62E-05	2	3.49E-06	13%	Pass
80	22.196	15	2.62E-05	2	3.49E-06	13%	Pass
81	22.458	15	2.62E-05	2	3.49E-06	13%	Pass
82	22.721	14	2.44E-05	2	3.49E-06	14%	Pass
83	22.983	12	2.09E-05	2	3.49E-06	17%	Pass
84	23.245	12	2.09E-05	2	3.49E-06	17%	Pass
85	23.507	12	2.09E-05	2	3.49E-06	17%	Pass
86	23.769	12	2.09E-05	2	3.49E-06	17%	Pass
87	24.032	11	1.92E-05	1	1.75E-06	9%	Pass
88	24.294	11	1.92E-05	1	1.75E-06	9%	Pass
89	24.556	11	1.92E-05	1	1.75E-06	9%	Pass
90	24.818	10	1.75E-05	1	1.75E-06	10%	Pass
91	25.081	9	1.57E-05	1	1.75E-06	11%	Pass
92	25.343	9	1.57E-05	1	1.75E-06	11%	Pass
93	25.605	9	1.57E-05	1	1.75E-06	11%	Pass
94	25.867	8	1.40E-05	1	1.75E-06	13%	Pass
95	26.129	8	1.40E-05	1	1.75E-06	13%	Pass
96	26.392	7	1.22E-05	1	1.75E-06	14%	Pass
97	26.654	6	1.05E-05	1	1.75E-06	17%	Pass
98	26.916	6	1.05E-05	1	1.75E-06	17%	Pass
99	27.178	6	1.05E-05	1	1.75E-06	17%	Pass
100	27.441	6	1.05E-05	1	1.75E-06	17%	Pass

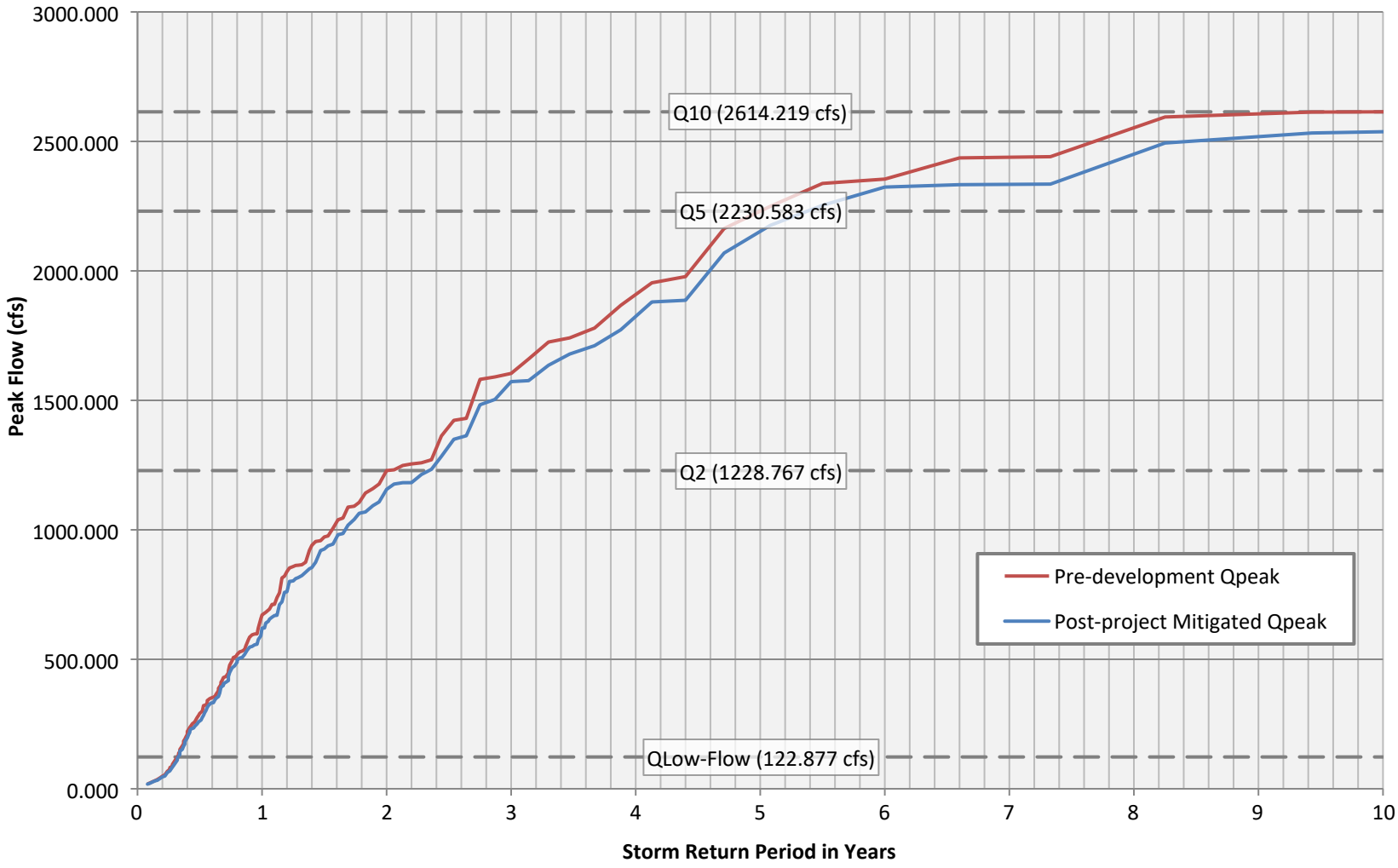

POC-9 Flow Duration Exceedance Curves
30.000
25.000
20.000
15.000
10.000
5.000
0.000
Flow (cfs)
1.0E-06
1.0E-05
1.0E-04
1.0E-03
% Time Exceeding
Pre-development Qpeak
Post-project Mitigated Qpeak

3. DP- 88 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

	HMP Flow Frequency Range Based on:	SWMM - Weibull	
Return Period	**Pre-development Qpeak (cfs)**	**Post-project - Mitigated Q (cfs)**	*Check*
Low-Flow = 0.1*Q2	122.9	115.6	*Okay! -> Decreased by 7.249 cfs*
2-year	1,228.8	1,156.3	*Okay! -> Decreased by 72.493 cfs*
3-year	1,604.0	1,572.3	*Okay! -> Decreased by 31.66 cfs*
4-year	1,908.6	1,824.1	*Okay! -> Decreased by 84.579 cfs*
5-year	2,230.6	2,152.5	*Okay! -> Decreased by 78.049 cfs*
6-year	2,354.4	2,323.6	*Okay! -> Decreased by 30.842 cfs*
7-year	2,438.8	2,334.1	*Okay! -> Decreased by 104.742 cfs*
8-year	2,552.6	2,450.7	*Okay! -> Decreased by 101.954 cfs*
9-year	2,606.3	2,518.4	*Okay! -> Decreased by 87.967 cfs*
10-year	2,614.2	2,537.3	*Okay! -> Decreased by 76.883 cfs*

DP88 Peak Flow Frequency Curves



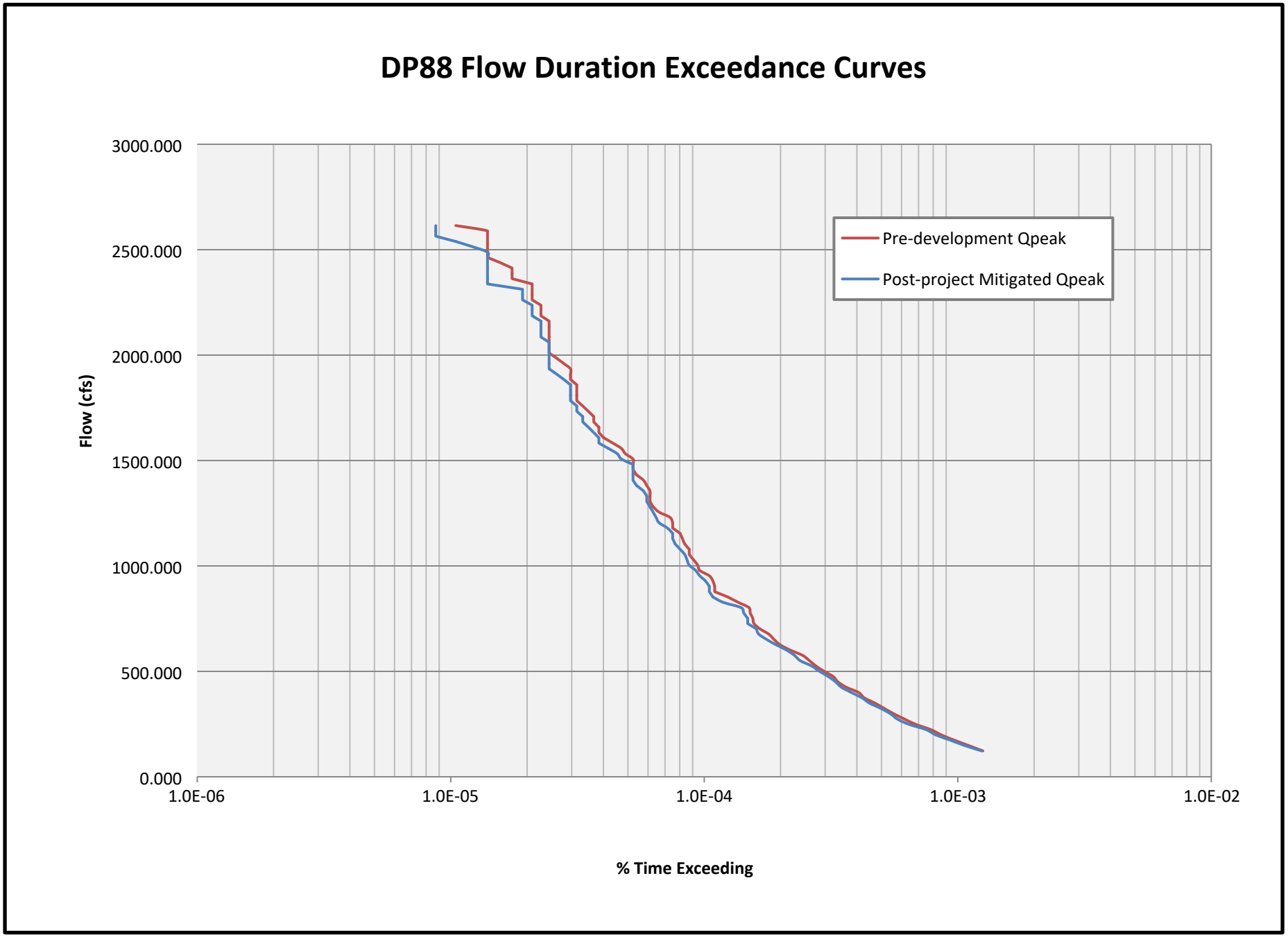
Low-flow Threshold:	10%	
0.1xQ2 (Pre):	122.8767	cfs
Q10 (Pre):	2614.219	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	25.16507	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	122.877	720	1.26E-03	712	1.24E-03	99%	Pass
2	148.042	633	1.10E-03	611	1.07E-03	97%	Pass
3	173.207	557	9.72E-04	537	9.37E-04	96%	Pass
4	198.372	494	8.62E-04	470	8.20E-04	95%	Pass
5	223.537	449	7.84E-04	430	7.50E-04	96%	Pass
6	248.702	391	6.82E-04	368	6.42E-04	94%	Pass
7	273.867	353	6.16E-04	331	5.78E-04	94%	Pass
8	299.032	320	5.58E-04	311	5.43E-04	97%	Pass
9	324.197	294	5.13E-04	285	4.97E-04	97%	Pass
10	349.362	270	4.71E-04	257	4.48E-04	95%	Pass
11	374.527	245	4.28E-04	240	4.19E-04	98%	Pass
12	399.692	233	4.07E-04	218	3.80E-04	94%	Pass
13	424.858	208	3.63E-04	199	3.47E-04	96%	Pass
14	450.023	193	3.37E-04	189	3.30E-04	98%	Pass
15	475.188	185	3.23E-04	177	3.09E-04	96%	Pass
16	500.353	170	2.97E-04	163	2.84E-04	96%	Pass
17	525.518	158	2.76E-04	152	2.65E-04	96%	Pass
18	550.683	149	2.60E-04	137	2.39E-04	92%	Pass
19	575.848	140	2.44E-04	130	2.27E-04	93%	Pass
20	601.013	125	2.18E-04	121	2.11E-04	97%	Pass
21	626.178	114	1.99E-04	110	1.92E-04	96%	Pass
22	651.343	108	1.88E-04	101	1.76E-04	94%	Pass
23	676.508	103	1.80E-04	94	1.64E-04	91%	Pass
24	701.673	95	1.66E-04	92	1.61E-04	97%	Pass
25	726.838	90	1.57E-04	85	1.48E-04	94%	Pass
26	752.003	89	1.55E-04	85	1.48E-04	96%	Pass
27	777.169	87	1.52E-04	82	1.43E-04	94%	Pass
28	802.334	86	1.50E-04	80	1.40E-04	93%	Pass
29	827.499	78	1.36E-04	68	1.19E-04	87%	Pass
30	852.664	71	1.24E-04	62	1.08E-04	87%	Pass
31	877.829	63	1.10E-04	60	1.05E-04	95%	Pass
32	902.994	63	1.10E-04	60	1.05E-04	95%	Pass
33	928.159	62	1.08E-04	58	1.01E-04	94%	Pass
34	953.324	60	1.05E-04	55	9.60E-05	92%	Pass
35	978.489	55	9.60E-05	53	9.25E-05	96%	Pass
36	1003.654	54	9.42E-05	50	8.73E-05	93%	Pass
37	1028.819	52	9.07E-05	49	8.55E-05	94%	Pass
38	1053.984	50	8.73E-05	48	8.38E-05	96%	Pass
39	1079.149	50	8.73E-05	46	8.03E-05	92%	Pass
40	1104.314	48	8.38E-05	44	7.68E-05	92%	Pass
41	1129.480	47	8.20E-05	43	7.50E-05	91%	Pass
42	1154.645	46	8.03E-05	43	7.50E-05	93%	Pass
43	1179.810	43	7.50E-05	41	7.15E-05	95%	Pass
44	1204.975	43	7.50E-05	38	6.63E-05	88%	Pass
45	1230.140	42	7.33E-05	37	6.46E-05	88%	Pass
46	1255.305	38	6.63E-05	36	6.28E-05	95%	Pass
47	1280.470	36	6.28E-05	35	6.11E-05	97%	Pass
48	1305.635	35	6.11E-05	34	5.93E-05	97%	Pass
49	1330.800	35	6.11E-05	34	5.93E-05	97%	Pass
50	1355.965	35	6.11E-05	33	5.76E-05	94%	Pass
51	1381.130	34	5.93E-05	31	5.41E-05	91%	Pass

Flow Frequency Range Based on: **SWMM - Weibull**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
52	1406.295	33	5.76E-05	30	5.24E-05	91%	Pass
53	1431.460	31	5.41E-05	30	5.24E-05	97%	Pass
54	1456.625	30	5.24E-05	30	5.24E-05	*100%*	*Pass^*
55	1481.790	30	5.24E-05	30	5.24E-05	*100%*	*Pass^*
56	1506.956	30	5.24E-05	27	4.71E-05	90%	Pass
57	1532.121	28	4.89E-05	26	4.54E-05	93%	Pass
58	1557.286	27	4.71E-05	24	4.19E-05	89%	Pass
59	1582.451	25	4.36E-05	22	3.84E-05	88%	Pass
60	1607.616	23	4.01E-05	22	3.84E-05	96%	Pass
61	1632.781	22	3.84E-05	21	3.66E-05	95%	Pass
62	1657.946	22	3.84E-05	20	3.49E-05	91%	Pass
63	1683.111	21	3.66E-05	19	3.32E-05	90%	Pass
64	1708.276	21	3.66E-05	19	3.32E-05	90%	Pass
65	1733.441	20	3.49E-05	18	3.14E-05	90%	Pass
66	1758.606	19	3.32E-05	18	3.14E-05	95%	Pass
67	1783.771	18	3.14E-05	17	2.97E-05	94%	Pass
68	1808.936	18	3.14E-05	17	2.97E-05	94%	Pass
69	1834.101	18	3.14E-05	17	2.97E-05	94%	Pass
70	1859.267	18	3.14E-05	17	2.97E-05	94%	Pass
71	1884.432	17	2.97E-05	16	2.79E-05	94%	Pass
72	1909.597	17	2.97E-05	15	2.62E-05	88%	Pass
73	1934.762	17	2.97E-05	14	2.44E-05	82%	Pass
74	1959.927	16	2.79E-05	14	2.44E-05	88%	Pass
75	1985.092	15	2.62E-05	14	2.44E-05	93%	Pass
76	2010.257	14	2.44E-05	14	2.44E-05	*100%*	*Pass^*
77	2035.422	14	2.44E-05	14	2.44E-05	*100%*	*Pass^*
78	2060.587	14	2.44E-05	14	2.44E-05	*100%*	*Pass^*
79	2085.752	14	2.44E-05	13	2.27E-05	93%	Pass
80	2110.917	14	2.44E-05	13	2.27E-05	93%	Pass
81	2136.082	14	2.44E-05	13	2.27E-05	93%	Pass
82	2161.247	14	2.44E-05	13	2.27E-05	93%	Pass
83	2186.412	13	2.27E-05	12	2.09E-05	92%	Pass
84	2211.578	13	2.27E-05	12	2.09E-05	92%	Pass
85	2236.743	13	2.27E-05	12	2.09E-05	92%	Pass
86	2261.908	12	2.09E-05	11	1.92E-05	92%	Pass
87	2287.073	12	2.09E-05	11	1.92E-05	92%	Pass
88	2312.238	12	2.09E-05	11	1.92E-05	92%	Pass
89	2337.403	12	2.09E-05	8	1.40E-05	67%	Pass
90	2362.568	10	1.75E-05	8	1.40E-05	80%	Pass
91	2387.733	10	1.75E-05	8	1.40E-05	80%	Pass
92	2412.898	10	1.75E-05	8	1.40E-05	80%	Pass
93	2438.063	9	1.57E-05	8	1.40E-05	89%	Pass
94	2463.228	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
95	2488.393	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
96	2513.558	8	1.40E-05	7	1.22E-05	88%	Pass
97	2538.723	8	1.40E-05	6	1.05E-05	75%	Pass
98	2563.888	8	1.40E-05	5	8.73E-06	63%	Pass
99	2589.054	8	1.40E-05	5	8.73E-06	63%	Pass
100	2614.219	6	1.05E-05	5	8.73E-06	83%	Pass


DP88 Flow Duration Exceedance Curves
3000.000
2500.000
2000.000
1500.000
1000.000
500.000
0.000
Flow (cfs)
1.0E-06
1.0E-05
1.0E-04
1.0E-03
1.0E-02
% Time Exceeding
Pre-development Qpeak
Post-project Mitigated Qpeak

4. POC - 5, 6 , 8 , and 9 and DP88 CUHP Inputs

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (mi^2)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
5	5	100	0.072969	0.173484848	0.391288	0.107	5	0.35	0.1	3	0.0018	0.5	0
6	6	100	0.069325	0.382765152	0.734659	0.046	5	0.35	0.1	3	0.0018	0.5	0
8	8	100	0.237637	0.646780303	1.163258	0.056	5	0.35	0.1	3	0.0018	0.5	0
9	9	100	0.033998	0.186363636	0.404924	0.067	5	0.35	0.1	3	0.0018	0.5	0
20	20	100	0.049541	0.193560606	0.37803	0.02	5	0.35	0.1	3	0.0018	0.5	0
O1	O1	100	4.415156	1.772916667	3.694508	0.04	5	0.35	0.1	3	0.0018	0.5	0
O2	O2	100	0.111719	0.172348485	0.424053	4	5	0.35	0.1	3	0.0018	0.5	0

RUN MULTIPLE CUHP AND SWMM SCENARIOS

Columns with this color heading are for required user-input
Columns with this color heading are for program-calculated values

SWMM Run Wait Time (sec)	(Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)
5	RP

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
5	5	48
6	5	43
8	5	56
9	5	40
20	5	5
O1	5	5
O2	5	5

Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
100	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40

Enter "X" to Run Scenario	Scenario ID	Land Use (E or F)	Return Period (yr)	Correction Area (Sq.Mi.)	(Optional) SWMM Time Series Inflow Table "NAME"
X	1	E	WQ	4	1_Ex_WQ_4mi^2_Pre_CUHP
X	2	E	2	4	2_Ex_2yr_4mi^2_Pre_CUHP
X	3	E	5	4	3_Ex_5yr_4mi^2_Pre_CUHP
X	4	E	10	4	4_Ex_10yr_4mi^2_Pre_CUHP
X	5	E	50	4	5_Ex_50yr_4mi^2_Pre_CUHP
X	6	E	100	4	6_Ex_100yr_4mi^2_Pre_CUHP

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (acre)	Length to Centroid (ft)	Length (ft)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
5A	5A	100	20.8	1057	1997	0.11	5	0.35	0.1	3	0.0018	0.5	0
5B	5B	100	24.9	1100	2400	0.07	48	0.35	0.1	3	0.0018	0.5	0
6	6	100	54.6	1725	3879	0.05	43	0.35	0.1	3	0.0018	0.5	0
8A	8A	100	122.4	2450	5184	0.06	5	0.35	0.1	3	0.0018	0.5	0
8B	8B	100	30.7	860	1706	0.04	56	0.35	0.1	3	0.0018	0.5	0
9A	9A	100	19.4	460	1833	0.04	40	0.35	0.1	3	0.0018	0.5	0
9B	9B	100	4.3	172	1100	0.04	40	0.35	0.1	3	0.0018	0.5	0
20	20	100	30.02687	1022	1996	0.02	5	0.35	0.1	3	0.0018	0.5	0
O1	O1	100	2824.264	9361	19443.12	0.04	5	0.35	0.1	3	0.0018	0.5	0
O2	O2	100	65.49384	696	2239.26	0.04	5	0.35	0.1	3	0.0018	0.5	0

RUN MULTIPLE CUHP AND SWMM SCENARIOS

Columns with this color heading are for required user-input
Columns with this color heading are for program-calculated values

SWMM Run Wait Time (sec)
60

(Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)
RP

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
5A	5	5
5B	5	48
6	5	43
8A	5	5
8B	5	56
9A	5	40
9B	5	40
20	5	5
O1	5	5
O2	5	5

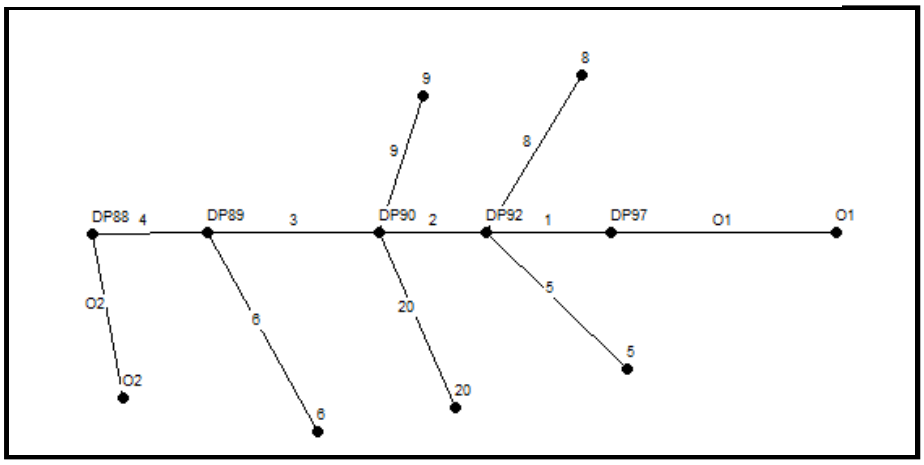
Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
100	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40

Enter "X" to Run Scenario	Scenario ID	Land Use (E or F)	Return Period (yr)	Correction Area (Sq.Mi.)	(Optional) SWMM Time Series Inflow Table "NAME"
X	1	F	WQ	4	1_Fut_WQ_0mi^2_POST_CUHP
X	2	F	2	4	2_Fut_2yr_4mi^2_Post_CUHP
X	3	F	5	4	3_Fut_5yr_4mi^2_Post_CUHP
X	4	F	10	4	4_Fut_10yr_4mi^2_Post_CUHP
X	5	F	50	4	5_Fut_50yr_4mi^2_Post_CUHP
X	6	F	100	4	6_Fut_100yr_4mi^2_Post_CUHP

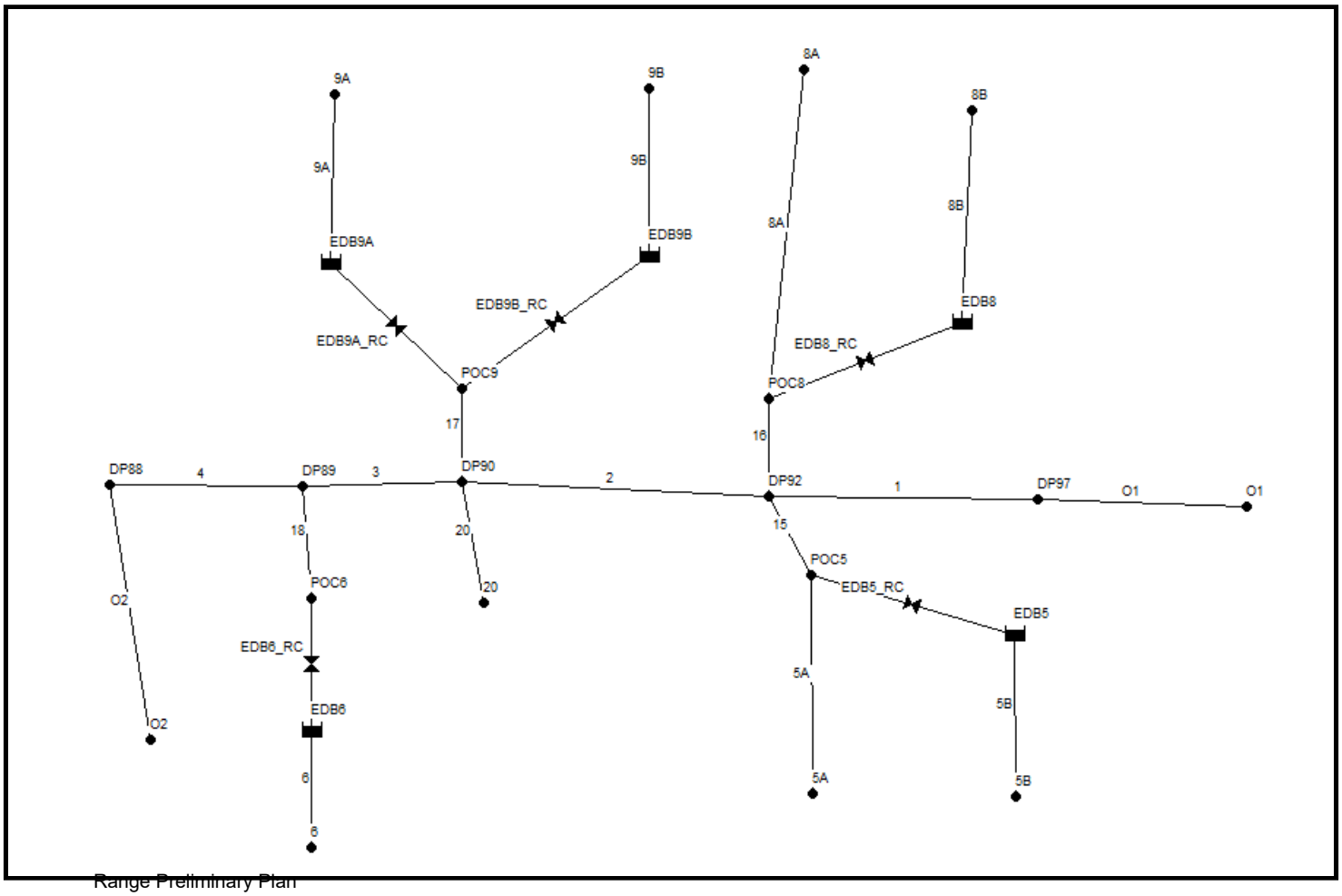
5. POC - 5, 6 , 8 , and 9 and DP88 SWMM Results using CUHP Input File

(Q25 & Q50 to be provided with Final Drainage Report)

Pre-Project SWMM Model Input Schematic using CUHP input file



Post-Project SWMM Model Input Schematic using CUHP input file



```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
------------------------------------------------------------

Scenario ID = 6_Ex_100yr_4mi^2_CUHP_Pre

WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2
WARNING 04: minimum elevation drop used for Conduit 3
WARNING 04: minimum elevation drop used for Conduit 5
WARNING 04: minimum elevation drop used for Conduit 6
WARNING 04: minimum elevation drop used for Conduit 8
WARNING 04: minimum elevation drop used for Conduit 9
WARNING 04: minimum elevation drop used for Conduit 20
WARNING 04: minimum elevation drop used for Conduit O1
WARNING 04: minimum elevation drop used for Conduit 4
WARNING 04: minimum elevation drop used for Conduit O2

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 02/06/2025 00:00:00
Ending Date .............. 02/06/2025 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       438.201       142.794
External Outflow .........       438.201       142.794
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days	hr:min	Reported Max Depth Feet
5	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
6	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
8	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
9	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
20	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
DP97	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
DP92	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
DP90	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
DP89	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
O1	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
O2	JUNCTION	0.00	0.00	0.00	0	00:00	0.00
DP88	JUNCTION	0.00	0.00	0.00	0	00:06	0.00

****
Node Inflow Summary
****

Pre-Project Q100 per CUHP run

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
5	JUNCTION	94.76	94.76	0	00:40	2.08	2.08	0.000
6	JUNCTION	46.85	46.85	0	00:55	1.99	1.99	0.000
8	JUNCTION	174.38	174.38	0	00:55	6.81	6.81	0.000
9	JUNCTION	30.67	30.67	0	00:45	0.971	0.971	0.000
20	JUNCTION	41.43	41.43	0	00:50	1.42	1.42	0.000
DP97	JUNCTION	0.00	2808.01	0	01:20	0	126	0.000
DP92	JUNCTION	0.00	2988.75	0	01:20	0	135	0.000
DP90	JUNCTION	0.00	3038.62	0	01:20	0	138	0.000
DP89	JUNCTION	0.00	3077.31	0	01:20	0	140	0.000
O1	JUNCTION	2808.01	2808.01	0	01:20	126	126	0.000
O2	JUNCTION	260.21	260.21	0	00:35	3.06	3.06	0.000
DP88	JUNCTION	0.00	3089.07	0	01:20	0	143	0.000

****
Node Flooding Summary
****

No nodes were flooded.

Pre-Project Q100 per CUHP run approx. at Property Line

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	DUMMY	2808.01	0	01:20			
2	DUMMY	2988.75	0	01:20			
3	DUMMY	3038.62	0	01:20			
5	DUMMY	94.76	0	00:40			
6	DUMMY	46.85	0	00:55			
8	DUMMY	174.38	0	00:55			
9	DUMMY	30.67	0	00:45			
20	DUMMY	41.43	0	00:50			
O1	DUMMY	2808.01	0	01:20			
4	DUMMY	3077.31	0	01:20			
O2	DUMMY	260.21	0	00:35			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Mar 19 16:14:00 2025
Analysis ended on: Wed Mar 19 16:14:00 2025
Total elapsed time: < 1 sec

```
[TITLE]
;;Project Title/Notes

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         HORTON
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           02/06/2025
START_TIME           00:00:00
REPORT_START_DATE    02/06/2025
REPORT_START_TIME    00:00:00
END_DATE             02/06/2025
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:15:00
WET_STEP             00:05:00
DRY_STEP             01:00:00
ROUTING_STEP         0:00:30

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[FILES]
;;Interfacing Files
USE INFLOWS "\\cp.rickeng.com\projects\D02000\2215_Range\WaterRes\Hydromod\CUHP\DP88\POST_CUHP.txt"

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
CONSTANT         0.0
DRY_ONLY         NO

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
5A               0          0          0          0          0
6                0          0          0          0          0
8A               0          0          0          0          0
9A               0          0          0          0          0
20               0          0          0          0          0
DP89             0          0          0          0          0
9B               0          0          0          0          0
8B               0          0          0          0          0
5B               0          0          0          0          0
DP97             0          0          0          0          0
DP92             0          0          0          0          0
DP90             0          0          0          0          0
O1               0          0          0          0          0
O2               0          0          0          0          0
DP88             0          0          0          0          0
POC5             0          0          0          0          0
POC8             0          0          0          0          0
POC9             0          0          0          0          0
POC6             0          0          0          0          0

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------          -------- --------
EDB5             0        9.5        0          TABULAR    EDB5                         0        0
EDB6             0        9.5        0          TABULAR    EDB6                         0        0
EDB9A            0        7.5        0          TABULAR    EDB9A                        0        0
EDB9B            0        8.75       0          TABULAR    EDB9B                        0        0
EDB8             0        8.5        0          TABULAR    EDB8                         0        0

[CONDUITS]
```

```
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
5A               5A               POC5             400        0.01       0          0          0          0
6                6                EDB6             400        0.01       0          0          0          0
8A               8A               POC8             400        0.01       0          0          0          0
9A               9A               EDB9A            400        0.01       0          0          0          0
20               20               DP90             400        0.01       0          0          0          0
5B               5B               EDB5             400        0.01       0          0          0          0
8B               8B               EDB8             400        0.01       0          0          0          0
9B               9B               EDB9B            400        0.01       0          0          0          0
1                DP97             DP92             400        0.01       0          0          0          0
2                DP92             DP90             400        0.01       0          0          0          0
3                DP90             DP89             400        0.01       0          0          0          0
O1               O1               DP97             400        0.01       0          0          0          0
O2               O2               DP88             400        0.01       0          0          0          0
4                DP89             DP88             400        0.01       0          0          0          0
15               POC5             DP92             400        0.01       0          0          0          0
16               POC8             DP92             400        0.01       0          0          0          0
17               POC9             DP90             400        0.01       0          0          0          0
18               POC6             DP89             400        0.01       0          0          0          0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type            QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- --------
EDB5_RC          EDB5             POC5             0          TABULAR/DEPTH   EDB5ratingcurve             NO
EDB6_RC          EDB6             POC6             0          TABULAR/DEPTH   EDB6_RatingCurve            NO
EDB9A_RC         EDB9A            POC9             0          TABULAR/DEPTH   EDB9A_RatCurve              NO
EDB9B_RC         EDB9B            POC9             0          TABULAR/DEPTH   EDB9B_RATINGCURVE            NO
EDB8_RC          EDB8             POC8             0          TABULAR/DEPTH   EDB8_RC                     NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
5A               DUMMY        0                0          0          0          1
6                DUMMY        0                0          0          0          1
8A               DUMMY        0                0          0          0          1
9A               DUMMY        0                0          0          0          1
20               DUMMY        0                0          0          0          1
5B               DUMMY        0                0          0          0          1
8B               DUMMY        0                0          0          0          1
9B               DUMMY        0                0          0          0          1
1                DUMMY        0                0          0          0          1
2                DUMMY        0                0          0          0          1
3                DUMMY        0                0          0          0          1
O1               DUMMY        0                0          0          0          1
O2               DUMMY        0                0          0          0          1
4                DUMMY        0                0          0          0          1
15               DUMMY        0                0          0          0          1
16               DUMMY        0                0          0          0          1
17               DUMMY        0                0          0          0          1
18               DUMMY        0                0          0          0          1

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
EDB5ratingcurve  Rating     0.00       0.000
EDB5ratingcurve             0.25       0.026
EDB5ratingcurve             0.50       0.039
EDB5ratingcurve             0.75       0.049
EDB5ratingcurve             1.00       0.057
EDB5ratingcurve             1.25       0.064
EDB5ratingcurve             1.50       0.071
EDB5ratingcurve             1.75       0.102
EDB5ratingcurve             2.00       0.121
EDB5ratingcurve             2.25       0.136
EDB5ratingcurve             2.50       0.149
EDB5ratingcurve             2.75       0.161
EDB5ratingcurve             3.00       0.172
EDB5ratingcurve             3.25       0.182
EDB5ratingcurve             3.50       0.722
EDB5ratingcurve             3.75       1.052
EDB5ratingcurve             4.00       1.252
EDB5ratingcurve             4.25       1.422
EDB5ratingcurve             4.50       1.572
EDB5ratingcurve             4.75       1.708
EDB5ratingcurve             5.00       1.833
EDB5ratingcurve             5.25       3.263
EDB5ratingcurve             5.50       5.773
EDB5ratingcurve             5.75       8.985
EDB5ratingcurve             6.00       12.765
EDB5ratingcurve             6.25       17.034
EDB5ratingcurve             6.50       21.741
EDB5ratingcurve             6.75       26.847
```

```
EDB5ratingcurve             7.00       32.323
EDB5ratingcurve             7.25       38.144
EDB5ratingcurve             7.50       44.292
EDB5ratingcurve             7.75       50.748
EDB5ratingcurve             8.00       57.499
EDB5ratingcurve             8.25       64.533
EDB5ratingcurve             8.50       71.838
;
EDB6_RatingCurve Rating     0.00       0.000
EDB6_RatingCurve            0.25       0.011
EDB6_RatingCurve            0.50       0.016
EDB6_RatingCurve            0.75       0.019
EDB6_RatingCurve            1.00       0.023
EDB6_RatingCurve            1.25       0.025
EDB6_RatingCurve            1.50       0.028
EDB6_RatingCurve            1.75       0.030
EDB6_RatingCurve            2.00       0.043
EDB6_RatingCurve            2.25       0.061
EDB6_RatingCurve            2.50       0.071
EDB6_RatingCurve            2.75       0.080
EDB6_RatingCurve            3.00       0.088
EDB6_RatingCurve            3.25       0.095
EDB6_RatingCurve            3.50       0.116
EDB6_RatingCurve            3.75       0.130
EDB6_RatingCurve            4.00       0.141
EDB6_RatingCurve            4.25       0.151
EDB6_RatingCurve            4.50       0.160
EDB6_RatingCurve            4.75       0.168
EDB6_RatingCurve            5.00       0.176
EDB6_RatingCurve            5.25       0.184
EDB6_RatingCurve            5.50       0.191
EDB6_RatingCurve            5.75       0.198
EDB6_RatingCurve            6.00       0.205
EDB6_RatingCurve            6.25       0.211
EDB6_RatingCurve            6.50       0.217
EDB6_RatingCurve            6.75       0.223
EDB6_RatingCurve            7.00       1.542
EDB6_RatingCurve            7.25       3.947
EDB6_RatingCurve            7.50       7.061
EDB6_RatingCurve            7.75       10.746
EDB6_RatingCurve            8.00       14.926
EDB6_RatingCurve            8.25       19.547
EDB6_RatingCurve            8.50       24.570
EDB6_RatingCurve            8.75       29.965
EDB6_RatingCurve            9.00       35.709
EDB6_RatingCurve            9.25       41.782
EDB6_RatingCurve            9.50       48.165
;
EDB9A_RatCurve   Rating     0.00       0.000
EDB9A_RatCurve              0.25       0.007
EDB9A_RatCurve              0.50       0.010
EDB9A_RatCurve              0.75       0.013
EDB9A_RatCurve              1.00       0.015
EDB9A_RatCurve              1.25       0.016
EDB9A_RatCurve              1.50       0.018
EDB9A_RatCurve              1.75       0.026
EDB9A_RatCurve              2.00       0.031
EDB9A_RatCurve              2.25       0.035
EDB9A_RatCurve              2.50       0.038
EDB9A_RatCurve              2.75       0.041
EDB9A_RatCurve              3.00       0.043
EDB9A_RatCurve              3.25       0.046
EDB9A_RatCurve              3.50       0.103
EDB9A_RatCurve              3.75       0.137
EDB9A_RatCurve              4.00       0.162
EDB9A_RatCurve              4.25       0.183
EDB9A_RatCurve              4.50       0.201
EDB9A_RatCurve              4.75       0.218
EDB9A_RatCurve              5.00       0.233
EDB9A_RatCurve              5.25       0.247
EDB9A_RatCurve              5.50       0.261
EDB9A_RatCurve              5.75       0.274
EDB9A_RatCurve              6.00       0.286
EDB9A_RatCurve              6.25       1.872
EDB9A_RatCurve              6.50       4.763
EDB9A_RatCurve              6.75       8.503
EDB9A_RatCurve              7.00       12.930
EDB9A_RatCurve              7.25       17.949
EDB9A_RatCurve              7.50       23.497
EDB9A_RatCurve              7.75       29.528
EDB9A_RatCurve              8.00       36.006
EDB9A_RatCurve              8.25       42.902
EDB9A_RatCurve              8.50       50.192
```

```
EDB9A_RatCurve              8.75       57.855
EDB9A_RatCurve              9.00       65.875
EDB9A_RatCurve              9.25       74.235
EDB9A_RatCurve              9.50       82.923
;
EDB9B_RATINGCURVE Rating     0.00        0.000
EDB9B_RATINGCURVE            0.25        0.006
EDB9B_RATINGCURVE            0.50        0.009
EDB9B_RATINGCURVE            0.75        0.011
EDB9B_RATINGCURVE            1.00        0.012
EDB9B_RATINGCURVE            1.25        0.014
EDB9B_RATINGCURVE            1.50        0.018
EDB9B_RATINGCURVE            1.75        0.023
EDB9B_RATINGCURVE            2.00        0.027
EDB9B_RATINGCURVE            2.25        0.030
EDB9B_RATINGCURVE            2.50        0.032
EDB9B_RATINGCURVE            2.75        0.035
EDB9B_RATINGCURVE            3.00        0.043
EDB9B_RATINGCURVE            3.25        0.048
EDB9B_RATINGCURVE            3.50        0.052
EDB9B_RATINGCURVE            3.75        0.055
EDB9B_RATINGCURVE            4.00        0.058
EDB9B_RATINGCURVE            4.25        0.061
EDB9B_RATINGCURVE            4.50        0.064
EDB9B_RATINGCURVE            4.75        0.855
EDB9B_RATINGCURVE            5.00        2.297
EDB9B_RATINGCURVE            5.25        4.164
EDB9B_RATINGCURVE            5.50        6.375
EDB9B_RATINGCURVE            5.75        8.881
EDB9B_RATINGCURVE            6.00       11.653
EDB9B_RATINGCURVE            6.25       14.666
EDB9B_RATINGCURVE            6.50       17.903
EDB9B_RATINGCURVE            6.75       21.348
EDB9B_RATINGCURVE            7.00       24.991
EDB9B_RATINGCURVE            7.25       28.820
EDB9B_RATINGCURVE            7.50       32.827
EDB9B_RATINGCURVE            7.75       37.005
EDB9B_RATINGCURVE            8.00       41.347
EDB9B_RATINGCURVE            8.25       45.847
EDB9B_RATINGCURVE            8.50       50.499
EDB9B_RATINGCURVE            8.75       55.299
EDB9B_RATINGCURVE            9.00       60.242
EDB9B_RATINGCURVE            9.25       65.324
EDB9B_RATINGCURVE            9.50       70.542
;
EDB8_RC          Rating      0.00       0.000
EDB8_RC                      0.25       0.034
EDB8_RC                      0.50       0.053
EDB8_RC                      0.75       0.066
EDB8_RC                      1.00       0.077
EDB8_RC                      1.25       0.121
EDB8_RC                      1.50       0.149
EDB8_RC                      1.75       0.170
EDB8_RC                      2.00       0.189
EDB8_RC                      2.25       0.206
EDB8_RC                      2.50       0.221
EDB8_RC                      2.75       0.236
EDB8_RC                      3.00       0.249
EDB8_RC                      3.25       0.262
EDB8_RC                      3.50       0.893
EDB8_RC                      3.75       1.279
EDB8_RC                      4.00       1.513
EDB8_RC                      4.25       1.712
EDB8_RC                      4.50       1.888
EDB8_RC                      4.75       2.048
EDB8_RC                      5.00       2.250
EDB8_RC                      5.25       2.420
EDB8_RC                      5.50       2.572
EDB8_RC                      5.75       2.714
EDB8_RC                      6.00       2.848
EDB8_RC                      6.25       2.975
EDB8_RC                      6.50       3.096
EDB8_RC                      6.75       3.212
EDB8_RC                      7.00       3.324
EDB8_RC                      7.25       4.745
EDB8_RC                      7.50       7.249
EDB8_RC                      7.75       10.458
EDB8_RC                      8.00       14.237
EDB8_RC                      8.25       18.507
EDB8_RC                      8.50       23.216
EDB8_RC                      8.75       28.326
EDB8_RC                      9.00       33.806
EDB8_RC                      9.25       39.632
```

```
EDB8_RC                 9.50       45.785
;
EDB5            Storage 0.00       50
EDB5                    0.50       228.165
EDB5                    1.00       1438.99
EDB5                    1.50       4516.218
EDB5                    2.00       8285.158
EDB5                    2.50       11043.235
EDB5                    3.00       11862.053
EDB5                    3.50       12413.191
EDB5                    4.00       12975.515
EDB5                    4.50       13549.011
EDB5                    5.00       14133.679
EDB5                    5.50       14729.526
EDB5                    6.00       15336.552
EDB5                    6.50       15954.75
EDB5                    7.00       16584.127
EDB5                    7.50       17223.36
EDB5                    8.00       17871.126
EDB5                    8.50       18527.432
;
EDB6            Storage 0.00       49
EDB6                    0.50       472.199
EDB6                    1.00       3271.801
EDB6                    1.50       10019.178
EDB6                    2.00       19869.33
EDB6                    2.50       31626.439
EDB6                    3.00       42038.906
EDB6                    3.50       48902.62
EDB6                    4.00       51957.243
EDB6                    4.50       54010.762
EDB6                    5.00       56099.719
EDB6                    5.50       58224.127
EDB6                    6.00       60383.986
EDB6                    6.50       62579.296
EDB6                    7.00       64810.057
EDB6                    7.50       67076.256
EDB6                    8.00       68828.448
EDB6                    8.50       70583.084
EDB6                    9.00       72364.357
EDB6                    9.50       74172.241
;
EDB9A           Storage 0.00       16.71
EDB9A                   0.25       130.75
EDB9A                   0.50       273.17
EDB9A                   0.75       765.78
EDB9A                   1.00       1834.41
EDB9A                   1.25       3377.24
EDB9A                   1.50       5361.33
EDB9A                   1.75       7458.61
EDB9A                   2.00       9226.71
EDB9A                   2.25       10607.94
EDB9A                   2.50       11558.1
EDB9A                   2.75       12126.63
EDB9A                   3.00       12575.61
EDB9A                   3.25       13032.1
EDB9A                   3.50       13496.06
EDB9A                   3.75       13967.5
EDB9A                   4.00       14446.54
EDB9A                   4.25       14933.34
EDB9A                   4.50       15427.86
EDB9A                   4.75       15930.12
EDB9A                   5.00       16440.11
EDB9A                   5.25       16957.81
EDB9A                   5.50       17483.24
EDB9A                   5.75       18016.39
EDB9A                   6.00       18557.26
EDB9A                   6.25       19105.86
EDB9A                   6.50       19662.17
EDB9A                   6.75       20225.42
EDB9A                   7.00       20795.15
EDB9A                   7.25       21371.34
EDB9A                   7.50       21954.01
;
EDB9B           Storage 0.00       91.99
EDB9B                   0.25       149.76
EDB9B                   0.50       336.56
EDB9B                   0.75       777.93
EDB9B                   1.00       1003.85
EDB9B                   1.25       1152.57
EDB9B                   1.50       1304.60
EDB9B                   1.75       1463.82
EDB9B                   2.00       1630.18
```

```
EDB9B                       2.25       1803.77
EDB9B                       2.50       1984.77
EDB9B                       2.75       2173.18
EDB9B                       3.00       2369.22
EDB9B                       3.25       2573.01
EDB9B                       3.50       2784.59
EDB9B                       3.75       3004.34
EDB9B                       4.00       3232.33
EDB9B                       4.25       3468.75
EDB9B                       4.50       3714.11
EDB9B                       4.75       3968.44
EDB9B                       5.00       4232.03
EDB9B                       5.25       4505.05
EDB9B                       5.50       4787.65
EDB9B                       5.75       5080.65
EDB9B                       6.00       5384.14
EDB9B                       6.25       5698.41
EDB9B                       6.50       6023.73
EDB9B                       6.75       6360.10
EDB9B                       7.00       6707.54
EDB9B                       7.25       7066.03
EDB9B                       7.50       7437.89
EDB9B                       7.75       7787.04
EDB9B                       8.00       8128.17
EDB9B                       8.25       8472.71
EDB9B                       8.50       8839.01
EDB9B                       8.75       9258.24
;
EDB8             Storage    0.00       106.00
EDB8                        0.25       234.69
EDB8                        0.50       609.46
EDB8                        0.75       1587.70
EDB8                        1.00       3144.83
EDB8                        1.25       5271.05
EDB8                        1.50       8092.39
EDB8                        1.75       11101.12
EDB8                        2.00       13866.55
EDB8                        2.25       16563.98
EDB8                        2.50       19035.07
EDB8                        2.75       21132.76
EDB8                        3.00       22804.22
EDB8                        3.25       24079.54
EDB8                        3.50       24897.17
EDB8                        3.75       25604.42
EDB8                        4.00       26317.58
EDB8                        4.25       27036.67
EDB8                        4.50       27761.69
EDB8                        4.75       28492.62
EDB8                        5.00       29229.48
EDB8                        5.25       29972.27
EDB8                        5.50       30720.98
EDB8                        5.75       31475.61
EDB8                        6.00       32236.16
EDB8                        6.25       33002.64
EDB8                        6.50       33775.05
EDB8                        6.75       34553.37
EDB8                        7.00       35337.62
EDB8                        7.25       36127.80
EDB8                        7.50       36923.90
EDB8                        7.75       37725.92
EDB8                        8.00       38533.86
EDB8                        8.25       39347.73
EDB8                        8.50       40167.52

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS -2642.626 0.000 12642.626 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
5A               4429.066           3010.381
6                472.895            2583.622
```

```
8A              4359.862          8742.791
9A              657.439           8546.713
20              1833.910          4521.338
DP89            403.691           5444.060
9B              3137.255          8592.849
8B              5686.275          8419.839
5B              6032.295          2987.313
DP97            6205.306          5340.254
DP92            4083.045          5363.322
DP90            1660.900          5478.662
O1              7854.671          5282.584
O2              -795.848          3437.140
DP88            -1118.800         5455.594
POC5            4417.532          4740.484
POC8            4083.045          6136.101
POC9            1660.900          6216.840
POC6            472.895           4555.940
EDB5            6020.761          4267.589
EDB6            472.895           3506.344
EDB9A           622.837           7208.766
EDB9B           3137.255          7266.436
EDB8            5605.536          6735.871

[VERTICES]
;;Link           X-Coord           Y-Coord
;;-------------- ----------------- -----------------
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

Scenario ID = 1_Fut_WQ_4mi^2_CUHP_Post

WARNING 04: minimum elevation drop used for Conduit 5A
WARNING 04: minimum elevation drop used for Conduit 6
WARNING 04: minimum elevation drop used for Conduit 8A
WARNING 04: minimum elevation drop used for Conduit 9A
WARNING 04: minimum elevation drop used for Conduit 20
WARNING 04: minimum elevation drop used for Conduit 5B
WARNING 04: minimum elevation drop used for Conduit 8B
WARNING 04: minimum elevation drop used for Conduit 9B
WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2
WARNING 04: minimum elevation drop used for Conduit 3
WARNING 04: minimum elevation drop used for Conduit O1
WARNING 04: minimum elevation drop used for Conduit O2
WARNING 04: minimum elevation drop used for Conduit 4
WARNING 04: minimum elevation drop used for Conduit 15
WARNING 04: minimum elevation drop used for Conduit 16
WARNING 04: minimum elevation drop used for Conduit 17
WARNING 04: minimum elevation drop used for Conduit 18

*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 02/06/2025 00:00:00
Ending Date .............. 02/06/2025 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         4.505         1.468
External Outflow .........         3.075         1.002
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         1.431         0.466
Continuity Error (%) .....         0.000


******************************
Highest Flow Instability Indexes
******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
5A	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
6	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
8A	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
9A	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP89	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
9B	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
8B	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
5B	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP97	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP92	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP90	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
O1	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
O2	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP88	JUNCTION	0.00	0.00	0.00	0 00:16	0.00
POC5	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC8	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC9	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC6	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
EDB5	STORAGE	2.71	3.27	3.27	0 02:35	3.27
EDB6	STORAGE	2.73	2.89	2.89	0 03:18	2.89
EDB9A	STORAGE	2.41	2.59	2.59	0 02:46	2.59
EDB9B	STORAGE	1.82	2.42	2.42	0 02:28	2.42
EDB8	STORAGE	2.58	3.03	3.03	0 02:26	3.03

WQ ponding depth per CUHP run

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
5A	JUNCTION	0.18	0.18	0 00:40	0.0046	0.0046	0.000
6	JUNCTION	9.34	9.34	0 00:35	0.294	0.294	0.000
8A	JUNCTION	0.87	0.87	0 00:45	0.0271	0.0271	0.000
9A	JUNCTION	3.99	3.99	0 00:30	0.0941	0.0941	0.000
20	JUNCTION	0.21	0.21	0 00:40	0.00664	0.00664	0.000
DP89	JUNCTION	0.00	15.10	0 01:20	0	0.987	0.000
9B	JUNCTION	0.88	0.88	0 00:30	0.0204	0.0204	0.000
8B	JUNCTION	11.41	11.41	0 00:30	0.228	0.228	0.000
5B	JUNCTION	5.83	5.83	0 00:30	0.153	0.153	0.000
DP97	JUNCTION	0.00	13.87	0 01:20	0	0.625	0.000
DP92	JUNCTION	0.00	14.85	0 01:20	0	0.894	0.000
DP90	JUNCTION	0.00	15.03	0 01:20	0	0.938	0.000
O1	JUNCTION	13.87	13.87	0 01:20	0.625	0.625	0.000
O2	JUNCTION	0.77	0.77	0 00:35	0.0145	0.0145	0.000
DP88	JUNCTION	0.00	15.31	0 01:20	0	1	0.000
POC5	JUNCTION	0.00	0.30	0 00:40	0	0.103	0.000
POC8	JUNCTION	0.00	1.08	0 00:45	0	0.166	0.000
POC9	JUNCTION	0.00	0.07	0 02:36	0	0.0373	0.000
POC6	JUNCTION	0.00	0.08	0 03:18	0	0.0491	0.000
EDB5	STORAGE	0.00	5.83	0 00:30	0	0.153	0.001
EDB6	STORAGE	0.00	9.34	0 00:35	0	0.294	-0.001
EDB9A	STORAGE	0.00	3.99	0 00:30	0	0.0941	-0.001
EDB9B	STORAGE	0.00	0.88	0 00:30	0	0.0204	0.004
EDB8	STORAGE	0.00	11.41	0 00:30	0	0.228	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB5	12.776	11	0	0	18.982	16	0 02:34	0.23
EDB6	34.112	8	0	0	38.527	9	0 03:17	0.08
EDB9A	10.527	11	0	0	12.261	13	0 02:46	0.04
EDB9B	1.539	4	0	0	2.504	7	0 02:27	0.03
EDB8	19.846	10	0	0	28.670	14	0 02:26	0.25

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
5A	DUMMY	0.18	0 00:40			
6	DUMMY	9.34	0 00:35			
8A	DUMMY	0.87	0 00:45			
9A	DUMMY	3.99	0 00:30			
20	DUMMY	0.21	0 00:40			
5B	DUMMY	5.83	0 00:30			
8B	DUMMY	11.41	0 00:30			
9B	DUMMY	0.88	0 00:30			
1	DUMMY	13.87	0 01:20			
2	DUMMY	14.85	0 01:20			
3	DUMMY	15.03	0 01:20			
O1	DUMMY	13.87	0 01:20			
O2	DUMMY	0.77	0 00:35			
4	DUMMY	15.10	0 01:20			
15	DUMMY	0.30	0 00:40			
16	DUMMY	1.08	0 00:45			
17	DUMMY	0.07	0 02:36			
18	DUMMY	0.08	0 03:18			
EDB5_RC	DUMMY	0.23	0 02:35			
EDB6_RC	DUMMY	0.08	0 03:18			
EDB9A_RC	DUMMY	0.04	0 02:46			
EDB9B_RC	DUMMY	0.03	0 02:28			
EDB8_RC	DUMMY	0.25	0 02:26			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Mar 19 16:53:27 2025
Analysis ended on: Wed Mar 19 16:53:27 2025
Total elapsed time: < 1 sec

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

Scenario ID = 6_Fut_100yr_4mi^2_CUHP_Post

WARNING 04: minimum elevation drop used for Conduit 5A
WARNING 04: minimum elevation drop used for Conduit 6
WARNING 04: minimum elevation drop used for Conduit 8A
WARNING 04: minimum elevation drop used for Conduit 9A
WARNING 04: minimum elevation drop used for Conduit 20
WARNING 04: minimum elevation drop used for Conduit 5B
WARNING 04: minimum elevation drop used for Conduit 8B
WARNING 04: minimum elevation drop used for Conduit 9B
WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2
WARNING 04: minimum elevation drop used for Conduit 3
WARNING 04: minimum elevation drop used for Conduit O1
WARNING 04: minimum elevation drop used for Conduit O2
WARNING 04: minimum elevation drop used for Conduit 4
WARNING 04: minimum elevation drop used for Conduit 15
WARNING 04: minimum elevation drop used for Conduit 16
WARNING 04: minimum elevation drop used for Conduit 17
WARNING 04: minimum elevation drop used for Conduit 18

*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 02/06/2025 00:00:00
Ending Date .............. 02/06/2025 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       444.087       144.712
External Outflow .........       436.406       142.209
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         7.665         2.498
Continuity Error (%) .....         0.004


******************************
Highest Flow Instability Indexes
******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
5A	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
6	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
8A	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
9A	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP89	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
9B	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
8B	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
5B	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP97	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP92	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP90	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
O1	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
O2	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
DP88	JUNCTION	0.00	0.00	0.00	0 00:06	0.00
POC5	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC8	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC9	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
POC6	JUNCTION	0.00	0.00	0.00	0 00:00	0.00
EDB5	STORAGE	3.47	7.42	7.42	0 01:03	7.40
EDB6	STORAGE	6.73	8.25	8.25	0 01:59	8.25
EDB9A	STORAGE	5.53	7.43	7.43	0 01:13	7.43
EDB9B	STORAGE	3.91	5.64	5.64	0 00:56	5.63
EDB8	STORAGE	4.79	8.28	8.28	0 01:21	8.23

100-Yr ponding depth per CUHP run

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
5A	JUNCTION	31.43	31.43	0 00:45	0.929	0.929	0.000
6	JUNCTION	117.39	117.39	0 00:40	3.08	3.08	0.000
8A	JUNCTION	161.50	161.50	0 00:50	5.47	5.47	0.000
9A	JUNCTION	53.39	53.39	0 00:35	1.06	1.06	0.000
20	JUNCTION	38.57	38.57	0 00:50	1.34	1.34	0.000
DP89	JUNCTION	0.00	3062.32	0 01:20	0	139	0.000
9B	JUNCTION	11.75	11.75	0 00:35	0.229	0.229	0.000
8B	JUNCTION	101.29	101.29	0 00:35	1.83	1.83	0.000
5B	JUNCTION	63.61	63.61	0 00:35	1.44	1.44	0.000
DP97	JUNCTION	0.00	2810.50	0 01:20	0	126	0.000
DP92	JUNCTION	0.00	3000.89	0 01:20	0	136	0.000
DP90	JUNCTION	0.00	3054.29	0 01:20	0	138	0.000
O1	JUNCTION	2810.50	2810.50	0 01:20	126	126	0.000
O2	JUNCTION	134.57	134.57	0 00:40	2.92	2.92	0.000
DP88	JUNCTION	0.00	3116.12	0 01:20	0	142	0.000
POC5	JUNCTION	0.00	69.84	0 00:59	0	2.29	0.000
POC8	JUNCTION	0.00	164.68	0 00:50	0	7.07	0.000
POC9	JUNCTION	0.00	28.18	0 01:10	0	0.908	0.000
POC6	JUNCTION	0.00	19.53	0 01:59	0	1.27	0.000
EDB5	STORAGE	0.00	63.61	0 00:35	0	1.44	0.082
EDB6	STORAGE	0.00	117.39	0 00:40	0	3.08	0.049
EDB9A	STORAGE	0.00	53.39	0 00:35	0	1.06	0.086
EDB9B	STORAGE	0.00	11.75	0 00:35	0	0.229	0.146
EDB8	STORAGE	0.00	101.29	0 00:35	0	1.83	0.069

Detained Q100 at POC per CUHP run

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB5	22.362	19	0	0	79.458	67	0 01:02	42.29
EDB6	252.148	57	0	0	350.136	80	0 01:58	19.53
EDB9A	56.068	60	0	0	92.576	98	0 01:13	22.01
EDB9B	6.463	18	0	0	13.203	38	0 00:56	7.78
EDB8	78.698	39	0	0	193.008	96	0 01:21	19.10

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
5A	DUMMY	31.43	0 00:45			
6	DUMMY	117.39	0 00:40			
8A	DUMMY	161.50	0 00:50			
9A	DUMMY	53.39	0 00:35			
20	DUMMY	38.57	0 00:50			
5B	DUMMY	63.61	0 00:35			
8B	DUMMY	101.29	0 00:35			
9B	DUMMY	11.75	0 00:35			
1	DUMMY	2810.50	0 01:20			
2	DUMMY	3000.89	0 01:20			
3	DUMMY	3054.29	0 01:20			
O1	DUMMY	2810.50	0 01:20			
O2	DUMMY	134.57	0 00:40			
4	DUMMY	3062.32	0 01:20			
15	DUMMY	69.84	0 00:59			
16	DUMMY	164.68	0 00:50			
17	DUMMY	28.18	0 01:10			
18	DUMMY	19.53	0 01:59			
EDB5_RC	DUMMY	42.29	0 01:03			
EDB6_RC	DUMMY	19.53	0 01:59			
EDB9A_RC	DUMMY	22.01	0 01:13			
EDB9B_RC	DUMMY	7.78	0 00:56			
EDB8_RC	DUMMY	19.10	0 01:21			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

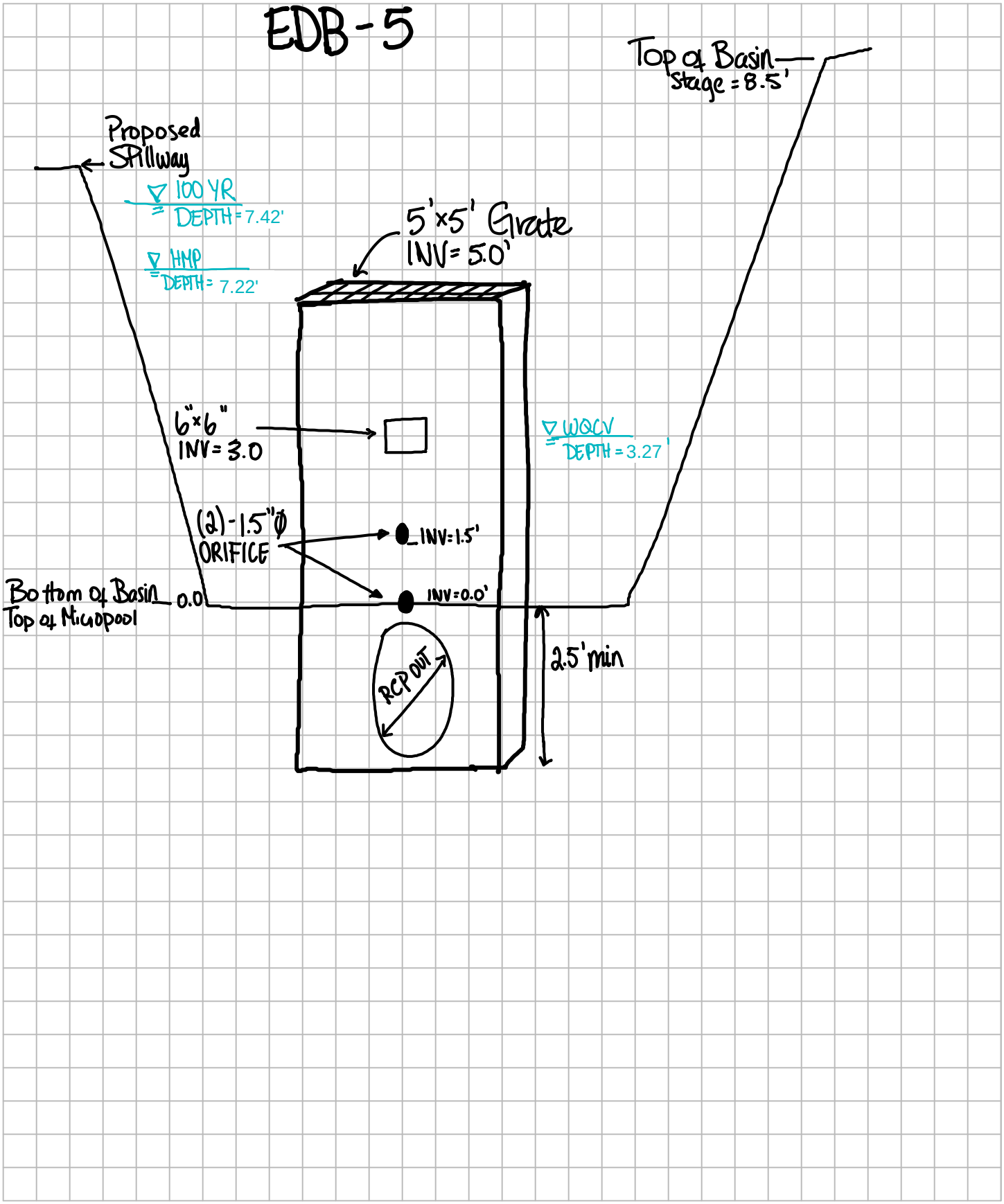
Analysis begun on: Wed Mar 19 16:58:31 2025
Analysis ended on: Wed Mar 19 16:58:31 2025
Total elapsed time: < 1 sec

6. EDB 5, 6, 8, 9A and 9B Cross Section

RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE: 8-7-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

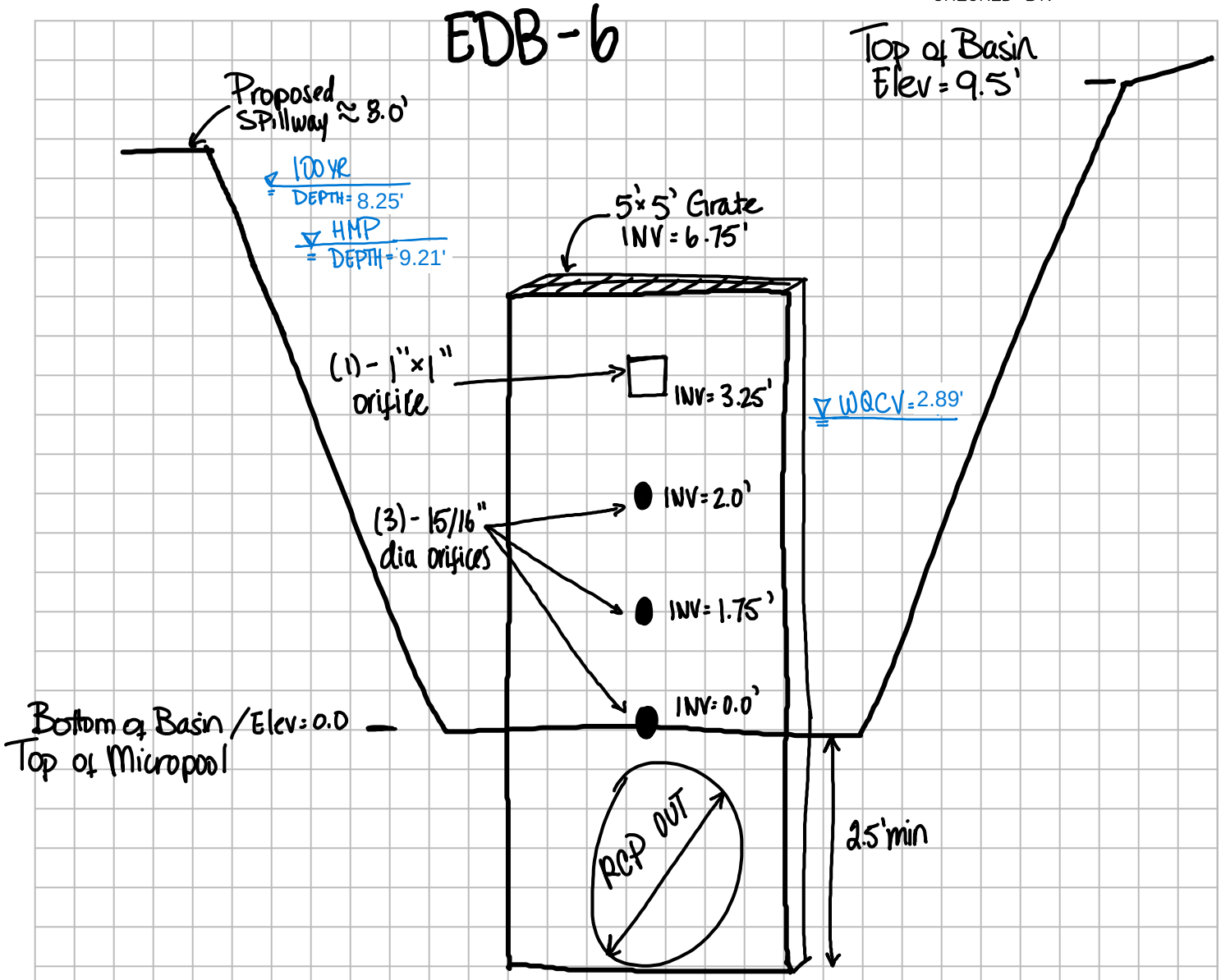
EDB-5



RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE: 8-7-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

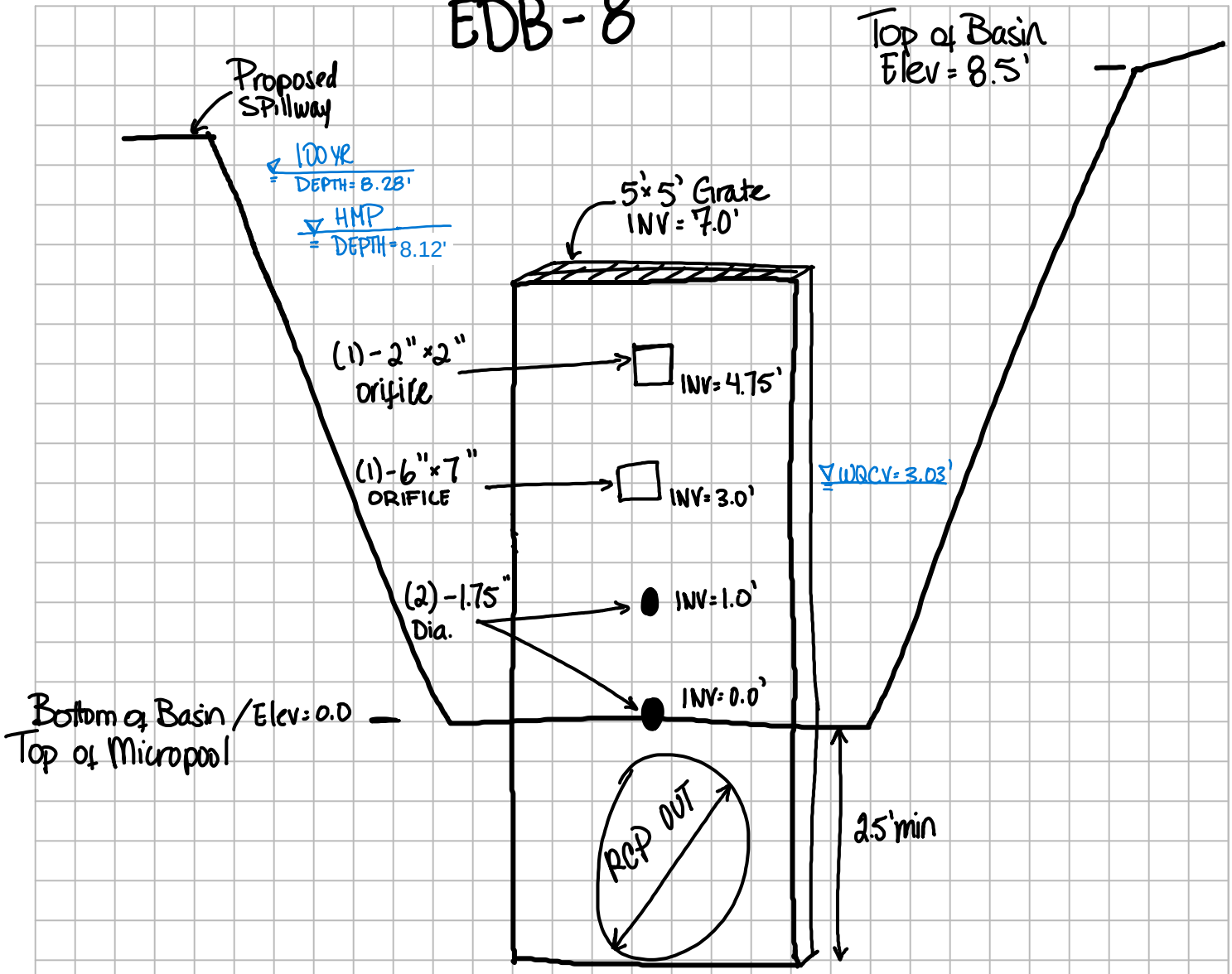
EDB-6



RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE: 8-7-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

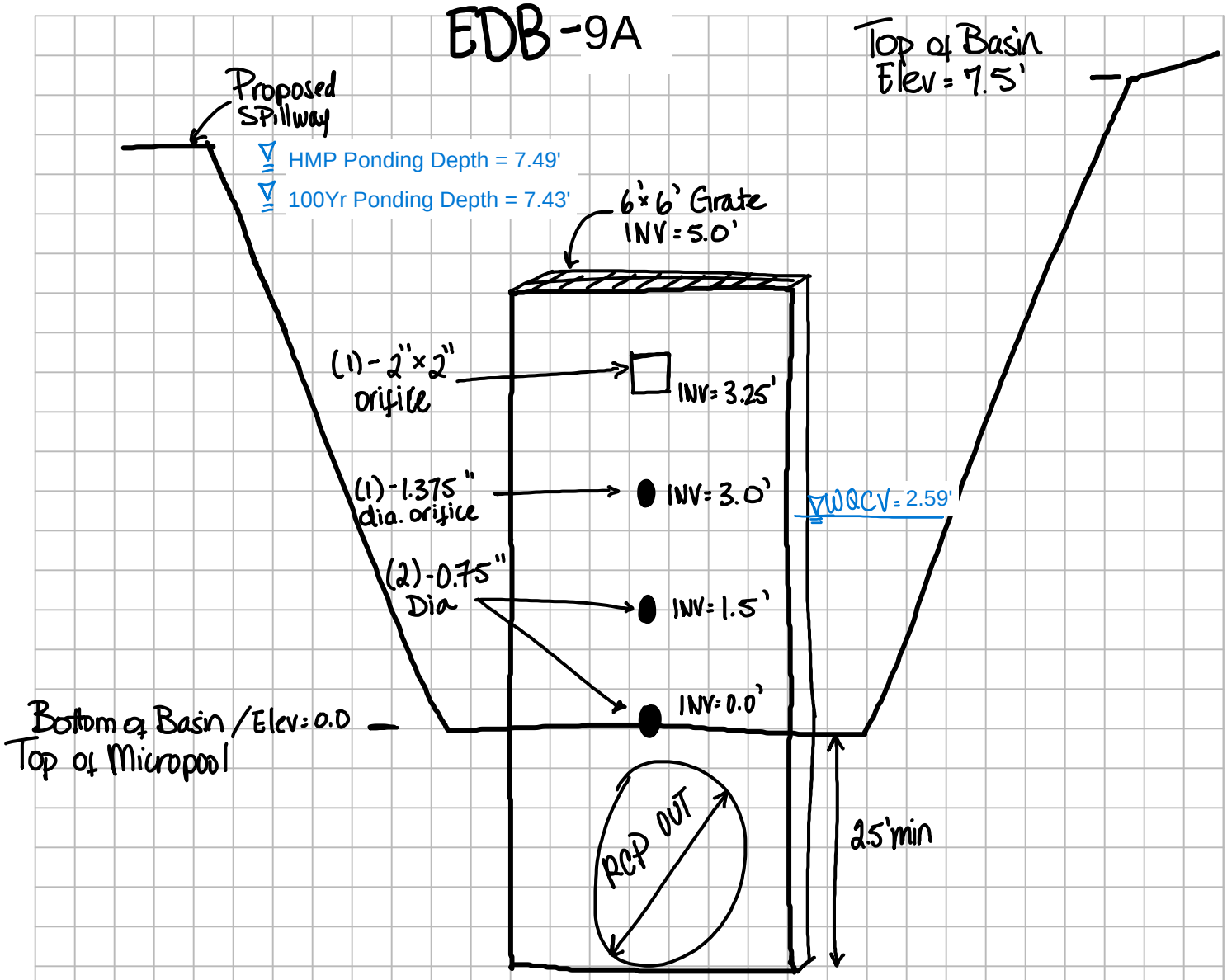
EDB-8



RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE: 8-7-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

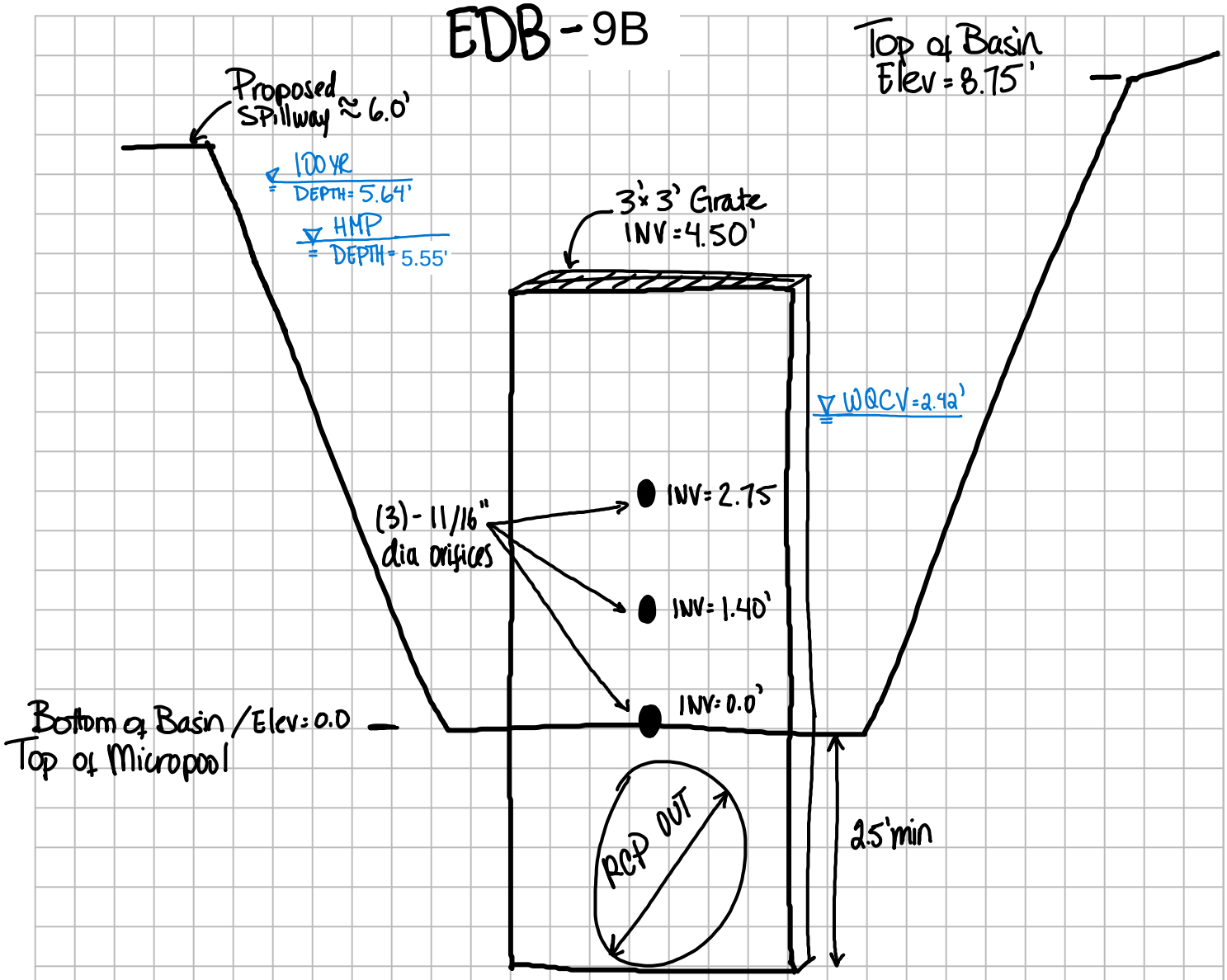
EDB-9A



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DATE: 8-7-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

EDB - 9B



7. EDB 5, 6, 8, 9A and 9B Stage Storage Discharge Table

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 1.5" dia.	1 x 1.5" dia.	None	None	None	None
# of openings	1	1	0			
Orifice Size (inches)	1.5	1.5	0			
Area Orifice (in2)	1.7671	1.7671	0.0000			
Area Orifice (ft2)	*0.01*	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*
Flowline of Orifice (ft)	0	1.500	0			

RECTANGULAR OPENINGS	1 x 6"H by 6"W	None	None	1 x 42"H by 42"W
# of openings	1	0	0	1
Height (inches)	6	0	0	42
Width (inches)	6	0	0	42
Area Orifice (ft2)	*0.25*	*0*	*0*	*12.25*
Flowline of Weir (ft)	3.00	0	0	5

Flowline (ft)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	0.000	0.000	0.000	0.000	**0.000**
0.25	0.026	-	0.000	0.000	0.000	0.000	**0.026**
0.50	0.039	-	0.000	0.000	0.000	0.000	**0.039**
0.75	0.049	-	0.000	0.000	0.000	0.000	**0.049**
1.00	0.057	-	0.000	0.000	0.000	0.000	**0.057**
1.25	0.064	-	0.000	0.000	0.000	0.000	**0.064**
1.50	0.071	No Value	0.000	0.000	0.000	0.000	**0.071**
1.75	0.077	0.026	0.000	0.000	0.000	0.000	**0.102**
2.00	0.082	0.039	0.000	0.000	0.000	0.000	**0.121**
2.25	0.087	0.049	0.000	0.000	0.000	0.000	**0.136**
2.50	0.092	0.057	0.000	0.000	0.000	0.000	**0.149**
2.75	0.097	0.064	0.000	0.000	0.000	0.000	**0.161**
3.00	0.101	0.071	0.000	0.000	0.000	0.000	**0.172**
3.25	0.105	0.077	0.000	0.000	0.000	0.000	**0.182**
3.50	0.110	0.082	0.000	0.000	0.000	0.000	**0.192**
3.75	0.113	0.087	0.000	0.000	0.000	0.000	**0.201**
4.00	0.117	0.092	0.000	0.000	0.000	0.000	**0.210**
4.25	0.121	0.097	0.000	0.000	0.000	0.000	**0.218**
4.50	0.124	0.101	0.000	0.000	0.000	0.000	**0.226**
4.75	0.128	0.105	0.000	0.000	0.000	0.000	**0.233**
5.00	0.131	0.110	0.000	0.000	0.000	0.000	**0.241**
5.25	0.135	0.113	0.000	0.000	0.000	0.000	**0.248**
5.50	0.138	0.117	0.000	0.000	0.000	0.000	**0.255**
5.75	0.141	0.121	0.000	0.000	0.000	0.000	**0.262**
6.00	0.144	0.124	0.000	0.000	0.000	0.000	**0.268**
6.25	0.147	0.128	0.000	0.000	0.000	0.000	**0.275**
6.50	0.150	0.131	0.000	0.000	0.000	0.000	**0.281**
6.75	0.153	0.135	0.000	0.000	0.000	0.000	**0.287**
7.00	0.156	0.138	0.000	0.000	0.000	0.000	**0.293**
7.25	0.158	0.141	0.000	0.000	0.000	0.000	**0.299**
7.50	0.161	0.144	0.000	0.000	0.000	0.000	**0.305**
7.75	0.164	0.147	0.000	0.000	0.000	0.000	**0.311**
8.00	0.166	0.150	0.000	0.000	0.000	0.000	**0.316**
8.25	0.169	0.153	0.000	0.000	0.000	0.000	**0.322**
8.50	0.172	0.156	0.000	0.000	0.000	0.000	**0.327**

Flowline (ft)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	-	-	-	-	-	-	-	-	-	-	**0.0**
2.50	-	-	-	-	-	-	-	-	-	-	**0.0**
2.75	-	-	-	-	-	-	-	-	-	-	**0.0**
3.00	-	-	-	-	-	-	-	-	-	-	**0.0**
3.25	0.188	0.000	0.000	-	-	-	-	-	-	-	**0.0**
3.50	0.530	0.602	0.530	-	-	-	-	-	-	-	**0.5**
3.75	0.974	0.851	0.851	-	-	-	-	-	-	-	**0.9**
4.00	1.500	1.042	1.042	-	-	-	-	-	-	-	**1.0**
4.25	2.096	1.204	1.204	-	-	-	-	-	-	-	**1.2**
4.50	2.756	1.346	1.346	-	-	-	-	-	-	-	**1.3**
4.75	3.473	1.474	1.474	-	-	-	-	-	-	-	**1.5**
5.00	4.243	1.592	1.592	-	-	-	-	-	-	-	**1.6**
5.25	5.063	1.702	1.702	-	-	-	-	-	-	1.313	**3.0**
5.50	5.929	1.806	1.806	-	-	-	-	-	-	3.712	**5.5**
5.75	6.841	1.903	1.903	-	-	-	-	-	-	6.820	**8.7**
6.00	7.794	1.996	1.996	-	-	-	-	-	-	10.500	**12.5**
6.25	8.789	2.085	2.085	-	-	-	-	-	-	14.674	**16.8**
6.50	9.822	2.170	2.170	-	-	-	-	-	-	19.290	**21.5**
6.75	10.893	2.252	2.252	-	-	-	-	-	-	24.308	**26.6**
7.00	12.000	2.331	2.331	-	-	-	-	-	-	29.698	**32.0**
7.25	13.142	2.407	2.407	-	-	-	-	-	-	35.438	**37.8**
7.50	14.319	2.482	2.482	-	-	-	-	-	-	41.505	**44.0**
7.75	15.529	2.554	2.554	-	-	-	-	-	-	47.884	**50.4**
8.00	16.771	2.623	2.623	-	-	-	-	-	-	54.560	**57.2**
8.25	18.044	2.692	2.692	-	-	-	-	-	-	61.520	**64.2**
8.50	19.348	2.758	2.758	-	-	-	-	-	-	68.753	**71.5**

Total Rating Curve for SWMM Analysis

Stage (ft)	Discharge (cfs)
0.00	0.000
0.25	0.026
0.50	0.039
0.75	0.049
1.00	0.057
1.25	0.064
1.50	0.071
1.75	0.102
2.00	0.121
2.25	0.136
2.50	0.149
2.75	0.161
3.00	0.172
3.25	0.182
3.50	0.722
3.75	1.052
4.00	1.252
4.25	1.422
4.50	1.572
4.75	1.708
5.00	1.833
5.25	3.263
5.50	5.773
5.75	8.985
6.00	12.765
6.25	17.034
6.50	21.741
6.75	26.847
7.00	32.323
7.25	38.144
7.50	44.292
7.75	50.748
8.00	57.499
8.25	64.533
8.50	71.838

Stage (ft)	Elevation (ft)	Area (sf)
0.00	5785.00	50.0
0.50	5785.50	228.2
1.00	5786.00	1,439.0
1.50	5786.50	4,516.2
2.00	5787.00	8,285.2
2.50	5787.50	11,043.2
3.00	5788.00	11,862.1
3.50	5788.50	12,413.2
4.00	5789.00	12,975.5
4.50	5789.50	13,549.0
5.00	5790.00	14,133.7
5.50	5790.50	14,729.5
6.00	5791.00	15,336.6
6.50	5791.50	15,954.8
7.00	5792.00	16,584.1
7.50	5792.50	17,223.4
8.00	5793.00	17,871.1
8.50	5793.50	18,527.4

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 0.9375" dia.	1 x 0.9375" dia.	1 x 0.9375" dia.	None	None	None
# of openings	1	1	1			
Orifice Size (inches)	0.9375	0.9375	0.9375			
Area Orifice (in2)	0.6903	0.6903	0.6903			
Area Orifice (ft2)	*0.005*	*0.005*	*0.005*	*0.00*	*0.00*	*0.00*
Flowline of Orifice (ft)	0	1.750	2			

RECTANGULAR OPENINGS	1 x 1"H by 1"W	None	None	1 x 42"H by 42"W
# of openings	1	0	0	1
Height (inches)	1	0	0	42.0
Width (inches)	1	0	0	42.0
Area Orifice (ft2)	*0.006944*	*0*	*0*	*12.25*
Flowline of Weir (ft)	3.25	0	0	6.75

Flowline (ft)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	-	0.000	0.000	0.000	**0.000**
0.25	0.011	-	-	0.000	0.000	0.000	**0.011**
0.50	0.016	-	-	0.000	0.000	0.000	**0.016**
0.75	0.019	-	-	0.000	0.000	0.000	**0.019**
1.00	0.023	-	-	0.000	0.000	0.000	**0.023**
1.25	0.025	-	-	0.000	0.000	0.000	**0.025**
1.50	0.028	-	-	0.000	0.000	0.000	**0.028**
1.75	0.030	No Value	-	0.000	0.000	0.000	**0.030**
2.00	0.032	0.011	No Value	0.000	0.000	0.000	**0.043**
2.25	0.034	0.016	0.011	0.000	0.000	0.000	**0.061**
2.50	0.036	0.019	0.016	0.000	0.000	0.000	**0.071**
2.75	0.038	0.023	0.019	0.000	0.000	0.000	**0.080**
3.00	0.040	0.025	0.023	0.000	0.000	0.000	**0.088**
3.25	0.041	0.028	0.025	0.000	0.000	0.000	**0.095**
3.50	0.043	0.030	0.028	0.000	0.000	0.000	**0.101**
3.75	0.044	0.032	0.030	0.000	0.000	0.000	**0.107**
4.00	0.046	0.034	0.032	0.000	0.000	0.000	**0.113**
4.25	0.047	0.036	0.034	0.000	0.000	0.000	**0.118**
4.50	0.049	0.038	0.036	0.000	0.000	0.000	**0.123**
4.75	0.050	0.040	0.038	0.000	0.000	0.000	**0.128**
5.00	0.051	0.041	0.040	0.000	0.000	0.000	**0.132**
5.25	0.053	0.043	0.041	0.000	0.000	0.000	**0.137**
5.50	0.054	0.044	0.043	0.000	0.000	0.000	**0.141**
5.75	0.055	0.046	0.044	0.000	0.000	0.000	**0.146**
6.00	0.056	0.047	0.046	0.000	0.000	0.000	**0.150**
6.25	0.058	0.049	0.047	0.000	0.000	0.000	**0.154**
6.50	0.059	0.050	0.049	0.000	0.000	0.000	**0.158**
6.75	0.060	0.051	0.050	0.000	0.000	0.000	**0.161**
7.00	0.061	0.053	0.051	0.000	0.000	0.000	**0.165**
7.25	0.062	0.054	0.053	0.000	0.000	0.000	**0.169**
7.50	0.063	0.055	0.054	0.000	0.000	0.000	**0.172**
7.75	0.064	0.056	0.055	0.000	0.000	0.000	**0.176**
8.00	0.065	0.058	0.056	0.000	0.000	0.000	**0.179**
8.25	0.066	0.059	0.058	0.000	0.000	0.000	**0.182**
8.50	0.067	0.060	0.059	0.000	0.000	0.000	**0.186**
8.75	0.068	0.061	0.060	0.000	0.000	0.000	**0.189**
9.00	0.069	0.062	0.061	0.000	0.000	0.000	**0.192**
9.25	0.070	0.063	0.062	0.000	0.000	0.000	**0.195**
9.50	0.071	0.064	0.063	0.000	0.000	0.000	**0.198**

Flowline (ft)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	-	-	-	-	-	-	-	-	-	-	**0.0**
2.50	-	-	-	-	-	-	-	-	-	-	**0.0**
2.75	-	-	-	-	-	-	-	-	-	-	**0.0**
3.00	-	-	-	-	-	-	-	-	-	-	**0.0**
3.25	-	-	-	-	-	-	-	-	-	-	**0.0**
3.50	0.031	0.015	0.015	-	-	-	-	-	-	-	**0.0**
3.75	0.088	0.023	0.023	-	-	-	-	-	-	-	**0.0**
4.00	0.162	0.028	0.028	-	-	-	-	-	-	-	**0.0**
4.25	0.250	0.033	0.033	-	-	-	-	-	-	-	**0.0**
4.50	0.349	0.037	0.037	-	-	-	-	-	-	-	**0.0**
4.75	0.459	0.040	0.040	-	-	-	-	-	-	-	**0.0**
5.00	0.579	0.044	0.044	-	-	-	-	-	-	-	**0.0**
5.25	0.707	0.047	0.047	-	-	-	-	-	-	-	**0.0**
5.50	0.844	0.050	0.050	-	-	-	-	-	-	-	**0.0**
5.75	0.988	0.052	0.052	-	-	-	-	-	-	-	**0.1**
6.00	1.140	0.055	0.055	-	-	-	-	-	-	-	**0.1**
6.25	1.299	0.058	0.058	-	-	-	-	-	-	-	**0.1**
6.50	1.465	0.060	0.060	-	-	-	-	-	-	-	**0.1**
6.75	1.637	0.062	0.062	-	-	-	-	-	-	-	**0.1**
7.00	1.815	0.064	0.064	-	-	-	-	-	-	1.313	**1.4**
7.25	2.000	0.067	0.067	-	-	-	-	-	-	3.712	**3.8**
7.50	2.190	0.069	0.069	-	-	-	-	-	-	6.820	**6.9**
7.75	2.386	0.071	0.071	-	-	-	-	-	-	10.500	**10.6**
8.00	2.588	0.073	0.073	-	-	-	-	-	-	14.674	**14.7**
8.25	2.795	0.074	0.074	-	-	-	-	-	-	19.290	**19.4**
8.50	3.007	0.076	0.076	-	-	-	-	-	-	24.308	**24.4**
8.75	3.225	0.078	0.078	-	-	-	-	-	-	29.698	**29.8**
9.00	3.447	0.080	0.080	-	-	-	-	-	-	35.438	**35.5**
9.25	3.674	0.082	0.082	-	-	-	-	-	-	41.505	**41.6**
9.50	3.906	0.083	0.083	-	-	-	-	-	-	47.884	**48.0**

Total Rating Curve for SWMM Analysis

Stage (ft)	Discharge (cfs)
0.00	0.000
0.25	0.011
0.50	0.016
0.75	0.019
1.00	0.023
1.25	0.025
1.50	0.028
1.75	0.030
2.00	0.043
2.25	0.061
2.50	0.071
2.75	0.080
3.00	0.088
3.25	0.095
3.50	0.116
3.75	0.130
4.00	0.141
4.25	0.151
4.50	0.160
4.75	0.168
5.00	0.176
5.25	0.184
5.50	0.191
5.75	0.198
6.00	0.205
6.25	0.211
6.50	0.217
6.75	0.223
7.00	1.542
7.25	3.947
7.50	7.061
7.75	10.746
8.00	14.926
8.25	19.547
8.50	24.570
8.75	29.965
9.00	35.709
9.25	41.782
9.50	48.165

Stage-Storage Curve

Stage (ft)	Elevation (ft)	Area (sf)
0.00	5,738.5	49.0
0.50	5,739.0	472.2
1.00	5,739.5	3,271.8
1.50	5,740.0	10,019.2
2.00	5,740.5	19,869.3
2.50	5,741.0	31,626.4
3.00	5,741.5	42,038.9
3.50	5,742.0	48,902.6
4.00	5,742.5	51,957.2
4.50	5,743.0	54,010.8
5.00	5,743.5	56,099.7
5.50	5,744.0	58,224.1
6.00	5,744.5	60,384.0
6.50	5,745.0	62,579.3
7.00	5,745.5	64,810.1
7.50	5,746.0	67,076.3
8.00	5,746.5	68,828.4
8.50	5,747.0	70,583.1
9.00	5,747.5	72,364.4
9.50	5,748.0	74,172.2

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 1.75" dia.	1 x 1.75" dia.	None	None	None	None
# of openings	1	1	0			
Orifice Size (inches)	1.75	1.75	0			
Area Orifice (in2)	2.4053	2.4053	0.0000			
Area Orifice (ft2)	*0.02*	*0.02*	*0.00*	*0.00*	*0.00*	*0.00*
Flowline of Orifice (ft)	0	1.000	0			

RECTANGULAR OPENINGS	1 x 6"H by 7"W	1 x 2"H by 2"W	None	1 x 42"H by 42"W
# of openings	1	1	0	1
Height (inches)	6	2	0	42
Width (inches)	7	2	0	42
Area Orifice (ft2)	*0.291667*	*0.027778*	*0*	*12.25*
Area Orifice (in2)	42.0000	4.0000		
Flowline of Weir (ft)	3.00	4.75	0	7

Flowline (ft)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	0.000	0.000	0.000	0.000	**0.000**
0.25	0.034	-	0.000	0.000	0.000	0.000	**0.034**
0.50	0.053	-	0.000	0.000	0.000	0.000	**0.053**
0.75	0.066	-	0.000	0.000	0.000	0.000	**0.066**
1.00	0.077	No Value	0.000	0.000	0.000	0.000	**0.077**
1.25	0.087	0.034	0.000	0.000	0.000	0.000	**0.121**
1.50	0.096	0.053	0.000	0.000	0.000	0.000	**0.149**
1.75	0.104	0.066	0.000	0.000	0.000	0.000	**0.170**
2.00	0.112	0.077	0.000	0.000	0.000	0.000	**0.189**
2.25	0.119	0.087	0.000	0.000	0.000	0.000	**0.206**
2.50	0.125	0.096	0.000	0.000	0.000	0.000	**0.221**
2.75	0.132	0.104	0.000	0.000	0.000	0.000	**0.236**
3.00	0.138	0.112	0.000	0.000	0.000	0.000	**0.249**
3.25	0.143	0.119	0.000	0.000	0.000	0.000	**0.262**
3.50	0.149	0.125	0.000	0.000	0.000	0.000	**0.274**
3.75	0.154	0.132	0.000	0.000	0.000	0.000	**0.286**
4.00	0.159	0.138	0.000	0.000	0.000	0.000	**0.297**
4.25	0.164	0.143	0.000	0.000	0.000	0.000	**0.308**
4.50	0.169	0.149	0.000	0.000	0.000	0.000	**0.318**
4.75	0.174	0.154	0.000	0.000	0.000	0.000	**0.328**
5.00	0.179	0.159	0.000	0.000	0.000	0.000	**0.338**
5.25	0.183	0.164	0.000	0.000	0.000	0.000	**0.347**
5.50	0.187	0.169	0.000	0.000	0.000	0.000	**0.357**
5.75	0.192	0.174	0.000	0.000	0.000	0.000	**0.366**
6.00	0.196	0.179	0.000	0.000	0.000	0.000	**0.374**
6.25	0.200	0.183	0.000	0.000	0.000	0.000	**0.383**
6.50	0.204	0.187	0.000	0.000	0.000	0.000	**0.391**
6.75	0.208	0.192	0.000	0.000	0.000	0.000	**0.399**
7.00	0.212	0.196	0.000	0.000	0.000	0.000	**0.407**
7.25	0.215	0.200	0.000	0.000	0.000	0.000	**0.415**
7.50	0.219	0.204	0.000	0.000	0.000	0.000	**0.423**
7.75	0.223	0.208	0.000	0.000	0.000	0.000	**0.431**
8.00	0.226	0.212	0.000	0.000	0.000	0.000	**0.438**
8.25	0.230	0.215	0.000	0.000	0.000	0.000	**0.445**
8.50	0.233	0.219	0.000	0.000	0.000	0.000	**0.453**
8.75	0.237	0.223	0.000	0.000	0.000	0.000	**0.460**
9.00	0.240	0.226	0.000	0.000	0.000	0.000	**0.467**
9.25	0.244	0.230	0.000	0.000	0.000	0.000	**0.474**
9.50	0.247	0.233	0.000	0.000	0.000	0.000	**0.480**

Flowline (ft)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_w (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	-	-	-	-	-	-	-	-	-	-	**0.0**
2.50	-	-	-	-	-	-	-	-	-	-	**0.0**
2.75	-	-	-	-	-	-	-	-	-	-	**0.0**
3.00	-	-	-	-	-	-	-	-	-	-	**0.0**
3.25	0.219	0.000	0.000	-	-	-	-	-	-	-	**0.0**
3.50	0.619	0.702	0.619	-	-	-	-	-	-	-	**0.6**
3.75	1.137	0.993	0.993	-	-	-	-	-	-	-	**1.0**
4.00	1.750	1.216	1.216	-	-	-	-	-	-	-	**1.2**
4.25	2.446	1.404	1.404	-	-	-	-	-	-	-	**1.4**
4.50	3.215	1.570	1.570	-	-	-	-	-	-	-	**1.6**
4.75	4.051	1.720	1.720	-	-	-	-	-	-	-	**1.7**
5.00	4.950	1.858	1.858	0.063	0.055	0.055	-	-	-	-	**1.9**
5.25	5.906	1.986	1.986	0.177	0.086	0.086	-	-	-	-	**2.1**
5.50	6.917	2.107	2.107	0.325	0.109	0.109	-	-	-	-	**2.2**
5.75	7.981	2.221	2.221	0.500	0.128	0.128	-	-	-	-	**2.3**
6.00	9.093	2.329	2.329	0.699	0.144	0.144	-	-	-	-	**2.5**
6.25	10.253	2.432	2.432	0.919	0.159	0.159	-	-	-	-	**2.6**
6.50	11.459	2.532	2.532	1.158	0.173	0.173	-	-	-	-	**2.7**
6.75	12.708	2.627	2.627	1.414	0.185	0.185	-	-	-	-	**2.8**
7.00	14.000	2.720	2.720	1.688	0.197	0.197	-	-	-	-	**2.9**
7.25	15.333	2.809	2.809	1.976	0.208	0.208	-	-	-	1.313	**4.3**
7.50	16.705	2.895	2.895	2.280	0.218	0.218	-	-	-	3.712	**6.8**
7.75	18.117	2.979	2.979	2.598	0.228	0.228	-	-	-	6.820	**10.0**
8.00	19.566	3.061	3.061	2.930	0.238	0.238	-	-	-	10.500	**13.8**
8.25	21.051	3.140	3.140	3.274	0.247	0.247	-	-	-	14.674	**18.1**
8.50	22.573	3.218	3.218	3.631	0.256	0.256	-	-	-	19.290	**22.8**
8.75	24.129	3.294	3.294	4.000	0.265	0.265	-	-	-	24.308	**27.9**
9.00	25.720	3.368	3.368	4.381	0.273	0.273	-	-	-	29.698	**33.3**
9.25	27.344	3.440	3.440	4.773	0.281	0.281	-	-	-	35.438	**39.2**
9.50	29.001	3.511	3.511	5.176	0.289	0.289	-	-	-	41.505	**45.3**

Total Rating Curve for SWMM Analysis

Stage (ft)	Discharge (cfs)
0.00	0.000
0.25	0.034
0.50	0.053
0.75	0.066
1.00	0.077
1.25	0.121
1.50	0.149
1.75	0.170
2.00	0.189
2.25	0.206
2.50	0.221
2.75	0.236
3.00	0.249
3.25	0.262
3.50	0.893
3.75	1.279
4.00	1.513
4.25	1.712
4.50	1.888
4.75	2.048
5.00	2.250
5.25	2.420
5.50	2.572
5.75	2.714
6.00	2.848
6.25	2.975
6.50	3.096
6.75	3.212
7.00	3.324
7.25	4.745
7.50	7.249
7.75	10.458
8.00	14.237
8.25	18.507
8.50	23.216
8.75	28.326
9.00	33.806
9.25	39.632
9.50	45.785

Elevation (ft)	Stage (ft)	Area (sf)
5770.50	0.00	106.0
5770.75	0.25	234.7
5771.00	0.50	609.5
5771.25	0.75	1,587.7
5771.50	1.00	3,144.8
5771.75	1.25	5,271.1
5772.00	1.50	8,092.4
5772.25	1.75	11,101.1
5772.50	2.00	13,866.6
5772.75	2.25	16,564.0
5773.00	2.50	19,035.1
5773.25	2.75	21,132.8
5773.50	3.00	22,804.2
5773.75	3.25	24,079.5
5774.00	3.50	24,897.2
5774.25	3.75	25,604.4
5774.50	4.00	26,317.6
5774.75	4.25	27,036.7
5775.00	4.50	27,761.7
5775.25	4.75	28,492.6
5775.50	5.00	29,229.5
5775.75	5.25	29,972.3
5776.00	5.50	30,721.0
5776.25	5.75	31,475.6
5776.50	6.00	32,236.2
5776.75	6.25	33,002.6
5777.00	6.50	33,775.1
5777.25	6.75	34,553.4
5777.50	7.00	35,337.6
5777.75	7.25	36,127.8
5778.00	7.50	36,923.9
5778.25	7.75	37,725.9
5778.50	8.00	38,533.9
5778.75	8.25	39,347.7
5779.00	8.50	40,167.5

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 0.75" dia.	1 x 0.75" dia.	None	None	None	None
# of openings	1	1				
Orifice Size (inches)	0.75	0.75				
Area Orifice (in2)	0.3712	0.3712	0.3712			
Area Orifice (ft2)	*0.003*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Flowline of Orifice (ft)	0	1.500				

RECTANGULAR OPENINGS	1 x 2"H by 2"W	None	None	1 x 50.4"H by 50.4"W
# of openings	1		0	1
Height (inches)	2		0	50.4
Width (inches)	2		0	50.4
Area Orifice (ft2)	*0.027778*	*0*	*0*	*17.64*
Flowline of Weir (ft)	3.25			6

Flowline (ft)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	0.000	0.000	0.000	0.000	**0.000**
0.25	0.007	-	0.000	0.000	0.000	0.000	**0.007**
0.50	0.010	-	0.000	0.000	0.000	0.000	**0.010**
0.75	0.013	-	0.000	0.000	0.000	0.000	**0.013**
1.00	0.015	-	0.000	0.000	0.000	0.000	**0.015**
1.25	0.016	-	0.000	0.000	0.000	0.000	**0.016**
1.50	0.018	No Value	0.000	0.000	0.000	0.000	**0.018**
1.75	0.019	0.007	0.000	0.000	0.000	0.000	**0.026**
2.00	0.021	0.010	0.000	0.000	0.000	0.000	**0.031**
2.25	0.022	0.013	0.000	0.000	0.000	0.000	**0.035**
2.50	0.023	0.015	0.000	0.000	0.000	0.000	**0.038**
2.75	0.024	0.016	0.000	0.000	0.000	0.000	**0.041**
3.00	0.025	0.018	0.000	0.000	0.000	0.000	**0.043**
3.25	0.027	0.019	0.000	0.000	0.000	0.000	**0.046**
3.50	0.028	0.021	0.000	0.000	0.000	0.000	**0.048**
3.75	0.028	0.022	0.000	0.000	0.000	0.000	**0.050**
4.00	0.029	0.023	0.000	0.000	0.000	0.000	**0.053**
4.25	0.030	0.024	0.000	0.000	0.000	0.000	**0.055**
4.50	0.031	0.025	0.000	0.000	0.000	0.000	**0.057**
4.75	0.032	0.027	0.000	0.000	0.000	0.000	**0.059**
5.00	0.033	0.028	0.000	0.000	0.000	0.000	**0.060**
5.25	0.034	0.028	0.000	0.000	0.000	0.000	**0.062**
5.50	0.035	0.029	0.000	0.000	0.000	0.000	**0.064**
5.75	0.035	0.030	0.000	0.000	0.000	0.000	**0.066**
6.00	0.036	0.031	0.000	0.000	0.000	0.000	**0.067**
6.25	0.037	0.032	0.000	0.000	0.000	0.000	**0.069**
6.50	0.038	0.033	0.000	0.000	0.000	0.000	**0.070**
6.75	0.038	0.034	0.000	0.000	0.000	0.000	**0.072**
7.00	0.039	0.035	0.000	0.000	0.000	0.000	**0.074**
7.25	0.040	0.035	0.000	0.000	0.000	0.000	**0.075**
7.50	0.040	0.036	0.000	0.000	0.000	0.000	**0.076**
7.75	0.041	0.037	0.000	0.000	0.000	0.000	**0.078**
8.00	0.042	0.038	0.000	0.000	0.000	0.000	**0.079**
8.25	0.042	0.038	0.000	0.000	0.000	0.000	**0.081**
8.50	0.043	0.039	0.000	0.000	0.000	0.000	**0.082**
8.75	0.044	0.040	0.000	0.000	0.000	0.000	**0.083**
9.00	0.044	0.040	0.000	0.000	0.000	0.000	**0.085**
9.25	0.045	0.041	0.000	0.000	0.000	0.000	**0.086**
9.50	0.045	0.042	0.000	0.000	0.000	0.000	**0.087**

Flowline (ft)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	-	-	-	-	-	-	-	-	-	-	**0.0**
2.50	-	-	-	-	-	-	-	-	-	-	**0.0**
2.75	-	-	-	-	-	-	-	-	-	-	**0.0**
3.00	-	-	-	-	-	-	-	-	-	-	**0.0**
3.25	-	-	-	-	-	-	-	-	-	-	**0.0**
3.50	0.063	0.055	0.055	-	-	-	-	-	-	-	**0.1**
3.75	0.177	0.086	0.086	-	-	-	-	-	-	-	**0.1**
4.00	0.325	0.109	0.109	-	-	-	-	-	-	-	**0.1**
4.25	0.500	0.128	0.128	-	-	-	-	-	-	-	**0.1**
4.50	0.699	0.144	0.144	-	-	-	-	-	-	-	**0.1**
4.75	0.919	0.159	0.159	-	-	-	-	-	-	-	**0.2**
5.00	1.158	0.173	0.173	-	-	-	-	-	-	-	**0.2**
5.25	1.414	0.185	0.185	-	-	-	-	-	-	-	**0.2**
5.50	1.688	0.197	0.197	-	-	-	-	-	-	-	**0.2**
5.75	1.976	0.208	0.208	-	-	-	-	-	-	-	**0.2**
6.00	2.280	0.218	0.218	-	-	-	-	-	-	-	**0.2**
6.25	2.598	0.228	0.228	-	-	-	-	-	-	1.575	**1.8**
6.50	2.930	0.238	0.238	-	-	-	-	-	-	4.455	**4.7**
6.75	3.274	0.247	0.247	-	-	-	-	-	-	8.184	**8.4**
7.00	3.631	0.256	0.256	-	-	-	-	-	-	12.600	**12.9**
7.25	4.000	0.265	0.265	-	-	-	-	-	-	17.609	**17.9**
7.50	4.381	0.273	0.273	-	-	-	-	-	-	23.148	**23.4**
7.75	4.773	0.281	0.281	-	-	-	-	-	-	29.169	**29.5**
8.00	5.176	0.289	0.289	-	-	-	-	-	-	35.638	**35.9**
8.25	5.590	0.297	0.297	-	-	-	-	-	-	42.525	**42.8**
8.50	6.015	0.304	0.304	-	-	-	-	-	-	49.806	**50.1**
8.75	6.449	0.311	0.311	-	-	-	-	-	-	57.461	**57.8**
9.00	6.894	0.318	0.318	-	-	-	-	-	-	65.472	**65.8**
9.25	7.348	0.325	0.325	-	-	-	-	-	-	73.824	**74.1**
9.50	7.813	0.332	0.332	-	-	-	-	-	-	82.504	**82.8**

Total Rating Curve for SWMM Analysis

Stage (ft)	Discharge (cfs)
0.00	0.000
0.25	0.007
0.50	0.010
0.75	0.013
1.00	0.015
1.25	0.016
1.50	0.018
1.75	0.026
2.00	0.031
2.25	0.035
2.50	0.038
2.75	0.041
3.00	0.043
3.25	0.046
3.50	0.103
3.75	0.137
4.00	0.162
4.25	0.183
4.50	0.201
4.75	0.218
5.00	0.233
5.25	0.247
5.50	0.261
5.75	0.274
6.00	0.286
6.25	1.872
6.50	4.763
6.75	8.503
7.00	12.930
7.25	17.949
7.50	23.497
7.75	29.528
8.00	36.006
8.25	42.902
8.50	50.192
8.75	57.855
9.00	65.875
9.25	74.235
9.50	82.923

Elevation (ft)	Stage (ft)	Area (sf)
5,794.5	0.0	16.7
5,794.8	0.3	130.8
5,795.0	0.5	273.2
5,795.3	0.8	765.8
5,795.5	1.0	1,834.4
5,795.8	1.3	3,377.2
5,796.0	1.5	5,361.3
5,796.3	1.8	7,458.6
5,796.5	2.0	9,226.7
5,796.8	2.3	10,607.9
5,797.0	2.5	11,558.1
5,797.3	2.8	12,126.6
5,797.5	3.0	12,575.6
5,797.8	3.3	13,032.1
5,798.0	3.5	13,496.1
5,798.3	3.8	13,967.5
5,798.5	4.0	14,446.5
5,798.8	4.3	14,933.3
5,799.0	4.5	15,427.9
5,799.3	4.8	15,930.1
5,799.5	5.0	16,440.1
5,799.8	5.3	16,957.8
5,800.0	5.5	17,483.2
5,800.3	5.8	18,016.4
5,800.5	6.0	18,557.3
5,800.8	6.3	19,105.9
5,801.0	6.5	19,662.2
5,801.3	6.8	20,225.4
5,801.5	7.0	20,795.2
5,801.8	7.3	21,371.3
5,802.0	7.5	21,954.0

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 0.6875" dia.	1 x 0.6875" dia.	1 x 0.6875" dia.	None	None	None
# of openings	1	1	1			
Orifice Size (inches)	0.6875	0.6875	0.6875			
Area Orifice (in2)	0.3712	0.3712	0.3712			
Area Orifice (ft2)	*0.003*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Flowline of Orifice (ft)	0	1.400	2.75			

RECTANGULAR OPENINGS	None	None	None	1 x 25.2"H by 25.2"W
# of openings	0	0	0	1
Height (inches)	0	0	0	25.2
Width (inches)	0	0	0	25.2
Area Orifice (ft2)	*0*	*0*	*0*	*4.41*
Flowline of Weir (ft)	3.00	0	0	4.5

Flowline (ft)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	-	0.000	0.000	0.000	**0.000**
0.25	0.006	-	-	0.000	0.000	0.000	**0.006**
0.50	0.009	-	-	0.000	0.000	0.000	**0.009**
0.75	0.011	-	-	0.000	0.000	0.000	**0.011**
1.00	0.012	-	-	0.000	0.000	0.000	**0.012**
1.25	0.014	-	-	0.000	0.000	0.000	**0.014**
1.50	0.015	0.003	-	0.000	0.000	0.000	**0.018**
1.75	0.016	0.007	-	0.000	0.000	0.000	**0.023**
2.00	0.017	0.009	-	0.000	0.000	0.000	**0.027**
2.25	0.019	0.011	-	0.000	0.000	0.000	**0.030**
2.50	0.020	0.013	-	0.000	0.000	0.000	**0.032**
2.75	0.020	0.014	No Value	0.000	0.000	0.000	**0.035**
3.00	0.021	0.016	0.006	0.000	0.000	0.000	**0.043**
3.25	0.022	0.017	0.009	0.000	0.000	0.000	**0.048**
3.50	0.023	0.018	0.011	0.000	0.000	0.000	**0.052**
3.75	0.024	0.019	0.012	0.000	0.000	0.000	**0.055**
4.00	0.025	0.020	0.014	0.000	0.000	0.000	**0.058**
4.25	0.026	0.021	0.015	0.000	0.000	0.000	**0.061**
4.50	0.026	0.022	0.016	0.000	0.000	0.000	**0.064**
4.75	0.027	0.023	0.017	0.000	0.000	0.000	**0.067**
5.00	0.028	0.023	0.019	0.000	0.000	0.000	**0.070**
5.25	0.028	0.024	0.020	0.000	0.000	0.000	**0.072**
5.50	0.029	0.025	0.020	0.000	0.000	0.000	**0.075**
5.75	0.030	0.026	0.021	0.000	0.000	0.000	**0.077**
6.00	0.030	0.027	0.022	0.000	0.000	0.000	**0.079**
6.25	0.031	0.027	0.023	0.000	0.000	0.000	**0.081**
6.50	0.032	0.028	0.024	0.000	0.000	0.000	**0.083**
6.75	0.032	0.029	0.025	0.000	0.000	0.000	**0.086**
7.00	0.033	0.029	0.026	0.000	0.000	0.000	**0.088**
7.25	0.033	0.030	0.026	0.000	0.000	0.000	**0.090**
7.50	0.034	0.031	0.027	0.000	0.000	0.000	**0.091**
7.75	0.034	0.031	0.028	0.000	0.000	0.000	**0.093**
8.00	0.035	0.032	0.028	0.000	0.000	0.000	**0.095**
8.25	0.036	0.032	0.029	0.000	0.000	0.000	**0.097**
8.50	0.036	0.033	0.030	0.000	0.000	0.000	**0.099**
8.75	0.037	0.034	0.030	0.000	0.000	0.000	**0.101**

Flowline (ft)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	-	-	-	-	-	-	-	-	-	-	**0.0**
2.50	-	-	-	-	-	-	-	-	-	-	**0.0**
2.75	-	-	-	-	-	-	-	-	-	-	**0.0**
3.00	-	-	-	-	-	-	-	-	-	-	**0.0**
3.25	-	-	-	-	-	-	-	-	-	-	**0.0**
3.50	-	-	-	-	-	-	-	-	-	-	**0.0**
3.75	-	-	-	-	-	-	-	-	-	-	**0.0**
4.00	-	-	-	-	-	-	-	-	-	-	**0.0**
4.25	-	-	-	-	-	-	-	-	-	-	**0.0**
4.50	-	-	-	-	-	-	-	-	-	-	**0.0**
4.75	-	-	-	-	-	-	-	-	-	0.788	**0.8**
5.00	-	-	-	-	-	-	-	-	-	2.227	**2.2**
5.25	-	-	-	-	-	-	-	-	-	4.092	**4.1**
5.50	-	-	-	-	-	-	-	-	-	6.300	**6.3**
5.75	-	-	-	-	-	-	-	-	-	8.805	**8.8**
6.00	-	-	-	-	-	-	-	-	-	11.574	**11.6**
6.25	-	-	-	-	-	-	-	-	-	14.585	**14.6**
6.50	-	-	-	-	-	-	-	-	-	17.819	**17.8**
6.75	-	-	-	-	-	-	-	-	-	21.263	**21.3**
7.00	-	-	-	-	-	-	-	-	-	24.903	**24.9**
7.25	-	-	-	-	-	-	-	-	-	28.730	**28.7**
7.50	-	-	-	-	-	-	-	-	-	32.736	**32.7**
7.75	-	-	-	-	-	-	-	-	-	36.912	**36.9**
8.00	-	-	-	-	-	-	-	-	-	41.252	**41.3**
8.25	-	-	-	-	-	-	-	-	-	45.750	**45.7**
8.50	-	-	-	-	-	-	-	-	-	50.400	**50.4**
8.75	-	-	-	-	-	-	-	-	-	55.198	**55.2**

Total Rating Curve for SWMM Analysis

Stage (ft)	Discharge (cfs)
0.00	0.000
0.25	0.006
0.50	0.009
0.75	0.011
1.00	0.012
1.25	0.014
1.50	0.018
1.75	0.023
2.00	0.027
2.25	0.030
2.50	0.032
2.75	0.035
3.00	0.043
3.25	0.048
3.50	0.052
3.75	0.055
4.00	0.058
4.25	0.061
4.50	0.064
4.75	0.855
5.00	2.297
5.25	4.164
5.50	6.375
5.75	8.881
6.00	11.653
6.25	14.666
6.50	17.903
6.75	21.348
7.00	24.991
7.25	28.820
7.50	32.827
7.75	37.005
8.00	41.347
8.25	45.847
8.50	50.499
8.75	55.299

Elevation (ft)	Stage (ft)	Area (sf)
5,755.3	0.00	92.0
5,755.5	0.25	149.8
5,755.8	0.50	336.6
5,756.0	0.75	777.9
5,756.3	1.00	1,003.9
5,756.5	1.25	1,152.6
5,756.8	1.50	1,304.6
5,757.0	1.75	1,463.8
5,757.3	2.00	1,630.2
5,757.5	2.25	1,803.8
5,757.8	2.50	1,984.8
5,758.0	2.75	2,173.2
5,758.3	3.00	2,369.2
5,758.5	3.25	2,573.0
5,758.8	3.50	2,784.6
5,759.0	3.75	3,004.3
5,759.3	4.00	3,232.3
5,759.5	4.25	3,468.8
5,759.8	4.50	3,714.1
5,760.0	4.75	3,968.4
5,760.3	5.00	4,232.0
5,760.5	5.25	4,505.1
5,760.8	5.50	4,787.7
5,761.0	5.75	5,080.7
5,761.3	6.00	5,384.1
5,761.5	6.25	5,698.4
5,761.8	6.50	6,023.7
5,762.0	6.75	6,360.1
5,762.3	7.00	6,707.5
5,762.5	7.25	7,066.0
5,762.8	7.50	7,437.9
5,763.0	7.75	7,787.0
5,763.3	8.00	8,128.2
5,763.5	8.25	8,472.7
5,763.8	8.50	8,839.0
5,764.0	8.75	9,258.2

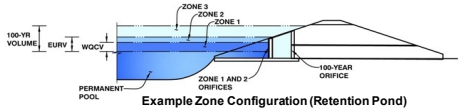
8. EDB 5, 6, 8, 9A and 9B MHFD-Detention – Stage-Storage Table

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Range

Basin ID: Basin 5



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB		
Watershed Area =	24.90	acres	
Watershed Length =	2,400	ft	
Watershed Length to Centroid =	1,330	ft	
Watershed Slope =	0.070	ft/ft	**Steep Slope > 0.06 ft/ft**
Watershed Imperviousness =	48.00%	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 =	Sedalia		

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) =	0.417	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.127	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	0.739	acre-feet		inches
5-yr Runoff Volume (P1 = 1.43 in.) =	1.781	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.52 in.) =	1.951	acre-feet	1.52	inches
25-yr Runoff Volume (P1 = 1.71 in.) =	2.431	acre-feet		inches
50-yr Runoff Volume (P1 = 2 in.) =	3.041	acre-feet		inches
100-yr Runoff Volume (P1 = 2.6 in.) =	4.415	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.03 in.) =	5.354	acre-feet		inches
Approximate 2-yr Detention Volume =	0.689	acre-feet		
Approximate 5-yr Detention Volume =	1.422	acre-feet		
Approximate 10-yr Detention Volume =	1.477	acre-feet		
Approximate 25-yr Detention Volume =	1.578	acre-feet		
Approximate 50-yr Detention Volume =	1.701	acre-feet		
Approximate 100-yr Detention Volume =	2.260	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.417	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.710	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.133	acre-feet
Total Detention Basin Volume =	2.260	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 = 0.10 ft

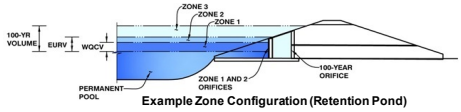
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	35	0.001		
	--	0.50	--	--	--	228	0.005	66	0.002
	--	1.00	--	--	--	1,439	0.033	483	0.011
	--	1.50	--	--	--	4,516	0.104	1,971	0.045
	--	2.00	--	--	--	8,285	0.190	5,172	0.119
	--	2.50	--	--	--	11,043	0.254	10,004	0.230
	--	3.00	--	--	--	11,862	0.272	15,730	0.361
	--	3.50	--	--	--	12,413	0.285	21,799	0.500
	--	4.00	--	--	--	12,976	0.298	28,146	0.646
	--	4.50	--	--	--	13,549	0.311	34,777	0.798
	--	5.00	--	--	--	14,134	0.324	41,698	0.957
	--	5.50	--	--	--	14,730	0.338	48,914	1.123
	--	6.00	--	--	--	15,337	0.352	56,430	1.295
	--	6.50	--	--	--	15,955	0.366	64,253	1.475
	--	7.00	--	--	--	16,584	0.381	72,388	1.662
	--	7.50	--	--	--	17,223	0.395	80,840	1.856
	--	8.00	--	--	--	17,871	0.410	89,613	2.057
	--	8.50	--	--	--	18,527	0.425	98,713	2.266

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Range

Basin ID: Basin 6



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	54.60	acres
Watershed Length =	3,450	ft
Watershed Length to Centroid =	1,650	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	43.00%	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 =	User Input	

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) =	0.854	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.195	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	1.433	acre-feet	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	3.656	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.52 in.) =	4.023	acre-feet	1.52 inches
25-yr Runoff Volume (P1 = 1.69 in.) =	5.003	acre-feet	inches
50-yr Runoff Volume (P1 = 1.99 in.) =	6.380	acre-feet	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	9.456	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	12.043	acre-feet	inches
Approximate 2-yr Detention Volume =	1.332	acre-feet	
Approximate 5-yr Detention Volume =	2.817	acre-feet	
Approximate 10-yr Detention Volume =	2.932	acre-feet	
Approximate 25-yr Detention Volume =	3.118	acre-feet	
Approximate 50-yr Detention Volume =	3.392	acre-feet	
Approximate 100-yr Detention Volume =	4.605	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.854	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.340	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.410	acre-feet
Total Detention Basin Volume =	4.605	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 = 0.10 ft

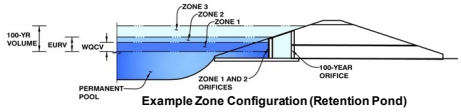
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	49	0.001		
	--	0.50	--	--	--	472	0.011	130	0.003
	--	1.00	--	--	--	3,272	0.075	1,066	0.024
	--	1.50	--	--	--	10,019	0.230	4,389	0.101
	--	2.00	--	--	--	19,869	0.456	11,861	0.272
	--	2.50	--	--	--	31,626	0.726	24,735	0.568
	--	3.00	--	--	--	42,039	0.965	43,151	0.991
	--	3.50	--	--	--	48,903	1.123	65,887	1.513
	--	4.00	--	--	--	51,957	1.193	91,101	2.091
	--	4.50	--	--	--	54,011	1.240	117,593	2.700
	--	5.00	--	--	--	56,100	1.288	145,121	3.332
	--	5.50	--	--	--	58,224	1.337	173,702	3.988
	--	6.00	--	--	--	60,384	1.386	203,354	4.668
	--	6.50	--	--	--	62,579	1.437	234,095	5.374
	--	7.00	--	--	--	64,810	1.488	265,942	6.105
	--	7.50	--	--	--	67,076	1.540	298,914	6.862
	--	8.00	--	--	--	68,828	1.580	332,890	7.642
	--	8.50	--	--	--	70,583	1.620	367,743	8.442
	--	9.00	--	--	--	72,364	1.661	403,480	9.263
	--	9.50	--	--	--	74,172	1.703	440,114	10.104

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Range

Basin ID: EDB 8



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	31.00	acres
Watershed Length =	1,600	ft
Watershed Length to Centroid =	790	ft
Watershed Slope =	0.045	ft/ft
Watershed Imperviousness =	56.00%	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 =	Sedalia	

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) =	0.577	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.657	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	1.527	acre-feet	1.06 inches
5-yr Runoff Volume (P1 = 1.43 in.) =	2.395	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.66 in.) =	2.970	acre-feet	1.66 inches
25-yr Runoff Volume (P1 = 1.71 in.) =	3.179	acre-feet	inches
50-yr Runoff Volume (P1 = 2.26 in.) =	4.613	acre-feet	2.26 inches
100-yr Runoff Volume (P1 = 2.6 in.) =	5.592	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.03 in.) =	6.740	acre-feet	inches
Approximate 2-yr Detention Volume =	1.311	acre-feet	
Approximate 5-yr Detention Volume =	2.043	acre-feet	
Approximate 10-yr Detention Volume =	2.319	acre-feet	
Approximate 25-yr Detention Volume =	2.246	acre-feet	
Approximate 50-yr Detention Volume =	2.726	acre-feet	
Approximate 100-yr Detention Volume =	3.131	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.577	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.080	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.474	acre-feet
Total Detention Basin Volume =	3.131	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 = 0.10 ft

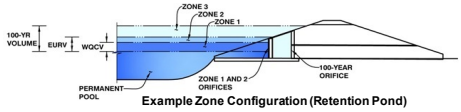
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	106	0.002		
	--	0.25	--	--	--	235	0.005	43	0.001
	--	0.50	--	--	--	610	0.014	148	0.003
	--	0.75	--	--	--	1,588	0.036	423	0.010
	--	1.00	--	--	--	3,145	0.072	1,014	0.023
	--	1.25	--	--	--	5,271	0.121	2,066	0.047
	--	1.50	--	--	--	8,092	0.186	3,737	0.086
	--	1.75	--	--	--	11,101	0.255	6,136	0.141
	--	2.00	--	--	--	13,867	0.318	9,257	0.213
	--	2.25	--	--	--	16,564	0.380	13,061	0.300
	--	2.50	--	--	--	19,035	0.437	17,510	0.402
	--	2.75	--	--	--	21,133	0.485	22,531	0.517
	--	3.00	--	--	--	22,804	0.524	28,024	0.643
	--	3.25	--	--	--	24,080	0.553	33,884	0.778
	--	3.50	--	--	--	24,897	0.572	40,006	0.918
	--	3.75	--	--	--	25,604	0.588	46,319	1.063
	--	4.00	--	--	--	26,318	0.604	52,809	1.212
	--	4.25	--	--	--	27,037	0.621	59,478	1.365
	--	4.50	--	--	--	27,762	0.637	66,328	1.523
	--	4.75	--	--	--	28,493	0.654	73,360	1.684
	--	5.00	--	--	--	29,230	0.671	80,575	1.850
	--	5.25	--	--	--	29,972	0.688	87,975	2.020
	--	5.50	--	--	--	30,721	0.705	95,562	2.194
	--	5.75	--	--	--	31,476	0.723	103,337	2.372
	--	6.00	--	--	--	32,236	0.740	111,301	2.555
	--	6.25	--	--	--	33,003	0.758	119,456	2.742
	--	6.50	--	--	--	33,775	0.775	127,803	2.934
	--	6.75	--	--	--	34,553	0.793	136,344	3.130
	--	7.00	--	--	--	35,338	0.811	145,080	3.331
	--	7.25	--	--	--	36,128	0.829	154,013	3.536
	--	7.50	--	--	--	36,924	0.848	163,145	3.745
	--	7.75	--	--	--	37,726	0.866	172,476	3.960
	--	8.00	--	--	--	38,534	0.885	182,009	4.178
	--	8.25	--	--	--	39,348	0.903	191,744	4.402
	--	8.50	--	--	--	40,168	0.922	201,683	4.630

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Range

Basin ID: EDB9A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	19.40	acres
Watershed Length =	1,840	ft
Watershed Length to Centroid =	820	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	38.00%	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 =	Sedalia	

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) =	0.282	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.682	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.679	acre-feet	1.06 inches
5-yr Runoff Volume (P1 = 1.43 in.) =	1.192	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.66 in.) =	1.545	acre-feet	1.66 inches
25-yr Runoff Volume (P1 = 1.71 in.) =	1.697	acre-feet	inches
50-yr Runoff Volume (P1 = 2.26 in.) =	2.594	acre-feet	2.26 inches
100-yr Runoff Volume (P1 = 2.6 in.) =	3.232	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.03 in.) =	3.954	acre-feet	inches
Approximate 2-yr Detention Volume =	0.529	acre-feet	
Approximate 5-yr Detention Volume =	0.894	acre-feet	
Approximate 10-yr Detention Volume =	1.020	acre-feet	
Approximate 25-yr Detention Volume =	1.014	acre-feet	
Approximate 50-yr Detention Volume =	1.241	acre-feet	
Approximate 100-yr Detention Volume =	1.511	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.282	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.400	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.828	acre-feet
Total Detention Basin Volume =	1.511	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 = 0.10 ft

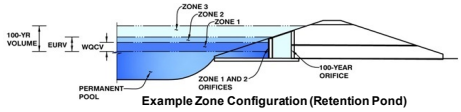
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	17	0.000		
	--	0.25	--	--	--	131	0.003	18	0.000
	--	0.50	--	--	--	273	0.006	69	0.002
	--	0.75	--	--	--	766	0.018	199	0.005
	--	1.00	--	--	--	1,834	0.042	524	0.012
	--	1.25	--	--	--	3,377	0.078	1,175	0.027
	--	1.50	--	--	--	5,361	0.123	2,268	0.052
	--	1.75	--	--	--	7,459	0.171	3,870	0.089
	--	2.00	--	--	--	9,227	0.212	5,956	0.137
	--	2.25	--	--	--	10,608	0.244	8,435	0.194
	--	2.50	--	--	--	11,558	0.265	11,206	0.257
	--	2.75	--	--	--	12,127	0.278	14,166	0.325
	--	3.00	--	--	--	12,576	0.289	17,254	0.396
	--	3.25	--	--	--	13,032	0.299	20,455	0.470
	--	3.50	--	--	--	13,496	0.310	23,771	0.546
	--	3.75	--	--	--	13,968	0.321	27,204	0.625
	--	4.00	--	--	--	14,447	0.332	30,756	0.706
	--	4.25	--	--	--	14,933	0.343	34,428	0.790
	--	4.50	--	--	--	15,428	0.354	38,223	0.877
	--	4.75	--	--	--	15,930	0.366	42,143	0.967
	--	5.00	--	--	--	16,440	0.377	46,189	1.060
	--	5.25	--	--	--	16,958	0.389	50,364	1.156
	--	5.50	--	--	--	17,483	0.401	54,669	1.255
	--	5.75	--	--	--	18,016	0.414	59,107	1.357
	--	6.00	--	--	--	18,557	0.426	63,678	1.462
	--	6.25	--	--	--	19,106	0.439	68,386	1.570
	--	6.50	--	--	--	19,662	0.451	73,232	1.681
	--	6.75	--	--	--	20,225	0.464	78,218	1.796
	--	7.00	--	--	--	20,795	0.477	83,346	1.913
	--	7.25	--	--	--	21,371	0.491	88,617	2.034
	--	7.50	--	--	--	21,954	0.504	94,032	2.159

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Range

Basin ID: EDB 9B



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	4.30	acres
Watershed Length =	920	ft
Watershed Length to Centroid =	300	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	40.00%	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 =	User Input	

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) =	0.064	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.160	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.156	acre-feet	1.06 inches
5-yr Runoff Volume (P1 = 1.43 in.) =	0.268	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.66 in.) =	0.345	acre-feet	1.66 inches
25-yr Runoff Volume (P1 = 1.69 in.) =	0.372	acre-feet	inches
50-yr Runoff Volume (P1 = 2.26 in.) =	0.574	acre-feet	2.26 inches
100-yr Runoff Volume (P1 = 2.6 in.) =	0.713	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.911	acre-feet	inches
Approximate 2-yr Detention Volume =	0.124	acre-feet	
Approximate 5-yr Detention Volume =	0.208	acre-feet	
Approximate 10-yr Detention Volume =	0.236	acre-feet	
Approximate 25-yr Detention Volume =	0.231	acre-feet	
Approximate 50-yr Detention Volume =	0.286	acre-feet	
Approximate 100-yr Detention Volume =	0.346	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.064	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.095	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.186	acre-feet
Total Detention Basin Volume =	0.346	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 = 0.10 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	--	--	--	92	0.002		
	--	0.25	--	--	--	150	0.003	30	0.001
	--	0.50	--	--	--	337	0.008	91	0.002
	--	0.75	--	--	--	778	0.018	230	0.005
	--	1.00	--	--	--	1,004	0.023	453	0.010
	--	1.25	--	--	--	1,153	0.026	723	0.017
	--	1.50	--	--	--	1,305	0.030	1,030	0.024
	--	1.75	--	--	--	1,464	0.034	1,376	0.032
	--	2.00	--	--	--	1,630	0.037	1,763	0.040
	--	2.25	--	--	--	1,804	0.041	2,192	0.050
	--	2.50	--	--	--	1,985	0.046	2,665	0.061
	--	2.75	--	--	--	2,173	0.050	3,185	0.073
	--	3.00	--	--	--	2,369	0.054	3,753	0.086
	--	3.25	--	--	--	2,573	0.059	4,371	0.100
	--	3.50	--	--	--	2,785	0.064	5,040	0.116
	--	3.75	--	--	--	3,004	0.069	5,764	0.132
	--	4.00	--	--	--	3,232	0.074	6,544	0.150
	--	4.25	--	--	--	3,469	0.080	7,381	0.169
	--	4.50	--	--	--	3,714	0.085	8,279	0.190
	--	4.75	--	--	--	3,968	0.091	9,239	0.212
	--	5.00	--	--	--	4,232	0.097	10,264	0.236
	--	5.25	--	--	--	4,505	0.103	11,357	0.261
	--	5.50	--	--	--	4,788	0.110	12,518	0.287
	--	5.75	--	--	--	5,081	0.117	13,752	0.316
	--	6.00	--	--	--	5,384	0.124	15,060	0.346
	--	6.25	--	--	--	5,698	0.131	16,445	0.378
	--	6.50	--	--	--	6,024	0.138	17,910	0.411
	--	6.75	--	--	--	6,360	0.146	19,458	0.447
	--	7.00	--	--	--	6,708	0.154	21,092	0.484
	--	7.25	--	--	--	7,066	0.162	22,814	0.524
	--	7.50	--	--	--	7,438	0.171	24,627	0.565
	--	7.75	--	--	--	7,787	0.179	26,530	0.609
	--	8.00	--	--	--	8,128	0.187	28,519	0.655
	--	8.25	--	--	--	8,473	0.195	30,594	0.702
	--	8.50	--	--	--	8,839	0.203	32,758	0.752
	--	8.75	--	--	--	9,258	0.213	35,020	0.804

1. SWMM Schematics for POC 12

Pre-Project DMA 12

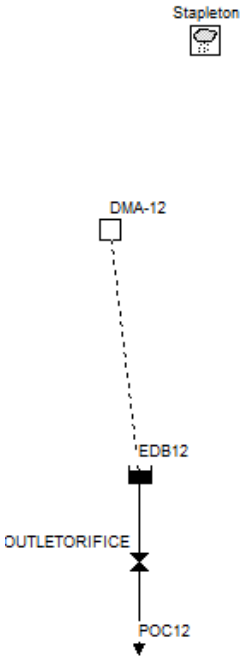


Subcatchment DMA-12

Property	Value
Name	DMA-12
X-Coordinate	4021.330
Y-Coordinate	7804.266
Description	Pre-Project Condition
Tag	
Rain Gage	Stapleton
Outlet	POC12
Area	22.2
Width	659
% Slope	6
% Imperv	5
N-Imperv	.013
N-Perv	.10
Dstore-Imperv	.05
Dstore-Perv	.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

Post Project DMA 12



Subcatchment DMA-12

Property	Value
Name	DMA-12
X-Coordinate	3389.058
Y-Coordinate	7467.072
Description	
Tag	
Rain Gage	Stapleton
Outlet	EDB12
Area	22.8
Width	829
% Slope	6
% Imperv	60
N-Imperv	0.013
N-Perv	0.10
Dstore-Imperv	0.05
Dstore-Perv	0.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

2. POC 12 SWMM Inputs & Results for HMP Run

```
[TITLE]
;;Project Title/Notes
2215 Range
Pre-Project Condition POC 12

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
;Pre-Project Condition
DMA-12           Stapleton        POC12            22.2     5        659      6        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-12           .013       .10        .05        .20        25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-12           9          0.025    0.3

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC12            0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
```

```
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC12            4021.330           5821.832

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-12           4021.330           7804.266

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition POC 12


***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      1777.332       960.720
Evaporation Loss .........        96.135        51.965
Infiltration Loss ........      1463.153       790.893
Surface Runoff ...........       244.564       132.197
Final Storage ............         0.002         0.001
Continuity Error (%) .....        -1.492


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------      ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       244.564        79.695
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       244.564        79.695
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


**************************
Subcatchment Runoff Summary
**************************

-----------------------------------------------------------------------------------------------------
                         Total      Total      Total      Total      Total       Total     Peak  Runoff
                        Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------
DMA-12                  960.72       0.00      51.96     790.89     132.20       79.69    28.55   0.138


Analysis begun on:  Mon Mar 17 16:31:43 2025
Analysis ended on:  Mon Mar 17 16:32:00 2025
Total elapsed time: 00:00:17
```

```
[TITLE]
;;Project Title/Notes
2215 Range
Post-Project Condition

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
DMA-12           Stapleton        EDB12            22.8     60       829      6        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-12           0.013      0.10       0.05       0.20       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-12           9.0        0.025      0.3

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC12            0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- -------- -------- -------- --------
EDB12            0        9.5        0          TABULAR    EDB12                        0        0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type            QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- --------
OUTLETORIFICE    EDB12            POC12            0          TABULAR/DEPTH   EDB12_ratingcurve            NO
```

```
[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
EDB12_ratingcurve Rating     0.00       0.000
EDB12_ratingcurve            0.25       0.043
EDB12_ratingcurve            0.50       0.068
EDB12_ratingcurve            0.75       0.086
EDB12_ratingcurve            1.00       0.101
EDB12_ratingcurve            1.25       0.156
EDB12_ratingcurve            1.50       0.193
EDB12_ratingcurve            1.75       0.221
EDB12_ratingcurve            2.00       0.246
EDB12_ratingcurve            2.25       0.311
EDB12_ratingcurve            2.50       0.356
EDB12_ratingcurve            2.75       0.393
EDB12_ratingcurve            3.00       0.425
EDB12_ratingcurve            3.25       0.455
EDB12_ratingcurve            3.50       0.667
EDB12_ratingcurve            3.75       0.746
EDB12_ratingcurve            4.00       0.814
EDB12_ratingcurve            4.25       0.875
EDB12_ratingcurve            4.50       1.461
EDB12_ratingcurve            4.75       1.834
EDB12_ratingcurve            5.00       2.075
EDB12_ratingcurve            5.25       3.858
EDB12_ratingcurve            5.50       6.924
EDB12_ratingcurve            5.75       10.824
EDB12_ratingcurve            6.00       15.399
EDB12_ratingcurve            6.25       20.557
EDB12_ratingcurve            6.50       26.237
EDB12_ratingcurve            6.75       32.394
EDB12_ratingcurve            7.00       38.991
EDB12_ratingcurve            7.25       46.002
EDB12_ratingcurve            7.50       53.402
EDB12_ratingcurve            7.75       61.172
EDB12_ratingcurve            8.00       69.294
EDB12_ratingcurve            8.25       77.755
EDB12_ratingcurve            8.50       86.540
EDB12_ratingcurve            8.75       95.638
EDB12_ratingcurve            9.00       105.038
EDB12_ratingcurve            9.25       114.732
EDB12_ratingcurve            9.50       124.710
;
EDB12            Storage     0.00       173.45
EDB12                        0.25       420.02
EDB12                        0.50       952.61
EDB12                        0.75       2066.41
EDB12                        1.00       3797.52
EDB12                        1.25       6204.45
EDB12                        1.50       8581.87
EDB12                        1.75       10384.94
EDB12                        2.00       11662.52
EDB12                        2.25       12627.32
EDB12                        2.50       13665.69
EDB12                        2.75       14746.56
EDB12                        3.00       15878.68
EDB12                        3.25       17069.41
EDB12                        3.50       18272.85
EDB12                        3.75       19303.36
EDB12                        4.00       19995.17
EDB12                        4.25       20689.23
EDB12                        4.50       21389.92
EDB12                        4.75       22097.24
EDB12                        5.00       22811.21
EDB12                        5.25       23531.80
EDB12                        5.50       24259.04
EDB12                        5.75       24992.91
EDB12                        6.00       25733.41
EDB12                        6.25       26480.56
EDB12                        6.50       27234.33
EDB12                        6.75       27994.75
EDB12                        7.00       28761.80
EDB12                        7.25       29535.48

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
```

```
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC12            3581.560           4640.324
EDB12            3581.560           5805.471

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-12           3434.650           7456.940
DMA-12           3343.465           7477.204

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Post-Project Condition


***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      1825.368       960.720
Evaporation Loss .........       299.883       157.833
Infiltration Loss ........       624.698       328.789
Surface Runoff ...........       921.976       485.251
Final Storage ............         0.030         0.016
Continuity Error (%) .....        -1.162


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       921.976       300.440
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       921.619       300.323
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.039


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


*************************
```

Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA-12	960.72	0.00	157.83	328.79	485.25	300.42	37.52	0.505

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
POC12	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
EDB12	STORAGE	0.13	6.38	6.38	20471 19:09	6.23

HMP Ponding Depth

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
POC12	OUTFALL	0.00	23.62	20471 19:09	0	300	0.000
EDB12	STORAGE	37.52	37.52	20471 19:01	300	300	0.039

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB12	0.608	0	0	0	97.245	50	20471 19:09	23.62

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC12	10.88	0.18	23.62	300.301
System	10.88	0.18	23.62	300.301

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
OUTLETORIFICE	DUMMY	23.62	20471 19:09			

```
************************
Conduit Surcharge Summary
************************

No conduits were surcharged.

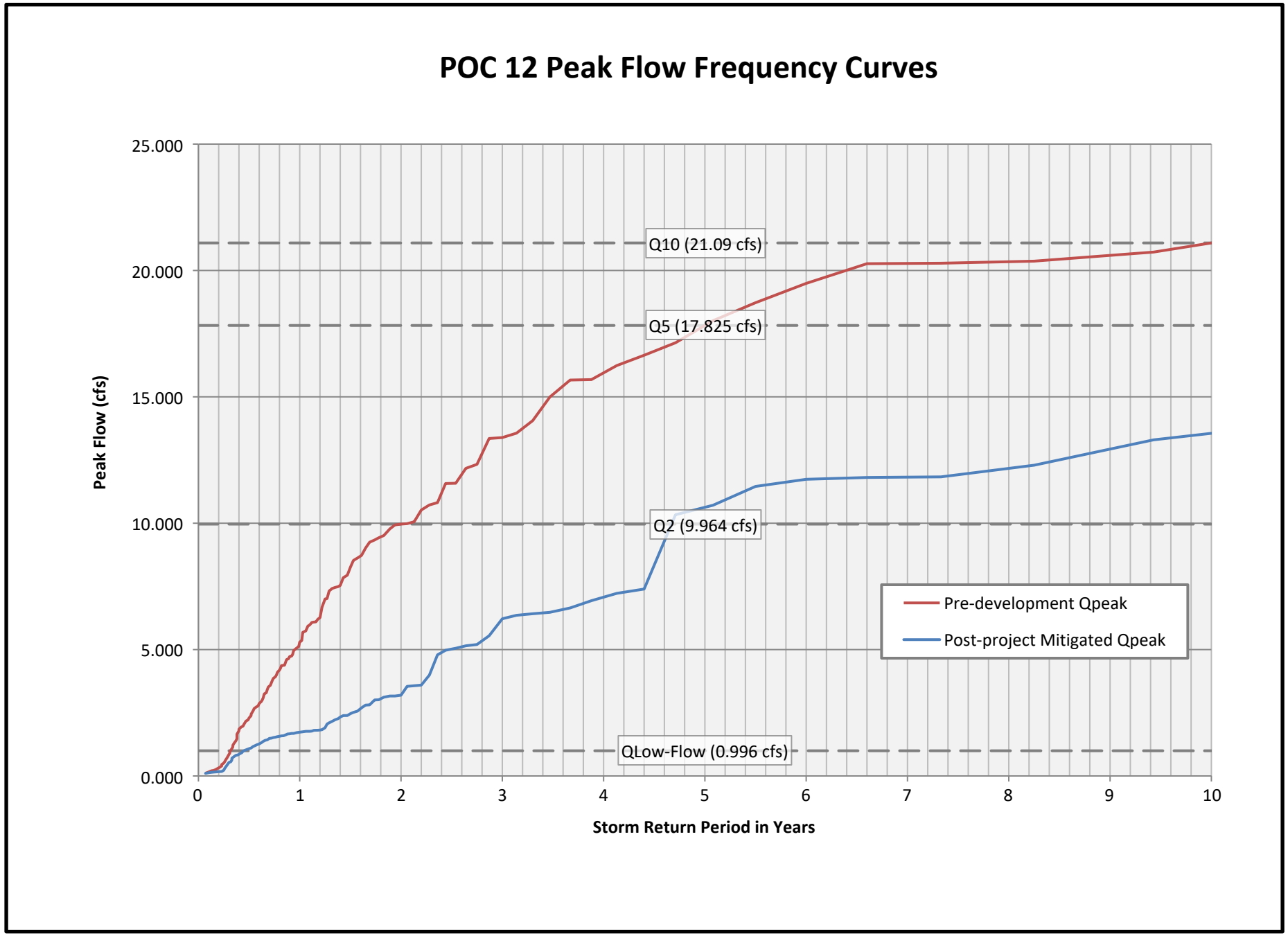

Analysis begun on:  Mon Mar 17 17:03:08 2025
Analysis ended on:  Mon Mar 17 17:03:31 2025
Total elapsed time: 00:00:23
```

3. POC -12 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

HMP Flow Frequency Range Based on: **SWMM - Weibull**

Return Period	Pre-development Qpeak (cfs)	Post-project - Mitigated Q (cfs)	*Check*
Low-Flow = 0.1*Q2	0.996	0.319	*Okay! -> Decreased by 0.677 cfs*
2-year	9.964	3.194	*Okay! -> Decreased by 6.77 cfs*
3-year	13.389	6.220	*Okay! -> Decreased by 7.169 cfs*
4-year	15.949	7.074	*Okay! -> Decreased by 8.875 cfs*
5-year	17.825	10.630	*Okay! -> Decreased by 7.195 cfs*
6-year	19.489	11.738	*Okay! -> Decreased by 7.751 cfs*
7-year	20.279	11.823	*Okay! -> Decreased by 8.456 cfs*
8-year	20.347	12.170	*Okay! -> Decreased by 8.177 cfs*
9-year	20.597	12.933	*Okay! -> Decreased by 7.664 cfs*
10-year	21.090	13.557	*Okay! -> Decreased by 7.532 cfs*


POC 12 Peak Flow Frequency Curves
25.000
20.000
15.000
10.000
5.000
0.000
Peak Flow (cfs)
Q10 (21.09 cfs)
Q5 (17.825 cfs)
Q2 (9.964 cfs)
QLow-Flow (0.996 cfs)
Pre-development Qpeak
Post-project Mitigated Qpeak
0
1
2
3
4
5
6
7
8
9
10
Storm Return Period in Years

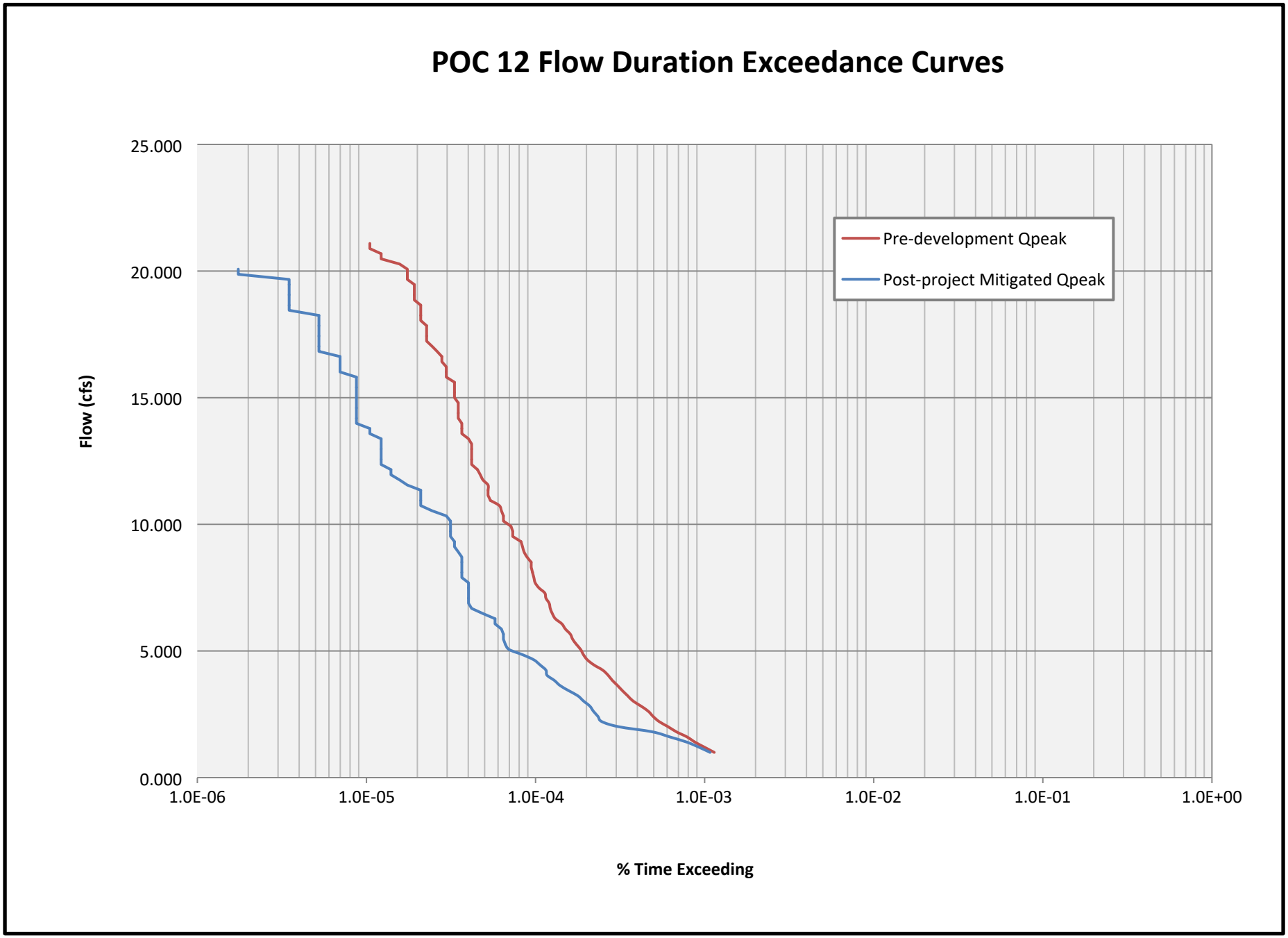
Low-flow Threshold:	10%	
0.1xQ2 (Pre):	0.9964	cfs
Q10 (Pre):	21.090	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	0.20296	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	0.996	653	1.14E-03	617	1.08E-03	94%	Pass
2	1.199	572	9.98E-04	531	9.27E-04	93%	Pass
3	1.402	502	8.76E-04	449	7.84E-04	89%	Pass
4	1.605	451	7.87E-04	357	6.23E-04	79%	Pass
5	1.808	390	6.81E-04	281	4.90E-04	72%	Pass
6	2.011	348	6.07E-04	177	3.09E-04	51%	Pass
7	2.214	308	5.37E-04	141	2.46E-04	46%	Pass
8	2.417	284	4.96E-04	134	2.34E-04	47%	Pass
9	2.620	266	4.64E-04	126	2.20E-04	47%	Pass
10	2.823	241	4.21E-04	120	2.09E-04	50%	Pass
11	3.026	216	3.77E-04	110	1.92E-04	51%	Pass
12	3.229	201	3.51E-04	102	1.78E-04	51%	Pass
13	3.432	187	3.26E-04	90	1.57E-04	48%	Pass
14	3.635	175	3.05E-04	80	1.40E-04	46%	Pass
15	3.838	163	2.84E-04	74	1.29E-04	45%	Pass
16	4.041	154	2.69E-04	67	1.17E-04	44%	Pass
17	4.244	143	2.50E-04	66	1.15E-04	46%	Pass
18	4.447	127	2.22E-04	61	1.06E-04	48%	Pass
19	4.650	116	2.02E-04	56	9.77E-05	48%	Pass
20	4.853	110	1.92E-04	48	8.38E-05	44%	Pass
21	5.056	106	1.85E-04	40	6.98E-05	38%	Pass
22	5.259	100	1.75E-04	38	6.63E-05	38%	Pass
23	5.462	95	1.66E-04	37	6.46E-05	39%	Pass
24	5.665	92	1.61E-04	37	6.46E-05	40%	Pass
25	5.867	86	1.50E-04	36	6.28E-05	42%	Pass
26	6.070	82	1.43E-04	33	5.76E-05	40%	Pass
27	6.273	75	1.31E-04	33	5.76E-05	44%	Pass
28	6.476	72	1.26E-04	28	4.89E-05	39%	Pass
29	6.679	70	1.22E-04	24	4.19E-05	34%	Pass
30	6.882	69	1.20E-04	23	4.01E-05	33%	Pass
31	7.085	66	1.15E-04	23	4.01E-05	35%	Pass
32	7.288	65	1.13E-04	23	4.01E-05	35%	Pass
33	7.491	60	1.05E-04	23	4.01E-05	38%	Pass
34	7.694	57	9.95E-05	23	4.01E-05	40%	Pass
35	7.897	56	9.77E-05	21	3.66E-05	38%	Pass
36	8.100	55	9.60E-05	21	3.66E-05	38%	Pass
37	8.303	54	9.42E-05	21	3.66E-05	39%	Pass
38	8.506	54	9.42E-05	21	3.66E-05	39%	Pass
39	8.709	51	8.90E-05	21	3.66E-05	41%	Pass
40	8.912	49	8.55E-05	20	3.49E-05	41%	Pass
41	9.115	48	8.38E-05	19	3.32E-05	40%	Pass
42	9.318	47	8.20E-05	19	3.32E-05	40%	Pass
43	9.521	42	7.33E-05	18	3.14E-05	43%	Pass
44	9.724	42	7.33E-05	18	3.14E-05	43%	Pass
45	9.927	41	7.15E-05	18	3.14E-05	44%	Pass
46	10.130	37	6.46E-05	18	3.14E-05	49%	Pass
47	10.333	37	6.46E-05	17	2.97E-05	46%	Pass
48	10.536	36	6.28E-05	14	2.44E-05	39%	Pass
49	10.739	35	6.11E-05	12	2.09E-05	34%	Pass
50	10.942	31	5.41E-05	12	2.09E-05	39%	Pass
51	11.144	30	5.24E-05	12	2.09E-05	40%	Pass

Flow Frequency Range Based on: **SWMM - Weibull**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
52	11.347	30	5.24E-05	12	2.09E-05	40%	Pass
53	11.550	30	5.24E-05	10	1.75E-05	33%	Pass
54	11.753	28	4.89E-05	9	1.57E-05	32%	Pass
55	11.956	27	4.71E-05	8	1.40E-05	30%	Pass
56	12.159	26	4.54E-05	8	1.40E-05	31%	Pass
57	12.362	24	4.19E-05	7	1.22E-05	29%	Pass
58	12.565	24	4.19E-05	7	1.22E-05	29%	Pass
59	12.768	24	4.19E-05	7	1.22E-05	29%	Pass
60	12.971	24	4.19E-05	7	1.22E-05	29%	Pass
61	13.174	24	4.19E-05	7	1.22E-05	29%	Pass
62	13.377	23	4.01E-05	7	1.22E-05	30%	Pass
63	13.580	21	3.66E-05	6	1.05E-05	29%	Pass
64	13.783	21	3.66E-05	6	1.05E-05	29%	Pass
65	13.986	21	3.66E-05	5	8.73E-06	24%	Pass
66	14.189	20	3.49E-05	5	8.73E-06	25%	Pass
67	14.392	20	3.49E-05	5	8.73E-06	25%	Pass
68	14.595	20	3.49E-05	5	8.73E-06	25%	Pass
69	14.798	20	3.49E-05	5	8.73E-06	25%	Pass
70	15.001	19	3.32E-05	5	8.73E-06	26%	Pass
71	15.204	19	3.32E-05	5	8.73E-06	26%	Pass
72	15.407	19	3.32E-05	5	8.73E-06	26%	Pass
73	15.610	19	3.32E-05	5	8.73E-06	26%	Pass
74	15.813	17	2.97E-05	5	8.73E-06	29%	Pass
75	16.016	17	2.97E-05	4	6.98E-06	24%	Pass
76	16.219	17	2.97E-05	4	6.98E-06	24%	Pass
77	16.421	16	2.79E-05	4	6.98E-06	25%	Pass
78	16.624	16	2.79E-05	4	6.98E-06	25%	Pass
79	16.827	15	2.62E-05	3	5.24E-06	20%	Pass
80	17.030	14	2.44E-05	3	5.24E-06	21%	Pass
81	17.233	13	2.27E-05	3	5.24E-06	23%	Pass
82	17.436	13	2.27E-05	3	5.24E-06	23%	Pass
83	17.639	13	2.27E-05	3	5.24E-06	23%	Pass
84	17.842	13	2.27E-05	3	5.24E-06	23%	Pass
85	18.045	12	2.09E-05	3	5.24E-06	25%	Pass
86	18.248	12	2.09E-05	3	5.24E-06	25%	Pass
87	18.451	12	2.09E-05	2	3.49E-06	17%	Pass
88	18.654	12	2.09E-05	2	3.49E-06	17%	Pass
89	18.857	11	1.92E-05	2	3.49E-06	18%	Pass
90	19.060	11	1.92E-05	2	3.49E-06	18%	Pass
91	19.263	11	1.92E-05	2	3.49E-06	18%	Pass
92	19.466	11	1.92E-05	2	3.49E-06	18%	Pass
93	19.669	10	1.75E-05	2	3.49E-06	20%	Pass
94	19.872	10	1.75E-05	1	1.75E-06	10%	Pass
95	20.075	10	1.75E-05	1	1.75E-06	10%	Pass
96	20.278	9	1.57E-05	0	0.00E+00	0%	Pass
97	20.481	7	1.22E-05	0	0.00E+00	0%	Pass
98	20.684	7	1.22E-05	0	0.00E+00	0%	Pass
99	20.887	6	1.05E-05	0	0.00E+00	0%	Pass
100	21.090	6	1.05E-05	0	0.00E+00	0%	Pass


POC 12 Flow Duration Exceedance Curves
25.000
20.000
15.000
10.000
5.000
0.000
Flow (cfs)
1.0E-06
1.0E-05
1.0E-04
1.0E-03
1.0E-02
1.0E-01
1.0E+00
% Time Exceeding
Pre-development Qpeak
Post-project Mitigated Qpeak

POC-12 CUHP

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (acre)	Length to Centroid (ft)	Length (ft)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
DMA-12	DMA-12	100	22.2	750	1466	0.06	5	0.35	0.1	3	0.0018	0.5	0

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (acre)	Length to Centroid (ft)	Length (ft)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
DMA-12	DMA-12	100	22.8	750	1700	0.06	60	0.35	0.1	3	0.0018	0.5	0

RUN MULTIPLE CUHP AND SWMM SCENARIOS

Columns with this color heading are for required user-input
Columns with this color heading are for program-calculated values

SWMM Run Wait Time (sec)
5

(Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)
LU

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
DMA-12	5	60

Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
2	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
5	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
10	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
50	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
100	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
WQ	WQ	0.6	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40

Enter "X" to Run Scenario	Scenario ID	Land Use (E or F)	Return Period (yr)	Correction Area (Sq.Mi.)	(Optional) SWMM Time Series Inflow Table "NAME"
X	1	F	WQ	0	1_Fut_WQ_0mi^2_Post12_out
X	2	F	2	0	2_Fut_2yr_0mi^2_Post12_out
X	3	F	5	0	3_Fut_5yr_0mi^2_Post12_out
X	4	F	10	0	4_Fut_10yr_0mi^2_Post12_out
X	5	F	50	0	5_Fut_50yr_0mi^2_Post12_out
X	6	F	100	0	6_Fut_100yr_0mi^2_Post12_out

POC-12 SWMM WQCV and 100-yr Detention Results

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition POC 1
Scenario ID = 6_Ex_100yr_0mi^2_POC12_RANGE_PRE

WARNING 04: minimum elevation drop used for Conduit 1

**********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
**********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         3.038         0.990
External Outflow .........         3.038         0.990
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
DMA-12               JUNCTION     0.00     0.00     0.00     0  00:00        0.00
POC12                OUTFALL      0.00     0.00     0.00     0  00:00        0.00
```

```
******************
Node Inflow Summary
******************

-------------------------------------------------------------------------------------------------
                                Maximum  Maximum                  Lateral       Total        Flow
                                Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type           CFS      CFS  days hr:min    10^6 gal    10^6 gal     Percent
-------------------------------------------------------------------------------------------------
DMA-12               JUNCTION     38.54    38.54     0  00:41        0.99        0.99       0.000
POC12                OUTFALL       0.00    38.54     0  00:41           0        0.99       0.000


*********************
Node Flooding Summary
*********************

No nodes were flooded.


***********************
Outfall Loading Summary
***********************

-----------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
-----------------------------------------------------------
POC12                 15.22     10.50     38.54       0.990
-----------------------------------------------------------
System                15.22     10.50     38.54       0.990


*******************
Link Flow Summary
*******************

-------------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                                |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type           CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
1                    DUMMY        38.54     0  00:41


************************
Conduit Surcharge Summary
************************

No conduits were surcharged.


Analysis begun on:  Wed Mar 19 13:49:28 2025
Analysis ended on:  Wed Mar 19 13:49:28 2025
Total elapsed time: < 1 sec
```

Pre-Project Q100 per CUHP run

```
[TITLE]
;;Project Title/Notes
2215 Range
Post-Project Condition

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           01/01/2024
START_TIME           00:00:00
REPORT_START_DATE    01/01/2024
REPORT_START_TIME    00:00:00
END_DATE             01/01/2024
END_TIME             06:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[FILES]
;;Interfacing Files
USE INFLOWS "POC12_Post_out.txt"

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
DMA-12           0          0          0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC12            0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------          -------- --------
EDB12            0        9.5        0          TABULAR    EDB12                        0        0

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
1                DMA-12           EDB12            400        0.01       0          0          0          0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type            QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- --------
OUTLETORIFICE    EDB12            POC12            0          TABULAR/DEPTH   EDB12_ratingcurve           NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
1                DUMMY        0                0          0          0          1

[CURVES]
```

```
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
EDB12_ratingcurve Rating     0.00       0.000
EDB12_ratingcurve            0.25       0.043
EDB12_ratingcurve            0.50       0.068
EDB12_ratingcurve            0.75       0.086
EDB12_ratingcurve            1.00       0.101
EDB12_ratingcurve            1.25       0.156
EDB12_ratingcurve            1.50       0.193
EDB12_ratingcurve            1.75       0.221
EDB12_ratingcurve            2.00       0.246
EDB12_ratingcurve            2.25       0.311
EDB12_ratingcurve            2.50       0.356
EDB12_ratingcurve            2.75       0.393
EDB12_ratingcurve            3.00       0.425
EDB12_ratingcurve            3.25       0.455
EDB12_ratingcurve            3.50       0.667
EDB12_ratingcurve            3.75       0.746
EDB12_ratingcurve            4.00       0.814
EDB12_ratingcurve            4.25       0.875
EDB12_ratingcurve            4.50       1.461
EDB12_ratingcurve            4.75       1.834
EDB12_ratingcurve            5.00       2.075
EDB12_ratingcurve            5.25       3.858
EDB12_ratingcurve            5.50       6.924
EDB12_ratingcurve            5.75       10.824
EDB12_ratingcurve            6.00       15.399
EDB12_ratingcurve            6.25       20.557
EDB12_ratingcurve            6.50       26.237
EDB12_ratingcurve            6.75       32.394
EDB12_ratingcurve            7.00       38.991
EDB12_ratingcurve            7.25       46.002
EDB12_ratingcurve            7.50       53.402
EDB12_ratingcurve            7.75       61.172
EDB12_ratingcurve            8.00       69.294
EDB12_ratingcurve            8.25       77.755
EDB12_ratingcurve            8.50       86.540
EDB12_ratingcurve            8.75       95.638
EDB12_ratingcurve            9.00       105.038
EDB12_ratingcurve            9.25       114.732
EDB12_ratingcurve            9.50       124.710
;
EDB12            Storage     0.00       173.45
EDB12                        0.25       420.02
EDB12                        0.50       952.61
EDB12                        0.75       2066.41
EDB12                        1.00       3797.52
EDB12                        1.25       6204.45
EDB12                        1.50       8581.87
EDB12                        1.75       10384.94
EDB12                        2.00       11662.52
EDB12                        2.25       12627.32
EDB12                        2.50       13665.69
EDB12                        2.75       14746.56
EDB12                        3.00       15878.68
EDB12                        3.25       17069.41
EDB12                        3.50       18272.85
EDB12                        3.75       19303.36
EDB12                        4.00       19995.17
EDB12                        4.25       20689.23
EDB12                        4.50       21389.92
EDB12                        4.75       22097.24
EDB12                        5.00       22811.21
EDB12                        5.25       23531.80
EDB12                        5.50       24259.04
EDB12                        5.75       24992.91
EDB12                        6.00       25733.41
EDB12                        6.25       26480.56
EDB12                        6.50       27234.33
EDB12                        6.75       27994.75
EDB12                        7.00       28761.80
EDB12                        7.25       29535.48

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]
```

```
[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-12           3437.140           7485.582
POC12            3581.560           4640.324
EDB12            3581.560           5805.471

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition
Scenario ID = 1_Fut_WQ_0mi^2_POC12_RANGE_POST

WARNING 04: minimum elevation drop used for Conduit 1

**********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
**********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.560         0.183
External Outflow .........         0.175         0.057
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.385         0.126
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type        Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
DMA-12               JUNCTION    0.00     0.00     0.00     0  00:00        0.00
POC12                OUTFALL     0.00     0.00     0.00     0  00:00        0.00
EDB12                STORAGE     2.50     2.91     2.91     0  02:17        2.88
```



```
******************
Node Inflow Summary
******************

-----------------------------------------------------------------------------------------------
                              Maximum  Maximum                 Lateral       Total        Flow
                              Lateral    Total  Time of Max      Inflow      Inflow     Balance
                               Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type         CFS      CFS  days hr:min    10^6 gal    10^6 gal     Percent
-----------------------------------------------------------------------------------------------
DMA-12               JUNCTION    9.51     9.51     0  00:31       0.183       0.183       0.000
POC12                OUTFALL     0.00     0.41     0  02:17           0      0.0571       0.000
EDB12                STORAGE     0.00     9.51     0  00:31           0       0.183      -0.002


*********************
Node Flooding Summary
*********************

No nodes were flooded.


**********************
Storage Volume Summary
**********************

-----------------------------------------------------------------------------------------------
                      Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                       Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit         1000 ft3    Full  Loss  Loss      1000 ft3    Full    days hr:min        CFS
-----------------------------------------------------------------------------------------------
EDB12                  17.149       9     0     0        21.799      11       0  02:16       0.41


***********************
Outfall Loading Summary
***********************

-------------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
-------------------------------------------------------------
POC12                 95.56      0.37      0.41       0.057
-------------------------------------------------------------
System                95.56      0.37      0.41       0.057


*******************
Link Flow Summary
*******************

-----------------------------------------------------------------------------
                             Maximum  Time of Max   Maximum    Max/    Max/
                              |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type         CFS  days hr:min    ft/sec    Flow   Depth
-----------------------------------------------------------------------------
1                    DUMMY       9.51     0  00:31
OUTLETORIFICE        DUMMY       0.41     0  02:17


*************************
Conduit Surcharge Summary
*************************

No conduits were surcharged.


Analysis begun on:  Wed Mar 19 13:45:26 2025
Analysis ended on:  Wed Mar 19 13:45:26 2025
Total elapsed time: < 1 sec
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition
Scenario ID = 6_Fut_100yr_0mi^2_POC12_RANGE_POST

WARNING 04: minimum elevation drop used for Conduit 1

**********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
**********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         4.191         1.366
External Outflow .........         3.112         1.014
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         1.076         0.351
Continuity Error (%) .....         0.085


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type        Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
DMA-12               JUNCTION    0.00     0.00     0.00     0  00:00        0.00
POC12                OUTFALL     0.00     0.00     0.00     0  00:00        0.00
EDB12                STORAGE     4.77     6.75     6.75     0  01:07        6.70
```

100-YR Ponding Depth

```
******************
Node Inflow Summary
******************

-----------------------------------------------------------------------------------------------
                              Maximum  Maximum                  Lateral       Total        Flow
                              Lateral    Total  Time of Max      Inflow      Inflow     Balance
                               Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type         CFS      CFS  days hr:min    10^6 gal    10^6 gal     Percent
-----------------------------------------------------------------------------------------------
DMA-12               JUNCTION   77.68    77.68     0  00:36        1.37        1.37       0.000
POC12                OUTFALL     0.00    32.47     0  01:07           0        1.01       0.000
EDB12                STORAGE     0.00    77.68     0  00:36           0        1.37       0.085


*********************
Node Flooding Summary
*********************

No nodes were flooded.


**********************
Storage Volume Summary
**********************

-----------------------------------------------------------------------------------------------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit         1000 ft3    Full  Loss  Loss      1000 ft3    Full    days hr:min        CFS
-----------------------------------------------------------------------------------------------
EDB12                  61.050      31     0     0       107.353      55       0  01:06      32.47


**********************
Outfall Loading Summary
**********************

-----------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
-----------------------------------------------------------
POC12                 98.06      6.40     32.47       1.014
-----------------------------------------------------------
System                98.06      6.40     32.47       1.014


*******************
Link Flow Summary
*******************

-------------------------------------------------------------------------------
                             Maximum  Time of Max   Maximum    Max/    Max/
                              |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type         CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
1                    DUMMY      77.68     0  00:36
OUTLETORIFICE        DUMMY      32.47     0  01:07


************************
Conduit Surcharge Summary
************************

No conduits were surcharged.


Analysis begun on:  Wed Mar 19 13:45:54 2025
Analysis ended on:  Wed Mar 19 13:45:54 2025
Total elapsed time: < 1 sec
```

Detained Q100 out of EDB

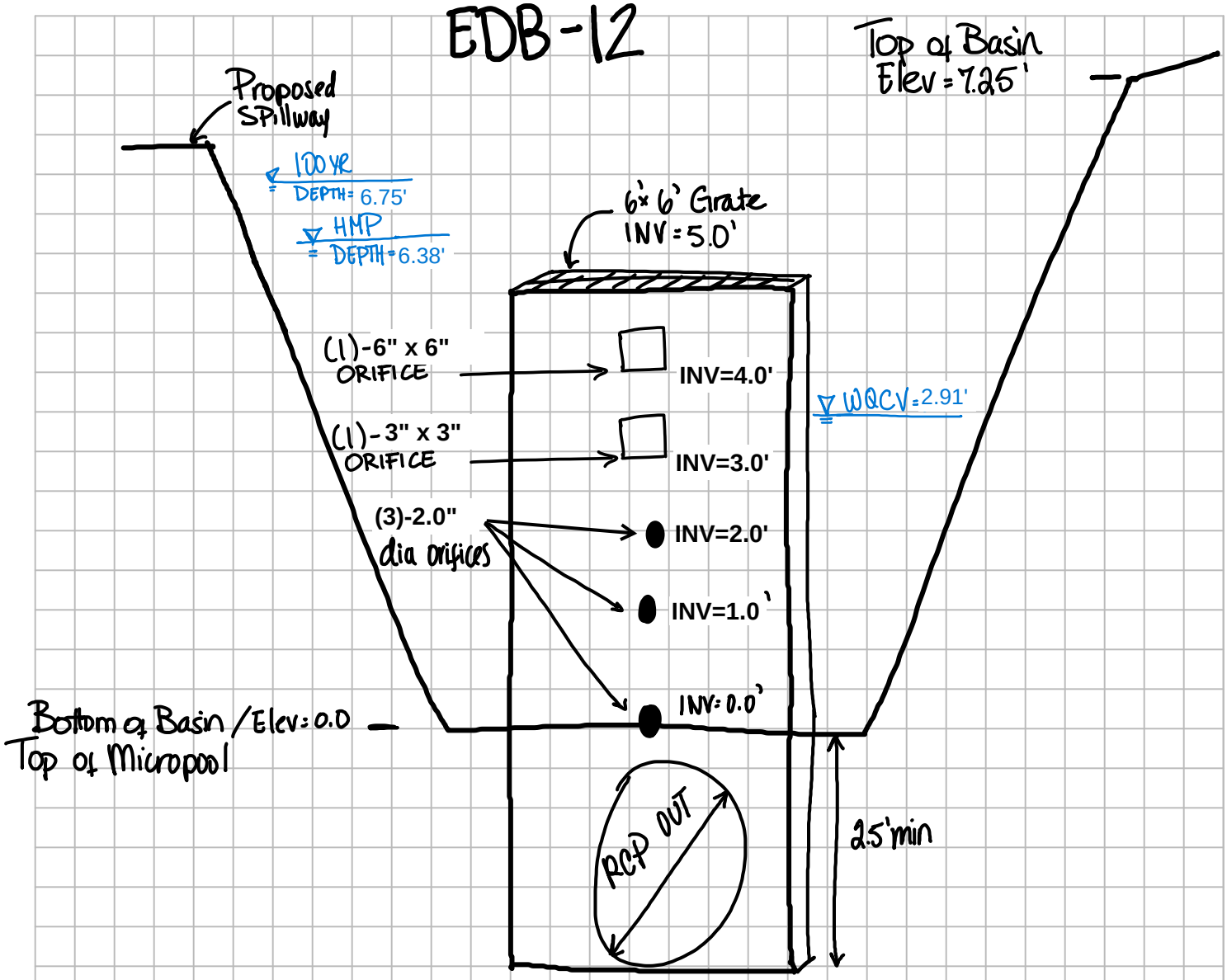
Mitigated Q100 at POC

EDB-12 Cross Section

RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE: 8-7-24
JOB NO: 2215
PAGE: 1 OF 1
DONE BY: LC
CHECKED BY:

EDB-12



EDB – 12 Stage-Storage-Discharge Table

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

6-ft x 6-ft Grate
(assumed 70% Open Area reduction)

CIRCULAR OPENINGS	1 x 2" dia.	1 x 2" dia.	1 x 2" dia.	None	None	None
# of openings	1	1	1			
Orifice Size (inches)	2	2	2			
Area Orifice (in2)	3.142	3.142	3.142			
Area Orifice (ft2)	*0.022*	*0.022*	*0.022*	*0.00*	*0.00*	*0.00*
Flowline of Orifice (ft)	0	1.000	2.000			

RECTANGULAR OPENINGS	1 x 3"H by 3"W	1 x 6"H by 6"W	None	1 x 50.4"H by 50.4"W
# of openings	1	1	0	1
Height (inches)	3	6	0	50.4
Width (inches)	3	6	0	50.4
Area Orifice (ft2)	*0.0625*	*0.25*	*0*	*17.64*
Flowline of Weir (ft)	3.00	4.000	0	5

Flowline (ft)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	-	0.000	0.000	0.000	**0.000**
0.25	0.043	-	-	0.000	0.000	0.000	**0.043**
0.50	0.068	-	-	0.000	0.000	0.000	**0.068**
0.75	0.086	-	-	0.000	0.000	0.000	**0.086**
1.00	0.101	No Value	-	0.000	0.000	0.000	**0.101**
1.25	0.113	0.043	-	0.000	0.000	0.000	**0.156**
1.50	0.125	0.068	-	0.000	0.000	0.000	**0.193**
1.75	0.136	0.086	-	0.000	0.000	0.000	**0.221**
2.00	0.145	0.101	No Value	0.000	0.000	0.000	**0.246**
2.25	0.155	0.113	0.043	0.000	0.000	0.000	**0.311**
2.50	0.163	0.125	0.068	0.000	0.000	0.000	**0.356**
2.75	0.172	0.136	0.086	0.000	0.000	0.000	**0.393**
3.00	0.179	0.145	0.101	0.000	0.000	0.000	**0.425**
3.25	0.187	0.155	0.113	0.000	0.000	0.000	**0.455**
3.50	0.194	0.163	0.125	0.000	0.000	0.000	**0.483**
3.75	0.201	0.172	0.136	0.000	0.000	0.000	**0.508**
4.00	0.208	0.179	0.145	0.000	0.000	0.000	**0.533**
4.25	0.214	0.187	0.155	0.000	0.000	0.000	**0.556**
4.50	0.221	0.194	0.163	0.000	0.000	0.000	**0.578**
4.75	0.227	0.201	0.172	0.000	0.000	0.000	**0.600**
5.00	0.233	0.208	0.179	0.000	0.000	0.000	**0.620**
5.25	0.239	0.214	0.187	0.000	0.000	0.000	**0.640**
5.50	0.244	0.221	0.194	0.000	0.000	0.000	**0.659**
5.75	0.250	0.227	0.201	0.000	0.000	0.000	**0.678**
6.00	0.256	0.233	0.208	0.000	0.000	0.000	**0.696**
6.25	0.261	0.239	0.214	0.000	0.000	0.000	**0.714**
6.50	0.266	0.244	0.221	0.000	0.000	0.000	**0.731**
6.75	0.271	0.250	0.227	0.000	0.000	0.000	**0.748**
7.00	0.276	0.256	0.233	0.000	0.000	0.000	**0.765**
7.25	0.281	0.261	0.239	0.000	0.000	0.000	**0.781**
7.50	0.286	0.266	0.244	0.000	0.000	0.000	**0.797**
7.75	0.291	0.271	0.250	0.000	0.000	0.000	**0.812**
8.00	0.296	0.276	0.256	0.000	0.000	0.000	**0.827**
8.25	0.300	0.281	0.261	0.000	0.000	0.000	**0.842**
8.50	0.305	0.286	0.266	0.000	0.000	0.000	**0.857**
8.75	0.309	0.291	0.271	0.000	0.000	0.000	**0.871**
9.00	0.314	0.296	0.276	0.000	0.000	0.000	**0.886**
9.25	0.318	0.300	0.281	0.000	0.000	0.000	**0.899**
9.50	0.322	0.305	0.286	0.000	0.000	0.000	**0.913**

Flowline (ft)	Q_{in} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{in} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{in} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{in} (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	-	-	-	-	-	-	-	-	-	-	**0.0**
2.50	-	-	-	-	-	-	-	-	-	-	**0.0**
2.75	-	-	-	-	-	-	-	-	-	-	**0.0**
3.00	-	-	-	-	-	-	-	-	-	-	**0.0**
3.25	0.094			-	-	-	-	-	-	-	**0.0**
3.50	0.265	0.184	0.184	-	-	-	-	-	-	-	**0.2**
3.75	0.487	0.238	0.238	-	-	-	-	-	-	-	**0.2**
4.00	0.750	0.281	0.281	-	-	-	-	-	-	-	**0.3**
4.25	1.048	0.319	0.319	0.188	0.000	0.000	-	-	-	-	**0.3**
4.50	1.378	0.353	0.353	0.530	0.602	0.530	-	-	-	-	**0.9**
4.75	1.736	0.384	0.384	0.974	0.851	0.851	-	-	-	-	**1.2**
5.00	2.121	0.412	0.412	1.500	1.042	1.042	-	-	-	-	**1.5**
5.25	2.531	0.439	0.439	2.096	1.204	1.204	-	-	-	1.575	**3.2**
5.50	2.965	0.464	0.464	2.756	1.346	1.346	-	-	-	4.455	**6.3**
5.75	3.420	0.488	0.488	3.473	1.474	1.474	-	-	-	8.184	**10.1**
6.00	3.897	0.510	0.510	4.243	1.592	1.592	-	-	-	12.600	**14.7**
6.25	4.394	0.532	0.532	5.063	1.702	1.702	-	-	-	17.609	**19.8**
6.50	4.911	0.553	0.553	5.929	1.806	1.806	-	-	-	23.148	**25.5**
6.75	5.446	0.573	0.573	6.841	1.903	1.903	-	-	-	29.169	**31.6**
7.00	6.000	0.592	0.592	7.794	1.996	1.996	-	-	-	35.638	**38.2**
7.25	6.571	0.611	0.611	8.789	2.085	2.085	-	-	-	42.525	**45.2**
7.50	7.159	0.629	0.629	9.822	2.170	2.170	-	-	-	49.806	**52.6**
7.75	7.764	0.647	0.647	10.893	2.252	2.252	-	-	-	57.461	**60.4**
8.00	8.385	0.664	0.664	12.000	2.331	2.331	-	-	-	65.472	**68.5**
8.25	9.022	0.681	0.681	13.142	2.407	2.407	-	-	-	73.824	**76.9**
8.50	9.674	0.698	0.698	14.319	2.482	2.482	-	-	-	82.504	**85.7**
8.75	10.341	0.714	0.714	15.529	2.554	2.554	-	-	-	91.499	**94.8**
9.00	11.023	0.729	0.729	16.771	2.623	2.623	-	-	-	100.800	**104.2**
9.25	11.719	0.745	0.745	18.044	2.692	2.692	-	-	-	110.396	**113.8**
9.50	12.429	0.760	0.760	19.348	2.758	2.758	-	-	-	120.279	**123.8**

Total Rating Curve for SWMM Analysis

Stage (ft)	Discharge (cfs)
0.00	0.000
0.25	0.043
0.50	0.068
0.75	0.086
1.00	0.101
1.25	0.156
1.50	0.193
1.75	0.221
2.00	0.246
2.25	0.311
2.50	0.356
2.75	0.393
3.00	0.425
3.25	0.455
3.50	0.667
3.75	0.746
4.00	0.814
4.25	0.875
4.50	1.461
4.75	1.834
5.00	2.075
5.25	3.858
5.50	6.924
5.75	10.824
6.00	15.399
6.25	20.557
6.50	26.237
6.75	32.394
7.00	38.991
7.25	46.002
7.50	53.402
7.75	61.172
8.00	69.294
8.25	77.755
8.50	86.540
8.75	95.638
9.00	105.038
9.25	114.732
9.50	124.710

Elevation (ft)	Stage (ft)	Area (sf)
5,785.25	0.00	173.45
5,785.50	0.25	420.02
5,785.75	0.50	952.61
5,786.00	0.75	2,066.41
5,786.25	1.00	3,797.52
5,786.50	1.25	6,204.45
5,786.75	1.50	8,581.87
5,787.00	1.75	10,384.94
5,787.25	2.00	11,662.52
5,787.50	2.25	12,627.32
5,787.75	2.50	13,665.69
5,788.00	2.75	14,746.56
5,788.25	3.00	15,878.68
5,788.50	3.25	17,069.41
5,788.75	3.50	18,272.85
5,789.00	3.75	19,303.36
5,789.25	4.00	19,995.17
5,789.50	4.25	20,689.23
5,789.75	4.50	21,389.92
5,790.00	4.75	22,097.24
5,790.25	5.00	22,811.21
5,790.50	5.25	23,531.80
5,790.75	5.50	24,259.04
5,791.00	5.75	24,992.91
5,791.25	6.00	25,733.41
5,791.50	6.25	26,480.56
5,791.75	6.50	27,234.33
5,792.00	6.75	27,994.75
5,792.25	7.00	28,761.80
5,792.50	7.25	29,535.48

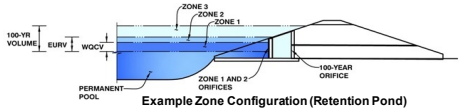
8. MHFD-Detention – Stage-Storage Table

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Range

Basin ID: EDB 12



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	22.80	acres
Watershed Length =	1,700	ft
Watershed Length to Centroid =	750	ft
Watershed Slope =	0.043	ft/ft
Watershed Imperviousness =	60.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	30.0%	percent
Percentage Hydrologic Soil Groups C/D =	70.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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) =	0.449 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.364 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	1.185 acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	1.823 acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	2.246 acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.69 in.) =	2.371 acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	3.463 acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	4.184 acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	5.255 acre-feet		inches
Approximate 2-yr Detention Volume =	1.035 acre-feet		
Approximate 5-yr Detention Volume =	1.563 acre-feet		
Approximate 10-yr Detention Volume =	1.840 acre-feet		
Approximate 25-yr Detention Volume =	1.760 acre-feet		
Approximate 50-yr Detention Volume =	2.165 acre-feet		
Approximate 100-yr Detention Volume =	2.450 acre-feet		

Define Zones and Basin Geometry

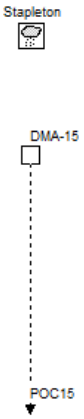
Zone 1 Volume (WQCV) =	0.449	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.916	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.086	acre-feet
Total Detention Basin Volume =	2.450	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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 = 0.10 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	--	--	--	173	0.004		
	--	0.25	--	--	--	420	0.010	74	0.002
	--	0.50	--	--	--	953	0.022	246	0.006
	--	0.75	--	--	--	2,066	0.047	623	0.014
	--	1.00	--	--	--	3,798	0.087	1,356	0.031
	--	1.25	--	--	--	6,204	0.142	2,606	0.060
	--	1.50	--	--	--	8,582	0.197	4,455	0.102
	--	1.75	--	--	--	10,385	0.238	6,825	0.157
	--	2.00	--	--	--	11,663	0.268	9,581	0.220
	--	2.25	--	--	--	12,627	0.290	12,618	0.290
	--	2.50	--	--	--	13,666	0.314	15,904	0.365
	--	2.75	--	--	--	14,747	0.339	19,456	0.447
	--	3.00	--	--	--	15,879	0.365	23,284	0.535
	--	3.25	--	--	--	17,069	0.392	27,402	0.629
	--	3.50	--	--	--	18,273	0.419	31,820	0.730
	--	3.75	--	--	--	19,303	0.443	36,517	0.838
	--	4.00	--	--	--	19,995	0.459	41,430	0.951
	--	4.25	--	--	--	20,689	0.475	46,515	1.068
	--	4.50	--	--	--	21,390	0.491	51,775	1.189
	--	4.75	--	--	--	22,097	0.507	57,211	1.313
	--	5.00	--	--	--	22,811	0.524	62,824	1.442
	--	5.25	--	--	--	23,532	0.540	68,617	1.575
	--	5.50	--	--	--	24,259	0.557	74,591	1.712
	--	5.75	--	--	--	24,993	0.574	80,748	1.854
	--	6.00	--	--	--	25,733	0.591	87,088	1.999
	--	6.25	--	--	--	26,481	0.608	93,615	2.149
	--	6.50	--	--	--	27,234	0.625	100,330	2.303
	--	6.75	--	--	--	27,995	0.643	107,233	2.462
	--	7.00	--	--	--	28,762	0.660	114,328	2.625
	--	7.25	--	--	--	29,535	0.678	121,615	2.792
	--		--	--	--				
	--		--	--	--				
	--		--	--	--			

1. SWMM Schematics for POC 15

Pre-Project DMA 15



Subcatchment DMA-15

Property	Value
Name	DMA-15
X-Coordinate	4021.330
Y-Coordinate	7804.266
Description	Pre-Project Condition
Tag	
Rain Gage	Stapleton
Outlet	POC15
Area	78.3
Width	829
% Slope	6
% Imperv	5
N-Imperv	.013
N-Perv	.10
Dstore-Imperv	.05
Dstore-Perv	.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

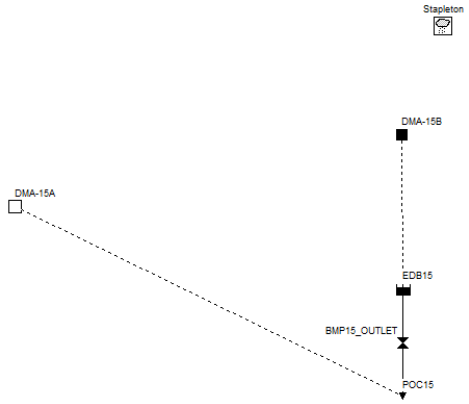
Groundwater flow parameters (click to edit)

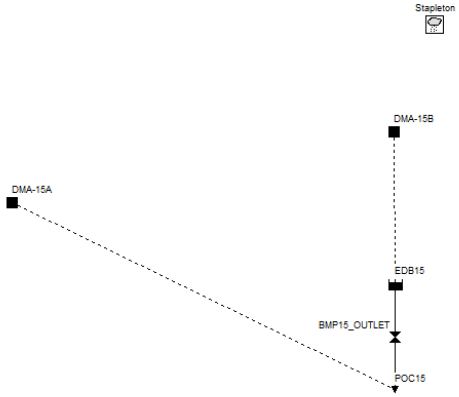
Post Project DMA 15A and DMA -15B

Subcatchment DMA-15A

Property	Value
Name	DMA-15A
X-Coordinate	-714.286
Y-Coordinate	6737.589
Description	Undisturbed Pervious Area (5% Impervious)
Tag	
Rain Gage	Stapleton
Outlet	POC15
Area	68.7
Width	829
% Slope	6
% Imperv	5
N-Imperv	.013
N-Perv	.10
Dstore-Imperv	.05
Dstore-Perv	.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Groundwater flow parameters (click to edit)





Subcatchment DMA-15B

Property	Value
Name	DMA-15B
X-Coordinate	3575.548
Y-Coordinate	7531.719
Description	
Tag	
Rain Gage	Stapleton
Outlet	EDB15
Area	9.9
Width	393
% Slope	4
% Imperv	65
N-Imperv	0.013
N-Perv	0.10
Dstore-Imperv	0.05
Dstore-Perv	0.20
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Groundwater flow parameters (click to edit)

2. POC 12 SWMM Inputs & Results for HMP Run

```
[TITLE]
;;Project Title/Notes
2215 Range
Pre-Project Condition POC 1

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;--------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
;Pre-Project Condition
DMA-15           Stapleton        POC15            78.3     5        829      6        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-15           .013       .10        .05        .20        25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-15           9          0.025    0.3

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC15            0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
```

```
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC15            4021.330           5821.832

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-15           4021.330           7804.266

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition POC 15


***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      6268.698       960.720
Evaporation Loss .........       346.388        53.086
Infiltration Loss ........      5239.317       802.961
Surface Runoff ...........       760.166       116.501
Final Storage ............         0.008         0.001
Continuity Error (%) .....        -1.231


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------      ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       760.166       247.711
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       760.166       247.711
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


**************************
Subcatchment Runoff Summary
**************************

-----------------------------------------------------------------------------------------------------
                         Total      Total      Total      Total      Total       Total     Peak  Runoff
                        Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------
DMA-15                  960.72       0.00      53.09     802.96     116.50      247.69    62.13   0.121


Analysis begun on:  Tue Mar 18 08:47:18 2025
Analysis ended on:  Tue Mar 18 08:47:36 2025
Total elapsed time: 00:00:18
```

```
[TITLE]
;;Project Title/Notes
2215 Range
Post-Project Condition

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           08/01/1948
START_TIME           00:00:00
REPORT_START_DATE    08/01/1948
REPORT_START_TIME    00:00:00
END_DATE             12/14/2013
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;--------------- ----------------
MONTHLY          .03    .05    .08    .11    .13    .15    .15    .13    .11    .08    .04    .02
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Stapleton        INTENSITY 1:00     1.0      TIMESERIES Stapleton

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
;Undisturbed Pervious Area (5% Impervious)
DMA-15A          Stapleton        POC15            68.7     5        829      6        0
DMA-15B          Stapleton        EDB15            9.9      65       393      4        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-15A          .013       .10        .05        .20        25         OUTLET
DMA-15B          0.013      0.10       0.05       0.20       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    Ksat       IMD
;;-------------- ---------- ---------- ----------
DMA-15A          9          0.025      0.3
DMA-15B          9          0.025      0.3

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC15            0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------          -------- --------
EDB15            0        9.5        0          TABULAR    EDB15                        0        0

[OUTLETS]
```

```
;;Name           From Node        To Node          Offset     Type            QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- --------
BMP15_OUTLET     EDB15            POC15            0          TABULAR/DEPTH   BMP15_RATINGCURVE            NO

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
BMP15_RATINGCURVE Rating     0.00       0.000
BMP15_RATINGCURVE            0.25       0.012
BMP15_RATINGCURVE            0.50       0.018
BMP15_RATINGCURVE            0.75       0.022
BMP15_RATINGCURVE            1.00       0.026
BMP15_RATINGCURVE            1.25       0.029
BMP15_RATINGCURVE            1.50       0.032
BMP15_RATINGCURVE            1.75       0.046
BMP15_RATINGCURVE            2.00       0.055
BMP15_RATINGCURVE            2.25       0.104
BMP15_RATINGCURVE            2.50       0.135
BMP15_RATINGCURVE            2.75       0.158
BMP15_RATINGCURVE            3.00       0.177
BMP15_RATINGCURVE            3.25       0.195
BMP15_RATINGCURVE            3.50       0.741
BMP15_RATINGCURVE            3.75       1.076
BMP15_RATINGCURVE            4.00       1.281
BMP15_RATINGCURVE            4.25       1.455
BMP15_RATINGCURVE            4.50       1.610
BMP15_RATINGCURVE            4.75       1.750
BMP15_RATINGCURVE            5.00       1.879
BMP15_RATINGCURVE            5.25       3.050
BMP15_RATINGCURVE            5.50       5.083
BMP15_RATINGCURVE            5.75       7.677
BMP15_RATINGCURVE            6.00       10.724
BMP15_RATINGCURVE            6.25       14.161
BMP15_RATINGCURVE            6.50       17.948
BMP15_RATINGCURVE            6.75       22.053
BMP15_RATINGCURVE            7.00       26.453
;
EDB15            Storage    0.00       103.59
EDB15                       0.25       281.75
EDB15                       0.50       871.18
EDB15                       0.75       1844.14
EDB15                       1.00       3476.46
EDB15                       1.25       5617.60
EDB15                       1.50       7614.85
EDB15                       1.75       9128.70
EDB15                       2.00       9734.90
EDB15                       2.25       10190.97
EDB15                       2.50       10653.77
EDB15                       2.75       11123.30
EDB15                       3.00       11599.55
EDB15                       3.25       12082.53
EDB15                       3.50       12572.25
EDB15                       3.75       13068.69
EDB15                       4.00       13571.86
EDB15                       4.25       14081.75
EDB15                       4.50       14598.38
EDB15                       4.75       15121.74
EDB15                       5.00       15651.82
EDB15                       5.25       16188.63
EDB15                       5.50       16732.18
EDB15                       5.75       17282.45
EDB15                       6.00       17839.44
EDB15                       6.25       18403.17
EDB15                       6.50       18973.63
EDB15                       6.75       19562.11
EDB15                       7.00       20208.29

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Stapleton        FILE "stapleton.dat"

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
```

```
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC15            3581.560           4640.324
EDB15            3581.560           5805.471

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-15A          -714.286           6737.589
DMA-15B          3580.614           7521.587
DMA-15B          3570.482           7541.850

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Stapleton        4046.424           8720.201
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Post-Project Condition


***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 08/01/1948 00:00:00
Ending Date .............. 12/14/2013 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      6292.716       960.720
Evaporation Loss .........       429.641        65.594
Infiltration Loss ........      4823.758       736.452
Surface Runoff ...........      1100.416       168.002
Final Storage ............         0.021         0.003
Continuity Error (%) .....        -0.971


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......      1100.416       358.587
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........      1100.326       358.558
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.001         0.000
Continuity Error (%) .....         0.008


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


*************************
```

Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA-15A	960.72	0.00	50.63	801.21	118.06	220.24	58.82	0.123
DMA-15B	960.72	0.00	169.44	287.09	514.55	138.32	16.38	0.536

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
POC15	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
EDB15	STORAGE	0.26	5.66	5.66	23722 19:06	5.63

HMP Ponding Depth

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
POC15	OUTFALL	58.82	60.68	20471 19:01	220	359	0.000
EDB15	STORAGE	16.38	16.38	20471 19:01	138	138	0.021

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB15	0.750	1	0	0	57.026	41	23722 19:05	6.70

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC15	21.67	0.11	60.68	358.531
System	21.67	0.11	60.68	358.531

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
BMP15_OUTLET	DUMMY	6.70	23722 19:06			

```
************************
Conduit Surcharge Summary
************************

No conduits were surcharged.

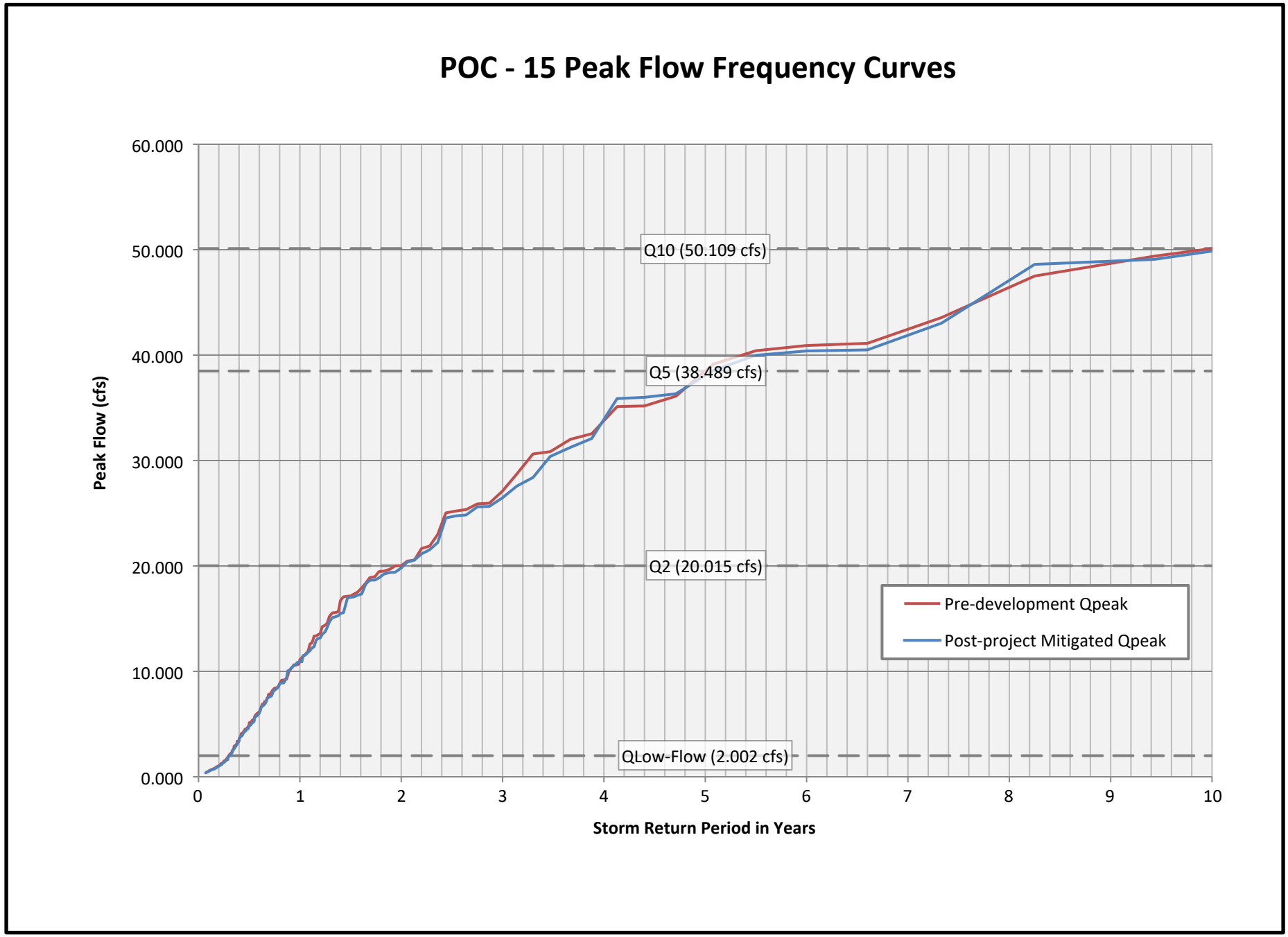

Analysis begun on:  Tue Mar 18 08:57:42 2025
Analysis ended on:  Tue Mar 18 08:58:06 2025
Total elapsed time: 00:00:24
```

3. POC -15 HMP Post-Processing Spreadsheet

Peak Flow Frequency Summary

HMP Flow Frequency Range Based on: **SWMM - Weibull**

Return Period	Pre-development Qpeak (cfs)	Post-project - Mitigated Q (cfs)	*Check*
Low-Flow = 0.1*Q2	2.002	1.981	*Okay! -> Decreased by 0.021 cfs*
2-year	20.015	19.805	*Okay! -> Decreased by 0.21 cfs*
3-year	27.114	26.470	*Okay! -> Decreased by 0.644 cfs*
4-year	33.776	33.906	*Okay! -> Decreased by -0.13 cfs*
5-year	38.489	38.067	*Okay! -> Decreased by 0.422 cfs*
6-year	40.912	40.393	*Okay! -> Decreased by 0.519 cfs*
7-year	42.456	41.882	*Okay! -> Decreased by 0.574 cfs*
8-year	46.430	47.090	*Okay! -> Decreased by -0.661 cfs*
9-year	48.698	48.908	*Okay! -> Decreased by -0.209 cfs*
10-year	50.109	49.866	*Okay! -> Decreased by 0.243 cfs*


POC - 15 Peak Flow Frequency Curves
60.000
50.000
40.000
30.000
20.000
10.000
0.000
Peak Flow (cfs)
Q10 (50.109 cfs)
Q5 (38.489 cfs)
Q2 (20.015 cfs)
QLow-Flow (2.002 cfs)
Pre-development Qpeak
Post-project Mitigated Qpeak
0
1
2
3
4
5
6
7
8
9
10
Storm Return Period in Years

[POC 15 - EDB-15]

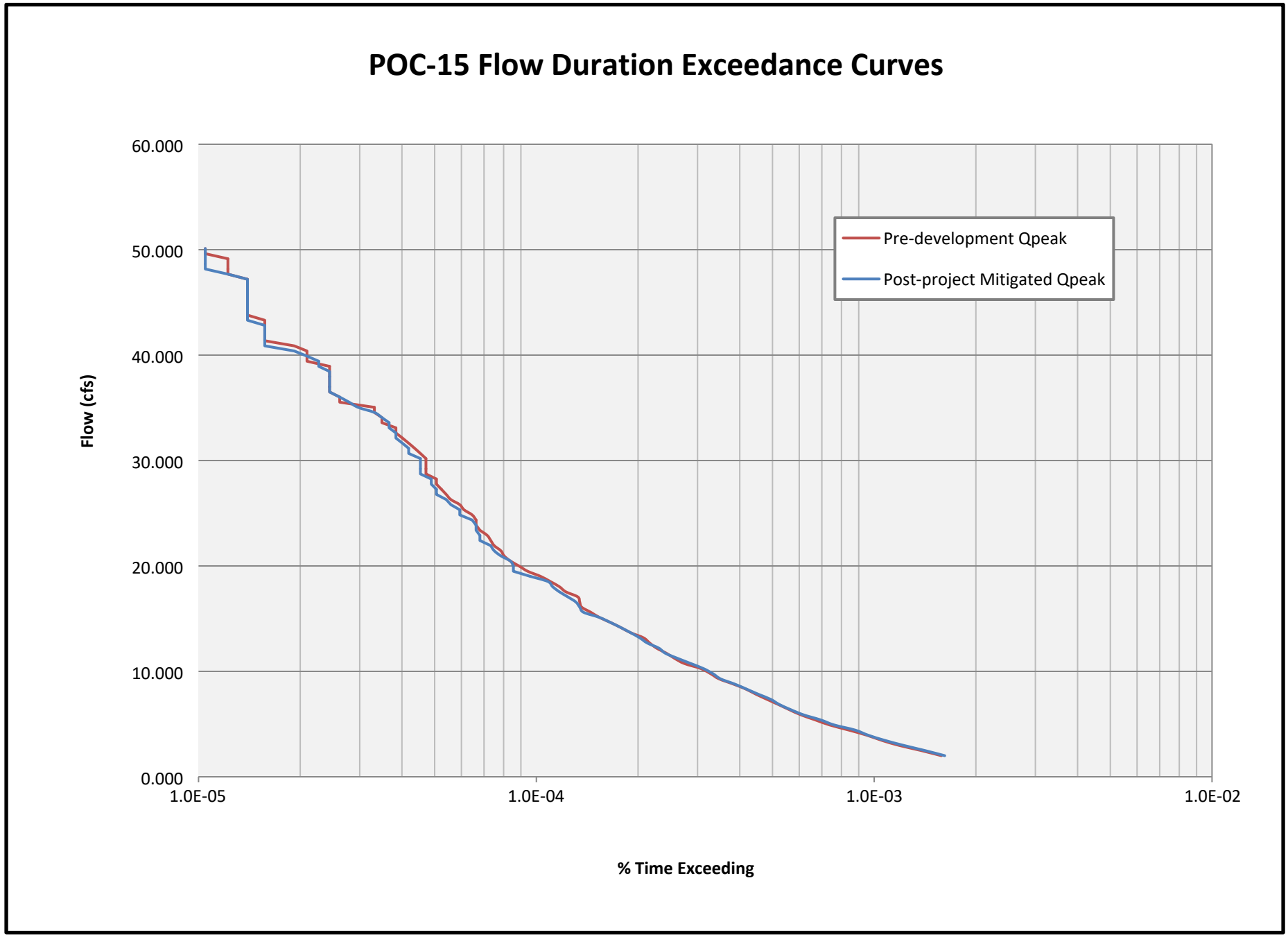
Low-flow Threshold:	10%	
0.1xQ2 (Pre):	2.0015	cfs
Q10 (Pre):	50.109	cfs
# of Intervals between flow bins:	99	
Incremental Q (Pre):	0.48594	cfs
Total Hourly Data:	573047	hours
Flow Frequency Range Based on:	**SWMM - Weibull**	

The proposed BMP: **PASSED**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	2.002	906	1.58E-03	927	1.62E-03	*102%*	*Pass^*
2	2.487	790	1.38E-03	810	1.41E-03	*103%*	*Pass^*
3	2.973	680	1.19E-03	701	1.22E-03	*103%*	*Pass^*
4	3.459	603	1.05E-03	615	1.07E-03	*102%*	*Pass^*
5	3.945	545	9.51E-04	550	9.60E-04	*101%*	*Pass^*
6	4.431	482	8.41E-04	503	8.78E-04	*104%*	*Pass^*
7	4.917	423	7.38E-04	436	7.61E-04	*103%*	*Pass^*
8	5.403	383	6.68E-04	397	6.93E-04	*104%*	*Pass^*
9	5.889	347	6.06E-04	353	6.16E-04	*102%*	*Pass^*
10	6.375	321	5.60E-04	324	5.65E-04	*101%*	*Pass^*
11	6.861	298	5.20E-04	300	5.24E-04	*101%*	*Pass^*
12	7.347	276	4.82E-04	283	4.94E-04	*103%*	*Pass^*
13	7.833	256	4.47E-04	260	4.54E-04	*102%*	*Pass^*
14	8.319	239	4.17E-04	240	4.19E-04	*100%*	*Pass^*
15	8.805	219	3.82E-04	221	3.86E-04	*101%*	*Pass^*
16	9.291	199	3.47E-04	201	3.51E-04	*101%*	*Pass^*
17	9.776	188	3.28E-04	191	3.33E-04	*102%*	*Pass^*
18	10.262	176	3.07E-04	179	3.12E-04	*102%*	*Pass^*
19	10.748	157	2.74E-04	164	2.86E-04	*104%*	*Pass^*
20	11.234	147	2.57E-04	150	2.62E-04	*102%*	*Pass^*
21	11.720	139	2.43E-04	138	2.41E-04	99%	Pass
22	12.206	130	2.27E-04	132	2.30E-04	*102%*	*Pass^*
23	12.692	124	2.16E-04	122	2.13E-04	98%	Pass
24	13.178	119	2.08E-04	116	2.02E-04	97%	Pass
25	13.664	109	1.90E-04	109	1.90E-04	*100%*	*Pass^*
26	14.150	102	1.78E-04	102	1.78E-04	*100%*	*Pass^*
27	14.636	95	1.66E-04	95	1.66E-04	*100%*	*Pass^*
28	15.122	88	1.54E-04	88	1.54E-04	*100%*	*Pass^*
29	15.608	83	1.45E-04	79	1.38E-04	95%	Pass
30	16.094	78	1.36E-04	77	1.34E-04	99%	Pass
31	16.580	77	1.34E-04	75	1.31E-04	97%	Pass
32	17.066	76	1.33E-04	71	1.24E-04	93%	Pass
33	17.551	70	1.22E-04	67	1.17E-04	96%	Pass
34	18.037	67	1.17E-04	64	1.12E-04	96%	Pass
35	18.523	63	1.10E-04	62	1.08E-04	98%	Pass
36	19.009	59	1.03E-04	55	9.60E-05	93%	Pass
37	19.495	54	9.42E-05	49	8.55E-05	91%	Pass
38	19.981	51	8.90E-05	49	8.55E-05	96%	Pass
39	20.467	48	8.38E-05	48	8.38E-05	*100%*	*Pass^*
40	20.953	46	8.03E-05	45	7.85E-05	98%	Pass
41	21.439	45	7.85E-05	43	7.50E-05	96%	Pass
42	21.925	43	7.50E-05	42	7.33E-05	98%	Pass
43	22.411	42	7.33E-05	39	6.81E-05	93%	Pass
44	22.897	41	7.15E-05	39	6.81E-05	95%	Pass
45	23.383	39	6.81E-05	38	6.63E-05	97%	Pass
46	23.869	38	6.63E-05	38	6.63E-05	*100%*	*Pass^*
47	24.355	38	6.63E-05	37	6.46E-05	97%	Pass
48	24.841	37	6.46E-05	34	5.93E-05	92%	Pass
49	25.326	35	6.11E-05	34	5.93E-05	97%	Pass
50	25.812	34	5.93E-05	32	5.58E-05	94%	Pass
51	26.298	32	5.58E-05	31	5.41E-05	97%	Pass

Flow Frequency Range Based on: **SWMM - Weibull**

Beginning of Interval (Flow Bin)	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
52	26.784	31	5.41E-05	29	5.06E-05	94%	Pass
53	27.270	30	5.24E-05	29	5.06E-05	97%	Pass
54	27.756	29	5.06E-05	28	4.89E-05	97%	Pass
55	28.242	29	5.06E-05	28	4.89E-05	97%	Pass
56	28.728	27	4.71E-05	26	4.54E-05	96%	Pass
57	29.214	27	4.71E-05	26	4.54E-05	96%	Pass
58	29.700	27	4.71E-05	26	4.54E-05	96%	Pass
59	30.186	27	4.71E-05	26	4.54E-05	96%	Pass
60	30.672	26	4.54E-05	24	4.19E-05	92%	Pass
61	31.158	25	4.36E-05	24	4.19E-05	96%	Pass
62	31.644	24	4.19E-05	23	4.01E-05	96%	Pass
63	32.130	23	4.01E-05	22	3.84E-05	96%	Pass
64	32.616	22	3.84E-05	22	3.84E-05	*100%*	*Pass^*
65	33.101	22	3.84E-05	21	3.66E-05	95%	Pass
66	33.587	20	3.49E-05	21	3.66E-05	*105%*	*Pass^*
67	34.073	20	3.49E-05	20	3.49E-05	*100%*	*Pass^*
68	34.559	19	3.32E-05	19	3.32E-05	*100%*	*Pass^*
69	35.045	19	3.32E-05	17	2.97E-05	89%	Pass
70	35.531	15	2.62E-05	16	2.79E-05	*107%*	*Pass^*
71	36.017	15	2.62E-05	15	2.62E-05	*100%*	*Pass^*
72	36.503	14	2.44E-05	14	2.44E-05	*100%*	*Pass^*
73	36.989	14	2.44E-05	14	2.44E-05	*100%*	*Pass^*
74	37.475	14	2.44E-05	14	2.44E-05	*100%*	*Pass^*
75	37.961	14	2.44E-05	14	2.44E-05	*100%*	*Pass^*
76	38.447	14	2.44E-05	14	2.44E-05	*100%*	*Pass^*
77	38.933	14	2.44E-05	13	2.27E-05	93%	Pass
78	39.419	12	2.09E-05	13	2.27E-05	*108%*	*Pass^*
79	39.905	12	2.09E-05	12	2.09E-05	*100%*	*Pass^*
80	40.391	12	2.09E-05	11	1.92E-05	92%	Pass
81	40.876	11	1.92E-05	9	1.57E-05	82%	Pass
82	41.362	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
83	41.848	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
84	42.334	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
85	42.820	9	1.57E-05	9	1.57E-05	*100%*	*Pass^*
86	43.306	9	1.57E-05	8	1.40E-05	89%	Pass
87	43.792	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
88	44.278	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
89	44.764	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
90	45.250	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
91	45.736	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
92	46.222	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
93	46.708	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
94	47.194	8	1.40E-05	8	1.40E-05	*100%*	*Pass^*
95	47.680	7	1.22E-05	7	1.22E-05	*100%*	*Pass^*
96	48.166	7	1.22E-05	6	1.05E-05	86%	Pass
97	48.651	7	1.22E-05	6	1.05E-05	86%	Pass
98	49.137	7	1.22E-05	6	1.05E-05	86%	Pass
99	49.623	6	1.05E-05	6	1.05E-05	*100%*	*Pass^*
100	50.109	6	1.05E-05	6	1.05E-05	*100%*	*Pass^*


POC-15 Flow Duration Exceedance Curves
60.000
50.000
40.000
30.000
20.000
10.000
0.000
Flow (cfs)
1.0E-05
1.0E-04
1.0E-03
1.0E-02
% Time Exceeding
Pre-development Qpeak
Post-project Mitigated Qpeak

4. POC -15 CUHP Inputs

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (acre)	Length to Centroid (ft)	Length (ft)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
DMA-15	DMA-15	100	78.3	2000	4118	0.06	5	0.35	0.1	3	0.0018	0.5	0

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (acre)	Length to Centroid (ft)	Length (ft)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
DMA-15A	DMA-15A	100	68.7	2100	4118	0.06	5	0.35	0.1	3	0.0018	0.5	0
DMA-15B	DMA-15B	100	9.9	597	1110	0.04	65	0.35	0.1	3	0.0018	0.5	0

RUN MULTIPLE CUHP AND SWMM SCENARIOS

Columns with this color heading are for required user-inpu
Columns with this color heading are for program-calculated value

SWMM Run Wait Time (sec)
5

(Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)
LU

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
DMA-15A	5	5
DMA-15B	5	65

Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
2	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
5	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
10	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
50	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
100	WQ	0.60	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40
WQ	WQ	0.6	N/A
	2	1.06	1.50
	5	1.43	2.00
	10	1.66	2.20
	25	2.00	2.50
	50	2.26	3.00
	100	2.60	3.20
	500	3.00	3.40

Enter "X" to Run Scenario	Scenario ID	Land Use (E or F)	Return Period (yr)	Correction Area (Sq.Mi.)	(Optional) SWMM Time Series Inflow Table "NAME"
X	1	F	WQ	0	1_Fut_WQ_0mi^2_Post15_out
X	2	F	2	0	2_Fut_2yr_0mi^2_Post15_out
X	3	F	5	0	3_Fut_5yr_0mi^2_Post15_out
X	4	F	10	0	4_Fut_10yr_0mi^2_Post15_out
X	5	F	50	0	5_Fut_50yr_0mi^2_Post15_out
X	6	F	100	0	6_Fut_100yr_0mi^2_Post15_out

5. POC –15 SWMM Results using CUHP Input File for the 100Yr Storm

(Q25 & Q50 to be provided with Final Drainage Report)

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Pre-Project Condition POC 1
Scenario ID = 6_Ex_100yr_0mi^2_POC15_RANGE_PRE

WARNING 04: minimum elevation drop used for Conduit 1

**********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
**********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        10.751         3.503
External Outflow .........        10.751         3.503
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type         Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
DMA-15               JUNCTION     0.00     0.00     0.00     0  00:00        0.00
POC15                OUTFALL      0.00     0.00     0.00     0  00:00        0.00
```

```
******************
Node Inflow Summary
******************

-------------------------------------------------------------------------------------------------
                                Maximum  Maximum                  Lateral       Total        Flow
                                Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type           CFS      CFS  days hr:min    10^6 gal    10^6 gal     Percent
-------------------------------------------------------------------------------------------------
DMA-15               JUNCTION    104.11   104.11     0  00:51         3.5         3.5       0.000
POC15                OUTFALL       0.00   104.11     0  00:51           0         3.5       0.000


*********************
Node Flooding Summary
*********************

No nodes were flooded.


***********************
Outfall Loading Summary
***********************

-----------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
-----------------------------------------------------------
POC15                 74.17     29.23    104.11       3.503
-----------------------------------------------------------
System                74.17     29.23    104.11       3.503


*******************
Link Flow Summary
*******************

-------------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                                |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
1                    DUMMY      104.11     0  00:51


*************************
Conduit Surcharge Summary
*************************

No conduits were surcharged.


Analysis begun on:  Wed Aug 07 13:23:10 2024
Analysis ended on:  Wed Aug 07 13:23:10 2024
Total elapsed time: < 1 sec
```

Pre-Project Q100 per CUHP run

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Post-Project Condition
Scenario ID = 1_Fut_WQ_0mi^2_POC15_RANGE_POST

WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.312         0.102
External Outflow .........         0.088         0.029
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.224         0.073
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type          Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
DMA-15A              JUNCTION      0.00     0.00     0.00     0  00:00        0.00
DMA-15B              JUNCTION      0.00     0.00     0.00     0  00:00        0.00
POC15                OUTFALL       0.00     0.00     0.00     0  00:00        0.00
```

```
EDB15                STORAGE      1.97     2.25     2.25     0  02:28        2.24
```

WQ ponding depth

```
********************
Node Inflow Summary
********************

-------------------------------------------------------------------------------------------------
                                 Maximum  Maximum                  Lateral       Total        Flow
                                 Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                  Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type           CFS      CFS  days hr:min    10^6 gal    10^6 gal     Percent
-------------------------------------------------------------------------------------------------
DMA-15A              JUNCTION      0.46     0.46     0  00:46      0.0152      0.0152       0.000
DMA-15B              JUNCTION      4.24     4.24     0  00:31      0.0865      0.0865       0.000
POC15                OUTFALL       0.00     0.53     0  00:46           0      0.0286       0.000
EDB15                STORAGE       0.00     4.24     0  00:31           0      0.0865      -0.004


*********************
Node Flooding Summary
*********************

No nodes were flooded.


**********************
Storage Volume Summary
**********************

-------------------------------------------------------------------------------------------------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit         1000 ft3    Full  Loss  Loss      1000 ft3    Full    days hr:min        CFS
-------------------------------------------------------------------------------------------------
EDB15                   8.927       6     0     0        10.913       8       0  02:27       0.09


************************
Outfall Loading Summary
************************

-------------------------------------------------------------
                     Flow       Avg       Max       Total
                     Freq      Flow      Flow      Volume
Outfall Node         Pcnt       CFS       CFS    10^6 gal
-------------------------------------------------------------
POC15               95.56      0.19      0.53       0.029
-------------------------------------------------------------
System              95.56      0.19      0.53       0.029


********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                                |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
1                    DUMMY        4.24     0  00:31
2                    DUMMY        0.46     0  00:46
BMP15_OUTLET         DUMMY        0.09     0  02:28


*************************
Conduit Surcharge Summary
*************************

No conduits were surcharged.


Analysis begun on:  Tue Mar 18 12:20:20 2025
Analysis ended on:  Tue Mar 18 12:20:20 2025
Total elapsed time: < 1 sec
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

2215 Range
Post-Project Condition
Scenario ID = 6_Fut_100yr_0mi^2_POC15_RANGE_POST

WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2

*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2024 00:00:00
Ending Date .............. 01/01/2024 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 60.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        11.293         3.680
External Outflow .........        10.560         3.441
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.731         0.238
Continuity Error (%) .....         0.013


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type          Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
DMA-15A              JUNCTION      0.00     0.00     0.00     0  00:00        0.00
DMA-15B              JUNCTION      0.00     0.00     0.00     0  00:00        0.00
POC15                OUTFALL       0.00     0.00     0.00     0  00:00        0.00
```

EDB15	STORAGE	4.35	5.71	5.71	0	01:17	5.38	

100Yr ponding depth

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
DMA-15A	JUNCTION	85.83	85.83	0 00:51	3.07	3.07	0.000
DMA-15B	JUNCTION	32.04	32.04	0 00:36	0.605	0.605	0.000
POC15	OUTFALL	0.00	88.12	0 00:56	0	3.44	0.000
EDB15	STORAGE	0.00	32.04	0 00:36	0	0.605	0.078

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
EDB15	38.455	27	0	0	58.006	41	0 01:16	9.32

Detained Q100 out of EDB

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC15	98.06	21.72	88.12	3.441
System	98.06	21.72	88.12	3.441

Mitigated Q100 at POC

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	DUMMY	32.04	0 00:36			
2	DUMMY	85.83	0 00:51			
BMP15_OUTLET	DUMMY	9.32	0 01:17			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

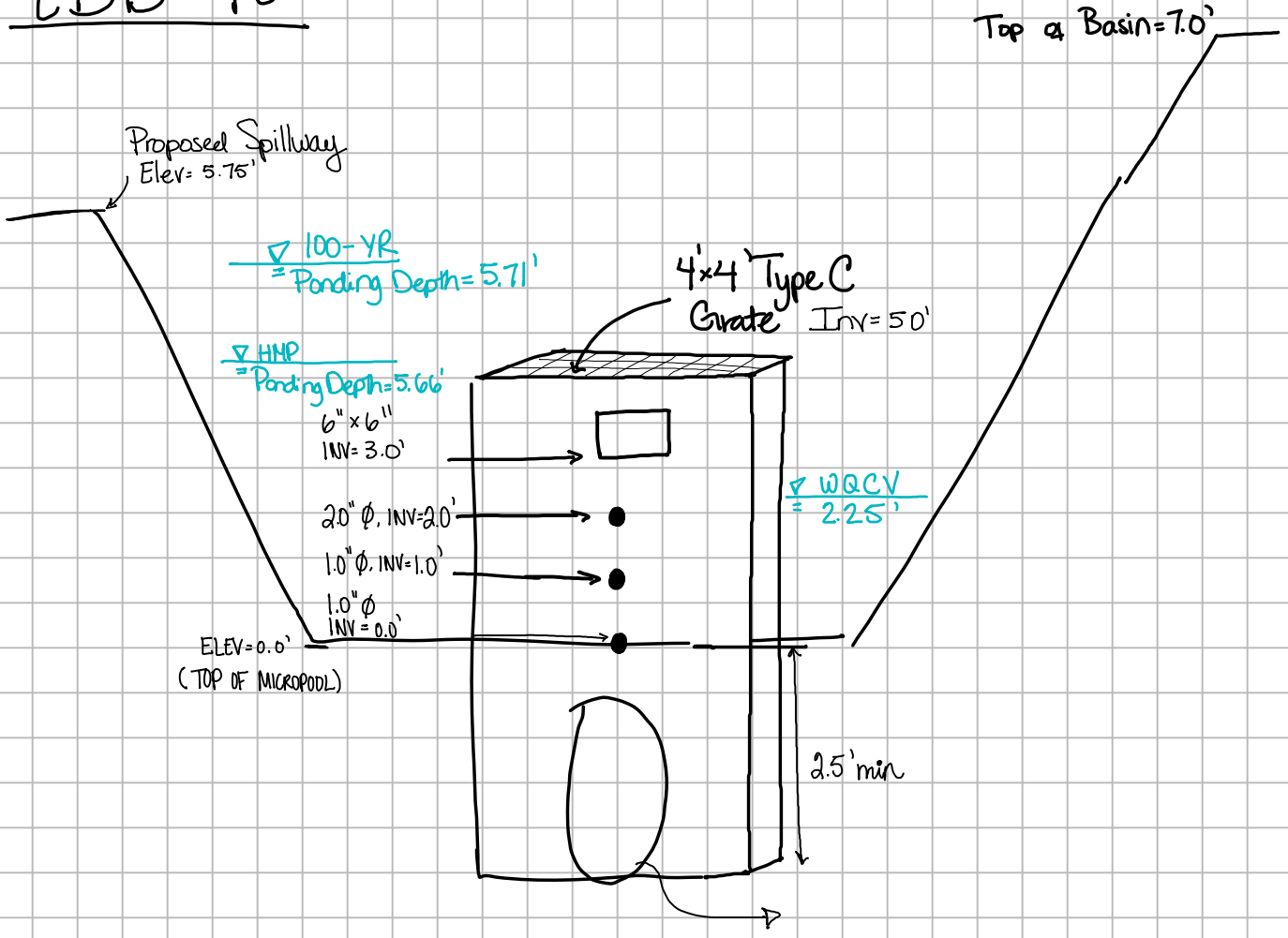
Analysis begun on: Tue Mar 18 12:20:45 2025
Analysis ended on: Tue Mar 18 12:20:45 2025
Total elapsed time: < 1 sec

6. EDB Cross Section

RICK
8678 CONCORD CENTER DR #200
ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

DATE:
JOB NO:
PAGE:
DONE BY:
CHECKED BY:

EDB-15



7. EDB Stage Storage Discharge Table

Orifice Equation Calculation

$Q_{orifice} = C_o * A * (2 * g * (H-h))^{0.5}$

Orifice Coefficient, C_o	0.6
g (ft/s2)	32.2
Increment (ft)	0.25

Weir Equation Calculation

$Q_{weir} = C_w * L * H^{3/2}$

Weir Coefficient, C_w	3
Increment (ft)	0.25

CIRCULAR OPENINGS	1 x 1" dia.	1 x 1" dia.	1 x 2" dia.	None	None	None
# of openings	1	1	1			
Orifice Size (inches)	1	1	2			
Area Orifice (ft2)	*0.01*	*0.01*	*0.02*	*0.00*	*0.00*	*0.00*
Flowline of Orifice (ft)	0	1.500	2			

RECTANGULAR OPENINGS	1 x 6"H by 6"W	None	None	1 x 33.6"H by 33.6"W
# of openings	1	0	0	1
Height (inches)	6	0	0	33.6
Width (inches)	6	0	0	33.6
Area Orifice (ft2)	*0.25*	*0*	*0*	*7.84*
Flowline of Weir (ft)	3.00		0	5

Flowline (ft)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	TOTAL
0.00	No Value	-	-	0.000	0.000	0.000	**0.000**
0.25	0.012	-	-	0.000	0.000	0.000	**0.012**
0.50	0.018	-	-	0.000	0.000	0.000	**0.018**
0.75	0.022	-	-	0.000	0.000	0.000	**0.022**
1.00	0.026	-	-	0.000	0.000	0.000	**0.026**
1.25	0.029	-	-	0.000	0.000	0.000	**0.029**
1.50	0.032	No Value	-	0.000	0.000	0.000	**0.032**
1.75	0.034	0.012	-	0.000	0.000	0.000	**0.046**
2.00	0.037	0.018	No Value	0.000	0.000	0.000	**0.055**
2.25	0.039	0.022	0.043	0.000	0.000	0.000	**0.104**
2.50	0.041	0.026	0.068	0.000	0.000	0.000	**0.135**
2.75	0.043	0.029	0.086	0.000	0.000	0.000	**0.158**
3.00	0.045	0.032	0.101	0.000	0.000	0.000	**0.177**
3.25	0.047	0.034	0.113	0.000	0.000	0.000	**0.195**
3.50	0.049	0.037	0.125	0.000	0.000	0.000	**0.211**
3.75	0.051	0.039	0.136	0.000	0.000	0.000	**0.225**
4.00	0.052	0.041	0.145	0.000	0.000	0.000	**0.239**
4.25	0.054	0.043	0.155	0.000	0.000	0.000	**0.252**
4.50	0.055	0.045	0.163	0.000	0.000	0.000	**0.264**
4.75	0.057	0.047	0.172	0.000	0.000	0.000	**0.276**
5.00	0.058	0.049	0.179	0.000	0.000	0.000	**0.287**
5.25	0.060	0.051	0.187	0.000	0.000	0.000	**0.297**
5.50	0.061	0.052	0.194	0.000	0.000	0.000	**0.308**
5.75	0.063	0.054	0.201	0.000	0.000	0.000	**0.318**
6.00	0.064	0.055	0.208	0.000	0.000	0.000	**0.327**
6.25	0.065	0.057	0.214	0.000	0.000	0.000	**0.337**
6.50	0.067	0.058	0.221	0.000	0.000	0.000	**0.346**
6.75	0.068	0.060	0.227	0.000	0.000	0.000	**0.355**
7.00	0.069	0.061	0.233	0.000	0.000	0.000	**0.364**

Flowline (ft)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	Q_o (cfs)	Q_{govern} (cfs)	Q_{sw} (cfs)	TOTAL
0.00	-	-	-	-	-	-	-	-	-	-	**0.0**
0.25	-	-	-	-	-	-	-	-	-	-	**0.0**
0.50	-	-	-	-	-	-	-	-	-	-	**0.0**
0.75	-	-	-	-	-	-	-	-	-	-	**0.0**
1.00	-	-	-	-	-	-	-	-	-	-	**0.0**
1.25	-	-	-	-	-	-	-	-	-	-	**0.0**
1.50	-	-	-	-	-	-	-	-	-	-	**0.0**
1.75	-	-	-	-	-	-	-	-	-	-	**0.0**
2.00	-	-	-	-	-	-	-	-	-	-	**0.0**
2.25	-	-	-	-	-	-	-	-	-	-	**0.0**
2.50	-	-	-	-	-	-	-	-	-	-	**0.0**
2.75	-	-	-	-	-	-	-	-	-	-	**0.0**
3.00	-	-	-	-	-	-	-	-	-	-	**0.0**
3.25	0.188	0.000	0.000	-	-	-	-	-	-	-	**0.0**
3.50	0.530	0.602	0.530	-	-	-	-	-	-	-	**0.5**
3.75	0.974	0.851	0.851	-	-	-	-	-	-	-	**0.9**
4.00	1.500	1.042	1.042	-	-	-	-	-	-	-	**1.0**
4.25	2.096	1.204	1.204	-	-	-	-	-	-	-	**1.2**
4.50	2.756	1.346	1.346	-	-	-	-	-	-	-	**1.3**
4.75	3.473	1.474	1.474	-	-	-	-	-	-	-	**1.5**
5.00	4.243	1.592	1.592	-	-	-	-	-	-	-	**1.6**
5.25	5.063	1.702	1.702	-	-	-	-	-	-	1.050	**2.8**
5.50	5.929	1.806	1.806	-	-	-	-	-	-	2.970	**4.8**
5.75	6.841	1.903	1.903	-	-	-	-	-	-	5.456	**7.4**
6.00	7.794	1.996	1.996	-	-	-	-	-	-	8.400	**10.4**
6.25	8.789	2.085	2.085	-	-	-	-	-	-	11.739	**13.8**
6.50	9.822	2.170	2.170	-	-	-	-	-	-	15.432	**17.6**
6.75	10.893	2.252	2.252	-	-	-	-	-	-	19.446	**21.7**
7.00	12.000	2.331	2.331	-	-	-	-	-	-	23.759	**26.1**

Stage-Discharge Rating Curve

Total Rating Curve for SWMM Analysis

Stage (ft)	Discharge (cfs)
0.00	0.000
0.25	0.012
0.50	0.018
0.75	0.022
1.00	0.026
1.25	0.029
1.50	0.032
1.75	0.046
2.00	0.055
2.25	0.104
2.50	0.135
2.75	0.158
3.00	0.177
3.25	0.195
3.50	0.741
3.75	1.076
4.00	1.281
4.25	1.455
4.50	1.610
4.75	1.750
5.00	1.879
5.25	3.050
5.50	5.083
5.75	7.677
6.00	10.724
6.25	14.161
6.50	17.948
6.75	22.053
7.00	26.453

Stage-Storage Curve

Elevation (ft)	Area(sf)
0.00	103.6
0.25	281.8
0.50	871.2
0.75	1,844.1
1.00	3,476.5
1.25	5,617.6
1.50	7,614.9
1.75	9,128.7
2.00	9,734.9
2.25	10,191.0
2.50	10,653.8
2.75	11,123.3
3.00	11,599.6
3.25	12,082.5
3.50	12,572.3
3.75	13,068.7
4.00	13,571.9
4.25	14,081.8
4.50	14,598.4
4.75	15,121.7
5.00	15,651.8
5.25	16,188.6
5.50	16,732.2
5.75	17,282.5
6.00	17,839.4
6.25	18,403.2
6.50	18,973.6
6.75	19,562.1
7.00	20,208.3

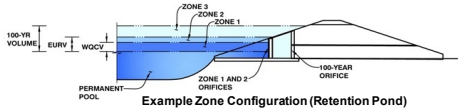
8. MHFD-Detention – Stage-Storage Table

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Range

Basin ID: EDB 15



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	9.90	acres
Watershed Length =	1,100	ft
Watershed Length to Centroid =	575	ft
Watershed Slope =	0.032	ft/ft
Watershed Imperviousness =	65.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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) =	0.210	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.703	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.535	acre-feet	1.06 inches
5-yr Runoff Volume (P1 = 1.43 in.) =	0.805	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.66 in.) =	0.979	acre-feet	1.66 inches
25-yr Runoff Volume (P1 = 1.69 in.) =	1.040	acre-feet	inches
50-yr Runoff Volume (P1 = 2.26 in.) =	1.507	acre-feet	2.26 inches
100-yr Runoff Volume (P1 = 2.6 in.) =	1.815	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.273	acre-feet	inches
Approximate 2-yr Detention Volume =	0.485	acre-feet	
Approximate 5-yr Detention Volume =	0.696	acre-feet	
Approximate 10-yr Detention Volume =	0.883	acre-feet	
Approximate 25-yr Detention Volume =	0.848	acre-feet	
Approximate 50-yr Detention Volume =	1.049	acre-feet	
Approximate 100-yr Detention Volume =	1.165	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.210	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.493	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.462	acre-feet
Total Detention Basin Volume =	1.165	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 = 0.10 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	--	--	--	104	0.002		
	--	0.25	--	--	--	282	0.006	48	0.001
	--	0.50	--	--	--	871	0.020	192	0.004
	--	0.75	--	--	--	1,844	0.042	532	0.012
	--	1.00	--	--	--	3,476	0.080	1,197	0.027
	--	1.25	--	--	--	5,618	0.129	2,333	0.054
	--	1.50	--	--	--	7,615	0.175	3,988	0.092
	--	1.75	--	--	--	9,129	0.210	6,080	0.140
	--	2.00	--	--	--	9,735	0.223	8,438	0.194
	--	2.25	--	--	--	10,191	0.234	10,929	0.251
	--	2.50	--	--	--	10,654	0.245	13,535	0.311
	--	2.75	--	--	--	11,123	0.255	16,257	0.373
	--	3.00	--	--	--	11,600	0.266	19,097	0.438
	--	3.25	--	--	--	12,083	0.277	22,057	0.506
	--	3.50	--	--	--	12,572	0.289	25,139	0.577
	--	3.75	--	--	--	13,069	0.300	28,344	0.651
	--	4.00	--	--	--	13,572	0.312	31,675	0.727
	--	4.25	--	--	--	14,082	0.323	35,131	0.807
	--	4.50	--	--	--	14,598	0.335	38,716	0.889
	--	4.75	--	--	--	15,122	0.347	42,431	0.974
	--	5.00	--	--	--	15,652	0.359	46,278	1.062
	--	5.25	--	--	--	16,189	0.372	50,258	1.154
	--	5.50	--	--	--	16,732	0.384	54,373	1.248
	--	5.75	--	--	--	17,282	0.397	58,625	1.346
	--	6.00	--	--	--	17,839	0.410	63,015	1.447
	--	6.25	--	--	--	18,403	0.422	67,545	1.551
	--	6.50	--	--	--	18,974	0.436	72,218	1.658
	--	6.75	--	--	--	19,562	0.449	77,035	1.768
	--	7.00	--	--	--	20,208	0.464	82,006	1.883

APPENDIX E

Hydraulic Calculations

Preliminary Storm Drain Size

The purpose of this table is to provide an estimated pipe size to convey the 100-year flow rates with a sizing factor.

Manning's n: 0.013

Sizing Factor (%): 30

	Slope at:	0.5%		1.0%		2.0%		3.0%	
Q_{100} (cfs[1])	Q_{100} with Sizing Factor (cfs[1])	Minimum Pipe Size[2] (feet)	Recommended Pipe Size (inches)	Minimum Pipe Size[2] (feet)	Recommended Pipe Size (inches)	Minimum Pipe Size[2] (feet)	Recommended Pipe Size (inches)	Minimum Pipe Size[2] (feet)	Recommended Pipe Size (inches)
1.0	1.3	0.78	10"	0.68	10"	0.60	8"	0.56	8"
2.0	2.6	1.01	12"	0.89	12"	0.78	10"	0.72	10"
5.0	6.5	1.43	18"	1.25	18"	1.10	18"	1.02	18"
10.0	13.0	1.85	24"	1.62	24"	1.43	18"	1.32	18"
15.0	19.5	2.15	30"	1.89	24"	1.66	24"	1.54	24"
20.0	26.0	2.40	30"	2.11	30"	1.85	24"	1.71	24"
24.6	31.9	2.59	36"	2.27	30"	2.00	24"	1.85	24"
30.0	39.0	2.79	36"	2.45	30"	2.15	30"	1.99	24"
35.0	45.5	2.96	36"	2.60	36"	2.28	30"	2.11	30"
40.0	52.0	3.11	42"	2.73	36"	2.40	30"	2.22	30"
50.0	65.0	3.38	42"	2.97	36"	2.61	36"	2.42	30"
60.0	78.0	3.62	48"	3.18	42"	2.79	36"	2.59	36"
70.0	91.0	3.83	48"	3.37	42"	2.96	36"	2.74	36"
80.0	104.0	4.03	54"	3.54	48"	3.11	42"	2.88	36"
90.0	117.0	4.21	54"	3.70	48"	3.25	42"	3.01	42"
110.0	143.0	4.54	60"	3.99	48"	3.50	42"	3.25	42"
145.0	188.5	5.04	72"	4.42	54"	3.89	48"	3.60	48"
170.0	221.0	5.35	72"	4.70	60"	4.12	54"	3.82	48"
240.0	312.0	6.09	84"	5.35	72"	4.69	60"	4.35	54"
350.0	455.0	7.01	96"	6.16	84"	5.41	72"	5.01	72"

Note:

1. "cfs" = cubic feet per second.
2. Minimum pipe sizes are calculated using the Manning's equation and are based on the flow rates with 30% factor.

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Urban Local Type I	Mod Urban Local	Typ Type R (On Grade)
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

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.0	1.0	7.1
Major Q_{Known} (cfs)	10.0	2.0	11.9

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)	**5.0**	**1.0**	**7.1**
Major Total Design Peak Flow, Q (cfs)	**10.0**	**2.0**	**11.9**
Minor Flow Bypassed Downstream, Q_b (cfs)			0.0
Major Flow Bypassed Downstream, Q_b (cfs)			0.8

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Typ Type R (In Sump)	TypTypeR OnGrade ModUrb
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.5	5.5
Major Q_{Known} (cfs)	15.3	15.3

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	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)	**5.5**	**5.5**
Major Total Design Peak Flow, Q (cfs)	**15.3**	**15.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	2.3

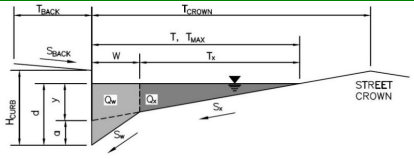
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **2215 Range**

Inlet ID: **Urban Local Type I**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.00	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.015	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.00	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 =	0.060	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} =	17.00	17.00	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.9	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 Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**16.4**	**29.2**	**cfs**

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

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

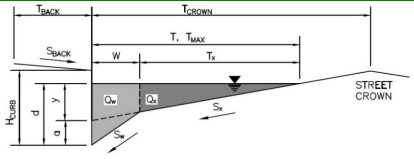
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: 2215 Range

Inlet ID: Mod Urban Local



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.015	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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 =	0.060	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	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 Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**8.3**	**29.2**	**cfs**

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

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

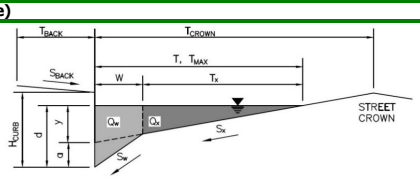
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **2215 Range**

Inlet ID: **Typ Type R (On Grade)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.015	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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 =	0.040	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} =	17.0	17.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.9	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 Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.3**	**23.9**	**cfs**

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

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

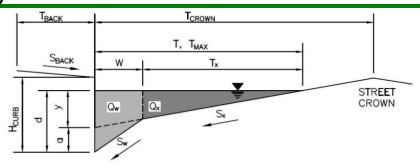
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **2215 Range**

Inlet ID: **Typ Type R (In Sump)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.015	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.9	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

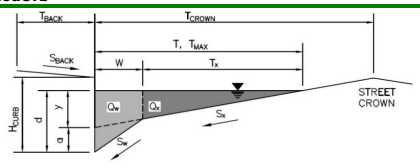
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **2215 Range**

Inlet ID: **TypTypeR OnGrade ModUrb**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.015	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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 =	0.040	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

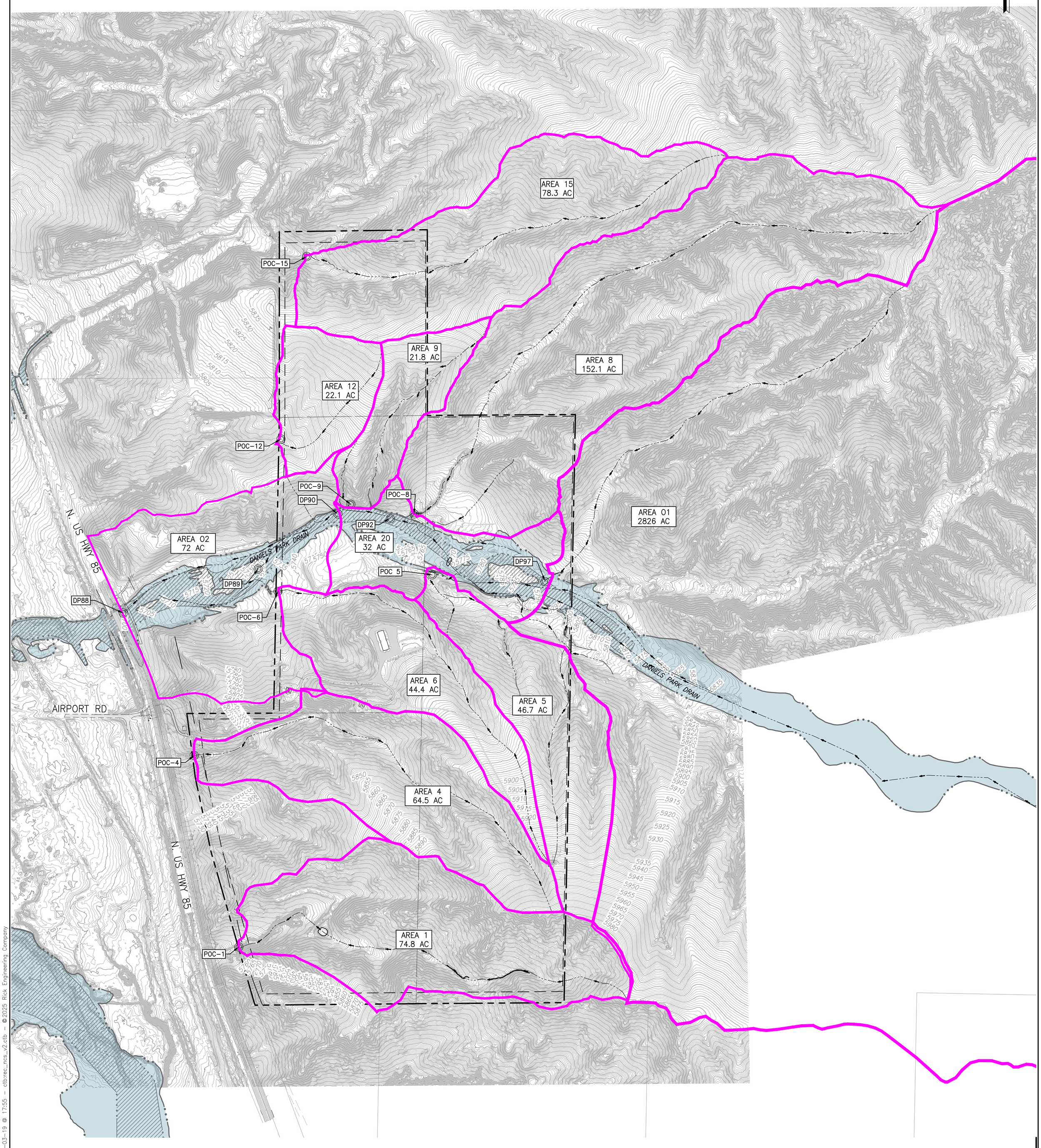
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**6.8**	**23.9**	**cfs**

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

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

APPENDIX F

Maps

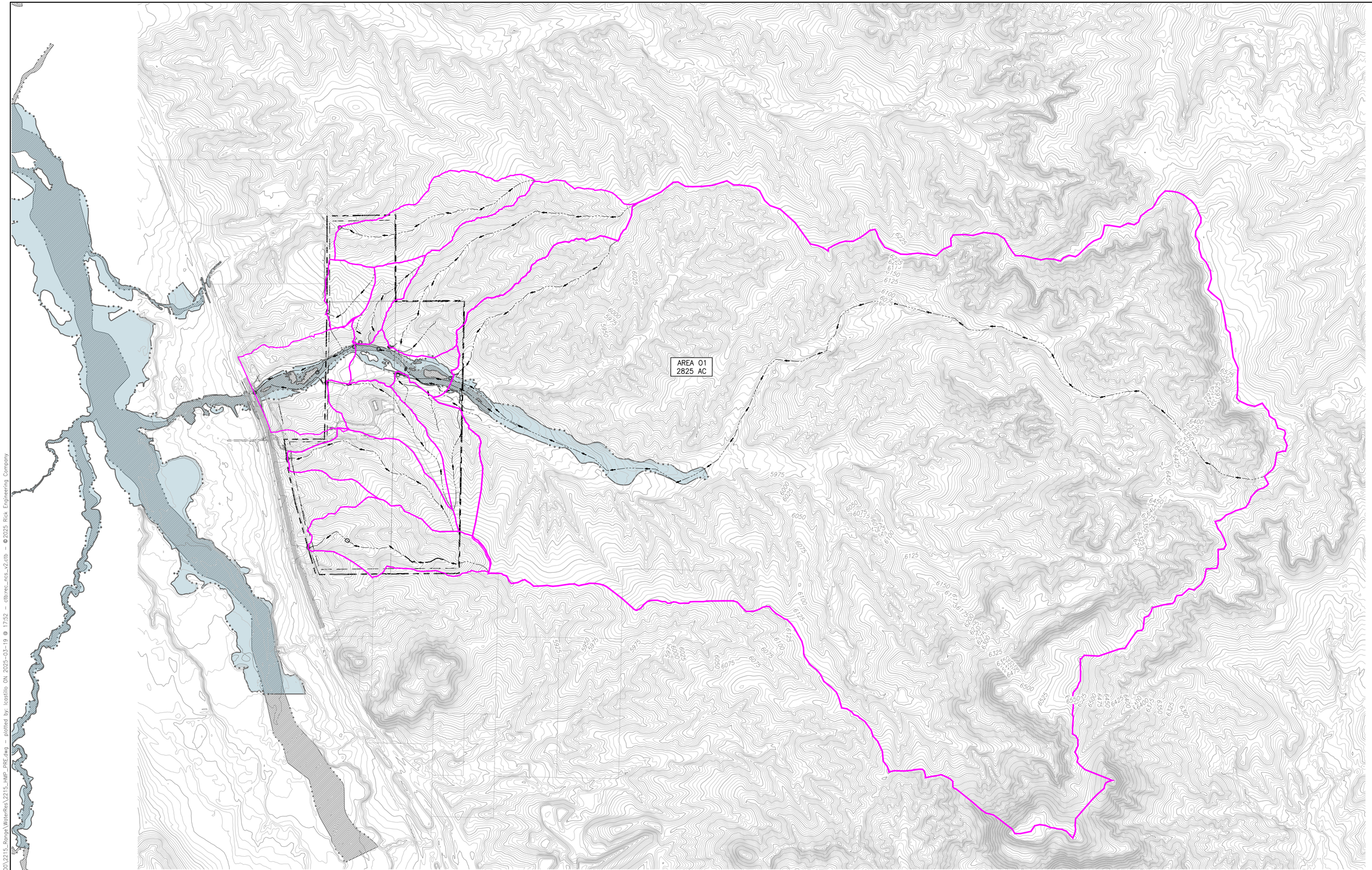


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ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

RANGE DEVELOPMENT
PRE-PROJECT
POINTS OF COMPLIANCE EXHIBIT
SHEET 1 OF 2

PROJECT NO:	2215	SCALE:	1"=400'
DRAWN BY:	LC	DATE:	3/19/2025

\\cp.rickeng.com\projects\D02000\2215_Range\WaterRes\2215_HMP_PRE.dwg - plotted by: lcostillo ON 2025-03-19 @ 17:55 - ctb:rec_ncs_v2.ctb - ©2025 Rick Engineering Company



N

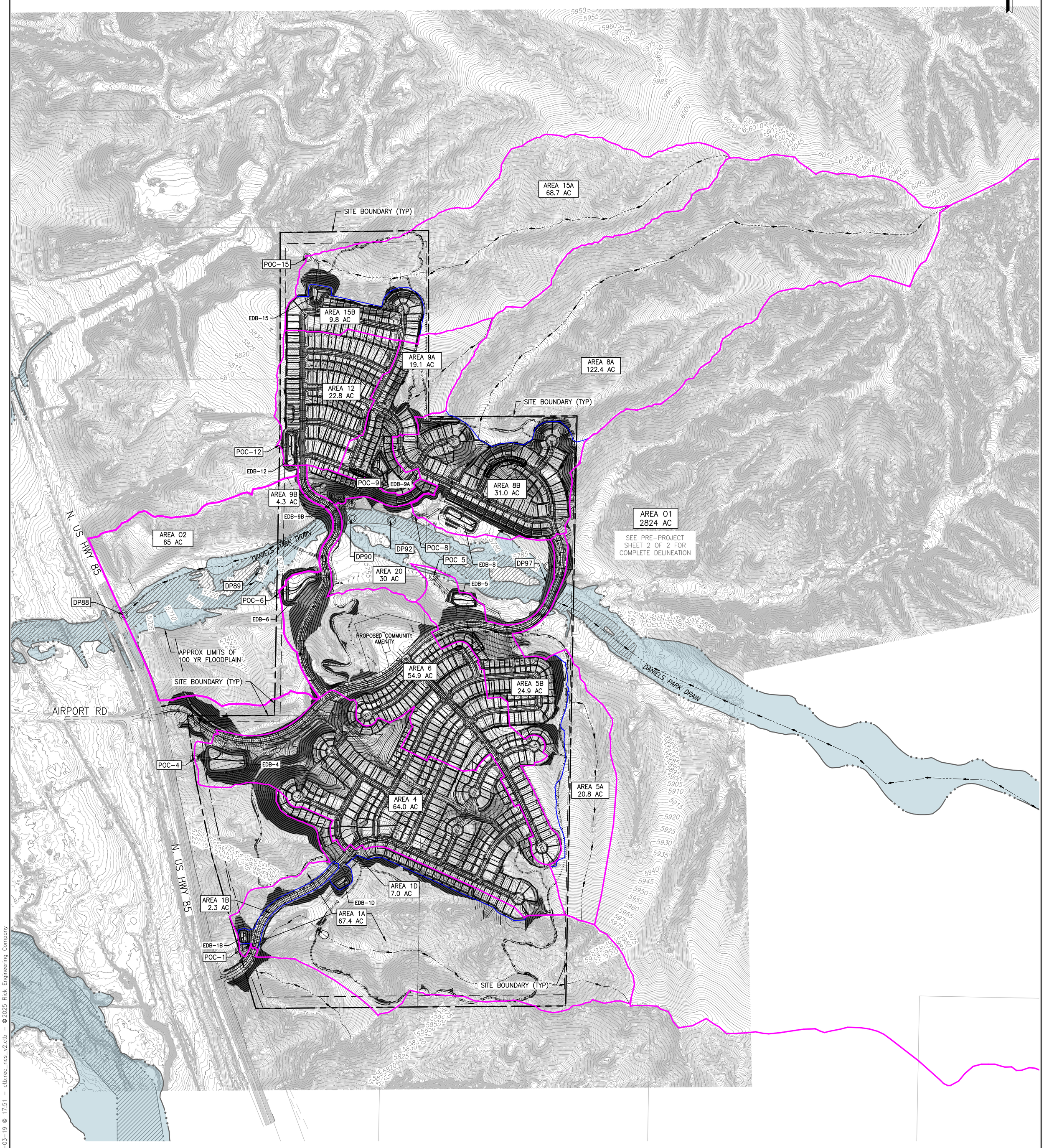
800 400 0 800 1600
GRAPHIC SCALE: 1"=800'

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303-537-8020
rickengineering.com

PRE-PROJECT
PRE-PROJECT
POINTS OF COMPLIANCE EXHIBIT
SHEET 2 OF 2

PROJECT NO:	2215	SCALE:	1"=200'
DRAWN BY:	LC	DATE:	3/19/2025

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LEGEND

- MAJOR BASIN BOUNDARY
- MINOR BASIN BOUNDARY
- FLOW PATH
- PROPERTY BOUNDARY
- LIMITS OF WORK
- 100-YR FEMA FLOODPLAIN
- MHFD STREAM MANAGEMENT CORRIDOR
- POINT OF COMPLIANCE LOCATION — POC-X

400 200 0 400 800

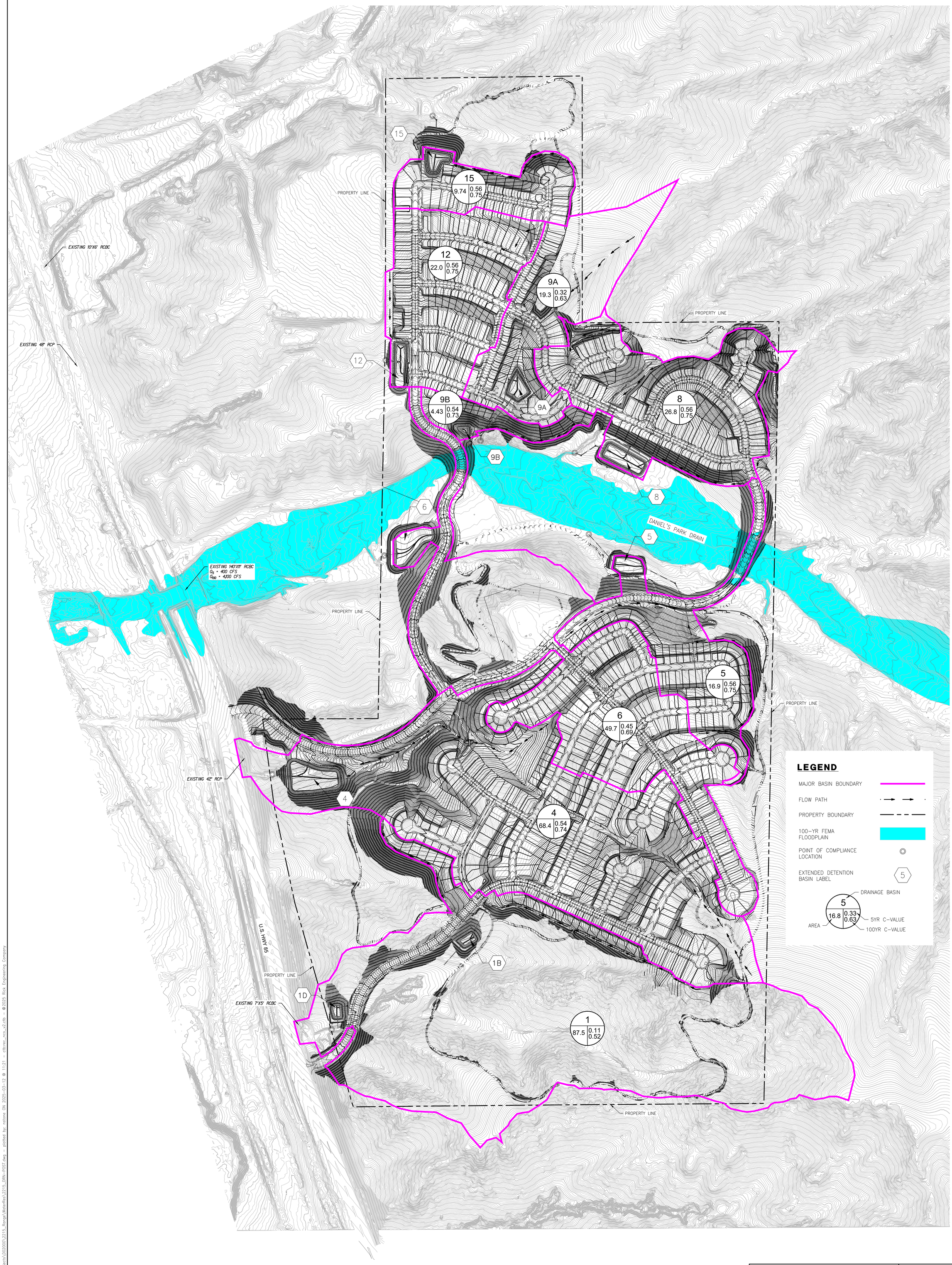
GRAPHIC SCALE: 1"=400'

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ENGLEWOOD, CO 80112
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RANGE DEVELOPMENT
POST-PROJECT
HYDROMODIFICATION MANAGEMENT PLAN
EXHIBIT

PROJECT NO:	2215	SCALE:	1"=400'
DRAWN BY:	LC	DATE:	3/19/2025

\\cp.rickeng.com\projects\D02000\2215_Range\WaterRes\2215_HMP_POST.dwg - plotted by: lcastillo ON 2025-03-19 @ 17:51 - ctb:rec_ncs_v2.ctb - © 2025 Rick Engineering Company



200 100 0 200 400

GRAPHIC SCALE: 1"=200'

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RANGE

POST-PROJECT MAJOR BASIN MAP

PROJECT NO:	02215	SCALE:	1"=200'
DRAWN BY:	NAS	DATE:	3/12/2025

\\Cer-rickeng.com\projects\002000\2215_Range\WaterRes\2215_DRN-POST.dwg – plotted by: nstone ON 2025-03-12 @ 11:21 – ctbrenc_ncs_v2.ctb – © 2025 Rick Engineering Company

EXISTING 140'X11' RCBC
Q_5 = 400 CFS
Q_{100} = 4,100 CFS

EXISTING 42" RCP

EXISTING 7'X5' RCBC

PROPERTY LINE

PROPERTY LINE

PROPERTY LINE

U.S. HWY 85

DRAIN

LEGEND

- MAJOR BASIN BOUNDARY
- MINOR BASIN BOUNDARY
- FLOW PATH
- PROPERTY BOUNDARY
- 100-YR FEMA FLOODPLAIN
- POINT OF COMPLIANCE LOCATION
- SUB-BASIN DESIGN POINT (e.g. 5E)
- EXTENDED DETENTION BASIN LABEL (e.g. 5)
- AREA | DRAINAGE BASIN | 5YR C-VALUE | 100YR C-VALUE (e.g. 5E: 2.71 | 0.56 | 0.75)

100 50 0 100 200
GRAPHIC SCALE: 1" = 100'

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RANGE

POST-PROJECT SUB-BASIN MAP (SOUTH)

PROJECT NO:	02215	SCALE:	1"=100'
DRAWN BY:	NAS	DATE:	3/12/2025

\\Cr-rickeng.com\projects\02000\2215_Range\MasterRev\2215_ESN_POST.dwg - plotted by: nstone ON 2025-03-12 @ 11:22 - ctb:rec_ess_v2.ctb - © 2025 Rick Engineering Company

PROPERTY LINE

PROPERTY LINE

DANIEL'S PARK DRAIN

LEGEND

- MAJOR BASIN BOUNDARY
- MINOR BASIN BOUNDARY
- FLOW PATH
- PROPERTY BOUNDARY
- 100-YR FEMA FLOODPLAIN
- POINT OF COMPLIANCE LOCATION
- SUB-BASIN DESIGN POINT (5E)
- EXTENDED DETENTION BASIN LABEL (5)
- 5E: AREA, DRAINAGE BASIN, 5YR C-VALUE, 100YR C-VALUE

GRAPHIC SCALE: 1"=100'

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ENGLEWOOD, CO 80112
303-537-8020
rickengineering.com

RANGE

POST-PROJECT SUB-BASIN MAP (NORTH)

PROJECT NO:	02215	SCALE:	1"=100'
DRAWN BY:	NAS	DATE:	3/12/2025

\\dc-rickeng.com\projects\02000\02215_Range\Waterflex\2215_DRN_PROT.dwg - plotted by: nstone ON 2025-03-12 @ 11:19 - dbrec_dcs_v2.ctb - © 2025 Rick Engineering Company

January 29, 2021

Mr. Bryan Horan
NL Range, LLC
9801 E. Easter Avenue
Centennial, CO 80112

RE: Noise Analysis Results for Range Planned Development, Louviers, Colorado

Dear Mr. Horan:

Felsburg Holt & Ullevig (FHU) has prepared this letter to present the findings of our traffic noise evaluation for the Range Planned Development site near Louviers, Colorado (Figure 1). The purpose of the evaluation was to assess traffic noise levels from US 85 for the site in response to a review comment from Douglas County staff. The comment was a request for information regarding Douglas County Comprehensive Master Plan Policy 2-6A.1 to locate residences outside 65 DNL (day/night noise level) zones.

Project Overview

The Range site included in this analysis is east of US 85 near Airport Road (Figure 1). FHU understands that NL Range, LLC is considering new housing at this site, as illustrated from the concept plan (Figure 1). The noise evaluation was based on this development concept and other supporting project information (e.g., future site grading, etc.) provided to FHU by your design team members.

Please note that local topography is important to the traffic noise conditions at the site. US 85 is about 100 feet lower in elevation. The nearest proposed homes are set back about 1,000 feet from US 85. Therefore, the ground may block or otherwise affect the transmission of noise to the site from some US 85 traffic. Also note that any substantive changes in site topography from what FHU analyzed may invalidate the noise findings described below.

Methods of Analysis

The Douglas County policy considers the DNL sound metric, which is a 24-hour average sound level that includes a 10 decibel "penalty" added to the noise levels between 10 PM and 7 AM. FHU calculated DNL values for several representative locations at the Range site to evaluate expected traffic noise levels from US 85 for compliance with the Douglas County policy (Figure 1). FHU used TNM Version 2.5 software from the Federal Highway Administration to perform the calculations and noise modeling. TNM is the standard software used for noise evaluations by the Colorado Department of Transportation (CDOT). FHU used the DNL capabilities built into TNM for this project. FHU also used this to estimate the set-back from US 85 of the 65 DNL line (Figure 1). The varying topography of the site was included in the TNM model.

The traffic noise of concern for this analysis is from US 85, which is west of the site (Figure 1). No other traffic noise sources were considered to be substantive enough to be included in this analysis. FHU evaluated estimated 2040 conditions for US 85, which included projected 2040 traffic volume data from CDOT's OTIS website and an approximation of a 4-lane profile for US 85 near the site (to account for expected US 85 improvements). The total traffic on US 85 used in the TNM modeling was 31,500 vehicles per day.

Results

The calculated DNL values for the seven representative site locations are presented in Figure 1. These locations are proposed home sites nearer to US 85. At all of these locations, traffic noise was calculated to be well below 65 DNL with the maximum being 56 DNL.

FHU estimated that the 2040 set-back from US 85 for the 65 DNL line is not more than approximately 325 feet (Figure 1). The Range site is well beyond this area. There are dramatic topographic changes along US 85 that may affect the set-back distance in specific locations if the ground can block some traffic noise.

Please note these results are for the specific conditions described for this analysis. A different set of conditions or assumptions may produce different results. FHU endeavored to complete this noise study in a manner consistent with the care and skill ordinarily exercised by members of the acoustical profession currently practicing under similar circumstances.

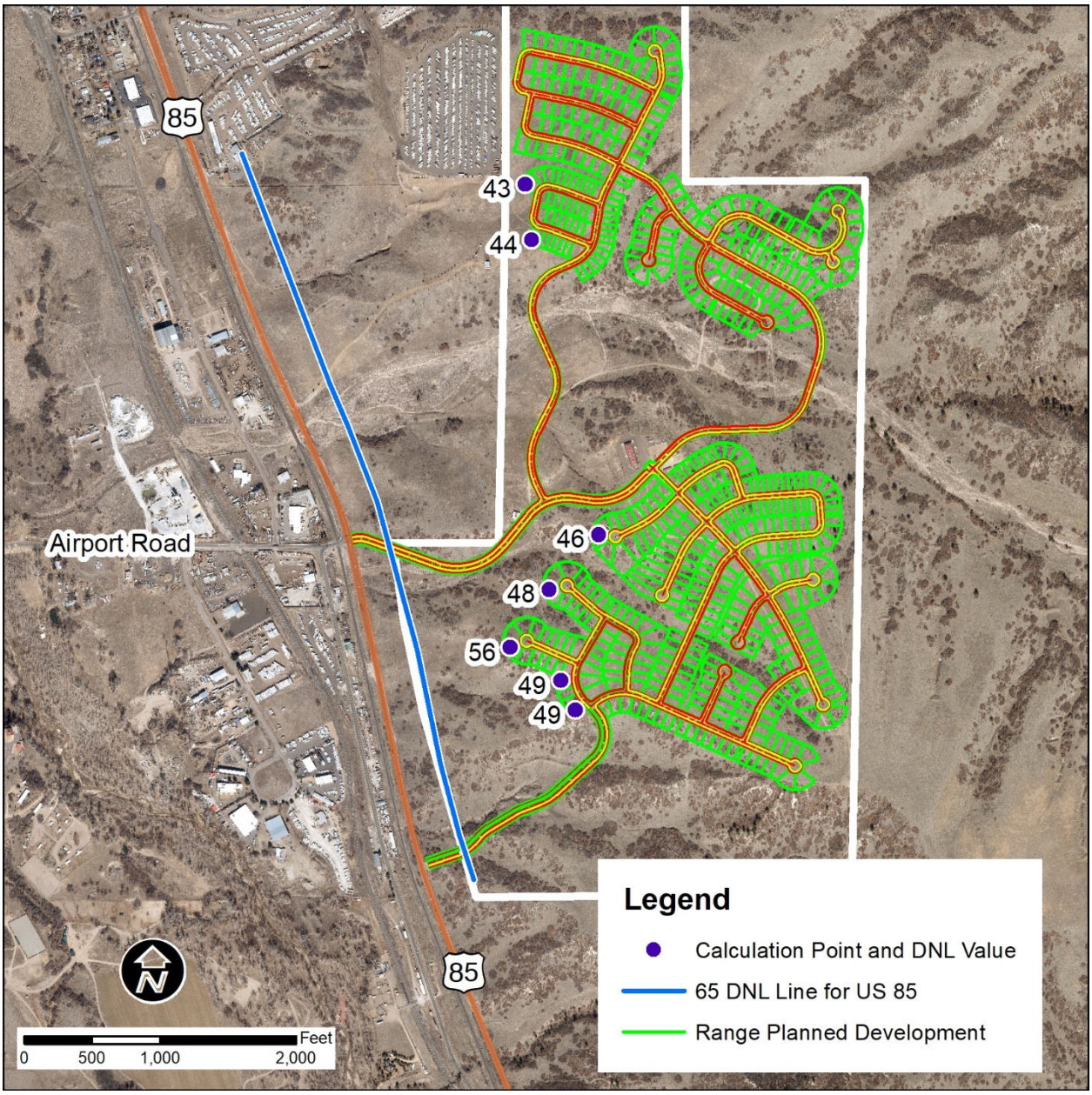
Thank you for the opportunity to provide this service to NL Range, LLC. We look forward to working with you on other projects in the future. If you have any questions regarding the analysis or this report, please contact me.

Sincerely,

FELSBURG HOLT & ULLEVIG

Dale Tischmak
Associate Environmental Scientist

Figure 1. Range Planned Development: Site Overview and DNL Results, Louviers, Colorado



ERO

Consultants in Natural Resources and the Environment

Wildlife Protection Plan
Range Development
U.S. 85 and Airport Road
Douglas County, Colorado

Prepared for—

Ventana Capital, Inc.
9801 East Easter Avenue
Centennial, Colorado 80112

Prepared by—

ERO Resources Corporation
1842 Clarkson Street
Denver, Colorado 80218
(303) 830-1188
ERO Project #20-139

February 12, 2021

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Wildlife Protection Plan
Range Development - U.S. 85 and Airport Road
Douglas County, Colorado

February 11, 2021

1.0 Introduction

Range Development (Range) is a proposed residential development in northwest Douglas County. The property is east of U.S. Highway 85 and Airport Road in Douglas County, Colorado (project area; Figure 1). Access to the property will be at two Colorado Department of Transportation (CDOT)-approved full-movement locations on U.S. Highway 85. The vision for Range is a planned development community with low-density clustered residential housing that incorporates 60 percent open space and 550 single-family residential units. The residential "clusters" will be in the central portion of the property that will integrate into the surrounding open spaces and provide wildlife corridors and minimize impacts on adjacent property owners. The project will preserve 60 percent (about 240 acres) of the total site as open space by clustering residential units on the remaining 159 acres. The homes will be grouped in areas with minimal disturbance to the native scrub oak and natural vegetation. Range will feature a network of trails within the community and open spaces.

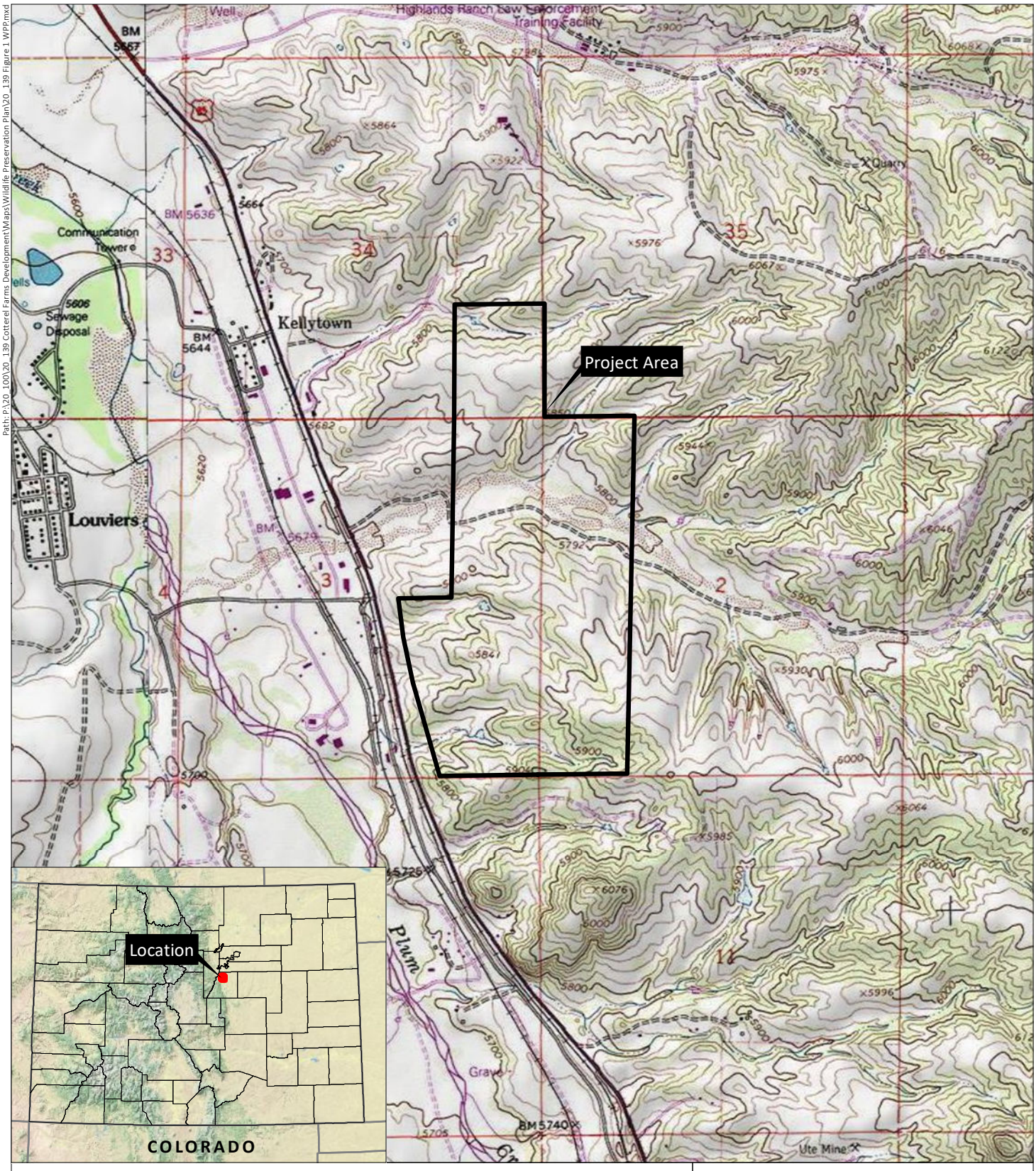
The Douglas County 2040 Comprehensive Master Plan (CMP) states that "Wildlife is one of the most valuable community assets" (https://www.douglas.co.us/land/comprehensive-master-plan/). Preservation of wildlife habitat will enrich the human experience by providing beautiful vistas and vital links to natural systems for Range residents. The overall wildlife resources goal of the CMP is to "Protect and enhance wildlife habitat and movement corridors and foster wildlife conservation." Range contracted ERO Resources Corporation (ERO) to develop this Wildlife Protection Plan (WPP) that is consistent with the vision and intent of the CMP, specifically Section 9.

1.1 How to Use the Plan

This WPP identifies three primary goals, describes the existing conditions of the project area, and presents specific objectives and strategies for achieving the stated goals. Specific conservation and management and prescriptions in Section 4.0 provide more detail to accomplish the goals as needed. The WPP is a working document, which will change and evolve over time.

1.2 Vision

The overall vision is to create a high-quality residential community, bring water and wastewater infrastructure to the U.S. Highway 85 corridor, preserve open space and wildlife corridors, and offer trail amenities and connections, all consistent with the goals, objectives, and policies of the Douglas County CMP, and compliant with the Douglas County Zoning Resolution. Range is creating a sustainable human community that promotes a healthy sustainable natural landscape.



Path: P:\20_100\20_139 Cotterel Farms Development\Maps\Wildlife Preservation Plan\20_139 Figure 1 WPP.mxd

The Range Development

Sections 34 and 35, T6S, R68W; Sections 2 and 3, T7S, R68W; 6th PM

UTM NAD 83: Zone 13N; 501656mE, 4369167mN

Longitude 104.980751°W, Latitude 39.472088°N

USGS Sedalia, CO Quadrangle

Douglas County, Colorado

Figure 1
Vicinity Map

Prepared for: Ventana Capital, Inc.
File: 20_139 Figure 1 WPP.mxd (WH)
January 13, 2021

ERO Resources Corp.

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Through thoughtful planning, Range believes the overall vision can be attained in a way that shapes residents' lives to be healthier and more informed about the landscape and wildlife around them. Range is committed to sustaining the ecosystem and continually seeking to balance the conservation of natural resources with the needs of urban development.

Goals for wildlife and habitat conservation and management at Range provide a philosophical foundation on which to base the WPP. The overriding goals of the WPP for Range are to:

1. Protect and enhance wildlife habitat and movement corridors.
2. Foster wildlife conservation by minimizing and mitigating impacts on wildlife.
3. Educating residents about proper land management and living alongside wildlife.

2.0 Existing Conditions

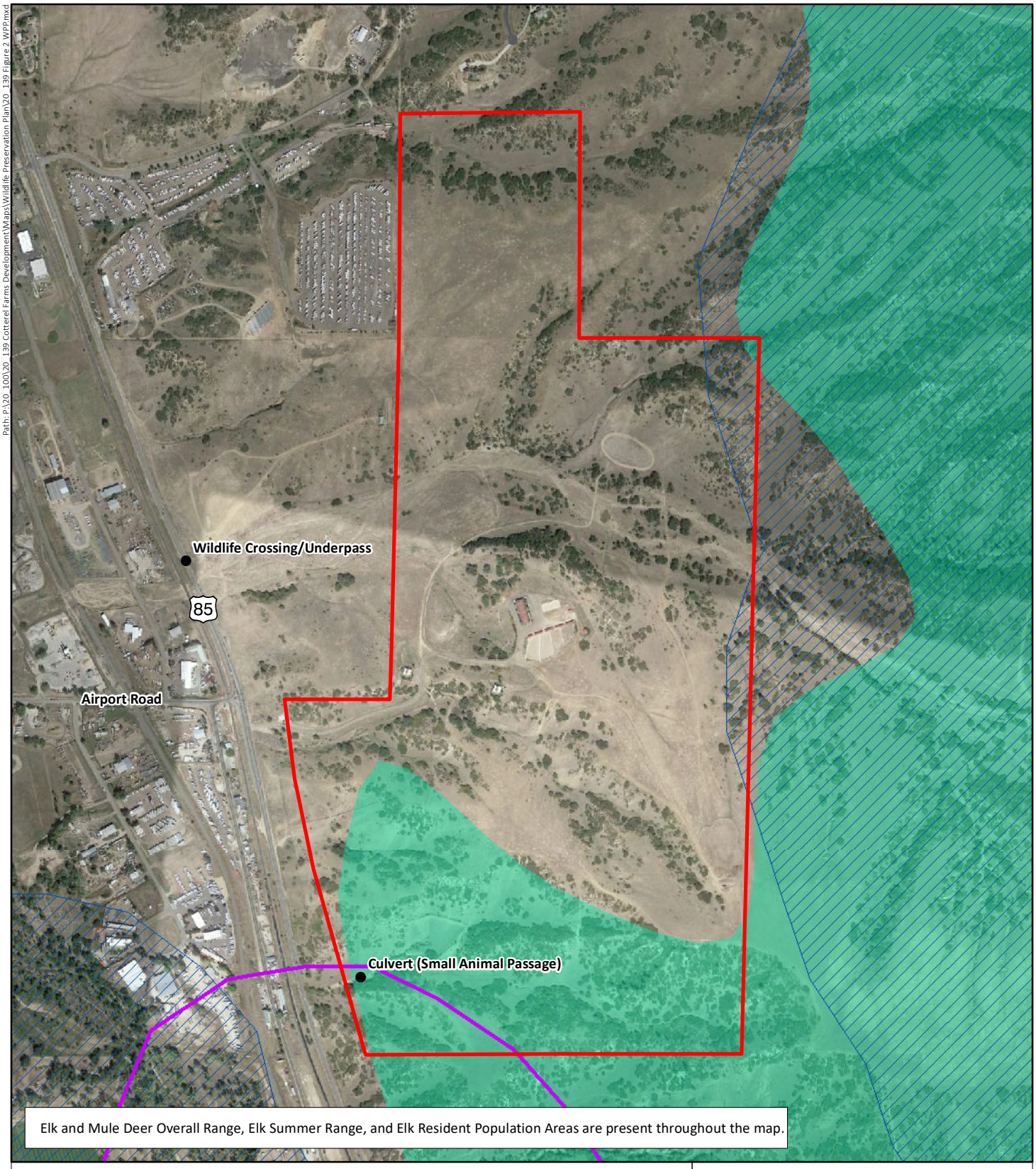
This section describes the current ecological conditions at Range to provide an understanding of which resources exist on the property and identify potential resource opportunities and constraints to consider when implementing the WPP.

2.1 Vegetation Communities

The topography of the property is characterized as rolling hills and valleys with several dry drainages that generally are oriented in an east to west direction. The rolling hills and drainages create various microhabitats and soil conditions that greatly influence vegetation and wildlife habitat. The vegetation in the more level areas of the project area consists of upland grasslands containing native species including sideoats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), and sand dropseed (*Sporobolus cryptandrus*). Nonnative grassland species are spread throughout the project area, particularly in areas heavily grazed by prairie dogs, including cheatgrass (*Bromus tectorum*), smooth brome (*Bromus inermis*), and an abundance of the invasive Scotch thistle (*Onopordum acanthium*). The drainages and more moist north-facing slopes support native trees and shrubs dominated by Gambel oak (*Quercus gambelii*), mountain mahogany (*Cercocarpus montanus*), skunkbush (*Rhus trilobata*), and ponderosa pine (*Pinus ponderosa*). Several areas have been disturbed by previous activities, including two residences, ranch roads, a large horse stable and multiple corrals, and a polo horse exercise track. The property has also been rotationally grazed and most grassland areas are currently occupied by prairie dogs, which has resulted in severe grazing and soil erosion.

2.2 Wildlife Resources

Properly managed habitats at Range can provide habitat and corridors for a diverse wildlife community. The upland grasslands provide breeding ungulate foraging areas and habitat for numerous ground-nesting bird species. Shrubland areas with intermixed grassland along Range drainages also provide food and cover for diverse wildlife (Figure 2). Drainages and wooded north slopes provide cover and suitable habitat for breeding songbirds and movement corridors for large mammals such as elk (*Cervus elaphus*), mule deer (*Odocoileus virginianus*), and coyote (*Canis latrans*) (Figure 3).



The Range Development

- Parcel Boundary
- Elk Migration Corridor
- Elk Winter Range
- Mule Deer Summer and Winter Range

0 500 1,000 Feet

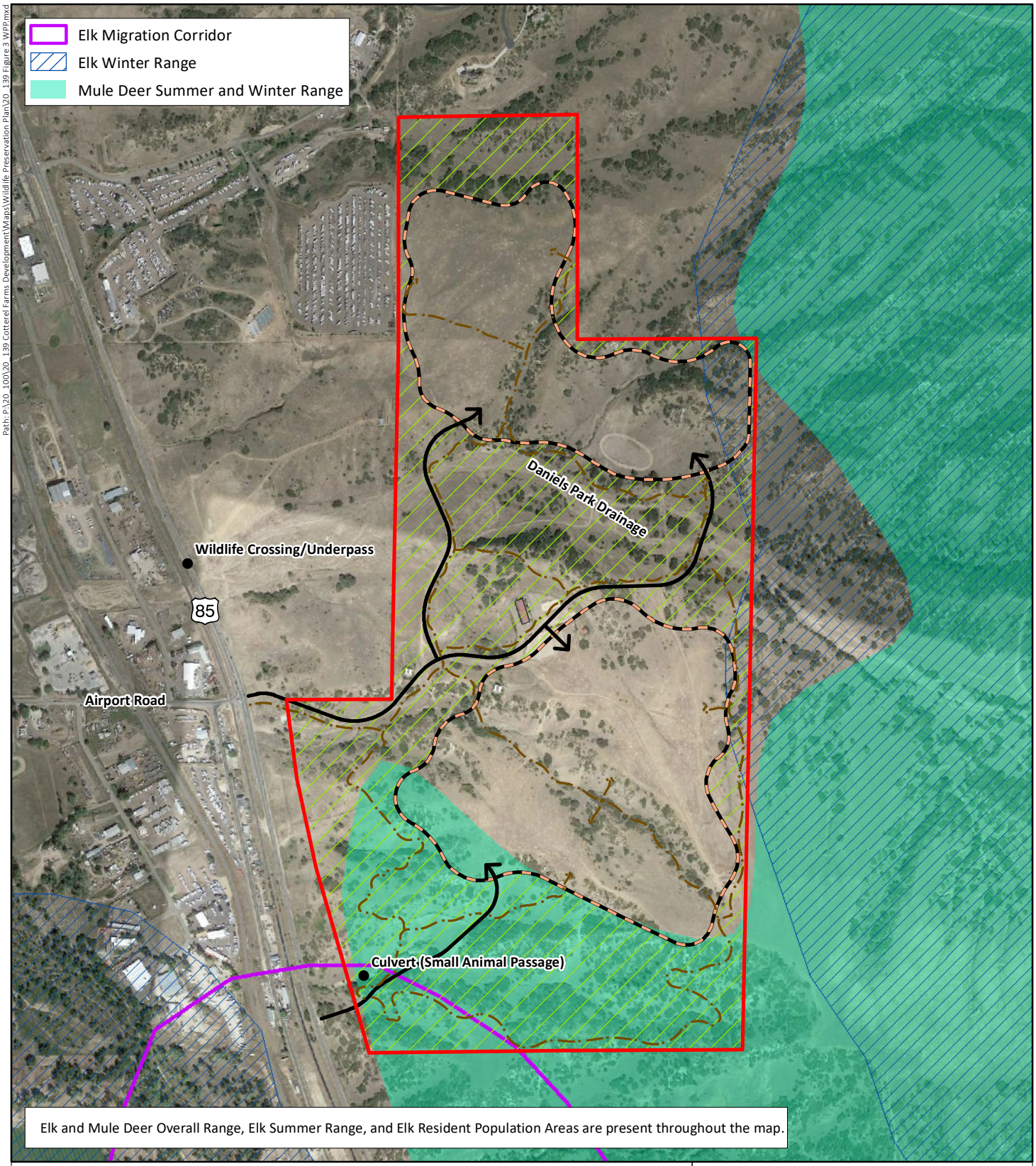
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Figure 2
Existing Conditions

Prepared for: Ventana Capital, Inc.
File: 20_139 Figure 2 WPP.mxd (WH)
February 12, 2021

ERO Resources Corp.

Source: Google Earth Scene Dec 12, 2019; CPW SAM December 2020



The Range Development

- Proposed Community Amenity
- Proposed Roadway Connection
- Proposed Trail
- Proposed Residential Unit
- Proposed Park/Open Space
- Parcel Boundary

0 500 1,000 Feet

N

Figure 3
Proposed Develoment
Clusters and Roadways

Prepared for: Ventana Capital, Inc.
File: 20_139 Figure 3 WPP.mxd (WH)
February 12, 2021

ERO Resources Corp.

Source: Google Earth September 12, 2019; CPW SAM December 2020

Mammals

Range contains some large areas of shrubland and native grassland vegetation. This provides a diversity of habitats that can attract native mammal species. Range is within the overall range for elk, mule deer, and white-tailed deer (Colorado Parks and Wildlife (CPW) 2020). CPW has mapped the southern and eastern portions of Range as important deer and elk winter ranges (Figure 3). Carnivores such as coyote, raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), and striped skunk (*Mephitis mephitis*) are also likely to occur in the project area. Range is also within the overall range of mountain lion (*Puma concolor*) and within the summer concentration of black bear (*Ursus americanus*) (Natural Diversity Information Source [NDIS] CPW 2020). Range is not currently identified as a human-wildlife conflict area, but with residential development, that area would likely be susceptible to human-wildlife conflicts. As described in the vegetation description, prairie dogs are currently abundant on the property and have resulted in extensive areas of bare ground and soil erosion.

Birds

Migratory birds and any active nests are protected under the Migratory Bird Treaty Act (MBTA). In Colorado, most birds, except for grouse species, European starling, house sparrow, rock pigeon, and Eurasian collared dove, are protected under the MBTA, even species such as magpie and great horned owl that tend to be present throughout the year. Birds of particular concern are raptors, including eagles, hawks, and owls.

Raptors are not currently nesting on the property (ERO 2020), but occasionally forage on the project area during migration and summer breeding seasons. Implementation of appropriate strategies and management of native grassland and woodland habitat as described in this WPP will continue to provide quality foraging habitat for raptors during and post-development.

Species of Concern

The project area does not contain habitat for any federally listed threatened or endangered species, including Preble's meadow jumping mouse and Ute ladies'-tresses orchid (ERO 2020). Prairie dog colonies provide habitat for burrowing owls, a Colorado state species of concern. In addition, the western rattlesnake (*Crotalus viridis*) is a species of concern, not because it is protected as a rare or declining species, but because it is a poisonous snake and potentially conflicts with human residents of Range.

3.0 Range WPP Wildlife Objectives and Strategies

This WPP establishes a framework to provide wildlife protection and management and outlines the core objectives with one or more strategies to achieve the goals listed above. This section presents objectives and management strategies to achieve overall wildlife goals. The objectives are modeled after Section 9 of the CMP as indicated in parenthesis at the end of each objective. The objectives and strategies are further developed into specific conservation and management prescriptions in Section 4.0 with more detailed policies and management protocols provided in Appendices A through C.

Objective 1: Establish, maintain, and improve the core habitat areas on Range connected by movement corridors (CMP Objective 9-1A).

Range Strategy 1.1: Identify core habitats and movement corridors based on state and county data and local knowledge. This strategy has already been implemented. ERO identified core habitat and movement corridors from CPW Species Activity Mapping (SAM), Douglas County wildlife resources mapping (CMP map 9.1), field observations, and discussions with the property caretaker (Figure 3). Important wildlife habitats, identified by CPW, specifically deer and elk winter ranges, are conserved in the more than 60 percent of the property that will remain open space (Figure 4).

Objective 2: Minimize impacts on wildlife by ensuring that development and land use are compatible with wildlife, wildlife habitat, and movement corridors (CMP Objective 9-1B).

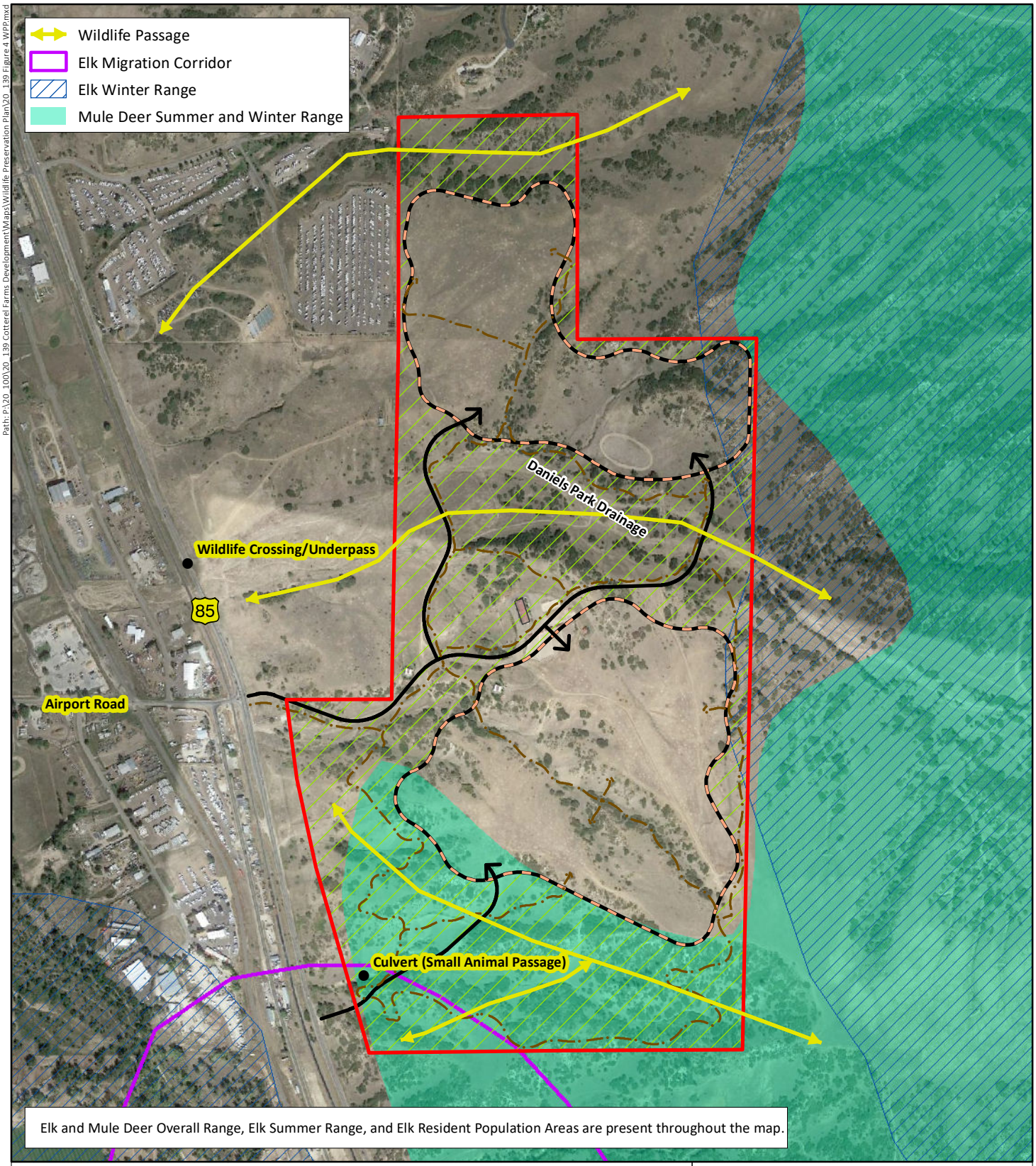
Range Strategy 2.1: Protect core habitat and corridors - See the strategy for Objective 1. Range was specifically designed with wide, east to west movement corridors to maintain connectivity between a network of protected lands to the west and Cherokee Ranch/Back Country Wilderness and other protected lands on the east, and to accommodate Wildlife Crossing Areas (Figure 3). These corridors also align with CDOT wildlife crossings designed in the U.S. Highway 85 expansion project currently under construction (Figure 3 and Figure 4).

Range Strategy 2.2: Consider wildlife on neighboring properties - Conserving portions of the property on the east and south provides buffers for neighboring properties and wildlife habitat.

Range Strategy 2.3: Minimize fencing that is exclusionary or dangerous to wildlife, except when necessary for human safety - Internal fencing will be kept to a minimum to permit free and unencumbered wildlife movement. All fencing will be consistent with CPW's wildlife-friendly fencing guidelines (provided below), except in areas that require more barrier type fencing to protect livestock and human safety (e.g., horse corrals, trash collection areas, etc.). (see https://cpw.state.co.us/Documents/LandWater/PrivateLandPrograms/FencingWithWildlifeInMind.pdf).

Range Strategy 2.4: Restore and enhance degraded and disturbed lands - This WPP is a living document and will be periodically updated and supplemented by more specific subplans as development proceeds. Subplans will be developed in consultation with professional agencies and local experts and will include, but are not limited to:

- Restoration and Vegetation Management Plan using native or beneficial vegetation and wildlife-friendly species in important wildlife habitat and movement corridors (i.e., Douglas County wildlife seed mix).
- Noxious Weed Management Plan based on Integrated Pest Management guidelines.



Path: P:\20_100\20_139 Cotterel Farms Development\Maps\Wildlife Preservation Plan\20_139 Figure 4 WPP.mxd

The Range Development

- Proposed Community Amenity
- Proposed Roadway Connection
- Proposed Trail
- Proposed Residential Unit
- Proposed Park/Open Space
- Parcel Boundary

0 500 1,000 Feet

N

Figure 4
Wildlife Protection Strategies

Prepared for: Ventana Capital, Inc.
File: 20_139 Figure 4 WPP.mxd (WH)
February 12, 2021

ERO Resources Corp.

Source: Google Earth September 12, 2019; CPW SAM December 2020

Objective 3: Support programs that foster wildlife conservation (CMP Objective 9-1C).

Range Strategy 3.1: Develop a homeowners guide, work with the homeowners association to develop educational programs and conservations projects, and install educational signage at trailheads. The Homeowners Guidebook would be shared with the homeowners through the entity that is responsible for managing open space (Range Metropolitan District or Homeowners Association).

Objective 4: Support the management of wildlife populations to maintain viable populations and species health (CMP Objective 9-1D).

Range Strategy 4.1: Develop a WPP that provides a planning framework for wildlife management and habitat conservation.

Objective 5: Avoid conflicts between people and wildlife (CMP Objective 9-1D).

Range Strategy 5.1: Manage prairie dogs for the protection of people, property, and healthy open space/core wildlife habitat (see Section 4.0 and Appendix A).

Range Strategy 5.2: Identify areas of potential conflict between people and potentially dangerous predators (coyotes, mountain lions, and bears) and work with CPW to implement the strategies described in "Living with Wildlife" (http://cpw.state.co.us/learn/Pages/LivingwithWildlife.aspx) (see Section 4.0).

Range Strategy 5.3: Identify areas of potential conflict between people and rattlesnakes and implement the rattlesnake management procedure provided in Section 4.0.

Range Strategy 5.4: Avoid and protect migratory bird nest sites (see Section 4.0 and Appendix B).

Range Strategy 5.5: Avoid and protect raptor nest sites (see Section 4.0, Appendix C).

Objective 6: Educate residents on safeguarding residents and injured wildlife.

Range Strategy 6.1: Leave all animals alone when injured wildlife is encountered and contact an expert to collect and rehabilitate the animal. Animals, particularly young animals may appear alone and abandoned when in reality the parent is usually in the vicinity keeping a watchful eye on its young. A primary defense mechanism of wildlife is for adult animals to hide their young and then move a safe distance away and try to distract or lure the disturbance (predator or human) away. Wildlife may also become injured along roadways or from collision with building and windows. Do not approach or touch injured wildlife, call an open space representative or other expert with the knowledge and experience in handling injured wildlife. CPW should be contacted for injuries to larger animals and predator. Several respected wildlife rehabilitators for specific groups of animals can be found in the Denver metropolitan area that are excellent at handling smaller mammals and birds.

4.0 Specific Conservation and Management Prescriptions

4.1 Black-tailed Prairie Dog

Conflict

Black-tailed prairie dogs present a unique set of management challenges because of their ecological importance and because of the conflicts that arise as a result of their feeding and burrowing activities. Prairie dogs in urban/suburban settings often cause damage to private property, creating hazards for both humans and livestock and, as carriers of plague and other diseases transmittable to humans and/or their pets, raise human health and safety concerns. Prairie dogs in urban settings also have the potential to negatively impact native plant communities by overgrazing relatively small, confined areas, often leading to severe noxious weed infestations.

Management Prescription

The following section addresses issues related to protection of human health and private property and management options available to Range. This prescription is adapted from the Douglas County Open Space and Natural Resources prairie dog conservation policy (https://www.douglas.co.us/documents/prairie-dog-conservation-policy.pdf/). Additional details of applicable regulations and managing prairie dogs at ecologically sustainable densities are provided in Appendix A.

Objective 1: Protect human health and private property.

> **Prescription 1:** Designate the entire property as a No-Prairie Dog Areas (NPD). Once developed the entire property would be unsuitable for prairie dogs because of ecological conditions and incompatible land uses (See Appendix A).
>
> **Prescription 2:** Implement viable and economically reasonable prairie dog management options, modeled on the Douglas County Open Space and Natural Resources Prairie Dog Conservation Policy https://www.douglas.co.us/documents/prairie-dog-conservation-policy.pdf/ (See Appendix A).

4.2 Predators and Large Mammals

Issues

The primary issues concerning mammals at Range include the following:

- Large carnivores (coyotes), presenting a real or perceived threat to the safety of residents, including children and pets.
- Small carnivores such as raccoon and striped skunk entering buildings, causing damage and possibly transmitting diseases such as rabies.
- Large and small carnivores interacting with domestic animals, causing disease or death.
- Large ungulates colliding with vehicles, leading to injury of residents and the animal, and causing property damage.

The following subsections provide brief descriptions of management actions and prescriptions to be used to address each of these issues.

Large Carnivores

Large carnivore species including coyotes and red fox, as well as an occasional black bear or mountain lion, can be a threat or a perceived threat to humans and pets. Interactions between humans and these species are uncommon but are potentially dangerous. Human settlement offers wildlife new food sources, usually in great abundance. Lawns and landscaping attract concentrations of mule deer and cottontail rabbits, which attract coyotes and mountain lions; garbage attracts bears. The availability of pets and pet food may also attract wild predators or reinforce a positive association with humans. Recommendations for coexisting with large carnivores based on information provided by the CPW can be found at:

- Mountain Lion: http://cpw.state.co.us/learn/Pages/LivingwithWildlifeLion1.aspx.
- Black Bear: https://cpw.state.co.us/Documents/Education/LivingWithWildlife/LivingWithBears.pdf.
- Coyote: http://cpw.state.co.us/learn/Pages/LivingwithWildlifeCoyote.aspx.

Resident education is also a large component of coexistence with large carnivores. Residents need to be aware of the presence of predators and need to know how to behave to avoid incidents and how to respond should they encounter a lion, bear, or coyote. Some of the essential concepts from these documents are summarized below:

- Keep pets under control; implement and enforce leash laws.
- Do not leave pet food outside.
- Bring pets in at night.
- Store and dispose of garbage properly.
- Hiking/biking at dawn or dusk may increase the chance of seeing wildlife and the risk of meeting a bear, lion, or coyote.
- Use extra caution in places where hearing or visibility is limited such as in brushy areas, near a stream, where the trail rounds a bend, or on windy days. Reduce the chances of surprising a bear, lion, or coyote by making noise, talking, or singing.
- Make sure children are close or at least within sight at all times.

Small Carnivores

Striped skunks and raccoons are mainly a concern because of the possible transmission of rabies and their ability to get into buildings and trash containers. The best way to minimize conflicts with smaller carnivores, such as raccoons and skunks, is to remove potential habitat from human occupied areas. Landscaped areas around buildings, parking lots, and pedestrian walkways should be kept trim and open, removing any cover that can hide carnivores. Potential entryways into buildings should be closed and sealed. Openings under foundations or small buildings, such as storage sheds, need to be filled with concrete or large boulders and fill material. Protective metal guards or heavy wire mesh can be placed over problem areas. If exclusion and avoidance methods fail, then animals can be live-trapped and

relocated by a commercial wildlife/pest management service. Recommendations for avoiding conflicts with small carnivores and other wildlife based on information provided by the CPW can be found at:

- Exposure to Rabies: http://cpw.state.co.us/learn/Pages/LivingwithWildlifeBatsRabies.aspx.
- Raccoons, Skunks, and Other Urban Wildlife: https://cpw.state.co.us/learn/Pages/LivingwithWildlife.aspx.

Large Ungulates

Most deer and elk on the property travel along vegetated corridors and ridgelines that provide protective cover and security. Wildlife-vehicle collisions are likely to occur as the property develops in areas where these corridors cross roads and other high-traffic areas. The following management prescriptions are presented to mitigate and minimize potential collisions:

- Keep corridors open and connected to CDOT wildlife passageways.
- Maintain speed limits within Range to 30 MPH or less and post signs directing vehicle drivers to slow down and be aware of ungulates in corridors and crossing areas.
- Preserve movement corridors in open space and provide alternate travel routes for ungulates that direct animals away from problem areas or to natural underpasses; trees, shrubs, and fencing can be used to direct ungulates toward alternate travel routes.

4.3 Poisonous Snakes

The only poisonous snake in the property area is the western rattlesnake. People and their pets that encounter a rattlesnake on a trail or open space should back away from the snake, leaving the animal as undisturbed or unprovoked as possible. Rattlesnakes near residences or high use parks and common areas may need to be removed. Rattlesnakes may be taken by anyone in possession of a valid Colorado small game hunting license, and by any method not specifically prohibited by regulation or law. According to the CPW, it is legal to kill rattlesnakes only during an open season or when necessary to protect life or property, provided the method used is in accordance with local ordinances.

> NOTE: Colorado State Statutes provide that “any person may kill rattlesnakes when necessary to protect life or property” [33-6-107(9), C.R.S.]

There are currently no frightening devices or legal toxicants or fumigants available to control snakes. The two basic strategies to avoid problems with snakes, rattlesnakes, and other poisonous snakes in particular are prevention and removal.

Prevention. Four basic methods can be used to discourage snakes from entering buildings or other areas of human activity:

- Eliminate cool, damp areas where snakes hide; remove brush and rock piles.
- Keep shrubbery away from foundations; cut tall grass in human activity areas.
- Control prey populations (primarily rodents) in human activity areas.

- Prevent snakes from entering buildings and crawlspaces by sealing all openings ¼ inch or larger with mortar, caulking compound, or ⅛-inch hardware cloth; check for access points around doors, windows, water pipes, and electrical lines.

Removal. When snakes seek shelter in places they do not belong, it becomes necessary to remove the snake by one of the following humane methods:

- Calling a professional animal control service to remove the snake.
- Nonpoisonous snakes can be swept into a large bucket with a broom, then released a distance away from buildings.
- Damp burlap sacks covered with dry sacks to retain moisture are attractive denning sites when placed along a wall where snakes have invaded; check bags daily and remove with a shovel.

4.4 Birds

Issue

Two main federal regulations pertain specifically to migratory birds and/or raptor nest sites: (1) the MBTA, and (2) the Bald and Golden Eagle Protection Act. Additionally, the state of Colorado has regulations and guidelines pertaining to raptors. These regulations all protect migratory birds, as well as their eggs and nests.

Of particular importance to Range activities is the MBTA stipulation that it is unlawful to destroy an active migratory bird nest, nestling, or eggs. The U.S. Fish and Wildlife Service allows vacant nests to be destroyed, but nests with active birds, young, or eggs must be left alone. For most migratory bird species, the active nesting season in Colorado is March through August, which may also coincide with the peak construction season for development and infrastructure activities on Range.

Management Prescription 1: Avoid inadvertently killing of migratory birds or disturbing active migratory bird nests to the extent that it causes abandonment of the nest in a manner that is consistent with state and federal recommendations during construction projects (see Appendix B for more detail).

Management Prescription 2: Comply with federal regulations pertaining to the MBTA by implementing the step-down avoidance and minimization approach provided in Appendix B. The step-down approach encourages conducting habitat-disturbing activities in the nonbreeding season to the extent practicable, removing or altering vegetation prior to the nesting season to discourage future nesting within construction sites, conducting preconstruction surveys to identify and locate active bird nests, and implementing avoidance measures around active bird nests until nesting is completed.

Implementing this approach demonstrates a “good faith” effort to avoid incidental violation of the MBTA but does not guarantee that migratory birds will not still nest in some areas despite these efforts.

Management - Raptors

The MBTA also protects raptors, including active nest sites. There are no federal recommendations pertaining to raptor mitigation and avoidance; however, CPW (2020) has adopted guidelines that

recommend seasonal restrictions on human disturbance within specified buffer zones around active raptor nest sites (Appendix C). Raptors potentially nest in the vicinity of Range. As development proceeds, Range will comply with federal regulations and CPW guidelines pertaining to raptors. CPW has developed buffer and seasonal restriction guidelines to protect active raptor nests. Appendix C provides guidelines for avoiding and minimizing take of raptors.

Management Prescription 1: Avoid and mitigate impacts on active raptor nests. Currently, there are no anticipated permanent impacts on existing raptor nests; however, there is the possibility that breeding raptors could build new active raptor nests in areas slated for development. The intent of any avoidance and mitigation strategy is to encourage individual raptor pairs to nest at selected and more secure locations. The top priority is to maintain a given pair within their normal home range despite disturbance or destruction of traditional nest sites.

Range will comply with federal and state regulations and guidelines by implementing avoidance and mitigation options for Range property. These mitigation options may consist of (1) avoidance, (2) habitat modification to avoid temporary impacts, and (3) habitat modification to avoid permanent impacts. Additional details of this strategy are provided in Appendix C.

5.0 References

Colorado Parks and Wildlife (CPW). 2020. Recommended buffer zones and seasonal restrictions for Colorado Raptors. February. https://cpw.state.co.us/Documents/WildlifeSpecies/LivingWithWildlife/Raptor-Buffer-Guidelines.pdf

ERO Resources (ERO) 2020. Natural Resources Assessment Cotterel Farms Development U.S. 85 and Airport Road, Sedalia, Colorado. November 23.

Natural Diversity Information Source (NDIS). 2020 https://ndismaps.nrel.colostate.edu/index.html?app=HuntingAtlas. Last accessed February 10, 2021.

Appendix A Sterling Ranch Prairie Dog Management Policy

Prairie Dog Management Policy

Introduction

Prairie Dogs in Urban Settings

Prairie dogs in urban settings have the potential to negatively impact native plant communities by overgrazing small, confined areas. Overgrazing can lead to severe noxious weed infestations. In confined suburban locations, prairie dogs can move onto adjacent private residences, damaging lawns, gardens, and property with grazing and digging activities. Prairie dogs are known carriers of plague and other diseases transmittable to humans and/or their pets that raise human health and safety concerns.

Range Open Space managers will monitor populations and habitat conditions to make informed decisions about management options and potential habitat restoration opportunities and strategies. Management decisions should be made based on professional analysis of habitat conditions, ecological sustainability, and safety concerns of residents and adjacent property owners. Emphasis should be placed on maintaining a healthy sustainable ecosystem. The purpose of this Prairie Dog Management Policy (policy) is to establish a framework for the conservation and humane management of prairie dogs.

Regulatory Background

Currently in Colorado, the prairie dog is classified both as a "destructive rodent pest" by the Colorado Department of Agriculture (CDOA) (see Colorado Revised Statute (CRS) §33-7-203) and small game and a species of concern by Colorado Parks and Wildlife (CPW) (CRS §33-1-102). CPW generally limits regulation of the prairie dog to issues pertaining to hunting and relocation from one site to another. Relocations are authorized only through a permit process. CPW allows the shooting of prairie dogs on private land year-round. In addition, the CPW allows (except as prohibited by federal, state, and local statutes or regulations) the use of toxicants or other legal extermination where necessary to control damage on private land. CDOA and the U.S. Environmental Protection Agency direct the types and manner in which fumigants and toxicants can be used.

In Colorado, it is lawful to capture, transport, and relocate prairie dogs from one site to another suitable site with, and only with, a CPW permit for this action. It is also lawful to capture, transport, and deliver prairie dogs to facilities that support the U.S. Fish and Wildlife Service's (Service) national Black-Footed Ferret Recovery Program or a licensed raptor rehabilitation program to be used as food. The capture, transport, and delivery of prairie dogs to these facilities requires a specific and separate permit from CPW unless the contractor performing such services can euthanize prairie dogs on-site and place them in a sealed container/cooler before transport. Local government and landowner approval also is required. Douglas County has no formal prairie dog policy. However, Douglas County Open Space and Parks Division does have a Prairie Dog Conservation Policy for addressing prairie dog issues on county open space. Many of the conservation principles of the Open Space policy have been incorporated into this policy.

Management

Range will manage prairie dogs using an ecological sustainability approach and decision process modeled after the Douglas County Open Space and Natural Resources prairie dog conservation policy (https://www.douglas.co.us/documents/prairie-dog-conservation-policy.pdf/). Following this approach Range evaluated the property and completed a designation using the three prairie

dog management/conservation categories commonly used along the Front Range and has designated the entire property a No Prairie Dog Areas (NPD). NPD areas are unsuitable for prairie dogs because of ecological conditions or incompatible land uses. Range evaluated the property and surrounding land uses and conservation priorities and determined the entire property should be designated as an NPD. This designation is based on habitat characteristics (e.g., soils, vegetation, slope, elevation, connectivity, and barriers); human health and safety; and current and future land use characteristics, including:

- Range residential communities or recreation amenities in most of the area currently occupied by prairie dogs.
- Steep topography, shrubland vegetation and shallow soils unsuitable for prairie dogs in the undeveloped and designated open space areas
- Incompatible with surrounding land use (commercial/residential on west and north, ranching and wildlife conservation on Cherokee Ranch to the east)

Management Activities

Nonlethal Management and Passive Dispersal

Several practices discourage prairie dogs from occupying a site or expanding onto adjacent private land, sensitive resource areas, or construction sites. These may include irrigating, tilling the soil, planting tall crops that limit visibility, installing barriers, or implementing innovative management techniques. There is NO opportunity for Passive Dispersal of prairie dogs at Range. The only suitable areas for healthy, sustainable prairie dog populations at Range significantly overlap with proposed residential development. Any Passive Dispersal would force prairie dogs onto surrounding private properties and adversely affect neighbors. Moving prairie dogs into designated open space areas would force the animals to occupy unsuitable and unsustainable habitat and severely compromise higher priority values of Open Space, such as providing seasonal and year-round forage, cover, and movement corridors for elk and deer.

Lethal Control, Including Use in Black-Footed Ferret and Other Recovery Wildlife Rehabilitation Programs

Range may retain the services of a professional exterminator/agent or use trained staff to eradicate all or part of a prairie dog colony using standard and legally permitted methods. Range shall use a commercial exterminator/agent with a valid state permit/license or trained staff to exterminate prairie dogs. Use of any lethal management tool shall be monitored to ensure compliance with label instructions. Range may elect to remove the prairie dogs using live-trapping or water flushing for (a) transport to a site designated by the Service for use in the Black-Footed Ferret Recovery Program or (b) use in other suitable wildlife recovery programs. Prairie dogs transported to the Service for use in the Black-Footed Ferret Recovery Program are generally euthanized and used as food for captive-reared ferrets. The Service currently accepts prairie dogs only from late April through mid-October. Prairie dogs transported to other suitable wildlife recovery programs (e.g., raptor rehabilitation) are also generally euthanized, frozen, and used as food for injured animals. Range shall require proof of receipt from the wildlife recovery programs.

Relocation to Alternative Sites

This is not considered a viable management option on Range. State law prohibits relocation to other counties without the approval of the commissioners of that county and all relocations

require CPW permits. Suitable relocation sites in Douglas County are extremely limited by elevation, topography, and vegetation communities. Viable prairie dog colonies are likely unsustainable above 7,000 feet in elevation, eliminating much of the southern and eastern portions of the county. Suitable open grassland habitats in northern and central Douglas County are also highly suitable for residential and commercial development and contain the population centers of Castle Rock, Parker, and Highlands Ranch. The remaining suitable grassland habitats in northern and central Douglas County are already occupied by prairie dogs or are in various stages of residential planning and development.

Range, under no circumstance, shall receive prairie dogs from off-site locations.

Response to Outbreaks of Sylvatic Plague
Should indications of disease in prairie dogs become evident prior to prior to removal or other management actions, Range shall notify the Tri-County Health Department (TCHD), which in turn, shall notify the Colorado Department of Public Health and Environment (CDPHE). Indications of disease could be sick or "mangey" looking animals, above ground prairie dog carcasses and sudden prairie dog die-off potentially associated with sylvatic plague. Range shall cooperate with these agencies in obtaining samples for epidemiological evaluation. If plague is confirmed in a prairie dog colony on Range or surrounding area, Range, in cooperation with the TCHD and CDPHE, shall implement a program to treat the affected area for fleas to eliminate or control the outbreak, and shall ensure that the area is posted by the TCHD. If plague is or suspected in a prairie dog colony on Range or surrounding area, based upon sudden die-offs in prairie dog populations, Range may immediately implement prairie dog population reduction or control activities to protect the health and safety of residents.

Appendix B Migratory Bird Treaty Act Compliance Procedure

Appendix B.
Migratory Bird Treaty Act Compliance Procedure

The Migratory Bird Treaty Act (MBTA) protects migratory birds, including raptors, and active nest sites. Originally passed in 1918, the MBTA commits to the protection "of the many species of birds that traverse certain parts of the United States and Canada in their annual migration." Unless permitted by regulations, the Act provides that it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not. The U.S. Fish and Wildlife Service's rules define "take" for MBTA purposes to mean to "pursue, hunt, shoot, wound, kill, trap, capture, or collect." (50 C.F.R. § 10.12). In Colorado, most birds except for European starling, house sparrow, Eurasian collared dove, and rock pigeon are protected under the MBTA.

Under the MBTA, it is unlawful to destroy an active migratory bird nest, nestling, or eggs. The U.S. Fish and Wildlife Service (Service) allows vacant nests to be destroyed, but nests with active birds, young, or the presence of eggs must be left alone. For most migratory bird species, the active nesting season in Colorado is between March and August, which may also coincide with peak construction season for Range.

Under the MBTA, the Service may issue Nest Depredation Permits, which allow a permittee to remove an active nest. The Service, however, issues very few Nest Depredation Permits, and only under very specific circumstances that are usually related to human health and safety. Obtaining a Nest Depredation Permit is unlikely, and is a process that takes from four to eight weeks.

Relevance to Range

Because Range is large area of open land with a mixture of native and non-native grassland, and shrubland vegetation with very little existing development, the area may contain active bird nests in all habitats throughout the breeding season. The nests of migratory birds may be found in a variety of locations at Range including on the ground, in tree branches, shrubs, tree cavities, in buildings, and in cutbanks. Unintentional destruction of active bird nests could occur during tree and shrub removal, mowing, or grading and excavation for development.

Compliance Procedure

To help Range continue to meet its goal of compliance with relevant environmental regulations, a standard procedure for MBTA compliance will be implemented. Although a standard procedure will not guarantee that every nest would be found or that birds would not build new nests prior to or during construction, Range will be able to demonstrate a good-faith effort in the event an unintentional violation is reported. Range will implement the following procedure in order to comply with the MBTA:

1. Conduct habitat-disturbing activities (e.g., tree removal, grading, scraping, and grubbing) in the nonbreeding season (September 1 to March 31) to the extent practicable avoid disturbing active nests or to avoid a "take" of the migratory bird nests in the project area. If impractical, consider step 2.
2. If work activities are planned between April 1 and August 31, remove or alter vegetation within construction footprints and road rights-of-way prior to the nesting season (April 1 to August 31), to discourage nesting so that construction can take place on schedule. This can be as simple as mowing the vegetation, disking the area, or removal of vegetation with a grader. Removal or alteration of vegetation will also discourage nesting in areas adjacent to the construction footprints and encourage birds to nest in more suitable habitat. Vegetation-altering activities can include mowing and/or trimming to a height of six (6) inches or less, disking, initial surface grading, and herbicides.
3. Once vegetation has been removed and/or trimmed, appropriate measures (i.e., repeated mowing/trimming/proper grazing) should be implemented as needed to ensure vegetation does not grow to more than six (6) inches high.
4. If activities 1 through 3 cannot be completed, preconstruction clearance surveys should be conducted by a trained biologist during the nesting season to identify any active nests and implement avoidance measures.
5. If an active nest is identified in a project area, activities that would directly impact the nest or that would encroach close enough to cause adult birds to abandon the nest will be restricted.

Note: Implementing this approach demonstrates a “Good Faith” effort to avoid incidental violation of the MBTA but does not guarantee that migratory birds will not still nest in some areas despite these efforts.

Appendix C Raptor Regulations, Management Guidelines, and Management Strategy

Appendix C
Raptor Regulations, Management Guidelines, and Management Strategy

Purpose and Objective

The purpose of this raptor monitoring and mitigation plan is to avoid and minimize take of raptors and establish site-specific guidelines and management protocol for nesting raptors potentially affected by project activities. This mitigation plan is consistent with Range's commitment to build an environmentally responsible project and to comply with the guidelines for buffer zones and seasonal restrictions developed by Colorado Parks and Wildlife (CPW).

Regulations

Two main federal regulations pertain specifically to migratory birds and/or raptor nest sites: 1) the Migratory Bird Treaty Act (MBTA), and 2) the Bald and Golden Eagle Protection Act. Additionally, the State of Colorado has regulations and guidelines pertaining to raptors. This section discusses regulatory backgrounds of the MBTA, the Bald and Golden Eagle Protection Act, and state regulations, and how these protections may affect existing and future activities on Range property. Because Range is outside the range of any threatened or endangered raptor species and because the nearest active eagle nests is more than 1-mile of Range this document will focus on the MBTA.

Migratory Bird Treaty Act

Migratory birds, as well as their eggs and nests, are protected under the MBTA. Unless permitted by regulations, the MBTA provides that it is unlawful to pursue; hunt; take; capture; kill; attempt to take, capture, or kill; possess; offer for sale; sell; offer to barter; barter; offer to purchase; purchase; deliver for shipment; ship; export; import; cause to be shipped, exported, or imported; deliver for transportation; transport or cause to be transported; carry or cause to be carried; or receive for shipment; transportation; carriage; or export any migratory bird, part, nest, egg, or product; manufactured or not (16 U.S.C. §§ 703-712). The MBTA does not contain any prohibition that applies to the destruction of a bird nest alone (without birds or eggs), provided that no possession occurs during the destruction. While destruction of a nest by itself is not prohibited under the MBTA, nest destruction that results in the unpermitted take of migratory birds or their eggs is illegal and fully prosecutable under the MBTA (Migratory Bird Permit Memorandum, U.S. Fish and Wildlife April 15, 2003). In Colorado, most nongame birds are

protected under the MBTA. Bird species not protected under the MBTA include grouse species and nonnative species such as, house sparrow, European starling, Eurasian collared dove, and rock pigeon (common pigeon).

Federal and State Recommendations

Bald Eagles

The U.S. Fish and Wildlife Service (Service) developed National Bald Eagle Management Guidelines in 2007. These guidelines are intended primarily as a tool for landowners and planners to avoid disturbing bald eagles. The guidelines provide specific recommendations for avoiding disturbance to nest sites. The recommendations include:

- Keeping a distance between the activity and the nest (distance buffers); the buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites;
- Maintaining forested (or natural) areas between the activity and around nest trees (landscape buffers); and
- Avoiding certain activities during the breeding season (temporal restrictions).

Although these guidelines establish specific buffer size recommendations, they caution that the distance between an activity and a nest site may need to consider several site-specific variables, including:

- Open habitats, particularly in western states, may require larger buffers;
- Physical and topographical landscape features that can screen or dampen visual impacts, noise, and artificial light (landscape buffer); and
- The historical tolerance of individual eagles or breeding pairs to human activities at particular localities.

Other Raptors

In Colorado, the Service coordinates closely with the CPW to provide guidelines and recommendations to protect individual raptor nest sites. CPW has established Recommended Buffer Zones and Seasonal Restrictions for Raptors (CPW 2020). Should a raptor nest become established on Range, Range will comply with federal and state regulations and guidelines. State guidelines for raptor species potentially nesting on Range are provided below:

Red-tailed Hawk

- Nest Site: No surface occupancy (beyond that which historically occurred in the area) within ⅓ mile radius of active nests. No permitted, authorized, or human encroachment activities within ⅓ mile radius of active nests from February 15

through July 15. Some individuals of this species have adapted to urbanization and may exhibit a high tolerance to human habitation and activities within 100 yards of their nest. Development that encroaches on rural nest sites is more likely to cause abandonment.

Swainson's hawk

- Nest Site: No surface occupancy (beyond that which historically occurred in the area) within ¼ mile (1320 feet, 400 meters) radius of active nests. No permitted, authorized, or human encroachment activities within ¼ mile (1320 feet, 400 meters) radius of active nests from April 1 through July 31. Some members of this species have adapted to urbanization and may tolerate human habitation to within 100 yards of their nest.

Great horned owl

- No specific buffer recommendations

Barn owl

- No specific buffer recommendations

American kestrel

- No specific buffer recommendations

Note: Although CPW has not identified specific buffer recommendations for great horned owl, barn owl and American kestrel, these species are still protected by the MBTA and consultation with the local CPW District Wildlife Manager is recommended prior to encroaching on active nests of these species.

Management Strategy

Inactive Hawk or Owl Nest – The removal of the nest or nest tree in the inactive season is permitted under the federal MBTA, and CPW frequently recommends nest removal for nests that cannot be protected or avoided by adhering to the state buffer or approved site-specific guidelines. The Service considers a nest active only during the nesting season when a breeding pair is attending the nest through the post-fledging period while the young are still dependent on the nest site. However, CPW typically considers a raptor nest active for five years after its last known occupancy.

Recommended Avoidance and Mitigation Procedures – Avoidance and mitigation options for Range consists of 1) avoidance, 2) habitat modification for temporary impacts, and 3) removal of inactive nests. The intent of any mitigation is to encourage individual raptor pairs to nest at selected and more secure locations. Range will implement the following management strategy for addressing raptor issues:

- **Establish Reasonable Buffer** – Comply with CPW-recommended buffer zones to provide adequate protection for any raptor species that may nest on the property. If vegetation screen or topography provide natural visual buffers to active raptor nests, consult with the CPW to develop site-specific buffer distances that take these natural buffers into consideration.

- **Avoid/Minimize** – Design project activities and scheduling that avoid disturbance to nest sites and important foraging areas, either spatially using reasonable buffers or temporally using seasonal restrictions. Conduct habitat-disturbing activities (e.g., tree removal, grading, scraping, and grubbing) in the nonbreeding season for all migratory birds (September 1 to February 15) to the extent practicable.

- **Habitat Modification for Temporary Impacts** – Install temporary nest deterrents, where appropriate, prior to the nesting season in any known or suspected active nests that will be temporarily rendered unproductive by Range activities. Nest deterrents in known or suspected active nests need to be coordinated with the CPW district wildlife managers. Nest deterrents will be removed upon project completion.

- **Habitat Modification for Permanent Impacts –** Federal and state regulations allow removes of inactive hawk or owl nests. Remove the nest or nest tree in the inactive season, which is permitted under the MBTA. The CPW frequently recommends nest removal for nests that cannot be protected or avoided by adhering to the state buffer or approved site-specific guidelines. The Service considers a nest active only during the nesting season when a breeding pair is attending the nest through the post-fledging period while the young are still dependent on the nest site. However, the CPW typically considers a raptor nest active for five years after its last known occupancy and generally recommends nest replacement with a mitigation nest.

JW

RANGE PROJECT 2025

WILDFIRE MITIGATION PLAN



PREPARED FOR:

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January 10, 2025

Society of American Foresters
Growing better all the time

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Picture and cover are a landscape view of the Range Project

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RANGE PROJECT
WILDFIRE MITIGATION PLAN

JANUARY 10, 2025

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LEGAL DESCRIPTION:

SE1/4 SECTION 34; SW1/4 SECTION 35
TOWNSHIP 6 SOUTH, RANGE 68 WEST, 6th PM.
W1/2 SECTION 2; E1/2 SECTION 3, TOWNSHIP 7 SOUTH,
RANGE 68 WEST, 6th PM
DOUGLAS COUNTY, COLORADO
398.7 TOTAL ACRES

I have reviewed this plan, which has been prepared at my request to guide my stewardship management for wildfire mitigation activities, and I will voluntarily apply them on my property. I believe the management requirements in this plan are appropriate to meet my goals and objectives and will benefit the natural resources on the property. I intend to apply the required practices, thus helping me to be a good steward of the forest, meadows and associated resources entrusted to me on my property. I agree to follow this plan to ensure the sustainability of my management.

Date: _____ Signed, Developer:_____

Date: _____ Signed, Douglas County Mitigation Forester: _____

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1.0 INTRODUCTION

This Wildfire Hazard Mitigation Plan has been prepared for the Range property located at the intersection of US 85 and Airport Road, 7440 North US 85 Sedalia, Colorado. The property is currently managed for agricultural purposes. The property is currently zoned as Planned Development. Our client Bryan Horan, Ventana Capital, Range, LLC. wishes to develop the site into a residential community (**Appendix 9.1**).

In 2022 an update to the Douglas County Community Wildfire Protection Plan (CWPP) was developed. Key components of the plan include a county-wide wildfire hazard assessment, identification of communities at risk, and recommendations on how communities can reduce their risk to wildfire. The plan will serve as an "umbrella" document to provide background information for finer-scale communities within Douglas County (i.e., subdivisions, or homeowners associations) who wish to develop a specific Community Wildfire Protection Plan for their area of interest, may tier to the CWPP for assistance.

2.0 GOALS & OBJECTIVES

The primary goal of this plan is to provide a scope of work and strategic requirements to thin hardwood and conifer forests and mow grass to reduce wildfire risk.

This plan will meet the following objectives:

- Assess the potential wildfire hazard and make wildfire mitigation strategic and tactical recommendations.
- The applicant must implement this approved plan prior to the development being eligible for permits.
- Identify any forest health concerns and make appropriate management recommendations.
- Assist the client in meeting the requirements of the Douglas County Land Development Regulations.

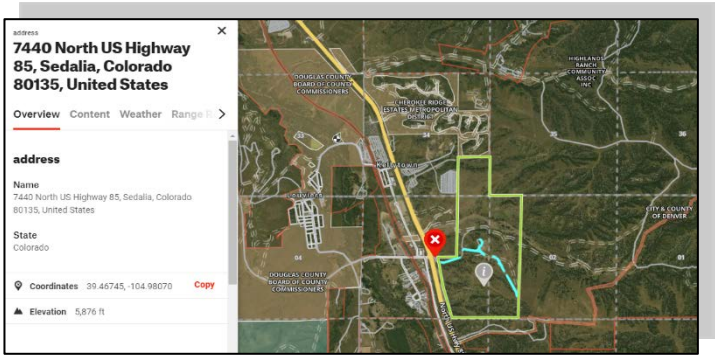
Further additional objectives and expectations are:

- To develop an Open Space (OS) Agreement with Range LLC, Douglas County, Metro District, and HOA.
- Agreement needs related wildfire strategies to be incorporated into larger open space management plans and agreements.
- Open space categories are comprised of open space parcels categorized as I, II, III.
- Preservation agreements should protect the area from development and encompass conservation strategies to manage land that reduce potential for high intensity wildfire, habitat enhancement and community protection.

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3.0 GENERAL PROPERTY DESCRIPTION

3.1 Location



Location Map

The Range property is in Douglas County, southeast of Sedalia located at 7440 North US 85, Sedalia, CO., 80135. The project is in portions of the Southeast ¼ of Section 34, the Southwest ¼ of Section 35 Township 6 South, Range 68 West, the West ½ of Section 2 and the East ½ of Section 3, Township 7 South, Range 68 West, 6th Principal Meridian. The property can be accessed from Sedalia, CO via US 85. Travel southeast approximately 3 miles from Sedalia, CO on US 85 to the intersection of Airport Road at 7440 North US 85, Sedalia CO, 80135.

3.2 Property Description

The property contains approximately 399 acres. The project area ranges in elevation from approximately 5,800 to 6,000 feet along the eastern boundary. The aspect is generally northwest. Slopes vary from gentle to moderate, ranging from 10 to 35 percent.

Natural vegetation on the property is predominately native grasslands, with shrubs and ponderosa pine occurring along the drainages. Significant portions of the Range property were used for livestock grazing and planted crop land.

3.3 Climate

Climatic data from the weather station in Castle Rock (*051401), Colorado, approximately 25.0 miles southeast of the property, provides the following averages based on records from 1893 to 2016 continuous data collection:

- Average annual maximum temperature: 63.4 °F
- Average annual minimum temperature: 31.3 °F
- Average annual total precipitation: 17.04 inches
- Average annual total snowfall: 60.8 inches

*Reference: (****Western Regional Climate Center****, wrcc@dri.edu)*

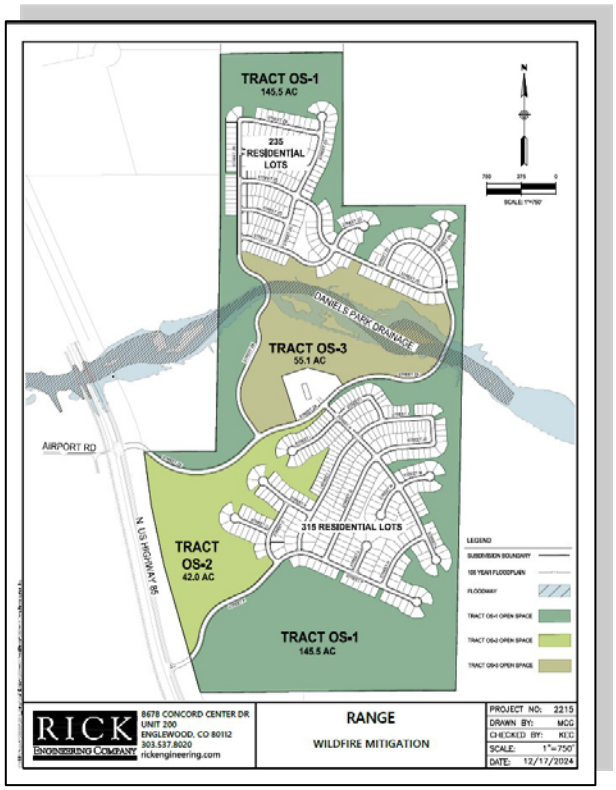
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3.4 Impacts on Neighbors

Several business and residences are near the west, south, and north Range boundary. A Wildlife Conservation Area owned by. Highlands Ranch Association is located east of the Range property. This development is near several businesses and homes that are likely to be affected by noise and visual impacts during construction. Refer to **Appendix 9.1 Adjacent Landowner Maps**

3.5 Range Planned Development

Range Planned Development (PD) is to provide 550 lots for single family residential homesites, while maintaining approximately 242 acres of open space on land that has minimal farming or ranching value, which creates country living in a rural atmosphere while preserving the vegetation, wildlife habitat/corridors, views and privacy. The PD (**Appendix 9.5)** is in the approval process with Douglas County.



Range PD

The PD indicates an open space agreement with the developer, County, Metro District, and HOA. Wildfire related strategies need to be incorporated into larger open space management plans and agreements. Open space categories are comprised of open space parcels categorized as I ,II,III. These preservation agreements should protect the area from development and encompass conservation strategies to manage land that reduce potential for high intensity wildfire, habitat enhancement and community protection.

4.0 WILDFIRE HAZARD ASSESSMENT

4.1 Wildfire Risk Assessment

Each year, wildfires on public and private lands consume millions of acres of forests, threatening lives, property, and watershed resources. The potential for wildfire or fire risk is the likelihood that wildfire will start from natural, or human caused ignitions, with potential for damaging effects to people, property, and/or the environment. Risk is also defined as the possibility of loss or harm from wildfire. Increased awareness of wildfire hazards and the need for active mitigation has led to advanced means of analyzing these hazards relative to communities and homes within the wildland-urban interface. Images such as the Black Forest fire help residents understand the intensity of wildfire risk to Colorado communities.

The Colorado State Forest Service developed the Colorado Wildfire Risk Assessment (**CO-WRA**) Portal, (https://coloradoforestatlas.org/), to aid in wildfire prevention planning. CO-WRA provides

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a spectrum of information, reports, and analyses supporting mitigation, education, and wildfire prevention initiatives the Range property. The report generated several indicators of risk elements. The Wildfire Risk Assessment described several fire behavior characteristics potentially impacting the development the Range property. The risk assessment provides critical information to make informed decisions. Additional indicators are available in the Range CO-WRA report available at: Range CO-WRA REPORT

A summary of this report's findings indicates the current wildfire risk is moderate to low; fire rate of spread is high to extreme over most of the property due to fuel types and slopes; expected flame lengths are moderate, (4-8 feet); and the likelihood of starting a wildfire in the highest-class rating. The report classifies the wildfire risk for the Range property "low to moderate." This rating is based on wildfire threat and fire effects. It identifies those areas with greatest potential impacts from wildfire, i.e., those areas most at risk, considering all values and assets combined. At the current time, there is little value on the property, hence the low-risk rating.

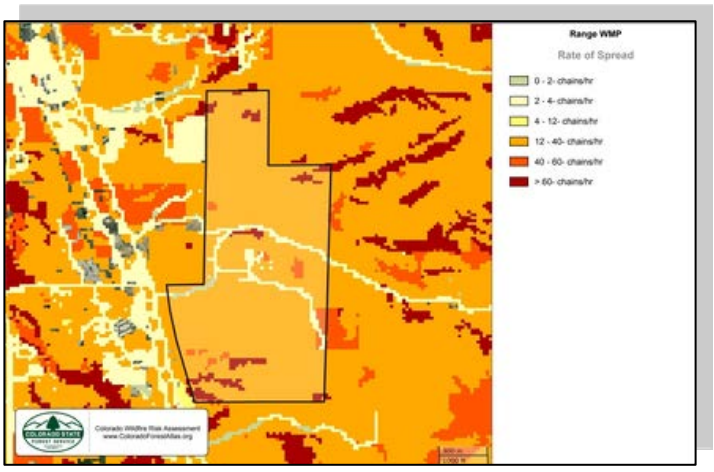
Wildfire Ignitions Map is an ignition density heat map represents the likelihood of a fire starting based on historical ignition patterns. The assessment indicates ~ 80 percent of the Range property is in the highest threat class of wildfire occurrence.



Range Fire Ignitions

Three fire behavior characteristics of importance to the Range property are rate of spread, flame length and fire intensity scale. All three of these fire behavior characteristics are influenced by three factors, fuels, weather, and topography.

Rate of spread, the speed with which fire moves across the landscape, is influenced by fuels, weather, and topography. Ninety five percent of the property is in areas defined as high to extreme rate of spread, with fire projected to move across the landscape 13 to 44 feet per minute. Slope, surface fuel conditions and weather contribute to the spread. Fuel models 2 and 5 show the variable surface fuels conditions generally associated with the property.



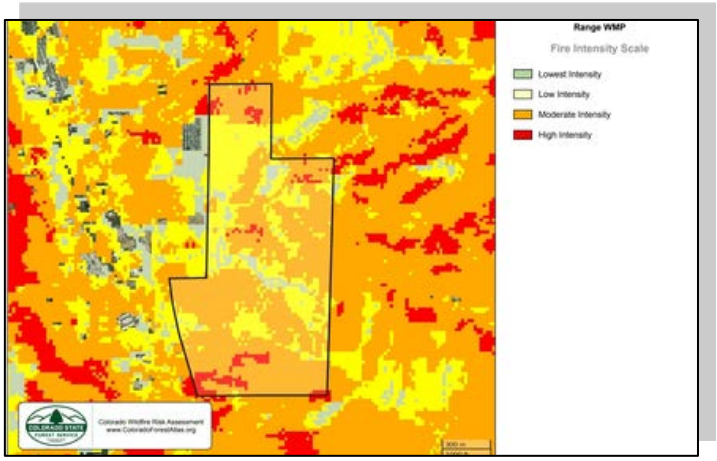
Range Wildfire Rate of Spread

Flame length is an indicator of fire intensity and is often used to indicate how much heat is being generated by the fire. Approximately 96 percent of the Range property is represented in the low to high classification, with flame

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lengths projected to range from 6 to 12 feet or greater in length. The remainder of the property is in a low to moderate classifications with flame lengths projected to range from 0 to 6 feet in length.

The fire intensity scale identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist. Like the Richter scale for earthquakes, the fire intensity scale provides a standard scale to measure potential wildfire intensity. Approximately 96 percent of the Range property is represented with a Class 2 to 4, low to high intensity scale. Flames 8 to 30 feet in length could be expected.



Range Wildfire Intensity Scale

The property is currently undeveloped. Creating defensible space for constructed homes needs to be an integral part of design standards for the community. Defensible space is the natural landscaped area around a home or other structures that has been modified to reduce fire hazard. Defensible space gives homes a fighting chance to resist the impact of wildfire. Creating and maintaining defensible space also reduces the chance of a structure fire spreading to the surrounding forest or other homes. Additional information on defensible space is included in **Appendix 9.2**.

Planned access roads in the development can be used to create effective barriers to the potential spread of wildfire. Access to proposed homes is limited with primary access through two main streets from Highway 85. In the event of a wildfire emergency we propose that two emergency crash gates be developed from the Range property that exits to the east and to the north with adjoining neighboring properties. This provides safe community emergency egress and allows Fire Department apparatus alternative access to the community in the event of wildfire and limited safe egress.

Further we recommend developing a post management plan keeping the vegetation managed, and mowing grass along all roads passing through the Range property to make ingress and egress during wildfire safer for citizens and fire personnel for the future. Creating fuelbreaks, along with roads, driveways, and trails, will break up the continuity of the forest cover and fuels. Modifying fuels will help keep fires small, provide access for fire suppression resources while allowing residents to evacuate if necessary.

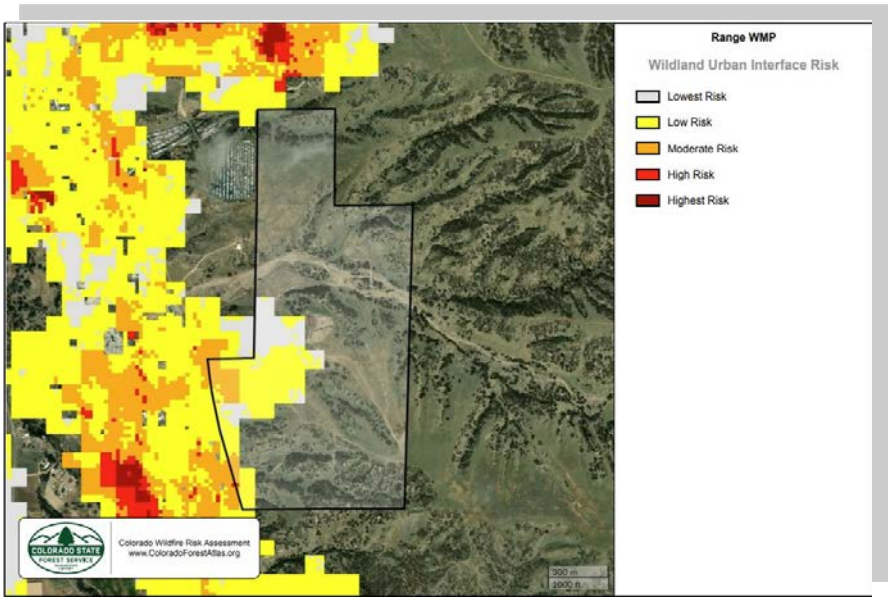
Additional information on fuelbreak guidelines can be found in **Appendix 9.2** (**Dennis 2005**). Information regarding creating wildfire-defensible zones, fire-resistant landscaping, forest home fire safety, and fire-wise plant materials are also included in **Appendix 9.2**. Defensible space will be required around each house as well as community open spaces in the future and should be maintained annually to remain effective.

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Wildland-Urban Interface Risk is a rating of the potential impact of wildfire on people and their homes (**CO-WRA**). The WUI Risk Index is derived using a response function modeling approach. Response functions are a method of assigning a net change in the value to a resource or asset based on susceptibility to fire at different intensity levels, such as flame length. To calculate the WUI Risk Index, the WUI housing density data were combined with flame length data and response functions were defined to represent potential impacts. The response functions were defined by a team of experts led by Colorado State Forest Service mitigation planning staff.

By combining flame length with the WUI housing density data, it is possible to determine where the greatest potential impact to homes and people is likely to occur. Customized urban encroachment algorithms were used to ensure those fringe urban areas were included in the WUI Risk outputs. Encroachment distances into urban areas were based on the underlying fuel models and their fuel types and propensity for spotting and spreading.

In summary, 64-acres are currently in the WUI. Of these acres, approximately 13% are in the moderate to high-risk class. The map shows WUI risk areas to the west which include the Union Pacific Railroad, a State Highway, County roads, businesses and industries resulting in a Burn **Probability Risk** rating.



Range Wildland Urban Interface Risk

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Burn Probability (BP) is the annual probability of any location burning due to wildfire. The annual BP was calculated as the number of times that a cell was burned and the number of iterations used to run the models. The map shows that 100% of the Range property has a high Burn Probability as they are made up of Fuel Models 2 and 5. This data is consistent with the WUI Map in **Section 4.2, Fuel Models**. Burn Probability was used to recommend a fuelbreak around the entire perimeter of the property, refer to **Appendix 9.1 MU Map**.

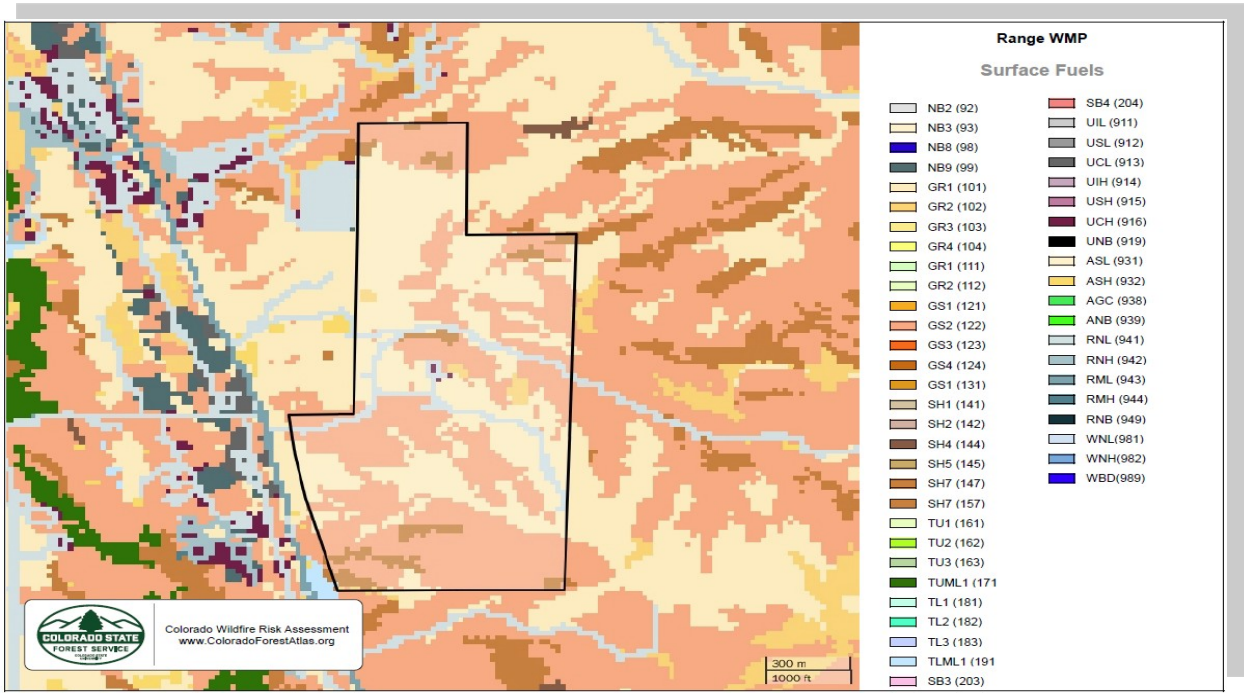


Range Burn Probability Index

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4.2 Fuel Models

Fuel models are a means of describing a wide variety of combustible conditions found in the wildland environment. Fuels model estimates of surface fuels are combined with fuel behavior maps to create fuel models that are useful for quantifying current stand conditions and predicting wildfire behavior. Fuel size class, fuels loading in tons/acre, fuel bed depth, and fuel continuity across a landscape are all factors that are considered when assigning a fuel model to a specific site.



CO-WRA, Range Surface Fuel Models

There are two main classification systems used in wildland fire management. The newer system is contained in the USDA Forest Service General Technical Report RMRS-GTR-153 *Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fuel Spread Model* (Scott and Burgan 2005). The second, older system is published in USDA Forest Service General Technical Report INT-GTR-122 *Aids to Determining Fuel Models for Estimating Fire Behavior* (Anderson 1982).

The best representative Surface Fuel Models describing fuel conditions across the property are Fuel Models **GS2 (122)** Moderate Load, Dry Climate Grass-Shrub and **GR1 (101)** Short, Sparse Dry Climate Grass. Refer to **Appendix 9.2 CO-WRA**, page 46.

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Fuel Model 2 (GS2, GR1) is present across 357 acres or ~ 90 percent of the Range property. GR1 applies to acres where the primary carrier of fire is sparse grass, though small amounts of fine dead fuel may be present. The grass is generally short, either naturally or by heavy grazing, and may be sparse or discontinuous.



Fuel Model 2

GS2 applies to acres where the primary carrier is grass and shrubs combined. Shrubs are 1-3-feet high, and the grass load is moderate. The spread rate is high with moderate flame lengths. Fuel loads in this model are around 4.0 tons per acre with a 1.0-foot fuel bed depth (**Anderson 1982**).

Fuel Model 5 (SH5) is present across 18 acres or ~ 5 percent of total acres. The primary carrier of fire is woody shrubs and live and dead shrub litter. This fuel model also contains small amounts of ponderosa pine with a moderate load of needle litter (**CO-WRA**). The fuels are located predominately in the ravines bisecting the property.



Fuel Model 5

Fuel model 5 applies to acres with a very heavy shrub load and closed canopy stands that support fire in the litter layer. This layer is mainly needles, leaves, and twigs because little undergrowth is present in the stand.

In this fuel model, slow to moderate burning ground fires with low flame lengths generally occur, although the fire may encounter an occasional “jackpot” or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humidity and high winds do the fuels pose fire hazards. Dead fuel loads range from 1.0 - 3.5 tons per acre with an average fuel bed depth of 2.0 feet (**Anderson 1982**).

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5.0 WILDFIRE MITIGATION MANAGEMENT

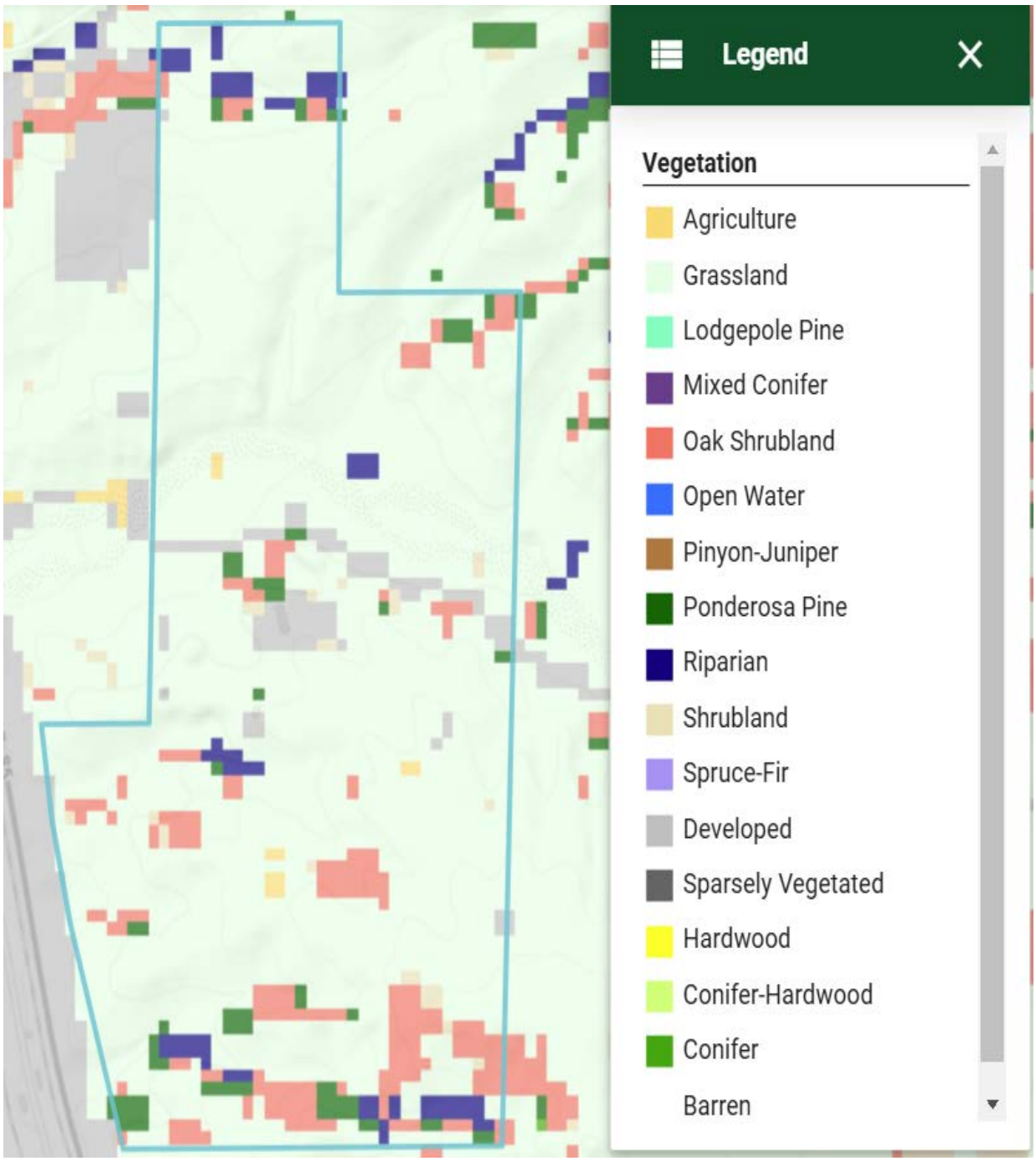
The property was defined with three major vegetative **Stand types**: **Grassland, Oak Shrubland/Shrubland**, and **Ponderosa Pine**. Each Stand Type becomes a Management Unit **(MU)** in this plan.

Vegetation Class	Acres	Percent
Agriculture	0	0 %
Grassland	343	86.1 %
Introduced Riparian	0	0 %
Lodgepole Pine	0	0 %
Mixed Conifer	0	0 %
Oak Shrubland	24	6.1 %
Open Water	0	0 %
Pinyon-Juniper	1	0.2 %
Ponderosa Pine	19	4.7 %
Riparian	0	0 %
Shrubland	5	1.3 %
Spruce-Fir	0	0 %
Developed	6	1.6 %
Sparsely Vegetated	0	0 %
Hardwood	0	0 %
Conifer-Hardwood	0	0 %
Conifer	0	0 %
Barren	0	0 %
Total	**399**	**100 %**

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Vegetation Map

General Vegetation and Landcover Types



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5.1 Scope of Work

The scope focuses on actions that are effective in reducing wildfire hazards on the Range property. The forest thinning objective reduces ladder fuels, diseased deformed damaged trees and removing all logging slash and roundwood. The rangeland objective focuses on managing grasslands and shrublands to stop unwanted wildfires. As an example, it is important to note that ponderosa pine is easy to thin, often remain strong and standing after high wind events. This is because the species generally have a deep root system that allow them to be "windfirm.

5.1.1 Stand 1 - Grasslands

The Grassland stands represent ~343 acres of the Range property. Mixed grass and scattered shrub thicket cover the dry southern slopes of the property. Common flora in this vegetative unit includes mountain mahogany (*Cercocarpus montanus*), buckbrush (*Ceanothus fendlen*), yucca (*Yucca glauca*), and scattered common juniper (*Juniperus communis*). Dominant grass species are western wheatgrass (*Agropyron smithii)*, big and little bluestem (*Andropogon* spp.), and blue gramma (*Bouteloua gracilis*). Introduced grasses such as smooth brome, intermediate wheatgrass and crested wheatgrass also occur on a graded area adjacent to the property.



Grassland

Grass-dominated landscapes are characterized by an abundance of fine fuels and dry conditions that are prone to fire and pose heightened risks to communities. One of the primary challenges lies in developing adaptive strategies that consider the dynamic nature of grass landscapes, climate influences and the need for effective risk reduction to ensure long-term resilience against wildfire threats. Refer to (CSFS Grasslands Mitigation Strategies).

Grasses represent 86% of the Range property. These areas are characterized by an **abundance of fine fuels** and can be particularly vulnerable to wildfire due to their rapid fuel accumulation and high fire frequency. Grass fuels are a large concern for communities because it is the predominate fuel type near homes bordering Open Spaces. These light flashy fuels are a risk to firefighter safety and can pose a serious threat to homes.

Most grasses are less than **¼ inches in diameter**, that quickly respond to changing environmental conditions. In contrast with forest litter fuels which are often coarser, have higher fuel-loading, are higher in density and have burnout times in the order of minutes to hours; grass fuels have burnout times around **5–15 seconds** (**Sullivan, 2010**). One-hour fuels can burn under a broader range of environmental conditions than other fuel types due to their rapid moisture extinction rate.

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The grass meadows were historically used for livestock pasture. There is evidence of deer and elk use of meadow vegetation. Accessibility and operability are very good (tractor operability) with development of skid road access since the ground conditions vary from 0 to 50%.

5.1.2 Stand 2 – Oak Shrublands/Shrublands

The combined Shrublands stand cover ~29 acres in the property. The common flora in this unit is primarily Gambel oak (*Quercus gambelii*), Rocky Mountain juniper, mountain mahogany, and scattered common juniper. A heavy amount of mountain mahogany also exists intermixed with the oak. In the ravines, Gambel oak has grown beyond its familiar brush form into small trees up to 18 feet tall. An intermittent drainage flows east to west within the Range property, see **Appendix 9.1 MU Map.**



Stand 2

The understory consists of Rocky Mountain maple (*Acer glabrum*), wax currant (*Ribes cereum*), snowberry (*Symphoricarpus albus*), shrubby cinquefoil (*Potentilla cinquefolia*), sage (*Artemisia* spp.), Rocky Mountain pussytoes (*Antennaria parvifolia*), squirreltail bottlebrush (*Elymus longifolius*), western yarrow (*Achillea lanulosa*), junegrass (*Koeleria macrantha*) and various sedges (*Carex spp*.).

5.1.3 Stand 3 – Ponderosa Pine

The ponderosa pine stand covers ~19 acres and would fall within Fire Behavior Fuel Model 5 where the stands are more open with a grass understory. Fire spread is primarily through the fine herbaceous fuels, either curing or dead. These are surface fires where fine fuels, litter and dead and down slash contribute to fire intensity.

Where possible remove ladder fuels under existing tree crowns and canopies. To maintain an uneven-aged, healthy stand of ponderosa pine on any open space areas, achieve stand diversity objectives and encourage natural reproduction of ponderosa pine.



MU 1 Thinning areas of hazardous fuels in ponderosa pine stands.

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5.2 Treatment Requirements

Stands are converted and treated as three Management Units (MU), see **Appendix 9.1 MU Map** for management direction. Included in this section are some general comments on each MU. It is recommended that a professional forester be consulted for all future tree markings and layout of future treatments prescriptions. Implementing these treatment prescriptions will reduce existing fuels, significantly modifying fire risk based on fuel loading. We recommend these activities take place before any planned development occurs. Additional mitigation activities will occur as individual landowners complete defensible space requirements per Douglas County land use regulations. *Additionally, the requirements described in **Section 6.0** should be incorporated into the HOA Covenants for Community.*

5.2.1 Prescription for Grassland Management MU1



MU1 – Meadow- Grass-Shrub

Grasses are perhaps the most pervasive and abundant surface fuel and are weather dependent on seasonal moistures in Colorado. Mow grasses and weeds as often as needed throughout the growing season and keep them 4 inches or shorter. This applies to irrigated lawns and wild or native grasses. This is critical in the fall, when grasses dry out, and in the spring, after the snow is gone but before plants green-up. Be especially careful when mowing in areas with rocks. Mower blades can hit rocks and create sparks, causing fires in dry grass. Consider using a higher blade setting on the mower and trimming grass that grow against the trunk only by hand. When mowing around trees, be sure to avoid damaging the root system and tree trunk by mowing only on days with high humidity or after recent moisture to reduce the risk of starting an unwanted fire. Individual lot owners will be responsible for mitigation on their lot.

Goal: To maintain grassland meadows that help break up blocks of forested stands of higher risk wildfire behavior, to help buffer the risk of wildfire from potential ignitions off from Union Pacific Railroad, US 85, adjacent residences, private business areas, and roads.

Mandatory Requirements:

- Require a mowed 30-foot grass strip while maintaining a minimum or maximum height of 4 inches along roadside cuts and fills, (refer to HIZ) and adjacent to neighboring residences and businesses where native grasses abut roads and structures.
- Mow a minimum 2 times per year or when needed during growing season. However, grasses dependent on seasonal moisture and whether events, therefore, more, or less cuttings may be necessary to achieve and maintain the 4-inch maximum standard grass height.

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- Homeowners adjacent to grasslands should focus their efforts on HIZ, Zones 1 and 2. It is particularly important to create fire hardened fences around homes and to reduce the chance of flames contacting structures. https://firesafemarin.org/harden-your-home/fire-resistant-fencing.

- Seasonally mow and remove the hay from meadows to reduce standing grass height to a maximum height of 4 inches and reduce residual material to reduce risk of fire spread through light and flashy fuels.

- Maintain ephemeral grassy water ways by removing any debris that would create barriers to runoff flows.

- Consider haying or agricultural grazing to manage open space grasslands.

5.2.2 Prescription for Oak Shrublands/Shrublands MU2

This MU 2 consists of conifer and hardwood shrubs mixes which are forested in their entirety. The MU forms an excellent cover type for wildlife on the Northern slopes of the Range property and provides hiding cover wildlife and calving habitat for elk and deer. Scattered rock outcrops and isolated steep slopes are present in the MU. Gambel oak fuel hazard measures refer to the continuity, both horizontal (across the ground) and vertical (from the ground up into the vegetation crown). Fuels with a high degree of vertical and horizontal continuity are the most hazardous, particularly when they occur on slopes. Heavier fuels (brush and trees) are more hazardous, producing more intense fires than light fuels (grass). Mitigation of wildfire fuel hazards focuses on breaking up the continuity of fuels. Increasing distances between fuels is necessary on slopes. This MU should be managed to create stand structure that reduces the threat of extreme fire behavior. This can be achieved by implementing fuels reduction prescriptions that break up the continuity of the fuels and maintain aesthetic value.

Use a hydro-axe, bush-hog, or similar equipment, to mow the acres occupied by Gambel oak and with Gambel oak understory. The configuration of the treated areas should be an irregular mosaic pattern, not in geometric shapes. Treated areas should not be arranged in a symmetrical pattern. Clumps to take or leave will be designated by description. An example of a decision process is to specify removal of oak in patches of ¼ to ½ acre with 120 to 160 feet between treated areas. In areas where conifers are present, if it can be determined that a particular clump is more likely than another clump to be a “ladder fuel” in the event of wildfire, then that clump should be selected for treatment. Treat or leave an entire clump to maintain clone integrity. Retain clumps with bole diameters of 9 inches or greater. Profuse sprouting can be expected to occur because of the mowing. To deplete the energy stores of the root system and diminish sprouting, mowing should be reapplied every two years over a six-year period in areas where a permanent reduction in oak is desired.

Goal: In developing fuelbreaks, attempt to join timber stands, meadows, and grasslands by creating Gambel oak mosaics that will break up the fuel continuity while protecting the aesthetics values of the landscapes. Any juniper in the oak’s understory will need thinning and cutting to provide wildfire protection for access roads, structures, and facilities.

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Mandatory Requirements:

- Modify fuels along roads and structures.
- Gambel oak brush should be cut back from access road cuts and fills generally 30 to 60 feet crafting mosaic edges that are irregular in shape.
- Recommended minimum spacing recommendations between clumps of shrubs should be 2.5 times their height. Maximum clump diameter should be 2 times its height. For example, 6-foot-high shrubs should have minimum spacing of 15 feet between clumps and the diameter of the clump should not exceed 12 feet from crown to crown.
- Dead standing Gambel oak should be cut and removed from residual oak stands.
- Herbicide all Gambel oak cut stems at ground level immediately after cutting (within 4 minutes).
- Areas treated for defensible space and mitigation must be maintained every year by mowing to prevent re-growth of Gambel oak.
- Consider using herbicide treatments in both year 2 and 3, on cut Gambel oak stumps to prevent re-sprouting.
- Treatments in this area should focus on creating a mosaic-clumping pattern with many spaces between clumps.
- It should be noted that as with all treatment prescriptions, especially if located in wildland urban interface areas, many variables (fuels, topography, building design and construction materials, view sheds, etc.) could influence final marking guidelines.
- Areas for immediate treatment would be in the development areas around any structure, along roads and trails and adjacent to any neighboring values at risk.

Standards for fuel mitigation are detailed in **Appendix 9.2**, **Gambel Oak Management no.6.311,** (**Jester, Rogers, and Dennis 2008**).

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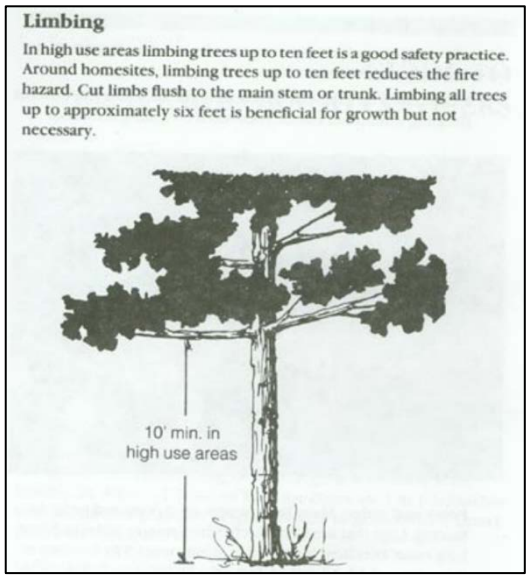
5.2.3 Prescription for Ponderosa Pine MU3

Maintain an uneven-aged, healthy stand of ponderosa pine on any open space areas and within the property to achieve stand diversity objectives and encourage natural reproduction of ponderosa pine.

Goal: Thinning areas are designated in the forested areas and along property boundaries, adjacent to neighboring developed.communities and modify the Fuel Model 5 to Fuel Model 2. A professional forester should implement the following guidelines.

Mandatory Requirements:

- Remove accumulations of dead and down trees, branches, and slash from the forest floor, or reduce by mastication methods.
- Thin and remove ponderosa pine seedlings to eliminate ladder fuels from under over-story trees.
- **Carefully** reduce the estimated ponderosa pine group stocking from an average estimated 100 square feet of basal area basal area to a range of ~ 60 square feet to ~ 80 square feet of basal area basal area by thinning from below.
- Remove slash from the area by hauling away to an approved disposal area.
- Where aspen is present, stimulate reproduction by suckering by clearcutting small patches.
- The recommended management objective is to maintain an open ponderosa pine savanna "park like" setting throughout this stand, removing the smaller diameter individuals retaining the larger diameter trees in the stand.
- As a general guide prune and limb all trees; small younger trees prune trees 3 feet from the ground, leaving 2/3 of tree crowns with good green foliage and large trees prune 10 feet to 16 feet from the ground.



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5.3 Fire-Resistant Landscaping

Future Desired Conditions and Recommendations:

Fire-resistant landscaping is an easy preventative measure to take. It can be achieved by considering the recommended list of plants and grass seed mixes for Colorado. Practices such as clearing dead brush, removing dead branches of trees or shrubs, and mowing grasses can also help protect against the spread of wildfire. Appropriate irrigation schedules are another step to prevent plant from becoming overly dry during the growing season. Deciduous plants are less flammable, generally, than evergreen plants (i.e., conifers or other such shrubs) cover plants. Controlling highly invasive plants such as cheatgrass (*Bromus tectorum*) help reduce not only fire risk but also support native plant growth. Flammable ground covers like much should be replaced with rock or other non-flammable material to prevent fire spreading to homes. Information concerning Firewise landscaping as well can be found in the links in the bibliography at the end of this assessment. See **Appendix 9.2**, Fire-Resistant Landscapes.

5.4 Structural Ignitability

Future Desired Conditions and Recommendations:

Reducing structural ignitability is an essential wildfire mitigation activity that needs to be implemented in the Range Community. Many of these activities should occur at the same time and in the same location as the defensible space treatments outlined in Section 5.8. The ideal time to address home ignition risk is when the structure is in the design phase.

For more information on appropriate roofing materials and other fire-resistant building designs and materials, refer to Appendix 9.2 and the CSFS publication: FireWise Construction: Site Design & Building Materials.

Maintenance activities to remove flammable fuels from on and around structures is a high priority. Cleaning gutters annually, or seasonally, will prevent dead leaves or conifer needles from accumulating and becoming a fire hazard from embers falling in advance of wildfire. Likewise, regularly removing dead leaves and especially conifer needles from roofs will also reduce this risk. Leave, needles, and other dead plant material should be cleaned out from under decks and around the walls of structures. Firewood for use in private residences should be stored away from the structures at least 30 feet in distance.

5.5 Dwelling and Structure Management

Future Desired Conditions and Recommendations:

Guidelines for defensible space are summarized in the CSFS publication Protect Your Home & Property from Wildfire and the Home Ignition Zone.

Homeowners who purchase new property lots for development of homesites will be required to implement defensible space for wildfire mitigation when applying for building permits in Douglas County. The future community can also decide if they wish to become a FireWise Community USA: http://www.firewise.org.

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Defensible space and FireWise landscaping around private residences are the primary fuels management practices that need to be implemented within the Range development. Defensible space is the natural and landscaped area around a home or other structure that has been modified to reduce fire hazard. This is a critical step for preventing a total loss of property and/or life as well as reducing the spread of flames from one structure to another. Defensible space is the creation of an area in which firefighters could safely defend and protect structures. Defensible space involves the evaluation and treatment of the existing vegetation around the structure and reducing the flammability of the vegetation that can allow wildfire to reach or impact the structure. Defensible space breaks up the fuel continuity and reduces the overall wildfire hazard in the development.

Defensible space reduces vegetation connectivity in both vertical and horizontal directions. Removing vertical connectivity helps prevent a wildfire from “climbing” the “ladder” fuels from the ground to the tops of shrubs and trees. Fire behavior becomes enhanced as entire shrubs and trees are on fire and becomes difficult for firefighters to defend. Removing horizontal connectivity helps slow or prevent the spread of wildfire across the landscape and through fuels towards the structure.

Changing the flammability of vegetation is typically done by replacing existing plants or ground cover with less hazardous species. This is known as Firewise landscaping and can be easily accomplished by utilizing the recommended list of plants and grass seed mixes for Colorado. Current information concerning Firewise plant materials and Fire-Resistant Landscaping can be found in the information within **Appendix 9.2.**

One important aspect of Fire- Resistant Landscaping is the selection of landscaping groundcover. Alternative types of ground cover, such as decorative rock, can be substituted around plans, in lieu of traditional bark mulch. In all cases, decorative rock should be used as a border around the walls, decks or other exposures of the structure that may be affected by fire spreading along the ground or by cinders falling in advance of a wildfire.

Dr. Jack Cohen, Fire Science Researcher with the U.S. Forest Service, explains current research about how homes ignite during wildfires, and the actions that homeowners can take to help their home survive the impacts of flames and embers.

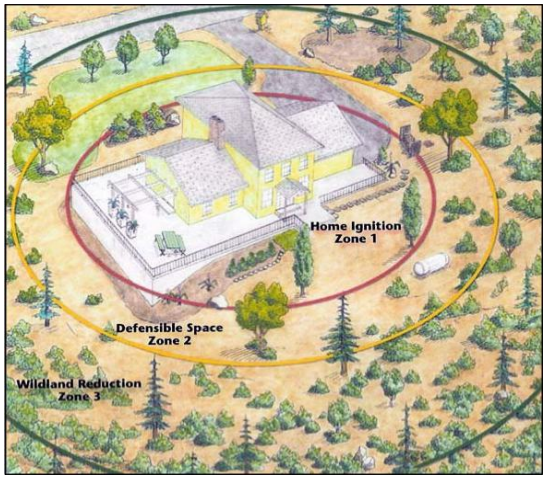
This Cohen video was produced by the National Fire Prevention Association How Your Home Can Survive A Wildfire. The homeowners have the ultimate responsibility to take action to lessen the ignitability of the home ignition zone. Their actions dramatically increase the survivability of the home (Cohen 2000).

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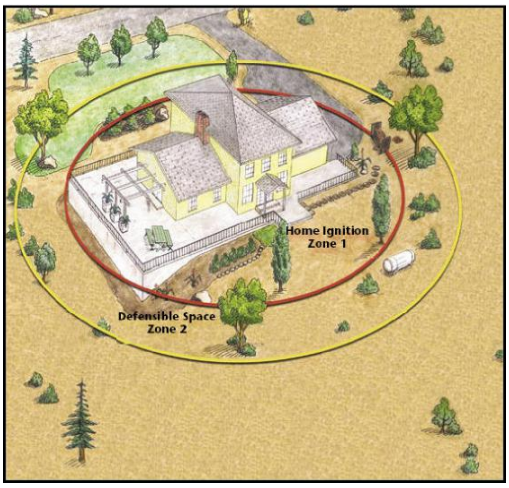
5.6 Defensible Space

Future Desired Conditions and Recommendations:

The general illustrations below show how to effectively implement defensible space inside the Home Ignition Zone, with wildfire resistant plants and fire-resistant landscaping **Appendix 9.2** in two types of wildland settings. The first image is of a home site in a grassland and shrubland settings. The second image is home site located in a forested landscape.

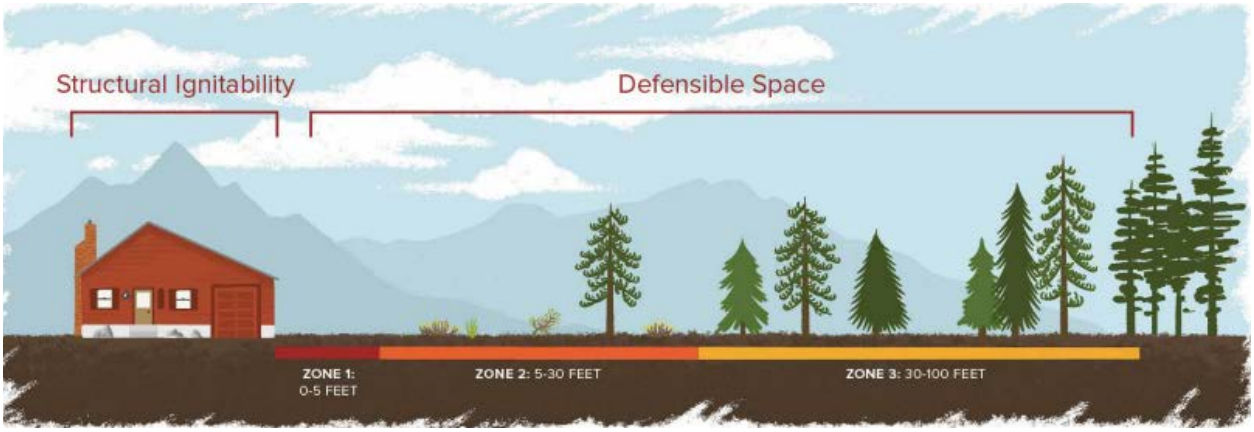


Forested Landscape

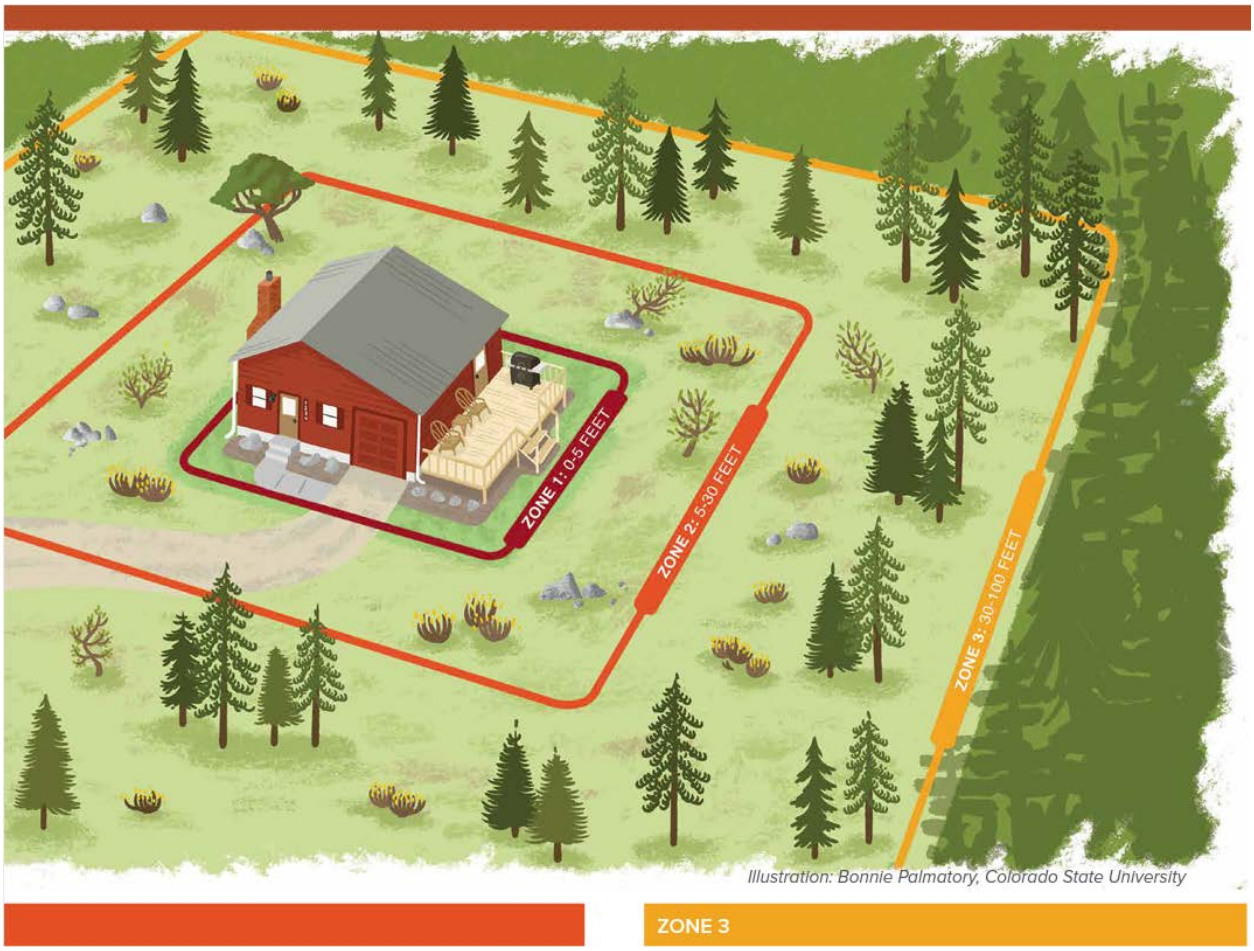


Grassland Shrubland Landscape

Structures can be made more fire resistant by using closed building eaves, installing proper screens for vents, screening or enclosing under decks, using fire resistant material for decks, using double pane tempered glass in sliding doors and multi-pane tempered glass windows, and utilizing Class A fire rated roofing material. Wooden fencing should not be attached to the house.



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Zone 1 (0 to 5 feet from structure): Shrubs and trees should be removed from this area. Non-flammable components such as decorative rock should be installed around the perimeter instead of flammable mulches. Well-spaced and pruned, low-flammability plants or mowed, irrigated grass is acceptable if the structure has noncombustible siding.

In the remainder of Zone 1 trees, lower branches should be pruned 5 to 10 feet above the ground (not to exceed one-third of the tree height). Dead wood, tall grass, and ladder fuels (low limbs, small trees, and shrubs that may carry fire into tree crowns) should be removed from this area. Leaves and overhanging branches should be trimmed back from the roof and gutters. Wood piles should be removed and stored in Zone 2, preferably to the side or upslope from structures.

Zone 2 (typically 5 feet from structure out to 30 feet): The size of this zone is dependent upon slope. Treatment of ground fuels and ladder fuels is generally the same as for Zone 1. Trees (or small groups of trees) and shrubs should be thinned to provide 10 to 20 feet of clearance among crowns. Grasses should be mowed because they dry in late summer.

Zone 3 (Zone 2 to 100 feet or property line): The size of this zone is dependent upon slope. This area should be managed for the appropriate land use objectives, such as forest health, aesthetics, recreation, and wildlife habitat. In Zone 3 the HIZ recommendations are consistent with defensible

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space guidelines zones for Zone 2 with some minor differences in recommended differences between crowns.

5.7 Range Property Fuelbreak

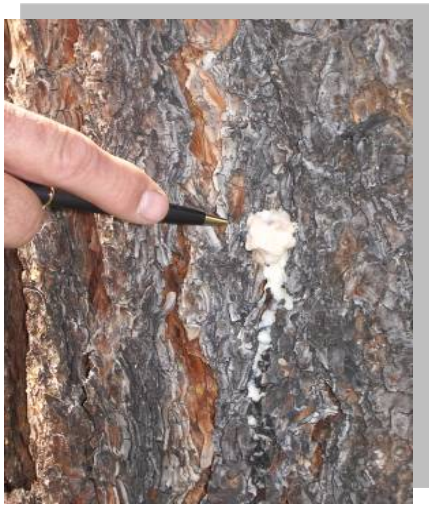
Specific recommendations for mitigation include a fuelbreak along the entire Range property boundary providing protection to homeowners from adjacent land potential wildland fire hazards. Requiring the fuelbreak around the entire Range property was based on several factors including the high hazard wildfire risks southwest and west of the property, (RR, Highway, Developed Land, and weather patterns, etc.). Additionally, the CO-WRA wildfire models for Burn Probability and Fire Ignitions (Heat Map) justify installing and maintaining a solid perimeter fuelbreak around the Range Community.

We recommend removing deciduous and coniferous vegetation and mowing tall grasses to distances if possible ~ 30 feet (HIZ Zone 2) from private property boundaries, into Range Open Space. The fuelbreak could be incorporated as part of an Open Space community trail system for the Range homeowners. Refer to **Appendix 9.1, MU Map** for site-specific fuelbreak location.

In addition, a trail network will be established in the Open Space which can provide both recreational access and another type of fuelbreak with the trail itself acting as a narrow strip of exposed mineral soil. These trails should also be mowed regularly ~ 5 feet on each side of the trail thread (HIZ Zone1), which will improve wildfire mitigation efforts. Require the HOA and Open Space Management Plan to perform seasonal mitigation treatments on all fuelbreak perimeters.

5.8 Insects and Diseases

The **mountain pine beetle** (*Dendroctonus ponderosae*) (MPB) is an insect native to the Rocky Mountain region. MPB kills ponderosa pine, lodgepole pine and occasionally limber pine in Colorado. Populations of MPB in Colorado are currently declining after epidemic outbreaks from 1998 through 2010. The level of infestation on the project area is currently low (endemic). Localized outbreaks are still occurring, so annual monitoring of the ponderosa pine should continue. We did not observe any MPB activity on ponderosa pine during our surveys.



MPB attack on ponderosa pine

Another insect of concern is the **ips beetle** (*Ips pini*). We observed no signs of ips beetle activity during our survey. Ips infested trees typically have dead tops and live foliage in the lower part of the crowns but can kill whole trees in a single year. Ips usually attack green slash on the ground. Local population build-ups can cause them to be primary pests. Maintaining stands in a healthy condition through density control and prompt removal of wind and snow-breakage and thinning slash can nearly eliminate losses to Ips. Due to the high level of Ips activity throughout the region, it is important to monitor them annually.

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Dwarf mistletoes (*Arceuthobium spp.*) are also a common problem in Colorado forests. They are small, leafless, parasitic flowering plants that grow into the phloem of trees that kill by slowly robbing the tree of food and water. Diseased trees decline and die from the top down as lower infected branches take more food and water. Death occurs slowly in most cases and depends on the severity of infection and on the vigor and size of the tree**.** We observed no dwarf mistletoe on ponderosa pine during field surveys.



Dwarf mistletoe attack on ponderosa pine.

5.9 Slash and Woody Debris Management

Treating project slash during development is especially important to reduce risk of wildfire in the community. Untreated slash and woody debris can be extremely hazardous as fuels for wildfire if left untreated. Therefore, it is recommended that the following treatments be used to treat activity fuels (slash) against potential wildfire and insect and disease infections. Listed below are the basic methods that should be used:

- **Chipping/Mastication** - using a chipper or masticating head to mulch slash material on site. Chips may be spread throughout a designated area and should not exceed four inches in depth. Chip piles should be utilized on the property or arranged for off-site hauling.
- **Pile and Burn** - creating burn piles that will be burned under proper conditions with guidance from the local fire authority.
- **Removal** - removing slash material completely from the property by way of hauling to a designated slash collection site.

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6.0 REQUIREMENTS

6.1 Development Requirements

These **Requirements** are to be firmly incorporated in the Douglas County Development Site Plan for issuing the permit to develop this subdivision and covenants. A wildfire is a fire, regardless of ignition source, which is unplanned, has escaped, or is not authorized. Because Range property is located within the Wildland Urban Interface, refer to CO-WRA, it is imperative that potential homeowners recognize the risks and responsibilities associated with living in a fire prone environment. The risk of wildfire will continue to exist if there is natural vegetation. Therefore, it is important to manage risk by following required practices and actions proven to reduce fire occurrence, fire risk, fire hazard, and slow the spread of fire near residences.

The following requirements should be incorporated into the requirements for the Range Development Plan and HOA Covenants.

- **Mandatory requirements** are implementing all treatment prescriptions in **Section 5.0** in MU1 Grassland, MU2 Shrublands, MU3 Ponderosa pine areas and **Section 6.2**
- Establish the Range property perimeter fuelbreak early in 2025 to prevent potential wildfires.
- Maintain and mitigate all perimeter fuelbreaks throughout the year according to **Section 5.7**.
- Monitor and treat insect and disease infestations.
- Require a grass mowed strip to no less than 4 inches in height along the roads, and where native grasses abut residential structures as needed during growing season, minimum 2 time per year.
- Implement the standards listed in the Colorado State University Cooperative Extension resource publication: *Low Flammability Landscape Plants, no 6.305* (**Carter et al 2023**) (replaces **Dennis 2006** *no 6.305* and **Dennis 2004** *no 6.303*)
- Follow the standards listed in the Colorado State University publication: *Seed Mixes to Reduce Wildfire Hazards*. *no 6.306* (**Dennis 2006**).
- Implement defensible space for new structures using FireWise Construction: Site Design and Building Materials listed in the Colorado State University resource publication: *FireWise Construction,* (**Bueche and Foley 2012**).
- Implement Colorado's Best Management Practices included in **Appendix 9.4**.
- The HOA or Metro District will be responsible for mitigation management in the Open Space areas.
- Provide Wildfire Awareness Checklists for new homeowners (**Appendix 9.5**).

Range landowners should be encouraged to work in cooperation with the neighboring residents in implementing this plan.

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6.2 Implementation Schedule

Wildfire Mitigation Activities	Reference Plan Section(s)	Start Date	Completed Date
Implement the Prescriptions and Requirements prior to construction	Section 5.0	2025	Prior to construction development
Implement Wildfire Hazard Mitigation Plan and Scope of Work in mandatory treatment prescriptions in Section 5.0 for OS and HOA Covenants	Section 5.0	2025	Prior to Douglas County permitting process
Create a Fire Adapted Community	Section 6.0	2025	Prior to and during construction development
Implement all Wildfire Mitigation Requirements for HOA and OS	Section 5.0	2025	During construction development
Incorporate standards for FireWise construction and landscape	Section 5.0	2025	During construction development
Implement defensible space around structures and roadways using HIZ.	Section 5.6	2025	During construction development
Treat all activity slash.	Section 5.9	2025	During construction development
Implement Fire Hardening building materials and landscaping into HOA covenants.	Section 5.4	2025	During construction development
Develop an egress plan north and east to adjacent properties for emergency evacuation.	Section 4.1	2025	During construction development
Implement protection on riparian areas listed in the BMP's.	Section 9.4	2025	During construction development
HOA, Metro District install and manage all fuelbreaks along property boundary	Section 5.7	2025-and-future years	Before, during and after construction development
Provide Wildfire Awareness Handouts to new homeowners	Appendix 9.5	2025	After construction development
Develop an OS Agreement with Range LLC, County, Metro District, and HOA on wildfire strategies to protect the community as Part of PD Requirements.	Chapter 2.0	2025	Prior to construction development

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7.0 GLOSSARY

basal area: the cross-sectional area of a single stem, including the bark, measured at breast height (4.5 feet)

blowdown: trees or trees felled or broken off by wind.

chipper: a mobile machine consisting of infeed conveyor, debarker (sometimes), and chipper, with chips being blown into a chip truck or a pile.

coppice: the production of new stems from the stump or roots; to cut the main stem at the base or to injure the roots to simulate the production of new shoots for regeneration.

defensible space: an area around a structure where fuels and vegetation are treated, cleared, or reduced to slow the spread of wildfire towards the structure.

density-dependent mortality: trees which die as a result of other (usually larger) trees being able to outcompete them for light, water, and nutrients.

diameter at breast height (dbh): the diameter of a stem of a tree at 4 ½ feet above the ground

even-aged stand: a stand of trees composed of a single age class.

fuel loading: the oven-dry weight of fuel per unit area.

improvement cutting: the removal of less desirable trees of any species in a stand of poles or larger trees, primarily to improve composition and quality.

ladder fuels: vegetative materials with vertical continuity that allows fire to burn from the ground level up to the branches and crowns of trees (Dennis 1999)

litter: the surface layer of a forest floor that is not in an advanced stage of decomposition, usually consisting of freshly fallen leaves, needles, twigs, stems, bark, and fruits.

lop-and-scatter: a hand method of removing the upward-extending branches from the top of felled trees to keep **slash** low to the ground, increase rate of decomposition, lower the fire hazard, or as a pre-treatment prior to burning.

noxious weed: a plant specified by law as being especially undesirable, troublesome, and difficult to control.

patch: a small part of a stand or forest

pure stand: a stand composed principally of one species, conventionally at least 80 percent based on numbers, basal areas, or volumes.

quadratic mean diameter: the diameter corresponding to a stand's mean basal area per acre divided by the mean number of trees per acre.

riparian area: related to, living, or located in conjunction with a wetland, on the bank of a river or stream but also at the edge of a lake or tidewater.

scarification: mechanical removal of competing vegetation or interfering debris, or disturbance of the surface, to enhance reforestation.

serotinous: pertaining to fruit or cones that remain on a tree without opening for one or more years.

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shrub: a woody, perennial plant, differing from cranial heard in its persistence and woody stem less definitely from a tree in its lower stature and the general absence of a well-defined main stem. i.e., a **brush tree**

skid road: a road on which logs are hauled.

slash: the residue, e.g., tree tops and branches, left on the ground after logging or accumulating as a result of storm, fire, **girdling**, or delimbing.

snag: a standing, generally unmerchantable dead tree from which the leaves and most of the branches have fallen.

stand: a contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.

sucker: a shoot arising from below the ground either from a rhizome or from a root.

thinning: a cultural treatment made to reduce stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality.

uneven-aged stand: a stand with trees in three or more distinct age classes, either intimately mixed or in small groups

windbreak: a strip of trees or shrubs maintained mainly to alter windflow and microclimates in the sheltered zone, usually farm buildings.

windfirm: trees are able to withstand strong winds and resist windthrow.

(Source: Helms, J. A., 1998)

The USDA Forest Service and National Park Service Fire Terminology

Abiotic factors: The non-living components of the environment, such as air, rocks, soil, water, peat, and plant litter.

Acre: an area of land containing 43,560 square feet. A square acre would be about 209 feet by 209 feet. A circular acre would have a radius of 117.75 feet.

Afforestation: The establishment of trees on an area that has lacked forest cover for a very long time or has never been forested.

Aerial fuels: Standing and supported live and dead combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, cones, bark, and vines: typically used in reference to the crowns of trees.

Basal area: the cross-sectional area of a single stem, including the bark, measured at breast height (4.5 feet).

Blowdown: trees or trees felled or broken off by wind.

Cambium: A single layer of cells between the woody part of the tree and the bark. Division of these cells result in diameter growth of the tree through formation of wood cells (xylem) and inner bark (phloem).

Canopy: The forest cover of branches and foliage formed by tree crowns.

Chain: A measuring tape, often nylon, 50 meters or 75 meters in length, used to measure distances. This term is derived from an old unit of measurement (80 Chains = 1 mile).

Chimney: A topographical feature such as a narrow drainage on a hillside or the upper end of a box canyon that could channel wind, smoke or flames up the slope; acting as a fireplace chimney would draw smoke and heat upward.

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Class A roof: Effective against severe fire test exposures, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a fairly high degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Class B roof: Effective against moderate fire test exposures, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a moderate degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Class C roof: Effective against light fire test exposure, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a measurable degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Clearcut: The cutting of essentially all trees, producing fully exposed microclimate for the development of a new age class. An area of forest land from which all merchantable trees have recently been harvested.

Climax forest: A forest community that represents the final stage of natural forest succession for its locality, i.e., for its environment.

Coarse Woody Debris (CWD): Sound and rotting logs and stumps that provide habitat for plants, animals, and insects, and a source of nutrients for soil development.

Colorado Champion Tree: The largest known tree of its species in the state. Trees are ranked by a point system based on three measurements: trunk circumference in inches at 4.5 feet above the ground, tree height in feet, and the average crown spread in feet.

Commercial thinning: A silviculture treatment that "thins" out an overstocked stand by removing trees that are large enough to be sold as poles or fence posts. It is conducted to improve the health and growth rate of the remaining crop trees.

Competing vegetation: Vegetation that seeks and uses the limited common resources (space, light, water, and nutrients) of a forest site needed by preferred trees for survival and growth.

Conifer: Cone-bearing trees having needles or scale-like leaves, usually evergreen, and producing wood known commercially as "softwoods."

Conservation: Management of the human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. It includes preservation, maintenance, sustainable utilization, restoration, and enhancement of the environment.

Crown fire / Crowning: A form of extreme wildland fire behavior consisting of fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.

Dead fuels: Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity segmentation), dry-bulb temperature, and solar radiation.

Deciduous: Perennial plants that are normally leafless for some time during the year.

Defensible space: An area around a structure where fuels and vegetation are treated, cleared, or reduced to slow the spread of wildfire towards the structure. An area within the perimeter of a parcel, development, neighborhood, or community where basic wildland fire protection practices and measures are implemented, providing the key point of defense from an approaching wildfire or defense against encroaching wildfires or escaping structure fires. The perimeter used herein is the area encompassing the parcels proposed for construction and/or development, excluding

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the physical structure itself. The area is characterized by the establishment and maintenance of emergency vehicle access, emergency water reserves, street names and building identification, and fuel modification measures. In simplest terms, it is adequate space between structures and flammable vegetation which allows firefighters a safe working area from which they can attack an oncoming wildfire. Defensible Space is the best element of fire protection for individual property owners.

Defoliator: An agent that damages trees by destroying leaves or needles.

Dripline: The outer most leaves on a tree define its dripline and the ground within the dripline is known as the drip zone; also defined as the area defined by the outermost circumference of a tree canopy.

Deforestation: The removal of a forest stand where the land is put to non-forest use.

Direct attack: A method of fire suppression where actions are taken directly along the fire's edge. In direct attack, burning fuel is treated directly, such as by wetting, smothering, or chemically quenching the fire or by physically separating burning from unburned fuel.

Eave opening: A vent located in an eave or soffit which allows airflow into the attic and/or walls of a structure.

Ecosystem: A functional unit consisting of all the living organisms (plants, animals, microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size a log, pond, field, forest, or the earth's biosphere but it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation; for example, forest ecosystem, old-growth ecosystem, or range ecosystem.

Engineering: Engineering is a fire mitigation strategy used to remove or reduce ignition sources from what can ignite or readily burn.

Escape route: A preplanned and understood route firefighters take to retreat from an unsafe or fire-threatened area and move to a safety zone or other low-risk area**.**

Extreme fire behavior: A level of fire behavior that ordinarily precludes firefighting methods involving direct attack on the fire. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

Felling: The cutting down of trees.

Firebrands: Flaming or glowing fuels lofted into the air during intense burning by strong upward convection currents. Also referred to as airborne embers.

Fire behavior: The way a fire reacts to the influences of fuel, weather, and topography.

Fire break: A natural or constructed fuel-free barrier used to stop or check fires that may occur, or to provide a control line from which to work.

Fire danger: The broad-scale condition of the rules as influenced by environmental factors.

Fire front / Flame front: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified, the fire front is assumed to be the leading edge of the fire perimeter.

Fire Dependent: Requiring one or more fires of varying frequency, timing, severity, and size to achieve optimal conditions for population survival or growth.

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Fire hazard: The presence of ignitable fuel coupled with the influence of terrain and weather.

Fire intensity: A general term relating to the heat released by fire.

Fire hazard mitigation: Various methods by which existing fire hazards can be reduced in a certain area, such as fuel breaks, non-combustible roofing, spark arresters, etc.

Fire management: The activities concerned with the protection of people, property, and forest areas from wildfire and the use of prescribed burning for the attainment of forest management and other land use objectives, all conducted in a manner that considers environmental, social, and economic criteria.

Fire suppression: All activities concerned with controlling and extinguishing a fire following its detection.

Firewise: A National Fire Protection Association's (NFPA) program encouraging local solutions for wildfire safety by involving homeowners, community leaders, planners, developers, firefighters, and others in the effort to protect people and property from wildfire risks.

Flame Height: The average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.

Flame Length: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.

Flaming Front: The zone of a moving fire where the combustion is primarily flaming. Behind this flaming zone combustion is primarily glowing. Light fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front. Also called fire front.

Forest fire: Any wildfire or prescribed burn that is burning in forest, grass, alpine, or tundra vegetation types.

Forest type: A group of forested areas or stands of similar composition (species, age, height, and stocking) which differentiates it from other such groups.

Fuel: Any living or dead material that will burn.

Fuelbreak: An existing barrier or change in fuel type (to one that is less flammable than that surrounding it) or a wide strip of land on which the native vegetation has been modified or cleared, that acts as a buffer to fire spread so that fires burning into them can be more readily controlled. Often selected or constructed to protect a high value area from fire.

Fuel management: The act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire in support of land management objectives.

Fuel reduction zone: An area similar to a fuel break but not necessarily linear, in which fuels have been reduced or modified to reduce the likelihood of ignition and/or to reduce fire intensity thereby lessening potential damage and resistance to control.

Germination: The development of a seedling from a seed.

Improvement cutting: the removal of less desirable trees of any species in a stand of poles or larger trees, primarily to improve composition and quality.

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Home Ignition Zone (HIZ): An area including the home and its immediate surroundings within which burning fuels could potentially ignite the structure; usually considered to be an area extending out roughly 100 feet from the home. The HIZ is often used to describe the area in which fuel modification measures should be taken to protect the home.

Ladder fuels: Fuels that provide vertical continuity between the surface fuels and crown fuels in a forest stand, thus contributing to crown fires. Vegetative materials with vertical continuity that allows fire to burn from the ground level up to the branches and crowns of trees (Dennis 1999).

Lines of effort: Tasks sets or sets of actions that are linked or coordinated with other task sets to accomplish a larger mission or reach a desired end state. Lines of effort allow leaders and decision makers to direct a variety of separate actions toward a unified result.

Litter: the surface layer of a forest floor that is not in an advanced stage of decomposition, usually consisting of freshly fallen leaves, needles, twigs, stems, bark, and fruits.

Maximum density: The maximum allowable stand density above which stands must be spaced to a target density of well-spaced, acceptable stems to achieve free-growing status.

Mid flame wind speed (MFWS): is defined as the velocity winds, in miles per hour taken at the mid-height of the flame length.

National Fire Protection Association (NFPA): A private, non-profit organization dedicated to reducing fire hazards and improving fire service.

Noxious weed: a plant specified by law as being especially undesirable, troublesome, and difficult to control.

Patch: a small part of a stand or forest.

Phloem: A layer of tree tissue just inside the bark that conducts food from the leaves to the stem and roots.

Pitch tubes: A tubular mass of resin that forms on bark surface at bark-beetle entrance holes.

Prescribed burning: Controlled application of fire to wildland fuels, in either their natural or modified state, under certain conditions of weather, fuel moisture, soil moisture, etc. as to allow the fire to be confined to a predetermined area and at the same time to produce results to meet planned land management objective.

Ready, Set, Go! (RSG): A program, managed by the International Association of Fire Chiefs (IAFC), seeking to develop and improve the dialogue between fire departments and residents. The program helps fire departments teach individuals who live in high-risk wildfire areas how to best prepare themselves and their properties against fire threats.

Regeneration: The act of renewing tree cover by establishing young trees, naturally or artificially note regeneration usually maintains the same forest type and is done promptly after the previous stand or forest was removed.

Riparian area: related to, living, or located in conjunction with a wetland, on the bank of a river or stream but also at the edge of a lake or tidewater.

Saddle: A depression, dip or pass in a ridgeline; significant in wildland firefighting because winds may be funneled through a saddle, causing an increase in wind speed.

Safety zone: An area essentially cleared of flammable materials, used by firefighters to escape unsafe or threatening fire conditions. Safety zones are greatly enlarged areas in which firefighters can distance themselves from threatening fire behavior without having to take extraordinary measure to shield themselves from fire/heat.

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Sapwood: The light-colored wood that appears on the outer portion of a cross-section of a tree.

Serotinous: Pertaining to fruit or cones that remain on a tree without opening for one or more years, note in some species cones open and seeds are shed when heat is provided by fires or hot and dry conditions.

Shaded fuelbreak: A fuelbreak built in a timbered area where the trees within the break are thinned and limbed up to reduce crown fire potential, yet retain enough crown canopy to provide shade, thereby making a less favorable microclimate for surface fires.

Silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

Snag: A standing dead tree or part of a dead tree from which at least the smaller branches have fallen.

Stand: A continuous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.

Spot Fire / Spotting: Fires ignited beyond control lines or outside the perimeter of a fire by firebrands landing on/among flammable material. Spot fires/spotting are a form of extreme fire behavior typically resulting from high wind conditions.

Structure protection: A defensive strategy in wildland firefighting in which firefighters are assigned to evaluate, prepare and, when possible, defend structures/homes that may be threatened by a wildfire.

Structure triage: Evaluating and sorting structures/homes into categories based on their relative likelihood of surviving a wildland fire threat (*defensibility*). Triage decisions are based multiple factors and conditions occurring during an actual fire - weather, fire behavior, home ignition potential, defensible space, presence of escape routes, and availability of firefighting resources, among others - with the goal of doing the best with the resources available.

Succession (or ecological succession): The replacement of one plant and/or animal species over time by another in progressive development toward climax vegetation.

Surface fuels: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low-lying live vegetation.

Survivable space: A term typically used to describe the area around a structure/home indicating that fuels in the area have been reduced to the point that there is little or no serious fire threat to the structure; the structure has a high probability of surviving a wildland fire without anyone on scene providing active protection.

Thinning: A cutting made in an immature crop or stand primarily to accelerate diameter increment, but also, by suitable selection, to improve the average form of the tree that remain.

Topography: Also referred to as “terrain.” The physical parameters of the “lay of the land” that influence fire behavior and spread. Key elements are slope (in percent), aspect (the direction a slope faces), elevation, and specific terrain features such as canyons, saddles, “chimneys,” and chutes.

Torching: The burning of the foliage of a single tree or a small group of trees, from the bottom up. Sometimes, also called candling. Torching is an extreme form of fire behavior, similar to but less extreme than crowning in that crowning affects larger numbers, even entire stands of trees.

USDA - FS: United States Department of Agriculture - Forest Service, what is commonly known as just “The Forest Service.”

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Windbreak: A strip of trees or shrubs maintained mainly to alter wind flow and microclimates in the sheltered zone, usually farm buildings.

Windfirm: trees are able to withstand strong winds and resist windthrow.

Wildland-Urban Interface or Wildland-Urban Intermix (WUI): The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Although ***Interface*** is the more general, more commonly used term; it technically refers specifically to the area where development and wildlands meet. ***Intermix*** indicates the presence of wildland vegetation/fuels intermingled throughout the developed area.

[Source : www.fs.fed.us/nwacfire/home/terminology.html]

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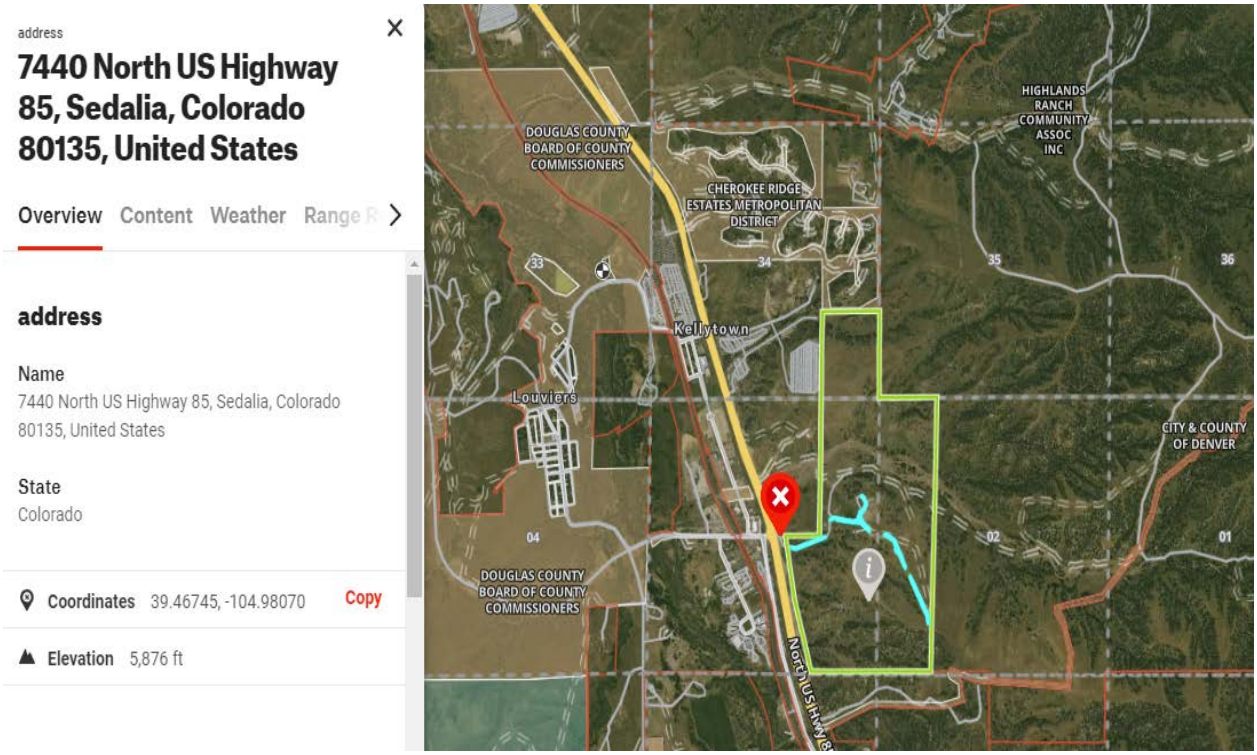
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9.0 APPENDICES

9.1 Maps

Location Map



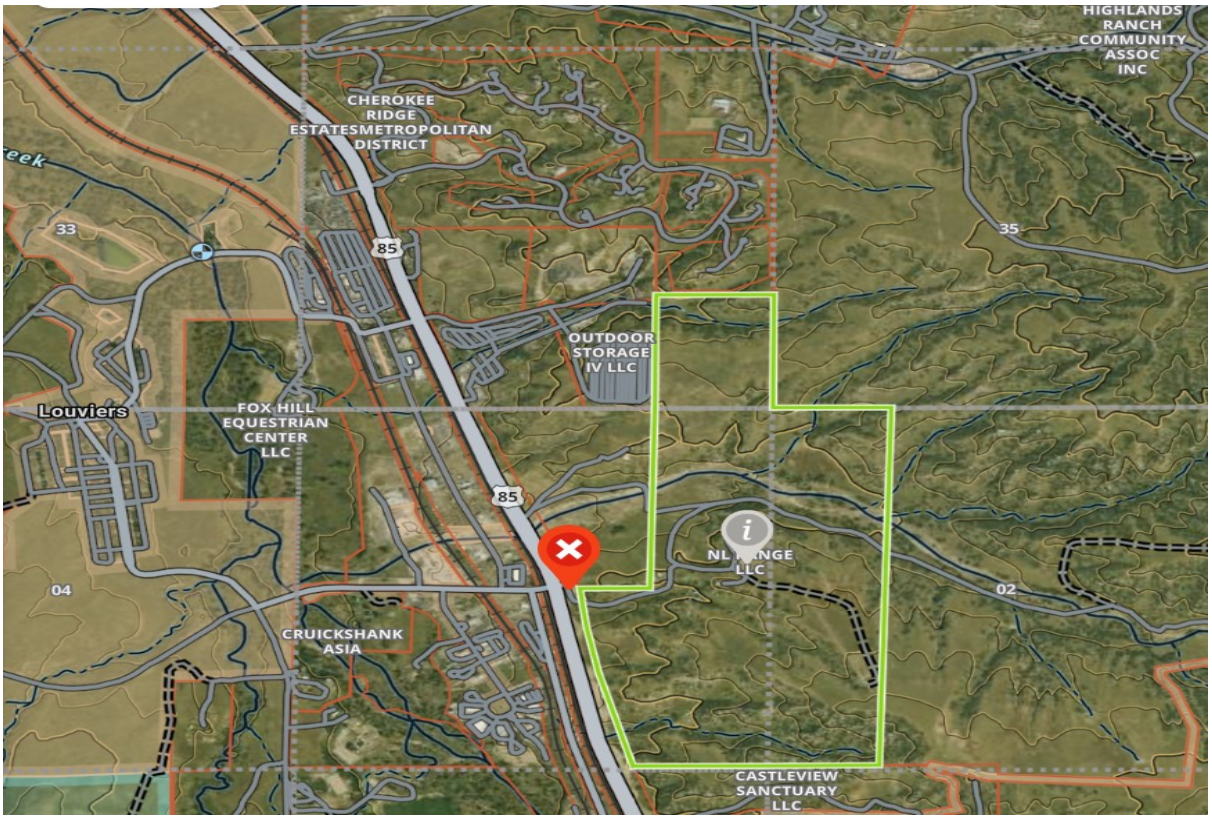
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Parcel Map



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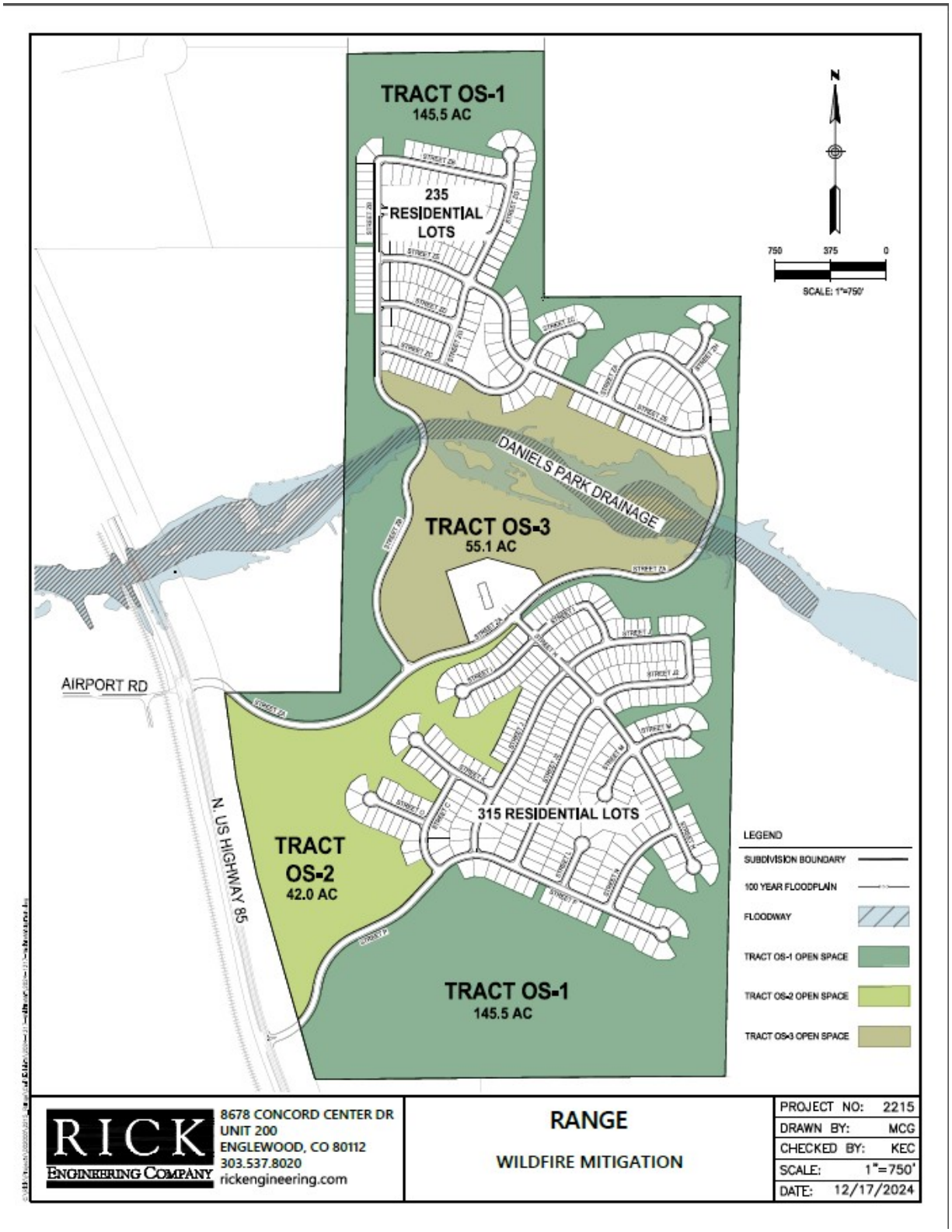
Adjacent Landowner Map





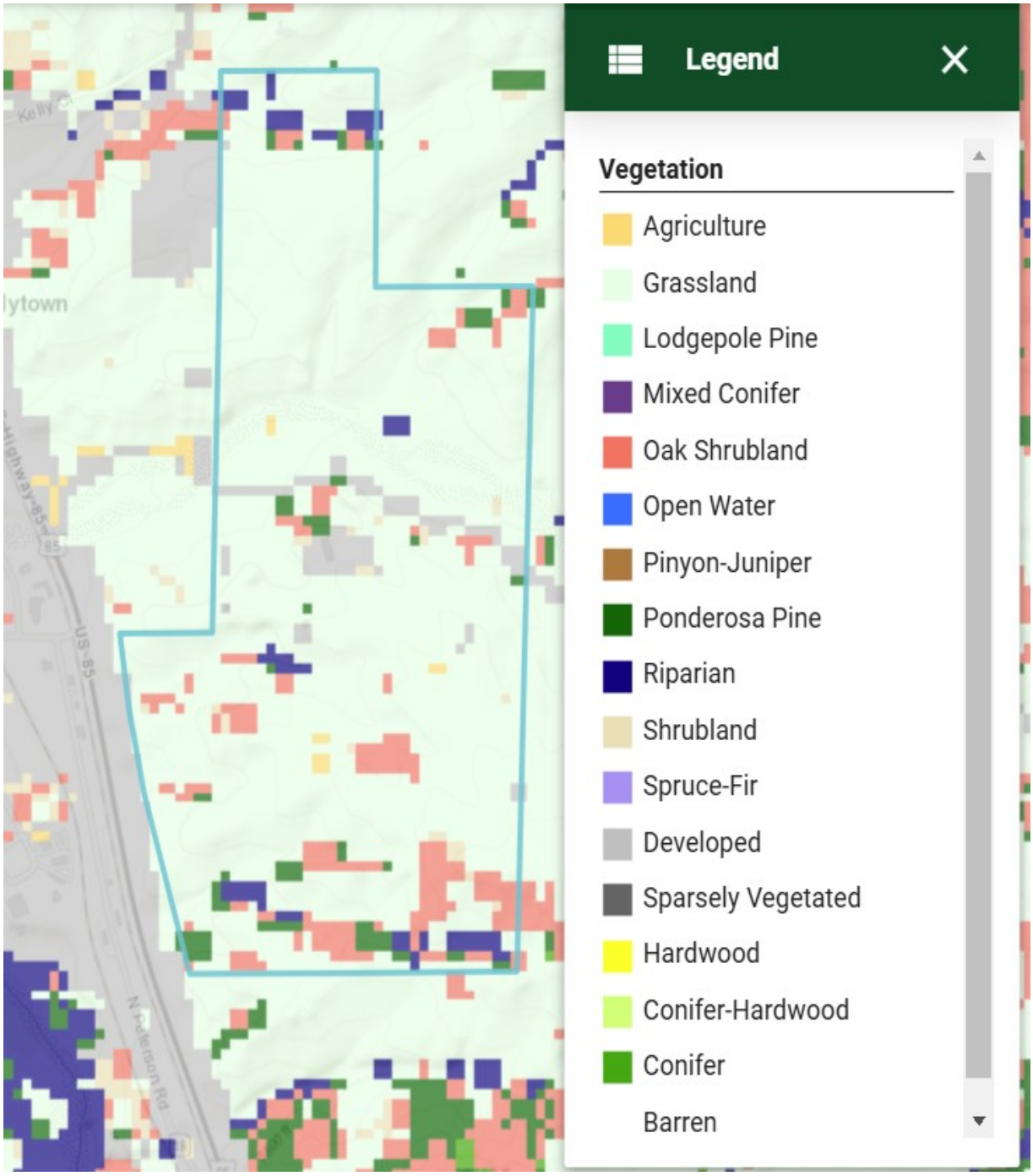
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Planned Development Map



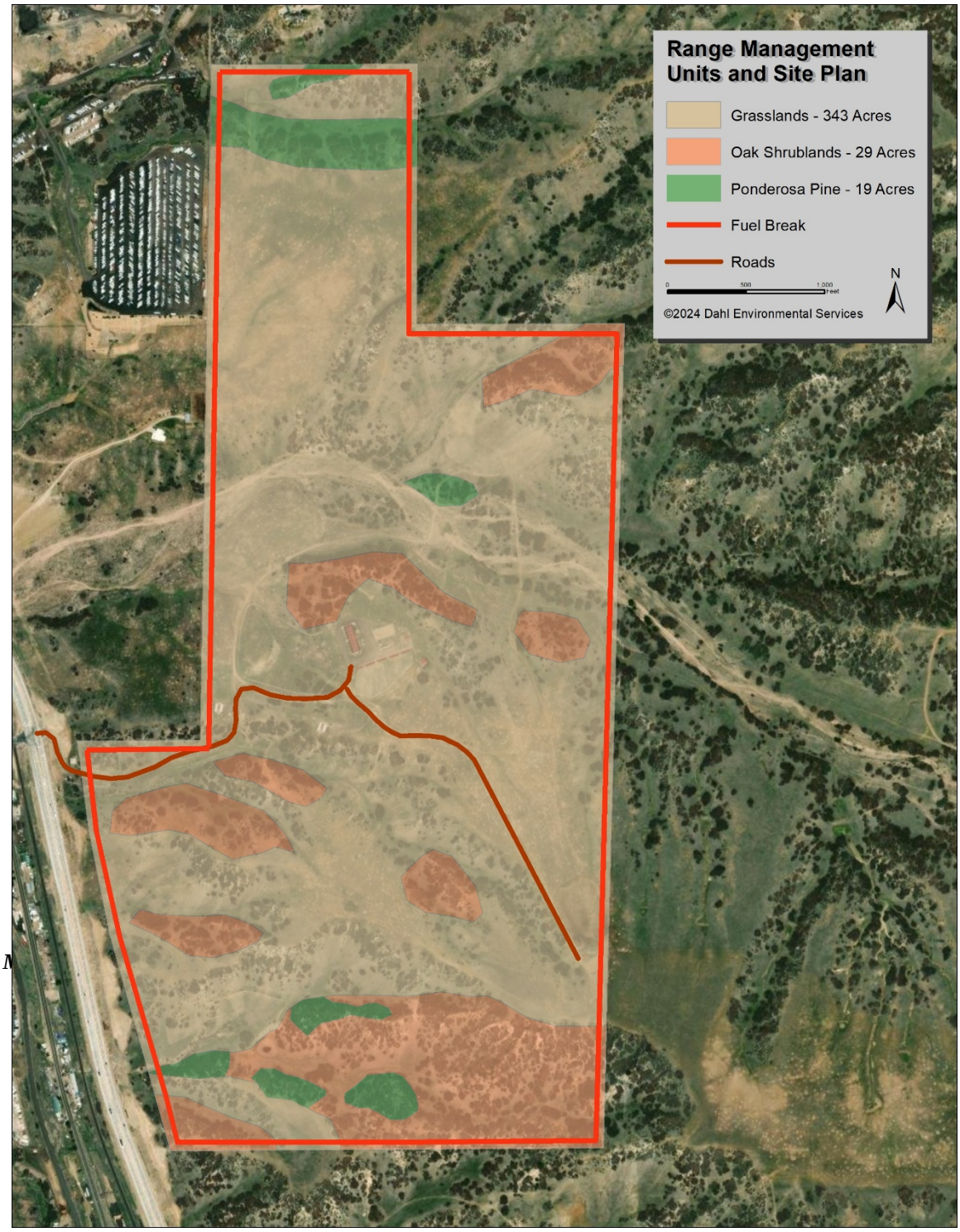
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Stand Map



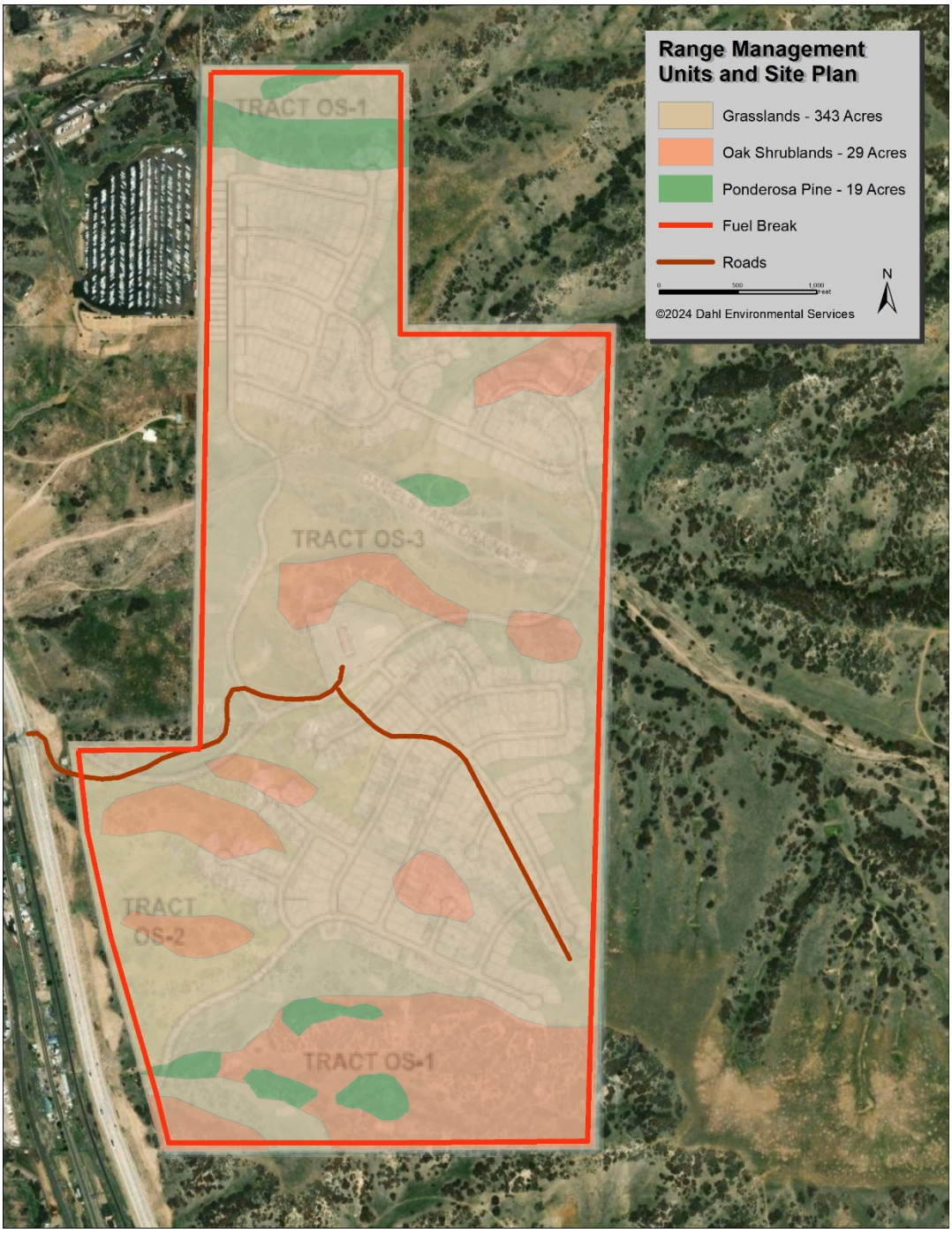
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Management Unit Map



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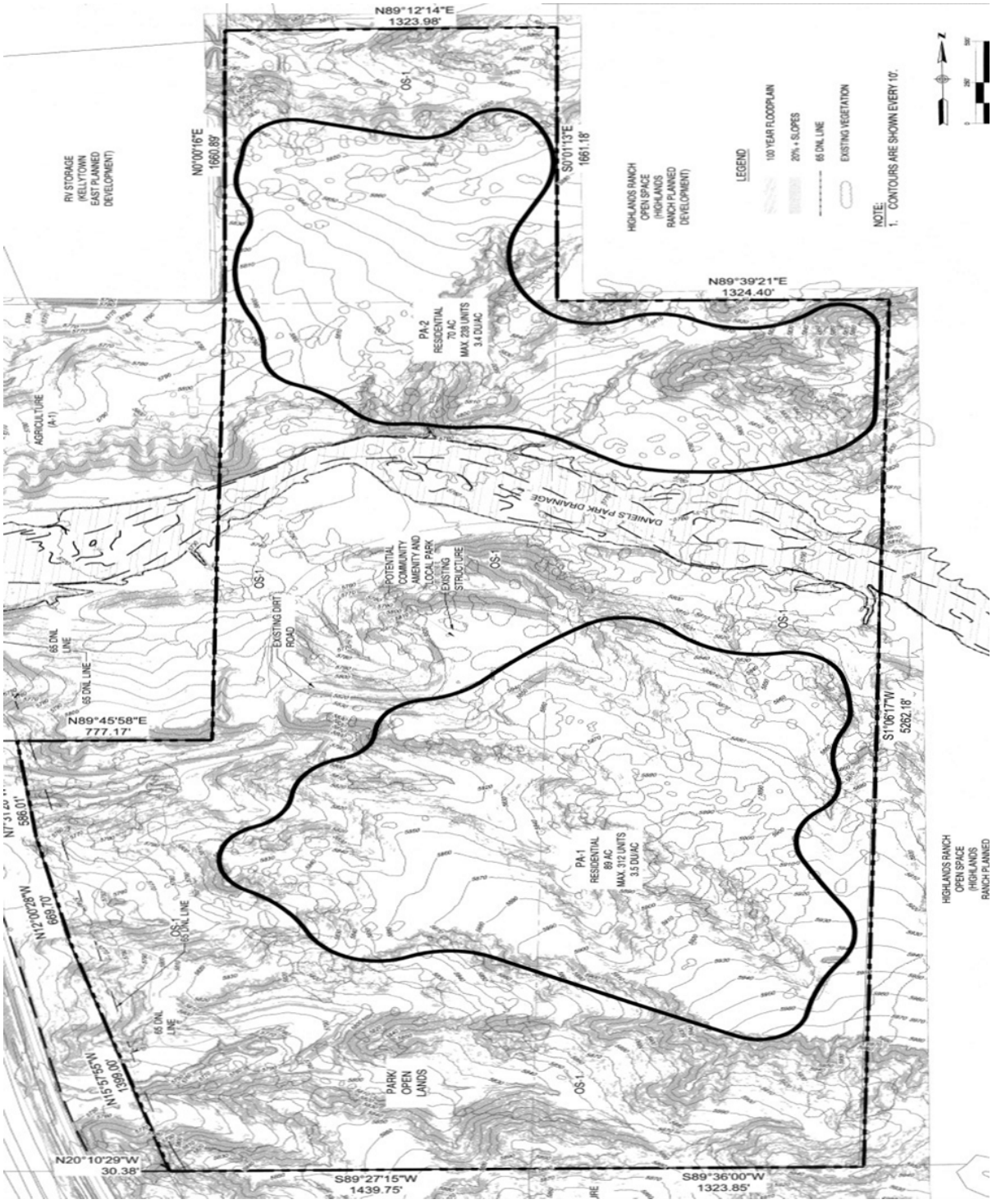
Management Unit Map with Housing



Management Units overlayed on-Site Development Plan Map is a graphic representation of existing vegetation.

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Topographic Map



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9.2 Wildfire Management

- **Home Ignition Zone**

2021/04/2021_CSFS_HIZGuide

- **Fuelbreaks Guideline for Subdivisions**

  Fuelbreak Guidelines for Forested Subdivisions & Communities

- **Defensible Space Fire 2012 Quick Guide**

FIRE 2012 D-Space QuickGuide

- **FireWise Construction**

FireWise Construction: Site Design & Building Materials

- **Protect Your Home and Property from Wildfire**

https://csfs.colostate.edu/wildfire-mitigation/protect-your-home-property-from-wildfire/

- **Low-Flammability Plant Index**

- **Fire Resistant Landscapes:**

  https://static.colostate.edu/client-files/csfs/pdfs/06303.pdf

- **Grass Seed Mixes to Reduce Wildfire Hazard**

  http://static.colostate.edu/client-files/csfs/pdfs/06306.pdf

- **Fire Adapted Communities**

https://fireadapted.org/.

- **CO-WRA Assessment Report is available at: The Range Property Risk Assessment.**

  Range CO-WRA REPORT

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9.3 Insect and Disease Management

Listed below are documents available on the Internet to assist in learning more about a specific forestry topic:

- **Mountain Pine Beetle**
  http://csfs.colostate.edu/forest-management/common-forest-insects-diseases/mountain-pine-beetle/
  http://static.colostate.edu/client-files/csfs/pdfs/pinebeetlemgmt.pdf
  files/csfs/documents/Solar_Treatment_for_Mountain_Pine_Beetle_April_2009.pdf
  http://static.colostate.edu/client-files/csfs/pdfs/MPB_Newspaper_Insert_Final.pdf

- **Ips Beetle**
  Ips Beetle
  http://static.colostate.edu/client-files/csfs/documents/IpsBeetleUpdate_final_000.pdf
  http://static.colostate.edu/client-files/csfs/pdfs/ipsbeetle.pdf

- **Douglas-fir Beetle**
  http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5299322.pdf

- **Dwarf Mistletoe in Pines**
  http://static.colostate.edu/client-files/csfs/pdfs/csfs-poster-dmt.pdf
  http://csfs.colostate.edu/forest-management/common-forest-insects-diseases/dwarf-mistletoe/

- **Aphids Colorado blue spruce**
  Cooley Spruce Gall

- **Aspen diseases**
  Aspen Insects & Diseases

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9.4 Management Practices

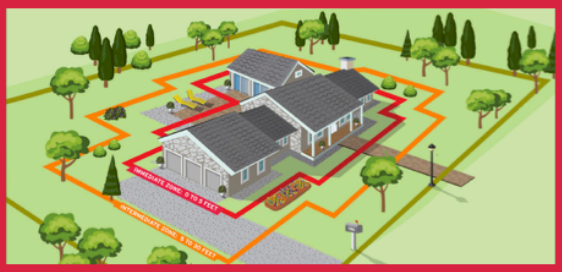
Listed below are documents available on the Internet to assist in learning more about a specific forest, shrubland or grassland topic.

- **Forestry Best Management Practices to Protect Water Quality in Colorado**
- **Landowner Guide to Thinning**
- **Mastication Guidelines**
- **Gambel Oak Management**
- **Grass-Dominated Landscapes**

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9.5 Homeowner Wildfire Awareness Handouts

HOW TO PREPARE YOUR HOME FOR WILDFIRES



WILDFIRE RISK REDUCTION STEPS THAT CAN MAKE YOUR HOME SAFER DURING A WILDFIRE

VEGETATION MANAGEMENT

1. HOME IGNITION ZONES

To increase your home's chance of surviving a wildfire, choose fire-resistant building materials and limit the amount of flammable vegetation in the three home ignition zones. The zones include the **Immediate Zone:** (0 to 5 feet around the house), the **Intermediate Zone** (5 to 30 feet), and the **Extended Zone** (30 to 100 feet).

2. LANDSCAPING AND MAINTENANCE

To reduce ember ignitions and fire spread, trim branches that overhang the home, porch, and deck and prune branches of large trees up to 6 to 10 feet (depending on their height) from the ground. Remove plants containing resins, oils, and waxes. Use crushed stone or gravel instead of flammable mulches in the **Immediate Zone** (0 to 5 feet around the house). Keep your landscape in good condition.

FIRE RESISTIVE CONSTRUCTION

3. ROOFING AND VENTS

Class A fire-rated roofing products, such as composite shingles, metal, concrete, and clay tiles, offer the best protection. Inspect shingles or roof tiles and replace or repair those that are loose or missing to prevent ember penetration. Box in eaves, but provide ventilation to prevent condensation and mildew. Roof and attic vents should be screened to prevent ember entry.

4. DECKS AND PORCHES

Never store flammable materials underneath decks or porches. Remove dead vegetation and debris from under decks and porches and between deck board joints.

5. SIDING AND WINDOWS

Embers can collect in small nooks and crannies and ignite combustible materials; radiant heat from flames can crack windows. Use fire-resistant siding such as brick, fiber-cement, plaster, or stucco, and use dual-pane tempered glass windows.

NFPA FIREWISE USA®
RESIDENTS REDUCING WILDFIRE RISKS

VISIT FIREWISE.ORG FOR MORE DETAILS

BE PREPARED

6. EMERGENCY RESPONDER ACCESS

Ensure your home and neighborhood have legible and clearly marked street names and numbers. Driveways should be at least 12 feet wide with a vertical clearance of 15 feet for emergency vehicle access.

- Develop, discuss, and practice an emergency action plan with everyone in your home. Include details for handling pets, large animals, and livestock.
- Know two ways out of your neighborhood and have a predesignated meeting place.
- Always evacuate if you feel it's unsafe to stay—don't wait to receive an emergency notification if you feel threatened from the fire.
- Conduct an annual insurance policy checkup to adjust for local building costs, codes, and new renovations.
- Create or update a home inventory to help settle claims faster.



TALK TO YOUR LOCAL FORESTRY AGENCY OR FIRE DEPARTMENT TO LEARN MORE ABOUT THE SPECIFIC WILDFIRE RISK WHERE YOU LIVE.

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Order a Reducing Wildfire Risks in the Home Ignition Zone checklist/poster at Firewise.org

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Make Home Ignition Zone Maintenance a Priority

WHY?

The home ignition zone requires regular, ongoing maintenance to be effective. Your home is located in a dynamic environment — trees, grasses and shrubs continue to grow, die and drop leaves each season, and there are ongoing maintenance needs on any structures on your property.

HOME IGNITION ZONE CHECKLIST

PREPARE YOUR HOME FOR WILDFIRE WITH THESE STEPS

TOP PRIORITIES

- ☐ **CLEAR** roof, deck and gutters of pine needles and other debris.*
- ☐ **MOW** grass and weeds to a height of 4 inches or less.*
- ☐ **RAKE AND REMOVE** all pine needles and other flammable debris from 5 feet around the foundation of your home and deck.*
- ☐ **TREAT** or mow shrubs that re-sprout aggressively (such as Gambel oak) every 3-5 years or more depending on growth rates.
- ☐ **REMOVE** branches that hang over the roof and chimney.
- ☐ **DISPOSE** of slash from thinning trees and shrubs by chipping, hauling to a disposal site or piling in open areas for burning later. *Any accumulation of slash that's chipped or otherwise should be 30 feet or more from the home.**
- ☐ **AVOID** creating continuous areas of wood chips on the ground when chipping logs and/or slash. Break up the layer of wood chips by adding nonflammable material, or allow for wide gaps of at least 3 feet between chip accumulations.

* *Address as needed, more than once a year.*

FIREWOOD

- ☐ Keep firewood stacked uphill from (or at the same elevation as) any structures, and keep the woodpile at least 30 feet away from the home.
- ☐ Do not stack firewood between remaining trees, underneath the deck or on the deck.
- ☐ Remove flammable vegetation within 10 feet of woodpiles.

PROPANE TANKS

- ☐ Keep aboveground tanks at least 30 feet from the home, preferably on the same elevation as the house.
- ☐ Remove flammable vegetation within 10 feet of all propane tanks and gas meters.

DRIVEWAYS

- ☐ Maintain at least 10 feet between tree crowns, thinning them a minimum of 30 feet back from each side of the driveway from the house to the main access road.
- ☐ Remove ladder fuels beneath trees after thinning.
- ☐ Remove any shrubs that are within 10 feet of the outer edge of tree crowns.
- ☐ Space shrubs apart at least 2 ½ times their mature height, as measured from the edge of the shrubs.
- ☐ Post signs at the end of the driveway with your house number that are noncombustible, reflective and easily visible to emergency responders.

SOLUTIONS FOR MANAGING SLASH

1. Spread slash and wood chips over a large area to avoid heavy accumulations and large piles. Being close to the ground will help speed decomposition.
2. Burn slash piles, but before doing so, always contact your county sheriff's office or local fire department for current information or possible restrictions.
3. Lop and scatter slash by cutting it into small pieces (less than 24 inches long) and spreading it over a wide area, to a depth not exceeding 18 inches. Don't scatter material over 4 inches in diameter.

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LIVE WILDFIRE READY

PREPARE YOUR HOME AND PROPERTY FOR WILDFIRE

Wildfire is a part of nature in Colorado. Grasses, shrubs and trees provide fuel for wildfires. If your home is located in or near the natural vegetation of Colorado's grasslands, shrublands, foothills or mountains, you live in the wildland–urban interface (WUI) and are at risk from a wildfire. If you live in the WUI, take action to prepare your home and property.

Start living wildfire ready with these simple, practical, low-cost actions.

- [ ] Regularly clear leaves, pine needles and other debris from your deck, roof and gutters.
- [ ] Rake and remove pine needles and leaves 5 feet from your home.
- [ ] Store firewood at least 30 feet from your home, preferably uphill, and never on or under your deck.
- [ ] Move items under your deck or porch to a storage area.
- [ ] Prune branches hanging over your roof and within 10 feet of your chimney.
- [ ] Remove flammable material within 6 vertical inches of your home's siding.
- [ ] Mow grasses to 4 inches or less within 30 feet of your home.
- [ ] Clear brush, shrubs and other plants within 10 feet of propane tanks and gas meters.
- [ ] Screen attic, roof, eaves and foundation vents and wall-in areas below decks and stilt foundations with 1/8-inch metal mesh.

The more you do to prepare and plan ahead, the more likely your home will survive a wildfire.

To learn more, consult a local natural resource professional, fire department or organization trained in wildfire mitigation practices where you live, or visit LiveWildfireReady.org.

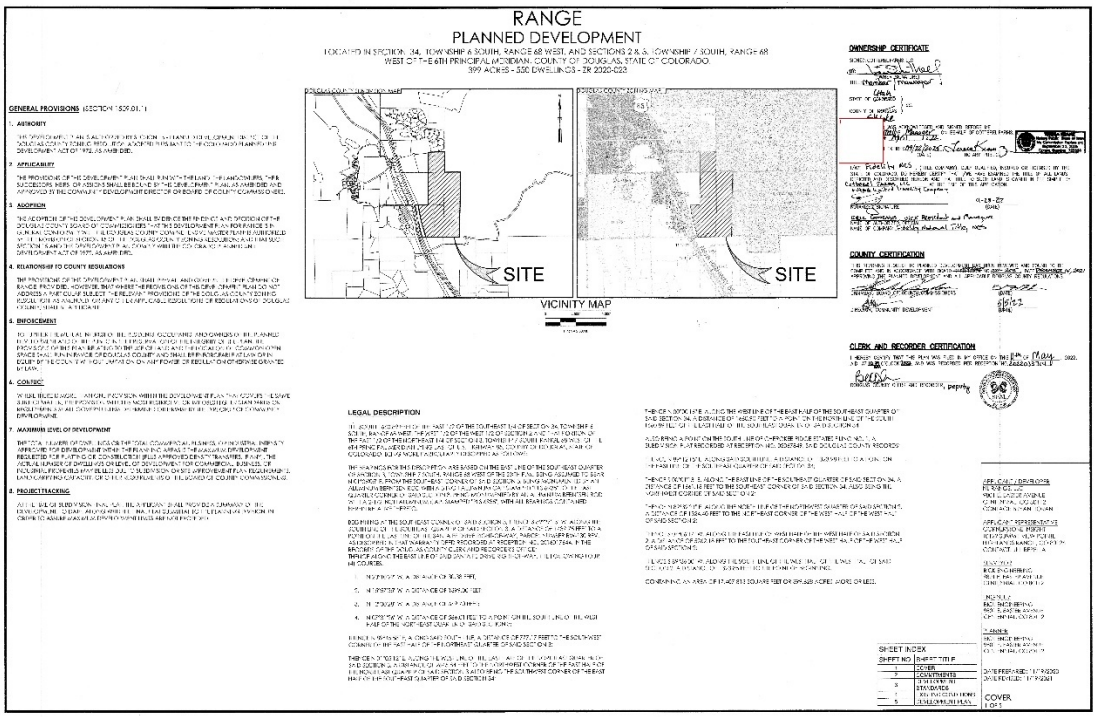
Live Wildfire Ready is generously funded by the State of Colorado.

COLORADO STATE FOREST SERVICE
COLORADO STATE UNIVERSITY



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9.6 Range Planned Development



RANGE
PLANNED DEVELOPMENT
LOCATED IN SECTION 34, TOWNSHIP 6 SOUTH, RANGE 68 WEST, AND SECTIONS 2 & 3, TOWNSHIP 7 SOUTH, RANGE 68 WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF DOUGLAS, STATE OF COLORADO.
399 ACRES - 550 DWELLINGS - ZR 2020-023

VICINITY MAP

SITE

SITE

OWNERSHIP CERTIFICATE

COUNTY CERTIFICATION

CLERK AND RECORDER CERTIFICATION

GENERAL PROVISIONS (SECTION 1.509.01.1)

1. AUTHORITY

2. APPLICABILITY

3. ADOPTION

4. RELATIONSHIP TO COUNTY REGULATIONS

5. ENFORCEMENT

6. CONFLICT

7. MAXIMUM LEVEL OF DEVELOPMENT

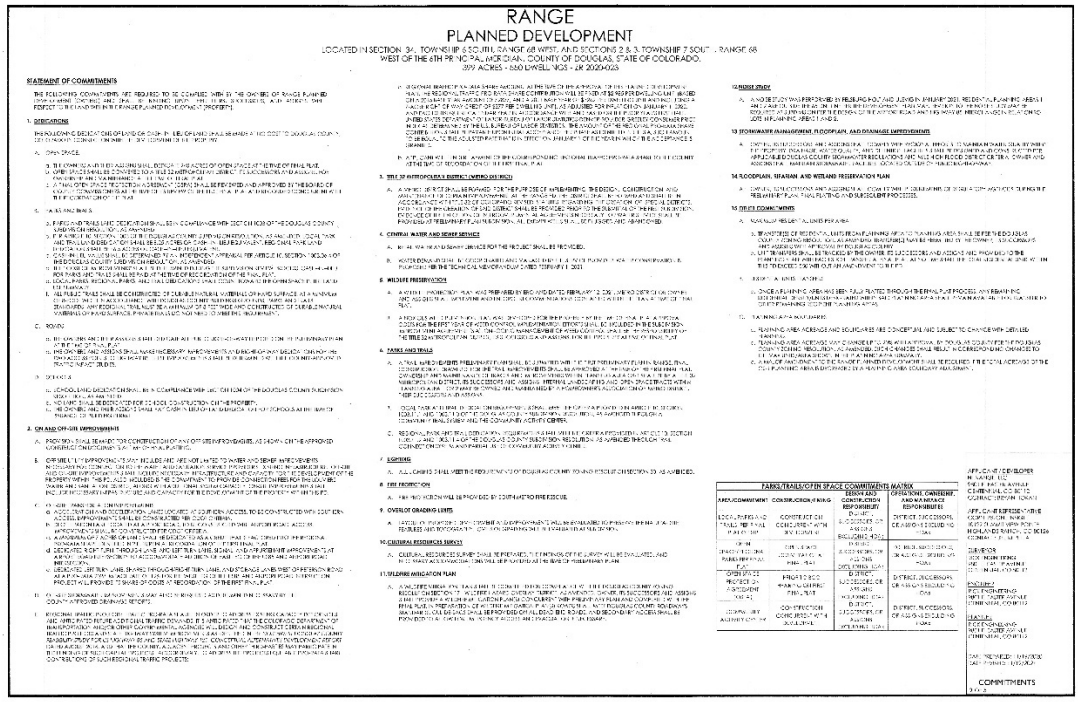
8. PHASE/PHASING

LEGAL DESCRIPTION

SHEET INDEX

SHEET NO.	SHEET TITLE
1	COVER
2	COMMITMENTS
3	DEVIATIONS
4	SITE PLAN (OVERALL)
5	DEVELOPMENT PLAN

COVER
1 OF 5



RANGE
PLANNED DEVELOPMENT
LOCATED IN SECTION 34, TOWNSHIP 6 SOUTH, RANGE 68 WEST, AND SECTIONS 2 & 3, TOWNSHIP 7 SOUTH, RANGE 68 WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF DOUGLAS, STATE OF COLORADO.
399 ACRES - 550 DWELLINGS - ZR 2020-023

STATEMENT OF COMMITMENTS

1. DEDICATIONS

A. OPEN SPACE

B. TRAILS AND PARKS

C. ROWN

D. SCHOOLS

2. ON AND OFF-SITE IMPROVEMENTS

A.

B.

C.

D.

E.

F. LIGHTING

G. FIRE PROTECTION

H. OVERLOT GRADING LIMITS

10. CULTURAL RESOURCES SURVEY

11. WILDFIRE MITIGATION PLAN

12. NOISE STUDY

13. STORMWATER MANAGEMENT, FLOODPLAIN, AND DRAINAGE IMPROVEMENTS

14. FLOODPLAIN, WETLAND AND WETLAND RESERVATION PLAN

15. OFF-SITE COMMITMENTS

16. PARKS/TRAILS/OPEN SPACE COMMITMENTS MATRIX

AREA/COMMITMENT	CONSTRUCTION/FUNDING	DESIGN AND CONSTRUCTION RESPONSIBILITY	OPERATIONS, OWNERSHIP, AND MAINTENANCE RESPONSIBILITY
LOCAL PARKS AND TRAILS (TRAIL PLAN)	CONTRACT OR CONSTRUCT WITH DEVELOPMENT	DEVELOPER OR ASSIGNS (INCLUDING METRO DISTRICT)	DISTRICT, SUCCESSORS, OR ASSIGNS
OPEN SPACE PROPERTY (ASSESSMENT)	PROPERTY OWNER FUNDING	DEVELOPER OR ASSIGNS (INCLUDING METRO DISTRICT)	DISTRICT, SUCCESSORS, OR ASSIGNS
	CONSTRUCTION CONSTRUCT WITH DEVELOPER	DEVELOPER OR ASSIGNS (INCLUDING METRO DISTRICT)	DISTRICT, SUCCESSORS, OR ASSIGNS

17. SCHEDULE

APPLICANT / DEVELOPER

APPLICANT REPRESENTATIVE

OWNER

ENGINEER

SURVEYOR

PLANNER

ARCHITECT

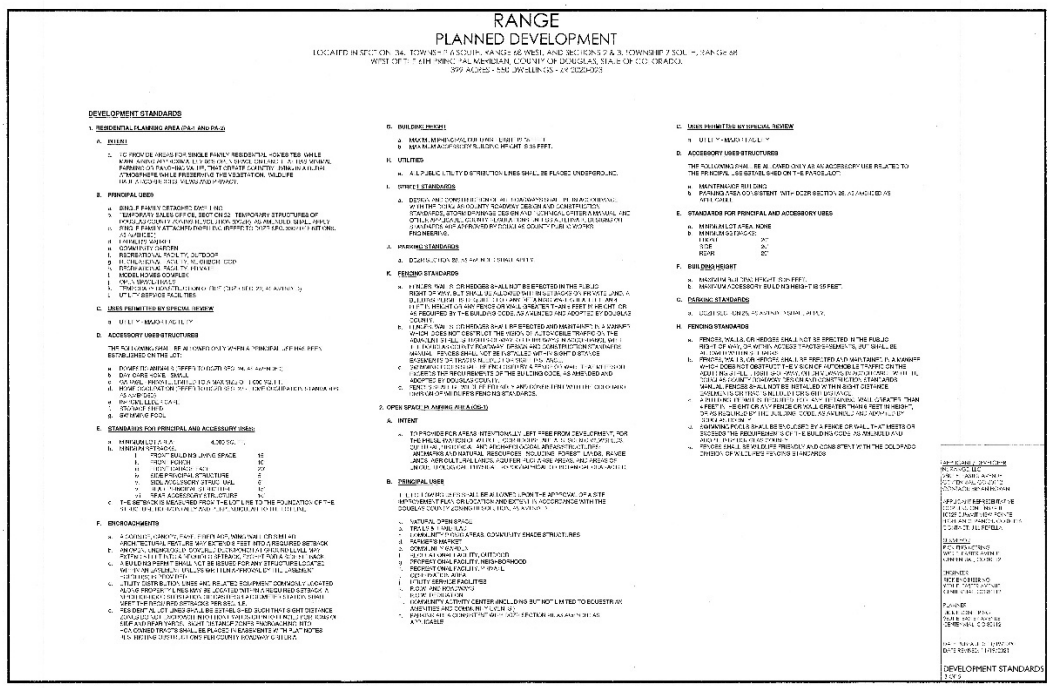
SHEET INDEX

SHEET NO.	SHEET TITLE
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4	SITE PLAN (OVERALL)
5	DEVELOPMENT PLAN

DATE PREPARED: 10/19/2020
DATE REVISED: 10/19/2021

COMMITMENTS
2 OF 5

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RANGE
PLANNED DEVELOPMENT
LOCATED IN SECTION 36, TOWNSHIP 6 SOUTH, RANGE 68 WEST, AND SECTIONS 2 & 3, TOWNSHIP 7 SOUTH, RANGE 68
WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF DOUGLAS, STATE OF COLORADO
399 ACRES - 550 DWELLINGS - ZP 2020-003

DEVELOPMENT STANDARDS

1. RESIDENTIAL PLANNING AREA (PA-1 AND PA-2)

A. INTENT

C. TO PROVIDE AREAS FOR SINGLE FAMILY RESIDENTIAL HOMESITES WHILE MAINTAINING PLANNING OPTIONS THAT OPERATE CAPACITY, REGULATE LAND ATMOSPHERE WHILE PRESERVING THE VEGETATION, WILDLIFE HABITAT AND NATURAL VIEWS AND PRIVACY.

B. PRINCIPAL USES

a. SINGLE FAMILY DETACHED DWELLING
b. TEMPORARY SALES OFFICE, SUBJECT ON SITE TEMPORARY STRUCTURES OF NONRESIDENTIAL CHARACTER, SUCH AS MOBILE HOMES, SHALL ONLY BE PERMITTED AS APPROVED BY THE DOUGLAS COUNTY BUILDING OFFICIAL
c. SINGLE FAMILY ATTACHED DWELLING (DUPLEX), SUBJECT TO ADDITIONAL STANDARDS AS APPROVED
d. PARK/OPEN SPACE
e. COMMUNITY GARDEN
f. RECREATIONAL FACILITY, OUTDOOR
g. RECREATIONAL FACILITY, INDOOR
h. RECREATIONAL FACILITY, PRIVATE
i. MODEL HOMES COMPLEX
j. ON-SITE SIGNAGE
k. TEMPORARY CONSTRUCTION OFFICE (SUBJECT TO ZONING REGULATIONS)
l. UTILITY SERVICE FACILITIES

C. USES PERMITTED BY SPECIAL REVIEW

a. UTILITY, MAJOR FACILITY

D. ACCESSORY USES/STRUCTURES

THE FOLLOWING SHALL BE ALLOWED ONLY AS AN ACCESSORY USE SUBJECT TO THE PRINCIPAL USE DETAILS SHOWN ON THE SITE PLAN(S):

a. GARAGE
b. SHED
c. GAZEBO, PERGOLA, OR SIMILAR STRUCTURE
d. HOME OCCUPATION (PER DOUGLAS COUNTY REGULATIONS)
e. PET ENCLOSURE
f. PLAYSET
g. SWIMMING POOL

E. STANDARDS FOR PRINCIPAL AND ACCESSORY USES:

a. MINIMUM LOT AREA: 4,000 SQ. FT.
b. MINIMUM SETBACKS:

i. FRONT BUILDING LIVING SPACE	15'
ii. REAR	10'
iii. SIDE	5'
iv. SIDE PRINCIPAL STRUCTURE	5'
v. SIDE ACCESSORY STRUCT. UNIT	0'
vi. REAR GARAGE ENTRY	10'
vii. SIDE ACCESSORY STRUCTURE	5'

c. THE SETBACKS MEASURED FROM THE LOT LINE TO THE FOUNDATION OF THE STRUCTURE AND OVERHANGS SHALL MEASURE TO THE LOT LINE.

F. ENCROACHMENTS

a. ARCHITECTURAL FEATURES MAY EXTEND 2 FEET INTO REQUIRED SETBACK
b. UNENCLOSED DECKS, ENCLOSED PORCHES AND SIMILAR ARCHITECTURAL FEATURES MAY EXTEND 5 FEET INTO REQUIRED SETBACK FROM THE REAR LOT LINE
c. A BUILDING PERMIT SHALL NOT BE ISSUED FOR ANY STRUCTURES LOCATED WITHIN UTILITY, UTILITY EASEMENT OR DRAINAGE EASEMENT UNLESS APPROVED BY THE APPLICABLE UTILITY OR DRAINAGE AUTHORITY.
c. UTILITY DISTRIBUTION LINES AND RELATED EQUIPMENT COMMONLY LOCATED ALONG PROPERTY LINES MAY BE LOCATED WITHIN A REQUIRED SETBACK. A VARIANCE SHALL NOT BE REQUIRED FOR SUCH PLACEMENT. STRUCTURES SHALL MEET THE REQUIRED SETBACKS FROM SUCH LINES.
c. RESIDENTIAL LOT LINES SHALL BE ESTABLISHED SUCH THAT A SIGHT DISTANCE CONSISTENT WITH DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS AND DRAINAGE ZONES FROM ALONG INTERSECTIONS, FOR EACH SIDE AND REAR YARDS. SUCH SETBACK ZONES FROM ALONG INTERSECTIONS SHALL BE PLACED IN EASEMENTS OF THE PLAT NOTES THIS RESTRICTION ON THE COUNTY ROADWAY SIGNAGE.

B. BUILDING HEIGHT

a. MAXIMUM BUILDING HEIGHT: 35 FEET.
b. MINIMUM BUILDING HEIGHT: 15 FEET.

H. UTILITIES

a. ALL PUBLIC UTILITY DISTRIBUTION LINES SHALL BE PLACED UNDERGROUND.

I. STREET STANDARDS

a. INTERNAL CONSTRUCTION OF ALL ROADWAYS IN PLAN SHALL BE IN ACCORDANCE WITH THE TYPICAL ROADWAY CROSS SECTIONS AND DESIGN STANDARDS, EXCEPTIONS, AND VARIANCES AS APPROVED BY THE DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS MANUAL AND OTHER APPLICABLE DOUGLAS COUNTY REGULATIONS, AS AMENDED BY THE PROJECT ENGINEER.

J. PARKING STANDARDS

a. DESIGN SECTION SHALL BE PER DOUGLAS COUNTY.

K. FENCING STANDARDS

a. FENCES, WALLS, OR HEDGES SHALL NOT BE ERECTED IN THE PUBLIC RIGHT-OF-WAY, BUT SHALL BE ALLOWED ON THE PROPERTY LINE ADJACENT TO PRIVATE, AND A BUILDING PERMIT SHALL BE REQUIRED FOR ANY FENCE EXCEEDING SIX (6) FEET IN HEIGHT OR ANY RETAINING WALL EXCEEDING FOUR (4) FEET IN HEIGHT OR ANY FENCE OR WALL SUPPORTING A SURCHARGE, AS REQUIRED BY THE BUILDING CODE AS AMENDED AND ADOPTED BY DOUGLAS COUNTY.
b. FENCES, WALLS, OR HEDGES SHALL BE ERECTED AND MAINTAINED IN A MANNER WHICH DOES NOT OBSTRUCT THE VISION OF AUTOMOBILE TRAFFIC ON THE ADJACENT PUBLIC STREET OR ALLEY, OR ANY ACCESS IN ACCORDANCE WITH THE DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS MANUAL. FENCES SHALL NOT BE INSTALLED WITHIN SIGHT DISTANCE EASEMENTS OR TRIANGLES AS SPECIFIED IN THE DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS MANUAL.
c. FENCES SHALL NOT BE INSTALLED WITHIN SIGHT DISTANCE EASEMENTS OR TRIANGLES AS SPECIFIED IN THE DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS MANUAL.
d. A PERSON MAY BE REQUIRED TO PLACE RETAINING WALLS GREATER THAN 4 FEET IN HEIGHT OR ANY FENCE OR WALL GREATER THAN 6 FEET IN HEIGHT, OR AS REQUIRED BY THE BUILDING CODE AS AMENDED AND ADOPTED BY THE BUILDING OFFICIAL.
e. RETAINING POOLS SHALL BE SURROUNDED BY A FENCE OR WALL THAT MEETS OR EXCEEDS THE REQUIREMENTS OF THE BUILDING CODE AS AMENDED AND ADOPTED BY THE BUILDING OFFICIAL.
f. FENCES SHALL BE WILDLIFE FRIENDLY AND CONSISTENT WITH THE DOUGLAS COUNTY DESIGN STANDARDS.

2. OPEN SPACE (PLANNING AREA (OS-1))

A. INTENT

a. TO PROVIDE FOR AREAS INTENTIONALLY LEFT FREE FROM DEVELOPMENT, FOR THE HEALTH, WELFARE, AND ENJOYMENT OF THE RESIDENTS OF THE DEVELOPMENT AND AREA AND NATURAL RESOURCES, INCLUDING FOREST LANDS, RIVER AREAS, AGRICULTURAL LANDS, WATER AQUIFER RECHARGE AREAS, AND AREAS OF UNIQUE BIOLOGICAL DIVERSITY, AS DESIGNATED ON THE APPROVED PLAN.

B. PRINCIPAL USES

a. ALL USES SHALL BE SUBJECT TO, OR ALREADY HAVE THE APPROVAL OF A SITE IMPROVEMENT PLAN OR LOCATION AND EXTENT IN ACCORDANCE WITH THE DOUGLAS COUNTY ZONING REGULATIONS, AS AMENDED:

a. NATURAL OPEN SPACE
b. TRAILS / PUBLIC ACCESS
c. LANDSCAPED AREAS, COMMUNITY GARDENS, STREETSCAPE AMENITIES
d. FARMER'S MARKET
e. DOG PARK AREAS
f. ACCESSORY FACILITY, OUTDOOR
g. PROPERTY OWNERS ASSOCIATION FACILITY, NEIGHBORHOOD RECREATIONAL FACILITY, PRIVATE
h. OPEN WATER AREAS
i. UTILITY SERVICE FACILITIES
j. ROAD AND ROADWAYS
k. ROAD OPERATION
l. COMMUNITY ACTIVITY CENTER (INCLUDING BUT NOT LIMITED TO EQUESTRIAN AMENITIES AND DOMESTIC USES)
m. PARKING AS ACCESSORY TO ANY USE LISTED AS A PERMISSIBLE

C. USES PERMITTED BY SPECIAL REVIEW

a. UTILITY, MAJOR FACILITY

D. ACCESSORY USES/STRUCTURES

THE FOLLOWING SHALL BE ALLOWED ONLY AS AN ACCESSORY USE SUBJECT TO THE PRINCIPAL USE DETAILS SHOWN ON THE SITE PLAN(S):

a. MAINTENANCE BUILDING
b. PARKING AREA CONSISTENT WITH DOUGLAS COUNTY REGULATIONS, AS AMENDED AND ADOPTED

E. STANDARDS FOR PRINCIPAL AND ACCESSORY USES

a. MINIMUM LOT AREA: NONE
b. MINIMUM SETBACKS:
FRONT: 20'
SIDE: 20'
REAR: 20'

F. BUILDING HEIGHT

a. MAXIMUM BUILDING HEIGHT: 35 FEET.
b. MAXIMUM ACCESSORY BUILDING HEIGHT: 15 FEET.

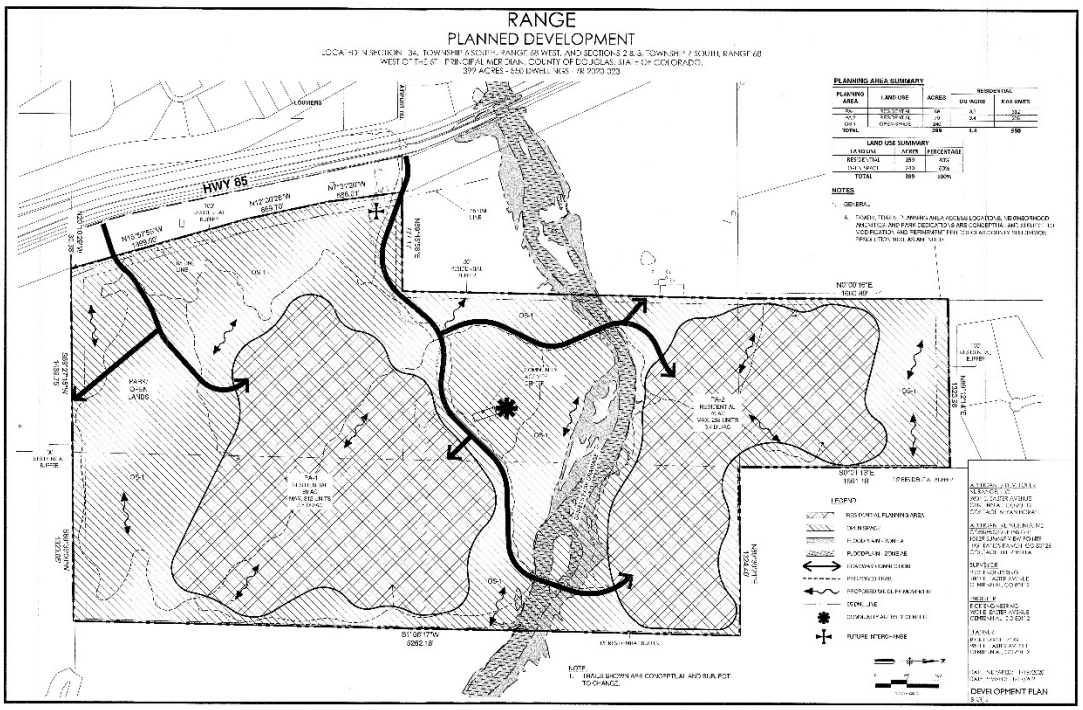
G. PARKING STANDARDS

a. DESIGN SECTION SHALL BE PER DOUGLAS COUNTY.

H. FENCING STANDARDS

a. FENCES, WALLS, OR HEDGES SHALL NOT BE ERECTED IN THE PUBLIC RIGHT-OF-WAY, OR WITHIN ACCESS TRACTS/EASEMENTS, BUT SHALL BE ALLOWED ON THE PROPERTY LINE.
b. FENCES, WALLS, OR HEDGES SHALL BE ERECTED AND MAINTAINED IN A MANNER WHICH DOES NOT OBSTRUCT THE VISION OF AUTOMOBILE TRAFFIC ON THE ADJACENT PUBLIC STREET OR ALLEY, OR ANY ACCESS IN ACCORDANCE WITH THE DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS MANUAL. FENCES SHALL NOT BE INSTALLED WITHIN SIGHT DISTANCE EASEMENTS OR TRIANGLES AS SPECIFIED IN THE DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS MANUAL.
c. FENCES SHALL NOT BE INSTALLED WITHIN SIGHT DISTANCE EASEMENTS OR TRIANGLES AS SPECIFIED IN THE DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS MANUAL.
d. A PERSON MAY BE REQUIRED TO PLACE RETAINING WALLS GREATER THAN 4 FEET IN HEIGHT OR ANY FENCE OR WALL GREATER THAN 6 FEET IN HEIGHT, OR AS REQUIRED BY THE BUILDING CODE AS AMENDED AND ADOPTED BY THE BUILDING OFFICIAL.
e. RETAINING POOLS SHALL BE SURROUNDED BY A FENCE OR WALL THAT MEETS OR EXCEEDS THE REQUIREMENTS OF THE BUILDING CODE AS AMENDED AND ADOPTED BY THE BUILDING OFFICIAL.
f. FENCES SHALL BE WILDLIFE FRIENDLY AND CONSISTENT WITH THE DOUGLAS COUNTY DESIGN STANDARDS.

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