PRELIMINARY DRAINAGE REPORT

FOR

BEN LOMAND MOUNTAIN VILLAGE

EL PASO COUNTY, COLORADO

OWNER/DEVELOPER:
UNITED CONGREGATIONAL CHURCH
3195 COUNTY LINE ROAD
MONUMENT, CO 80132
ATTN: ROGER SUNG

ENGINEER:
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FEBRUARY 27, 2026

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The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin. Manhard Consulting accepts responsibility for any liability caused by any negligent acts, errors or omissions on their part in preparing this report.

Daniel Madison, PE #50253
For and on behalf of Manhard Consulting

I, a representative of United Congregational Church, the developer have read and will comply with all of the requirements specified in this drainage report and plan.

United Congregational Church
Name of Developer

Roger Sung
Roger Sung

I. Introduction

The purpose of this report is to support the proposed Ben Lomand Mountain Village Preliminary Plan drainage improvements and to demonstrate it is in compliance with the El Paso County Land Development Code, and The El Paso County Drainage Criteria Manual. The Site generally sheet flows to the north with two existing culvert crossings underneath County Line Road serving as the historic outfalls along the northern boundary of the Site. The Site will be conveyed via storm sewer to two proposed ponds, Extended Detention Pond 1 to the northwest, and Extended Detention Pond 2 to the northeast. A portion of the Site to the west will sheet flow to the northwest off-site, and a portion of the Site to the south will sheet flow south off-site following historic drainage patterns.

A. Location

Ben Lomand Mountain Village is located in the Northwest Quarter of Section 3, Section 4, and the East half of Section 5, all within Township 11 South, Range 67 West of the 6th principal meridian, El Paso County, Colorado. El Paso County Parcels: 7104000002, 7104000001, 7104001010, and 7103000028 per El Paso County GIS. The Site is bounded by County Line Road (also known as West Palmer Divide Road) to the north, the existing Meier's Subdivision to the east, Colorado Estates Subdivision to the South, and undeveloped property to the west. See the Vicinity Map in **Appendix A** for more information.

B. Description of Property

Ben Lomand Mountain Village is approximately ± 344 acres within Unincorporated El Paso County, Colorado. This parcel of land is zoned as RR-2.5 rural residential. The property is currently meadow lowland with mountain tree-cover highlands and rock outcroppings with an existing church and youth center and a single private residence. The proposed development presented in this report will maintain the planned off-site flow through the Site and attenuate runoff to the proposed Pond 1 and Pond 2 providing water quality and detention storage, ultimately releasing at or below historic rates through the existing dual 24" CMP culverts at the two low points along County Road frontage. Low lying wetlands are present on site and wetland mitigation will be proposed as a part of this development. Steep slopes are also an existing characteristic of this property with existing slopes ranging from 5% to 15% on the north portion of the property and existing slopes ranging from 15% to 50% on the southern portion with pockets of exposed rock faces along the southern portion of the property. There are no other prominent geologic features, irrigation facilities, lakes or streams on this Site.

The proposed layout includes 73 large single-family lots served by rural streets with multiple open space tracts. This equates to a density of approximately 0.21 DU/acre.

The Site generally slopes from south to north in the existing condition. A ridgeline towards the south end of the property splits a small amount of the Site's runoff to the south. The Site has been split into four major drainage basins – Basins A, B, C, and D. These major basins are intended to route discharge from the Site to two extended detention basins, Pond 1 and Pond 2. There are 3 basins that cannot be routed to the proposed ponds and will flow offsite. These basins are Basin OS-1, OS-2 and OS-3. Any proposed residential improvements within these offsite basins will have to provide private, on-site stormwater detention facilities to meet the requirements of El Paso County.

Vertical relief is based on NGS designation "K354" (PID: KK0173), being a 3.5" brass disc approximately 0.3 miles north from palmer lake and 0.3 miles along the Denver and Rio Grande Western Railroad from the Atchison, Topeka and Santa Fe Rail Road Station at Palmer Lake, 14 feet east of the east rail, set in the top of the south end of the east headwall of a concrete pipe culvert, with an NAVD 88 elevation of 7141.87 feet.

C. Existing Soils

Existing soils for the site were researched on the NRCS web soil survey, see **Appendix A**. Ten principal soil groups exist onsite:

- Sandy Loams – 5 to 25% Slopes (Map Unit CrE). This soil type covers approximately 0.7% of the site and is located in the north corner. This soil is classified as hydrologic soil group B.
- Complex – 9 to 65% Slopes (Map Unit KfF). This soil type covers approximately 0.1% of the site and is located in the northeast corner. This soil is classified as hydrologic soil group A.
- Sandy Loam – 3% to 9% Slopes (Map Unit PeD). This soil type covers approximately 0.9% of the site and is located in the northwest corner. This soil is classified as hydrologic soil group C.
- Gravelly Sandy Loams – 1% to 25% Slopes (Map Unit PvE). This soil type covers approximately 1.6% of the site and is located in the north corner. This soil is classified as hydrologic soil group A.
- Gravelly Loamy Sand – 8% to 40% Slopes (Map Unit 41). This soil type covers approximately 39.8% of the site and is located in the center region. This soil is classified as hydrologic soil group B.
- Outcrop Complex - (Map Unit 42). This soil type covers approximately 22.2% of the site and is located in the west region. This soil is classified as hydrologic soil group B.
- Complex – 3% to 8% Slopes (Map Unit 68). This soil type covers approximately 0.0% of the site. This soil is classified as hydrologic soil group B.

- Complex – 8% to 15% Slopes (Map Unit 69). This soil type covers approximately 24.9% of the site and is located in the northwest and northeast corner. This soil is classified as hydrologic soil group B.
- Coarse Sandy Loam – 3% to 8% Slopes (Map Unit 71). This soil type covers approximately 0.1% of the site and is located in the south corner. This soil is classified as hydrologic soil group B.
- Complex – 8% to 15% Slopes (Map Unit 93). This soil type covers approximately 9.5% of the site and is located in the north center region. This soil is classified as hydrologic soil group B.

As over 97% of the site is covered by Group B soils, all calculations assumed Groupe B soil coverage.

II. Drainage Basins

A. Existing Basin Description

The existing drainage associated with Ben Lomand Mountain Village generally sheet flows north following historic drainage patterns. This flow drains to two respective culverts underneath County Line Road, both being dual 24" CMP, then ultimately discharging onto undeveloped Douglas County land. See **Appendix D** for the Drainage Basin Map.

This site is located outside of the 100-year floodplain (Zone X) as shown on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) numbers 08041C0044G, 08041C0256G and 08041C0257G, all dated December 7th, 2018. The FIRMs can be found in **Appendix A.**

B. Proposed Basin Development

The proposed Site has been divided into four major drainage basins - Basins A, B, C, and D. Three basins, Basins OS-1, OS-2 and OS-3, flow off-site and do not reach proposed detention ponds; any residential development and improvements within these Basins will have to provide private, on-lot detention to control developed flows. Basins A and B will convey flows via a proposed on-site storm sewer and swale collection system along with overland flow being conveyed to the proposed extended detention basin, Detention Pond 1, in the northwest corner of the Site ultimately discharging through the dual 24" CMP culvert underneath County Line Road. Basins C and D will convey flows via a proposed on-site storm sewer and swale collection system along with overland flow to the proposed extended detention basin, Detention Pond 2, in the northeast corner of the Site, ultimately discharging through the dual 24" CMP culvert underneath County Line Road. Both double barrel 24" CMP culverts underneath County Line Road discharge onto undeveloped Douglas County land, maintaining the historic drainage pattern.

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin. Manhard Consulting accepts responsibility for any liability caused by any negligent acts, errors or omissions on their part in preparing this report.

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I, a representative of United Congregational Church, the developer have read and will comply with all of the requirements specified in this drainage report and plan.

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A. Existing Basin Description

The existing drainage associated with Ben Lomand Mountain Village generally sheet flows north following historic drainage patterns. This flow drains to two respective culverts underneath County Line Road, both being dual 24" CMP, then ultimately discharging onto undeveloped Douglas County land. See **Appendix D** for the Drainage Basin Map.

This site is located outside of the 100-year floodplain (Zone X) as shown on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) numbers 08041C0044G, 08041C0256G and 08041C0257G, all dated December 7th, 2018. The FIRMs can be found in **Appendix A.**

B. Proposed Basin Development

The proposed Site has been divided into four major drainage basins - Basins A, B, C, and D. Three basins, Basins OS-1, OS-2 and OS-3, flow off-site and do not reach proposed detention ponds; any residential development and improvements within these Basins will have to provide private, on-lot detention to control developed flows. Basins A and B will convey flows via a proposed on-site storm sewer and swale collection system along with overland flow being conveyed to the proposed extended detention basin, Detention Pond 1, in the northwest corner of the Site ultimately discharging through the dual 24" CMP culvert underneath County Line Road. Basins C and D will convey flows via a proposed on-site storm sewer and swale collection system along with overland flow to the proposed extended detention basin, Detention Pond 2, in the northeast corner of the Site, ultimately discharging through the dual 24" CMP culvert underneath County Line Road. Both double barrel 24" CMP culverts underneath County Line Road discharge onto undeveloped Douglas County land, maintaining the historic drainage pattern.

It should be noted that the southern half of County Line Road was assumed to be treated in the proposed detention ponds and have been delineated with the proposed drainage basins shown on the map within Appendix D.

Low-lying wetlands are present on the property, as defined by the US Army Corps of Engineers, a jurisdictional determination is currently unknown. A Wetland Delineation Report was prepared for the project by Wildland Consultants Inc., dated October 2025. A map from said report is included in Appendix A. Any proposed impacts to wetlands will need to be mitigated.

III. Drainage Design Criteria

A. Development Criteria Reference

The project will be developed in accordance with El Paso County Land Development Code, Subdivision Criteria Manual, and The El Paso County Drainage Criteria Manual. This report used assumed imperviousness by land use, and specified 20% imperviousness for the proposed single-family lots, which is overly conservative to the required 10% within Table 6-6 in Volume I of the El Paso County Drainage Manual. See **Appendix B** for more information.

B. Hydrology Criteria

The El Paso County Drainage Criteria Manual (DCM) *Drainage Criteria Manual County of El Paso, Colorado* will be used for the storm drainage system design.

Runoff generated from the drainage sub-basins will be conveyed via the proposed storm sewer collection and swale system into the proposed extended detention basins, Pond 1 to the northwest and Pond 2 to the northeast, respectively. The proposed detention ponds will be designed for water quality treatment and peak runoff attenuation.

Design Rainfall: The 5-year and 100-year frequency storms are used as the minor and major design storms, respectively.

- 5-year storm: 1-hour Point Rainfall, P1 = 1.50 inches
- 100-year storm: 1-hour Point Rainfall, P1 = 2.52 inches

Runoff Calculation: Peak storm runoff is determined using the rational formula,

Q = CIA (CFS)
C = Runoff coefficient based on surface impermeability
I = Rainfall intensity in inches per hour
A = Drainage basin area in acres

As mentioned above, DCM Imperviousness Values and Runoff Coefficients (Table 6-6) will be used to develop basin runoff coefficients. These tables can be found in **Appendix B**.

Runoff coefficients for each storm event have been applied to each sub-basin for this project based on the predominant soil type Hydrologic Soil Group B.

Time of Concentration is determined using the criteria found in Section 3.2 of the DCM, Vol. I, Chapter 6 Hydrology.

Rainfall intensity (I) was found in Section 3.3 of the DCM, Vol. I, Chapter 6 Hydrology. The equation for intensity comes from Figure 6-5 Colorado Springs Rainfall Intensity Duration Frequency.

- 5-year storm: I_5=-1.50 ln(D) + 7.583
- 100-year storm: I_{100}=-2.52 ln(D) + 12.735

Where,

D = Duration (minutes), or time of concentration (T_c)

The recurrence intervals used for this study were based on a rural residential land use and El Paso County Drainage Criteria Manual. The minor drainage system is designed for a 5-year recurrence interval, and the major drainage system is designed for a 100-year recurrence interval.

C. Hydraulic Criteria

The following criteria were utilized in determining allowable street flow and thereby proposed inlet spacing.

Minor Storm (5-yr):
Local Roads (with curb and roadside ditch): Where local roads have curb and gutter, minor storm events shall not overtop the curb with a maximum flow depth of 6 inches from flow line. Flow may spread to crown of street or top of curb, whichever is most limiting. Where roadside ditches are employed, flow must not encroach upon street shoulder area.

Major Storm (100-yr):
Local Roads (with curb and roadside ditch): For major storm events where local roads have curb and gutter – residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line. The depth of water at the gutter flow line shall not exceed 12 inches. Where roadside ditches are employed – residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line. The depth of flow shall not exceed 6 inches at the street shoulder.

Proposed inlet capacities will be determined at time of Final Drainage Report for the minor and major storm events using Section 6.2.7 Inlets of the El Paso County DCM, Vol. I, Chapter 6 Design Criteria as well as the Streets and Inlet Hydraulics version 6.00 by MHFD.

The proposed Basin Map for Ben Lomand Mountain Village, included in **Appendix D** of this report, divides the Site's drainage into four major drainage basins with – Basin A, B, C, and D. Three additional basins, Basins OS-1, OS-2, and OS-3 account for basins that will flow offsite un-detained; any development and improvements within these basins will have to provide private, on-lot detention facilities to control the developed flows to historic conditions. The proposed Site flows north via a storm sewer collection system with a system of area and curb inlets and swales, then discharging into the extended detention ponds, Pond 1 and Pond 2. Basins A and B are tributary to Pond 1, and Basins B and C are tributary to Pond 2. Pond 1 is a full spectrum Extended Detention Basin in the northwest corner of the Site that will treat and detain the inflow volume from a water quality and water quantity standpoint, attenuating runoff to be released below historic release rates into a double barrel 24" CMP culvert under County Line Road in the northwest corner of the property. Pond 2 is also a full spectrum Extended Detention Basin in the northeast corner of the Site that will treat and detain the inflow volume for water quality and water quantity, attenuating runoff to be released below historic release rates into a double barrel 24" CMP culvert under County Line Road in the northeast corner of the property.

Swales have been preliminarily sized for their respective drainage basins. Swales are required to provide 1' of freeboard during the peak flow from the major (100-year) storm.

The project storm sewer will designed in the Final Drainage Report per El Paso County and MHFD standards for the minor and major storm events, containing the hydraulic grade line (HGL) within the pipe during the minor event and below one foot of freeboard from finished grade or street surfaces during the major event. Hydraulic grade lines will be calculated for both on-site and off-site storm systems using Bentley StormCAD.

IV. Stormwater Conveyance and Drainage Facilities

A. General Concept

A summary of impervious percentages, tributary areas, and runoff values for the Project area tributary to Pond 1 and Pond 2 can be found in **Appendix B.**

Basin A is comprised of six sub-basins, basins A-1, A-2, A-3, A-4, AOS-1, and AOS-2, and has a total tributary area of 51.32 acres and a composite imperviousness of 27.4%. The peak runoff in the minor storm event, the 5-year event, is Q_5=47.1 CFS. The peak runoff in the major storm event, the 100-year event, is Q_{100}=143.1 CFS. Basin A is tributary to Detention Pond 1. Basins AOS-1 and AOS-2 flow offsite undetained. Detention Pond 1 has been sized to overdetain flows to account for this off site flow.

Basin B is comprised of thirteen sub-basins, basins B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-8, B-9, B-10, B-11, B-12, and B-13, and has a total tributary area of 89.79 acres and a composite imperviousness of 32.4%. The peak runoff in the minor storm event, the 5-year event, is Q_5=103.6 CFS. The peak runoff in the major storm event, the 100-year event, is Q_{100}=284.2 CFS. Basin B is tributary to Detention Pond 1.

Basin C is comprised of five sub-basins, basins C-1, C-2, C-3, C-4, and C-5, and has a total tributary area of 46.94 acres and a composite imperviousness of 29.0%. The peak runoff in the minor storm event, the 5-year event, is Q_5=44.0 CFS. The peak runoff in the major storm event, the 100-year event, is Q_{100}=129.2 CFS. Basin C is tributary to Detention Pond 2.

Basin D is comprised of five sub-basins, basins D-1, D-2, D-3, D-4, and D-5, and has a total tributary area of 41.90 acres and a composite imperviousness of 33.0%. The peak runoff in the minor storm event, the 5-year event, is Q_5=45.4 CFS. The peak runoff in the major storm event, the 100-year event, is Q_{100}=127.5 CFS. Basin D is tributary to Detention Pond 2.

Basin OS-1 has a total tributary area of 15.81 acres and a composite imperviousness of 20.0%. The peak runoff in the minor storm event, the 5-year event, is Q_5=10.67 CFS. The peak runoff in the major event, the 100-year event, is Q_{100}=39.40 CFS. Basin OS-1 drains off-site to the northwest toward County Line Road, consistent with the characteristic runoff pattern in the existing condition. Any improvements within this basin will have to be controlled with private, on-lot detention systems developed at the time of Plot Plans to meet El Paso County requirements.

Basin OS-2 has a total tributary area of 24.96 acres and a composite imperviousness of 20.0%. The peak runoff in the minor storm event, the 5-year event, is Q_5=18.44 CFS. The peak runoff in the major event, the 100-year event, is Q_{100}=68.11 CFS. Basin OS-2 drains off-site to the south through the southern property line to the Lakeview Heights Subdivision, consistent with the characteristic runoff pattern in the existing condition. Any improvements within this basin will have to be controlled with private, on-lot detention systems developed at the time of Plot Plans to meet El Paso County requirements.

Basin OS-3 has a total tributary area of 5.02 acres and a composite imperviousness of 20.0%. The peak runoff in the minor storm event, the 5-year event, is Q_5=3.79 CFS. The peak runoff in the major event, the 100-year event, is Q_{100}=14.00 CFS. Basin OS-3 drains off-site to the southeast through the southern property line to the Colorado Estates Subdivision, consistent with the characteristic runoff pattern in the existing condition. Any improvements within this basin will have to be controlled with private, on-lot detention systems developed at the time of Plot Plans to meet El Paso County requirements.

Detention for Ponds 1 and 2 is designed in accordance with El Paso County's criteria for full-spectrum detention facilities that maintain or improve pre-development hydrologic conditions, with particular emphasis on controlling both peak discharge rates and runoff volumes. Historic runoff conditions were established for the tributary drainage area using pre-development land use assumptions consistent with County criteria, and post-development release rates are controlled to ensure that discharges from the WQCV/EURV, 10-year, and 100-year events do not exceed historic peak flow rates at the point of discharge. Outlet control structures are configured to provide stage-dependent flow control, ensuring effective attenuation across the full range of storm events without emergency spillway activation for storms up to and including the 100-year event. Emergency spillways are sized to safely pass flows in excess of the 100-year event while maintaining adequate freeboard and embankment stability, and all detention features are designed to provide access, sediment removal, and long-term maintenance. The proposed design provides long-term functionality consistent with County ownership and maintenance standards.

Detention Pond 1 is a permanent stormwater control facility that serves the dual purposes of detention storage and water quality treatment. The facility provides full-spectrum detention, attenuating post-development runoff such that discharges rates are at or below historic release rates for the water quality capture volume (WQCV/EURV), 10-year, and 100-year storm events.

Permanent stormwater infrastructure associated with Detention Pond 1 includes a concrete trickle channel to convey low flows, forebays at storm sewer inflow locations to promote sediment capture and facilitate maintenance, an outlet control structure to regulate discharge rates, and dedicated maintenance access to all relevant stormwater features. In addition, a soil-filled riprap emergency spillway with an associated reinforced concrete cutoff wall will be provided to safely convey and control flows in excess of the design capacity and to protect against erosion and structural instability.

The design and sizing methodology for Detention Pond 1 and its associated appurtenances were completed in accordance with the El Paso County Drainage Criteria Manual and were modeled using the Mile High Flood District (MHFD) Detention Spreadsheet, Version 4.07, consistent with the methodologies outlined in the MHFD Urban Storm Drainage Criteria Manual (USDCM), Volumes I and II.

Detention Pond 2 is a permanent stormwater control facility that serves the dual purposes of detention storage and water quality treatment. The facility provides full-spectrum detention, attenuating post-development runoff such that discharges rates are at or below historic release rates for the water quality capture volume (WQCV/EURV), 10-year, and 100-year storm events.

Permanent stormwater infrastructure associated with Detention Pond 2 includes a concrete trickle channel to convey low flows, forebays at storm sewer inflow locations

to promote sediment capture and facilitate maintenance, an outlet control structure to regulate discharge rates, and dedicated maintenance access to all relevant stormwater features. In addition, a soil-filled riprap emergency spillway with an associated reinforced concrete cutoff wall will be provided to safely convey and control flows in excess of the design capacity and to protect against erosion and structural instability.

The design and sizing methodology for Detention Pond 2 and its associated appurtenances were completed in accordance with the El Paso County Drainage Criteria Manual and were modeled using the Mile High Flood District (MHFD) Detention Spreadsheet, Version 4.07, consistent with the methodologies outlined in the MHFD Urban Storm Drainage Criteria Manual (USDCM), Volumes I and II.

See **Appendix C** for more information on the calculations and design for both ponds.

B. Proposed Sub-Basin Descriptions

Basin A-1

This 20.10-acre sub-basin is comprised of large lot single-family homes, landscaping, open space, and proposed detention pond area. The proposed impervious coverage for this sub-basin is 23.1%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 18.50-minutes. The peak runoff during a 5-year design storm is 14.61 CFS and 49.74 CFS during a 100-year design storm. Runoff from this sub-basin will flow overland and be intercepted by Swale A and conveyed to Detention Pond 1.

Basin A-2

This 1.79-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 12.32-minutes. The peak runoff during a 5-year design storm is 6.13 CFS and 10.98 CFS during a 100-year design storm. Runoff from this sub-basin will be conveyed via roadside swale along Street A to the north and discharge into Swale A where it will be conveyed to Detention Pond 1.

Basin A-3

This 3.12-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 53.8%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 13.97-minutes. The peak runoff during a 5-year design storm is 5.62 CFS and 12.54 CFS during a 100-year design storm. Runoff from this sub-basin will be conveyed via roadside swale along Street A to the north, flow under Street A via a 24” culvert and discharge into Swale A where it will be conveyed to Detention Pond 1.

Basin A-4

This 17.56-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 24.1%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 15.33-minutes. The peak runoff during a 5-year design storm is 14.17 CFS and 47.53 CFS during a 100-year design storm. Runoff from this sub-basin will sheet flow to the south side of Street E where it will be collected in a roadside swale and conveyed under Street E via a 30" culvert where it will discharge to Basin A-2.

Basin AOS-1

This 0.40-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 10.00-minutes. The peak runoff during a 5-year design storm is 1.47 CFS and 2.63 CFS during a 100-year design storm. Runoff from this sub-basin will be conveyed via roadside swale to the west and discharge offsite, following historic drainage patterns. Detention Pond 1 has been sized to account for this undetained discharge to the west.

Basin AOS-2

This 8.37-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 16.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 17.94-minutes. The peak runoff during a 5-year design storm is 5.06 CFS and 19.65 CFS during a 100-year design storm. Runoff from the sub-basin will sheet flow to the south side of Street E where it will be collected by a roadside swale and conveyed west off site, following historic drainage patterns. Detention Pond 1 has been sized to account for this undetained discharge to the west.

Basin B-1

This 20.68-acre sub-basin is comprised of large lot single-family homes, landscaping, open space, and proposed detention pond area. The proposed impervious coverage for this sub-basin is 27.1%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 18.58-minutes. The peak runoff during a 5-year design storm is 17.33 CFS and 53.97 CFS during a 100-year design storm. Runoff from this sub-basin flow overland to the north directly into Detention Pond 1 or be captured in Swale B1 and conveyed to Detention Pond 1.

Basin B-2

This 1.67-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 11.18-minutes. The peak runoff during a 5-

year design storm is 5.95 CFS and 10.66 CFS during a 100-year design storm. Runoff from this sub-basin will be collected in a roadside swale along the north side of Street E and west side of Street B and conveyed to Swale B1 and ultimately to Detention Pond 1.

Basin B-3

This 2.96-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 44.7%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 9.35-minutes. The peak runoff during a 5-year design storm is 5.22 CFS and 12.64 CFS during a 100-year design storm. Runoff from this sub-basin will be collected in roadside swales along the north side of Street E and the east side of Street B and collected in a 42" culvert under Street B and discharge to swale B1 and ultimately to Detention Pond 1.

Basin B-4

This 19.23-acre sub-basin is comprised of large lot single-family homes, and associated landscaping and open space. The proposed impervious coverage for this sub-basin is 20.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 18.03-minutes. The peak runoff during a 5-year design storm is 12.48 CFS and 46.08 CFS during a 100-year design storm. Runoff from this sub-basin flow overland to the north and be intercepted by Swales B2 and B3 and conveyed west to a 42" culvert underneath Street B and into Swale B1 and ultimately Detention Pond 1.

Basin B-5

This 0.73-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 10.00-minutes. The peak runoff during a 5-year design storm is 2.71 CFS and 4.86 CFS during a 100-year design storm. Runoff from this sub-basin will be collected in a roadside swale on the north side of Street E and conveyed to a lowpoint where it will discharge into Basin B4.

Basin B-6

This 18.88-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 23.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 16.97-minutes. The peak runoff during a 5-year design storm is 14.26 CFS and 48.59 CFS during a 100-year design storm. Runoff from this sub-basin will flow overland to the north and be collected in a roadside swale to the south of Street E and conveyed to a lowpoint, where it will be conveyed via 30" culvert underneath Street E and discharge into Basin B4.

Basin B-7

This 10.22-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 25.8%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 13.76-minutes. The peak runoff during a 5-year design storm is 9.37 CFS and 29.95 CFS during a 100-year design storm. Runoff from this sub-basin will flow overland to the north and be collected in a roadside swale to the south of Street E and conveyed to a storm sewer system that will convey it under Street E and discharge into a roadside swale within Basin B2.

Basin B-8

This 1.46-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 5.84-minutes. The peak runoff during a 5-year design storm is 6.50 CFS and 11.64 CFS during a 100-year design storm. Runoff from this sub-basin will be collected by curb and gutter on the west side of Street B and conveyed to a Type R inlet where it will be collected and discharged to a roadside swale within Basin B2.

Basin B-9

This 9.62-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 32.2%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 10.49-minutes. The peak runoff during a 5-year design storm is 11.96 CFS and 34.00 CFS during a 100-year design storm. Runoff from this sub-basin will be collected by curb and gutter on the east side of Street B and conveyed to a Type R inlet where it will be collected and discharged to a roadside swale within Basin B2.

Basin B-10

This 0.74-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 10.00-minutes. The peak runoff during a 5-year design storm is 2.74 CFS and 4.91 CFS during a 100-year design storm. Runoff from this sub-basin will be collected by curb and gutter on the north side of Street F and conveyed to a Type R inlet where it will be collected, conveyed via storm sewer along Street B and discharged to a roadside swale within Basin B2.

Basin B-11

This 0.75-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The

time-of-concentration was calculated to be 10.00-minutes. The peak runoff during a 5-year design storm is 2.80 CFS and 5.02 CFS during a 100-year design storm. Runoff from this sub-basin will be collected by curb and gutter on the south side of Street F and conveyed to a Type R inlet where it will be collected, conveyed via storm sewer along Street B and discharged to a roadside swale within Basin B2.

Basin B-12

This 1.51-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 6.52-minutes. The peak runoff during a 5-year design storm is 6.48 CFS and 11.60 CFS during a 100-year design storm. Runoff from this sub-basin will be collected by curb and gutter on the north side of Street F and conveyed to a Type R inlet where it will be collected, conveyed via storm sewer along Street B and discharged to a roadside swale within Basin B2.

Basin B-13

This 1.34-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 6.51-minutes. The peak runoff during a 5-year design storm is 5.74 CFS and 10.28 CFS during a 100-year design storm. Runoff from this sub-basin will be collected by curb and gutter on the south side of Street F and conveyed to a Type R inlet where it will be collected, conveyed via storm sewer along Street B and discharged to a roadside swale within Basin B2.

Basin C-1

This 8.62-acre sub-basin is comprised of large lot single-family homes, landscaping, open space, and proposed detention pond area. The proposed impervious coverage for this sub-basin is 26.9%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 15.42-minutes. The peak runoff during a 5-year design storm is 7.83 CFS and 24.44 CFS during a 100-year design storm. Runoff from this sub-basin will overland flow to the north and either be collected in an area inlet or flow directly into Detention Pond 2.

Basin C-2

This 1.65-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 11.74-minutes. The peak runoff during a 5-year design storm is 5.77 CFS and 10.34 CFS during a 100-year design storm. Runoff from this sub-basin will be collected in a roadside swale along the north side of Street E and the east side of Street C and be conveyed north to an area inlet near the cul de

sac of Street C. From there it will be conveyed via 24" storm sewer to Detention Pond 2.

Basin C-3

This 0.90-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 5.92-minutes. The peak runoff during a 5-year design storm is 3.97 CFS and 7.11 CFS during a 100-year design storm. Runoff from this sub-basin will be collected in a roadside swale along the north side of Street E and the west side of Street C and be conveyed north to an area inlet near the cul de sac of Street C. From there it will be conveyed via 24" storm sewer to Detention Pond 2.

Basin C-4

This 2.19-acre sub-basin is comprised of large lot single-family homes, and associated landscaping and open space. The proposed impervious coverage for this sub-basin is 20.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 14.94-minutes. The peak runoff during a 5-year design storm is 1.55 CFS and 5.71 CFS during a 100-year design storm. Runoff from this sub-basin will overland flow to the north and be collected into an area inlet near the cul de sac of Street C. From there it will be conveyed via 24" storm sewer to Detention Pond 2.

Basin C-5

This 33.57-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 24.8%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 20.22-minutes. The peak runoff during a 5-year design storm is 24.92 CFS and 81.54 CFS during a 100-year design storm. Runoff from will overland flow to the north and be collected in a swale on the south side of Street E where it will be conveyed to the lowpoint. A 36" culvert with convey the runoff underneath Street E and discharge to the roadside swale in Basin C-2.

Basin D-1

This 9.99-acre sub-basin is comprised of large lot single-family homes, landscaping, open space, and proposed detention pond area. The proposed impervious coverage for this sub-basin is 37.4%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 14.00-minutes. The peak runoff during a 5-year design storm is 12.84 CFS and 35.20 CFS during a 100-year design storm. Runoff from this sub-basin will overland flow to the north and either be collected and conveyed by Swale D1 or flow directly to Detention Pond 2.

Basin D-2

This 0.54-acre sub-basin is comprised of roadway improvements and associated roadside swales. The proposed impervious coverage for this sub-basin has been conservatively calculated at 100.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 10.00-minutes. The peak runoff during a 5-year design storm is 2.02 CFS and 3.61 CFS during a 100-year design storm. Runoff from this sub-basin will be collected and conveyed by a roadside swale along the north side of Street E and the west side of Street D. Runoff will then discharge into Swale D1 within Basin D-1 and ultimately end up in Detention Pond 2..

Basin D-3

This 4.11-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 54.5%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 14.87-minutes. The peak runoff during a 5-year design storm is 7.28 CFS and 16.18 CFS during a 100-year design storm. Runoff from this sub-basin will overland flow to the northwest and be collected in a roadside swale along Street E and Street D. Runoff will be conveyed to a 30" culvert underneath Street D and discharge to Swale D1 within Basin D-1 and ultimately end up in Detention Pond 2.

Basin D-4

This 18.12-acre sub-basin is comprised of large lot single-family homes, and associated landscaping and open space improvements. The proposed impervious coverage for this sub-basin is 22.1%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 19.53-minutes. The peak runoff during a 5-year design storm is 12.36 CFS and 43.11 CFS during a 100-year design storm. Runoff from this sub-basin will flow overland to the northwest and be collected in Swale D2 and conveyed to a 30" culvert underneath Street B and discharge to Swale D1 within Basin D-1 and ultimately end up in Detention Pond 2.

Basin D-5

This 9.14-acre sub-basin is comprised of large lot single-family homes, and associated roadway improvements, landscaping, and open space. The proposed impervious coverage for this sub-basin is 36.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 14.97-minutes. The peak runoff during a 5-year design storm is 10.95 CFS and 29.41 CFS during a 100-year design storm. Runoff from this sub-basin will overland flow to the northwest and be collected in a roadside swale on the west and east side of Street E. Runoff will be conveyed to a lowpoint and conveyed under Street E via a 24" storm sewer and discharge to the roadside swale within Basin D-2.

Basin OS-1

This 15.81-acre sub-basin is comprised of large lot single-family homes, and associated landscaping and open space improvements. The proposed impervious coverage for

this sub-basin is 20.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 16.56-minutes. The peak runoff during a 5-year design storm is 10.67 CFS and 39.40 CFS during a 100-year design storm. Runoff cannot reach the proposed detention ponds due to existing topography carrying it to the northwest. Any development in this area will require private, on-lot detention improvements at the time of Plot Plan to meet the requirements of El Paso County.

Basin OS-2

This 24.96-acre sub-basin is comprised of large lot single-family homes, and associated landscaping and open space improvements. The proposed impervious coverage for this sub-basin is 20.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 13.36-minutes. The peak runoff during a 5-year design storm is 18.44 CFS and 68.11 CFS during a 100-year design storm. Runoff cannot reach the proposed detention ponds due to existing topography carrying it to the southwest. Any development in this area will require private, on-lot detention improvements at the time of Plot Plan to meet the requirements of El Paso County.

Basin OS-3

This 5.02-acre sub-basin is comprised of large lot single-family homes, and associated landscaping and open space improvements. The proposed impervious coverage for this sub-basin is 20.0%, and the predominant soil group is Group B. The time-of-concentration was calculated to be 12.67-minutes. The peak runoff during a 5-year design storm is 3.79 CFS and 14.00 CFS during a 100-year design storm. Runoff cannot reach the proposed detention ponds due to existing topography carrying it to the southeast. Any development in this area will require private, on-lot detention improvements at the time of Plot Plan to meet the requirements of El Paso County.

V. Sediment, Erosion Control, Stormwater Quality

A. Temporary Sediment and Erosion Control

This site utilizes the temporary sediment and erosion control devices and Best Management Practices (BMPs) that will be developed with the Final Construction Documents. These temporary sediment and erosion control BMPs will include inlet protection, silt fence, sediment control logs, etc.

B. Permanent Water Quality BMPs

A separate Sediment & Erosion Control Plan Report (SESC) will be prepared and provided during the final design phase of this project in order to provide further direction for erosion control measures and implementation. The proposed detention ponds, Detention Pond 1 and Detention Pond 2, will provide storage and outlet control for the

Water Quality Control Volume and the Excess Urban Runoff Volume, as shown in the preliminary design contained within Appendix C of this report.

VI. Conclusion

A. Compliance with Standards

The drainage system for Ben Lomand Mountain Village has been designed in accordance with El Paso County Land Development Code, Subdivision Criteria Manual, and The City of Colorado Springs/El Paso County Drainage Criteria Manual and MHFD criteria. The existing Flood Insurance Rate Map (FIRM) in **Appendix A** shows no portion of the site to be within a flood hazard area. Therefore, no map revisions through FEMA are required as part of this development.

B. Drainage Concept

The drainage system was designed to allow storm water to be safely conveyed through and away from the Site without negatively impacting downstream properties. The drainage concepts proposed for this site are in accordance with El Paso County Drainage Criteria Manual and MHFD Criteria and direct flows to the two proposed extended detention basins, Detention Pond 1 and 2, within the development. Flows leaving the Site have been properly treated for water quality and attenuated to discharge below historic release rates, improving the downstream condition. There are two basin AOS-1 and AOS-2 that will leave the site directly. Detention Pond 1 has been sized to overdetain so that the net flow leaving the Site is less than historic flows. Additionally, there are three basins, OS-1, OS-2 and OS-3, containing future residential improvements that will require private, on-lot detention improvements to meet the requirements of El Paso County.

VII. References

1. *Drainage Criteria Manual County of El Paso, Colorado,* dated October 31, 2018.

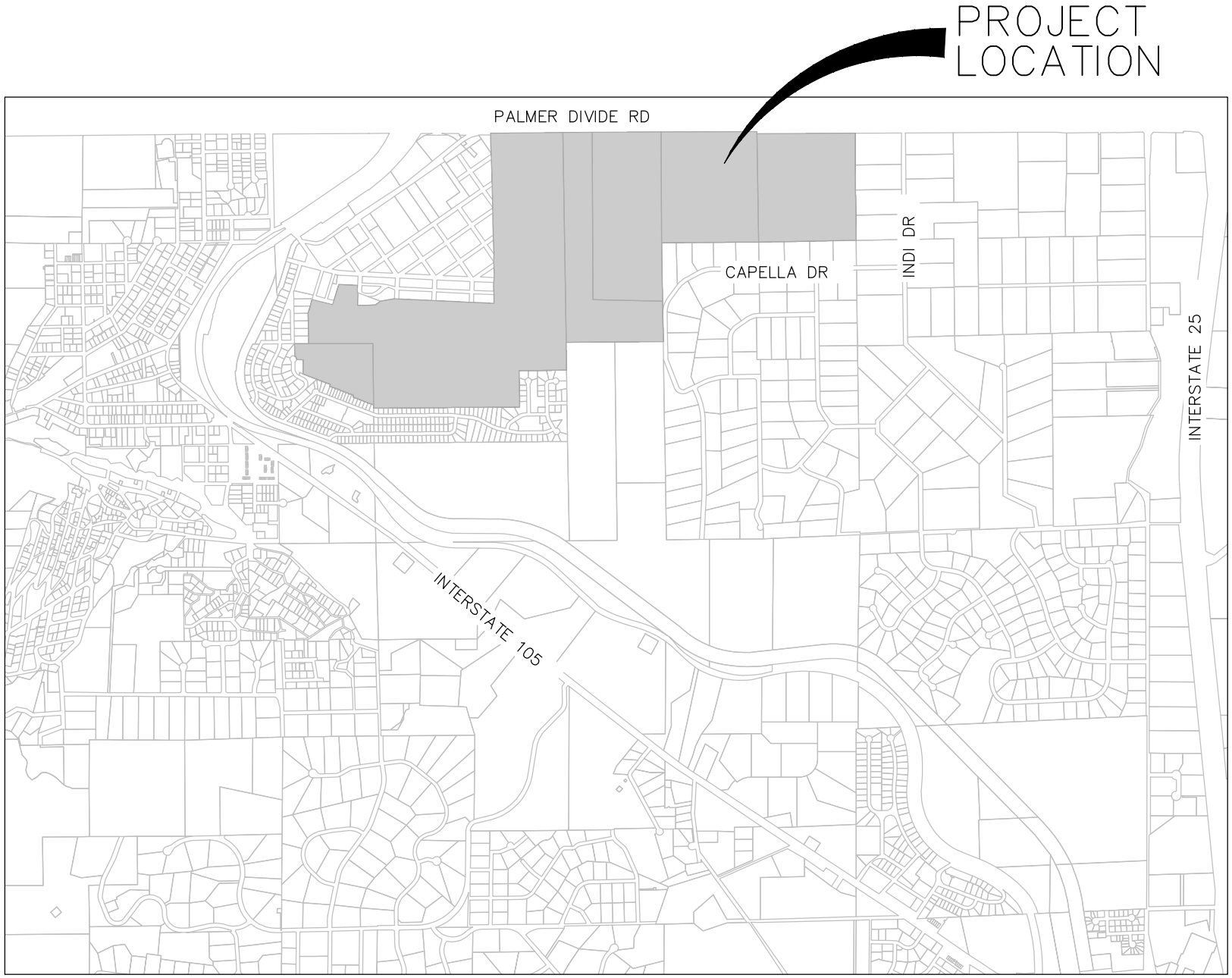
2. Engineering Criteria Manual of El Paso, Colorado, dated January 9th, 2025.

3. MHFD, Urban Storm Drainage Criteria Manual, Volume 1, March, 2024, Mile High Flood District.

4. MHFD, Urban Storm Drainage Criteria Manual, Volume 2, March 2024, Mile High Flood District.

5. MHFD, Urban Storm Drainage Criteria Manual, Volume 3, March 2024, Mile High Flood District

APPENDIX A



LOCATION MAP

N.T.S.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

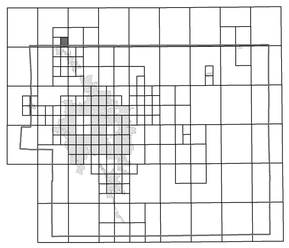
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

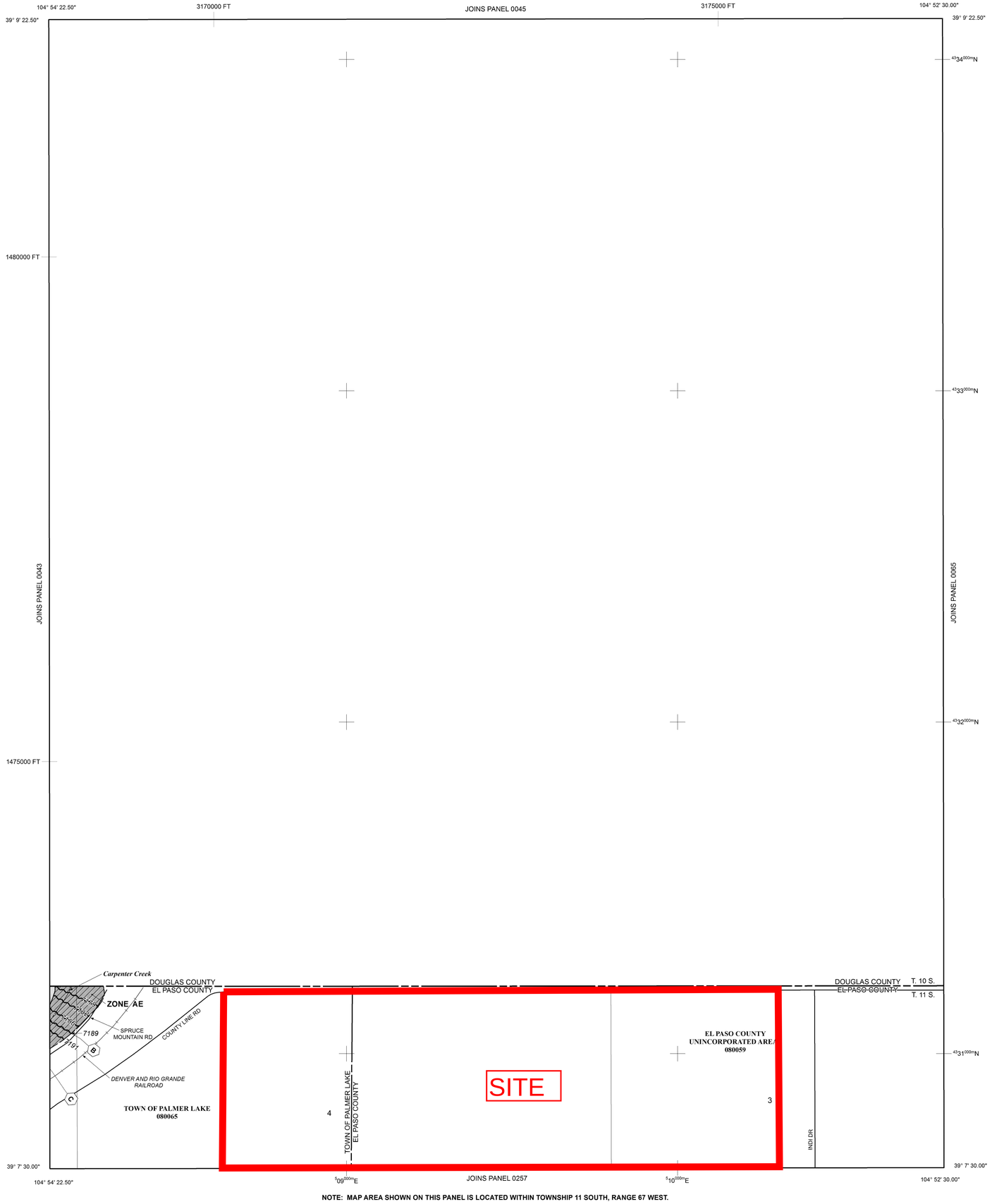
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 67 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0044G

MAP REVISED DECEMBER 7, 2018

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 44 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0044	G
PALMER LAKE, TOWN OF	080065	0044	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
08041C0044G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

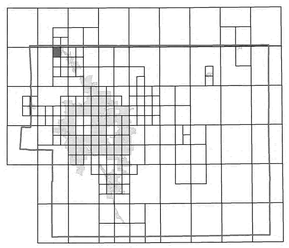
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

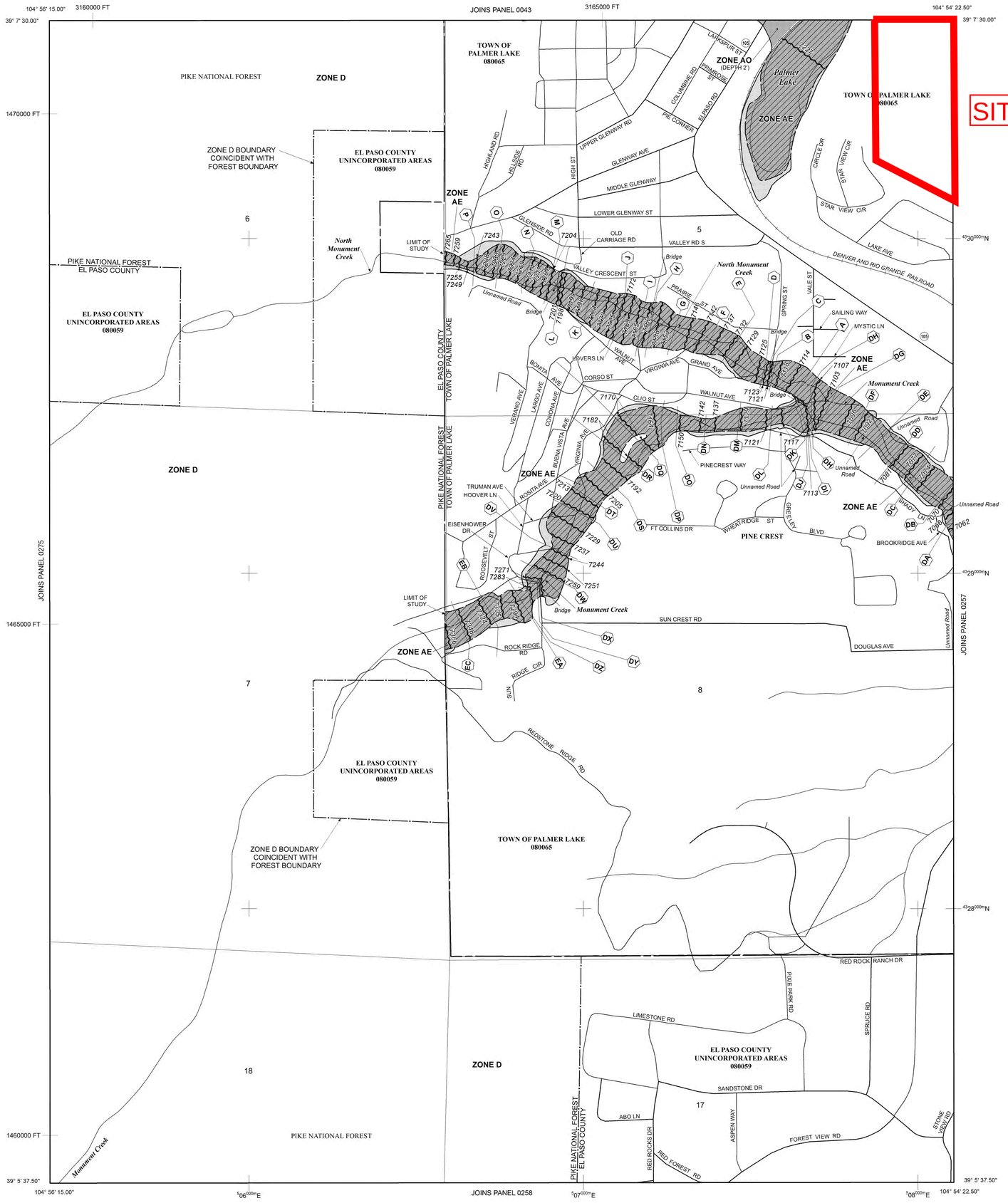
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 67 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

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DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0256G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 256 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0256	G
PALMER LAKE, TOWN OF	080065	0256	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 08041C0256G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

NOTES TO USERS

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SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

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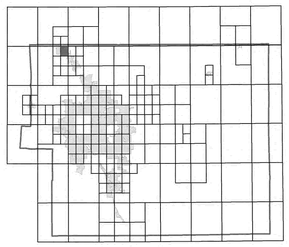
Panel Location Map



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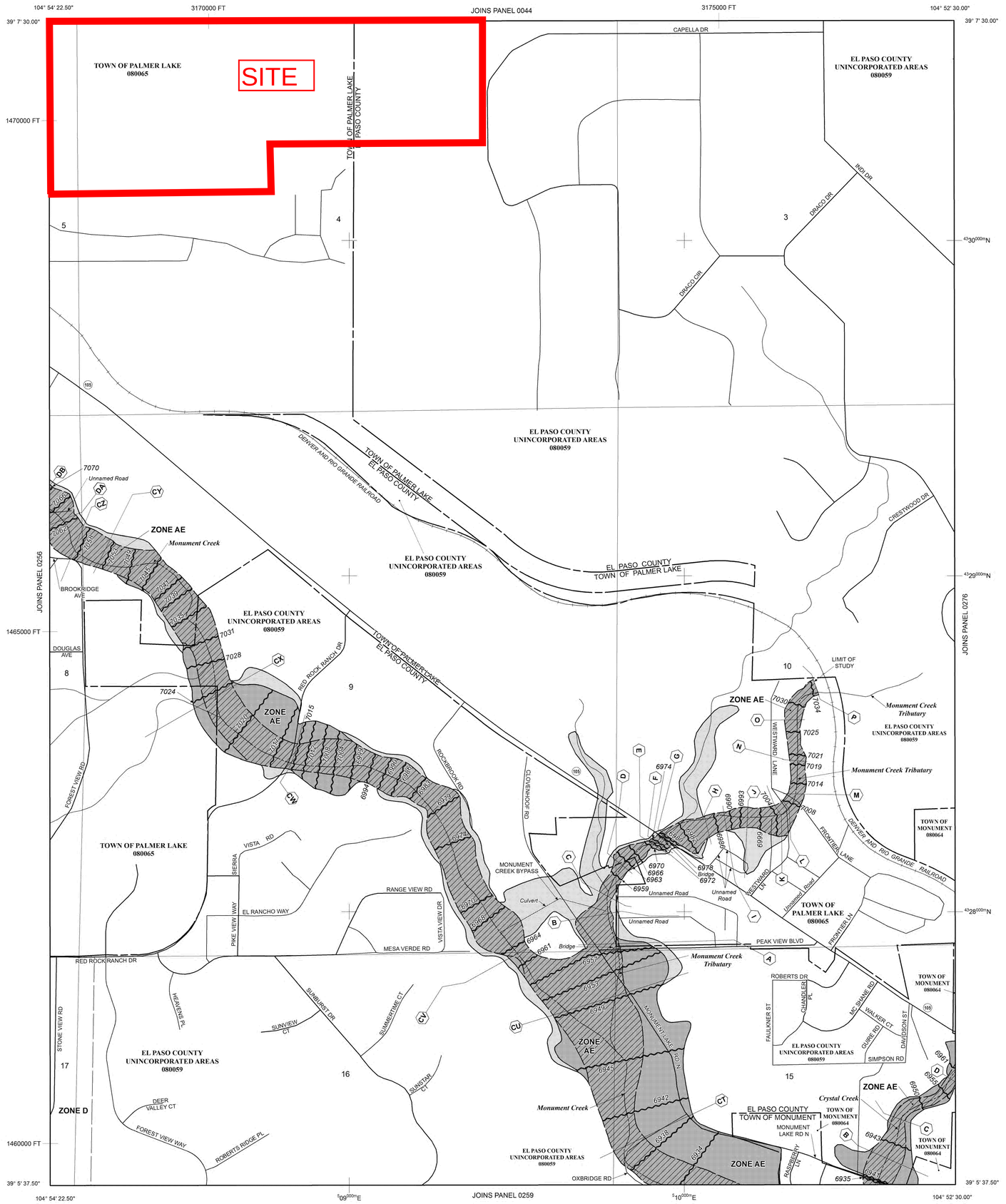

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

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ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

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OTHERWISE PROTECTED AREAS (OPAs)

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Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
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M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0257G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 257 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0257	G
MONUMENT, TOWN OF	080064	0257	G
PALMER LAKE, TOWN OF	080065	0257	G

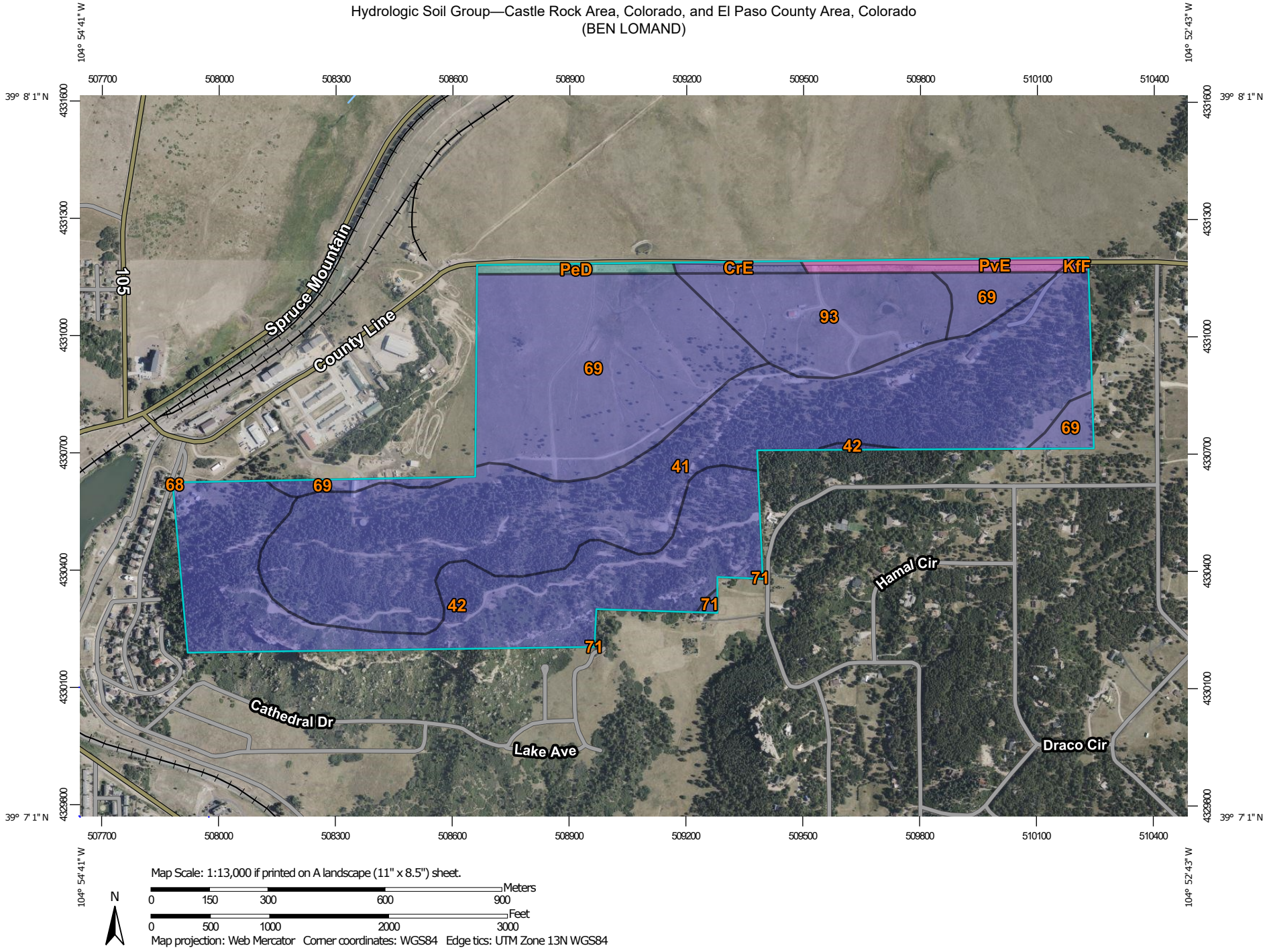
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0257G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Hydrologic Soil Group—Castle Rock Area, Colorado, and El Paso County Area, Colorado
(BEN LOMAND)



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 18, Aug 29, 2025

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 23, Aug 29, 2025

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 23, 2024—Aug 4, 2024

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
CrE	Crowfoot-Tomah sandy loams, 5 to 25 percent slopes	B	2.4	0.7%
KfF	Kettle-Falcon complex, 9 to 65 percent slopes	A	0.5	0.1%
PeD	Peyton sandy loam, 3 to 9 percent slopes	C	3.2	0.9%
PvE	Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes	A	5.7	1.6%
Subtotals for Soil Survey Area			**11.9**	**3.4%**
Totals for Area of Interest			**350.7**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	139.6	39.8%
42	Kettle-Rock outcrop complex	B	77.9	22.2%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	0.0	0.0%
69	Peyton-Pring complex, 8 to 15 percent slopes	B	87.3	24.9%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	0.5	0.1%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	33.5	9.5%
Subtotals for Soil Survey Area			**338.8**	**96.6%**
Totals for Area of Interest			**350.7**	**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.

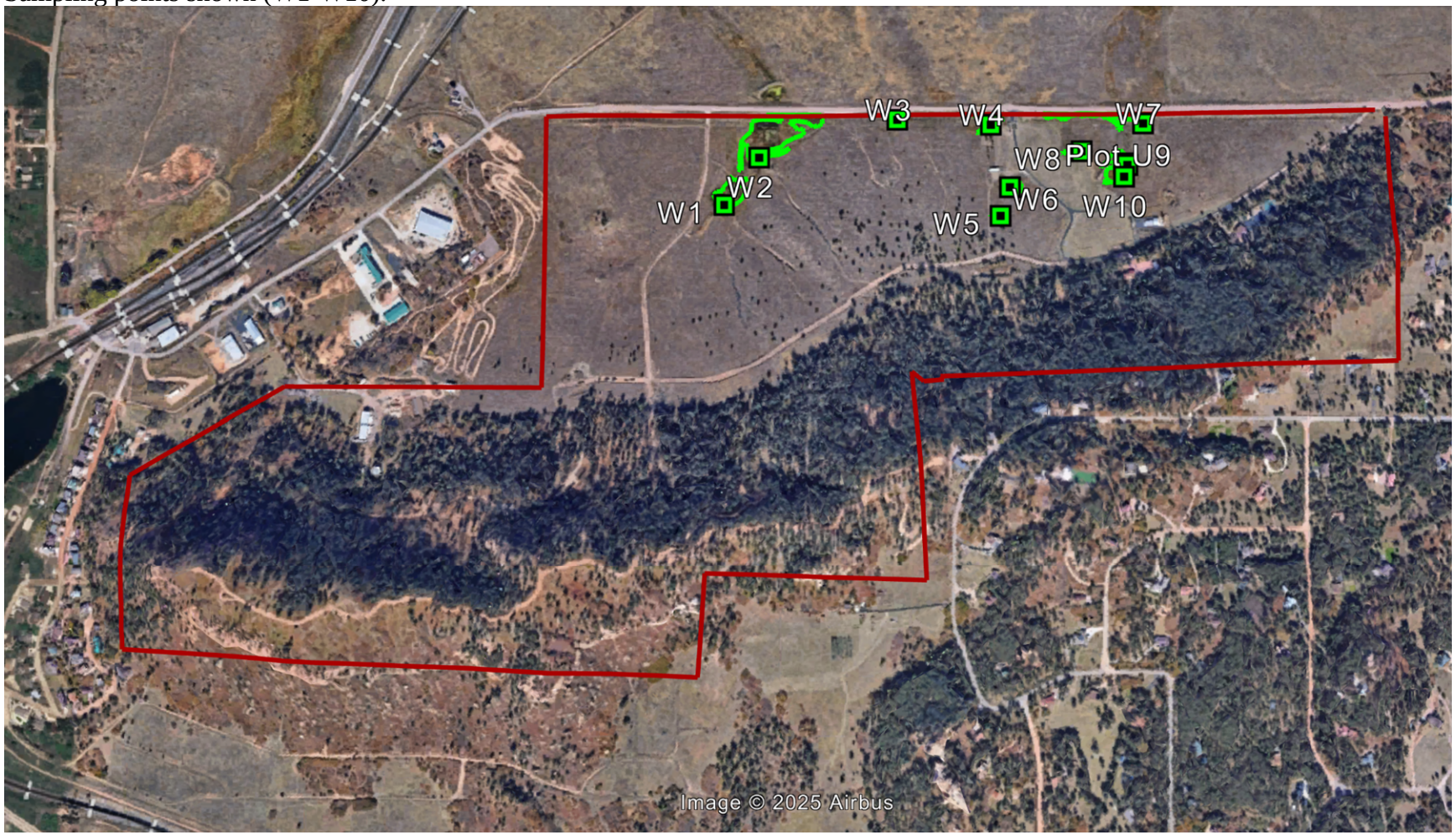
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Map 1 (Sheet 1 of 3). Aerial View of the Ben Lomand Mountain Village wetland delineation area, Delineated Wetlands and Wetland Sampling points shown (W1-W10).



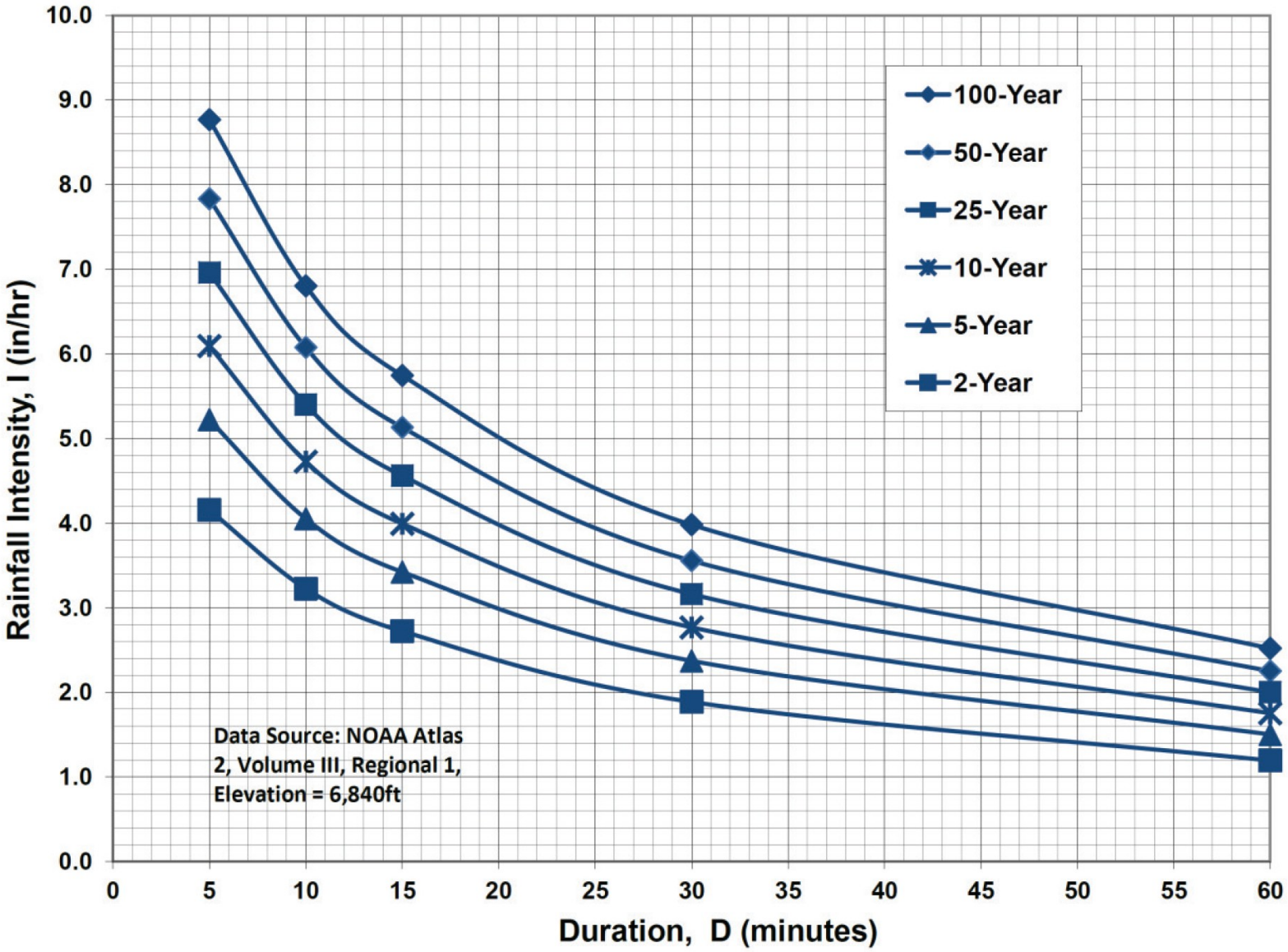
APPENDIX B

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60
Where Z = 6,840 ft/100			

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
⅛ Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
¼ Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
⅓ Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
½ Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Undeveloped Areas													
Historic Flow Analysis—Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Type of Land Surface	**C_v**
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried) *	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20
* For buried riprap, select C_v value based on type of vegetative cover.	



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

EXISTING RUNOFF COEFFICIENTS AND IMPERVIOUSNESS
Ben Lomand
El Paso County, Colorado
2/20/2026

Land Use	Runoff Coefficient				Impervious	
	2-Year	5-Year	10-Year	100-Year		
Ex. Pavement/Conc	0.89	0.90	0.92	0.96	100.0%	*
Gravel	0.57	0.59	0.63	0.70	80.0%	
Lawn/Open Space/Historic	0.03	0.09	0.17	0.36	2.0%	
Ex. Residential (2.5 Acre)	0.12	0.20	0.27	0.44	20.0%	**
Pond (HWL)	0.89	0.90	0.92	0.96	100.0%	

See Appendix A for soil descriptions
Hyrdrologic Group: Type B 100%

Runoff Coefficients: El Paso County Drainage Criteria Manual Table 6-6

Basin Designation	Total Area (AC)	Ex. Pavement/ Concrete/Building (AC)	Gravel (AC)	Lawn/Open Space/Historic (AC)	Ex. Residential (AC)	Pond HWL (AC)	Composite Runoff Coefficient				Composite Imperviousness (%)
							2-Year	5-Year	10-Year	100-Year	
E1	46.21	0.32		45.89			0.04	0.10	0.18	0.36	2.7%
E2	83.64	0.43		76.60	6.61		0.04	0.10	0.18	0.37	3.9%
E3	53.51	0.21		46.10	7.20		0.05	0.11	0.19	0.37	4.8%
E4	33.94	0.68		25.05	8.22		0.07	0.13	0.21	0.39	8.3%
EOS1	23.84			23.84			0.03	0.09	0.17	0.36	2.0%
EOS2	28.20			28.20			0.03	0.09	0.17	0.36	2.0%
EOS3	6.40			6.40			0.03	0.09	0.17	0.36	2.0%
TOTAL	**275.74**	**1.64**	**0.00**	**252.07**	**22.03**	**0.00**	**0.04**	**0.10**	**0.18**	**0.37**	**4.0%**

EXISTING TIME OF CONCENTRATION
Ben Lomand
El Paso County, Colorado

DATE: 2/20/2026
CALCULATED BY: BRB

PROJECT: UNC.MOCO.01

			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)					t_c CHECK (URBANIZED BASINS)			FINAL t_c
TRIBUTARY BASINS	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	Conveyance Coefficient	VEL fps (9)	t_t Min. (10)	COMP. t_c (11)	TOTAL LENGTH (12)	t_c CHECK Max. (13)	Min. (14)
E1	46.21	0.10	300	26.30	10.68	2850	8.62	2.5	0.73	64.71	75.39	3150	27.50	27.50
E2	83.64	0.10	300	33.60	9.78	2740	7.08	2.5	0.67	68.65	78.43	3040	26.89	26.89
E3	53.51	0.11	300	28.90	10.22	1710	9.47	2.5	0.77	37.05	47.27	2010	21.17	21.17
E4	33.94	0.13	300	13.60	12.78	1865	5.11	2.5	0.57	55.00	67.78	2165	22.03	22.03
EOS1	23.84	0.09	300	29.63	10.32	2050	12.75	2.5	0.89	38.27	48.60	2350	23.06	23.06
EOS2	28.20	0.09	300	24.76	10.95	335	34.38	2.5	1.47	3.81	14.76	635	13.53	13.53
EOS3	6.40	0.09	300	17.37	12.31	280	12.18	2.5	0.87	5.35	17.66	580	13.22	13.22

NOTES:

$T_i = [1.8 \times (1.1 - C_5) \times L^{0.5}] / (S^{0.33})$ *S IN %*

$T_t = L / (60 \times V)$

T_C Check = L/180+10

Tc Min = 10 Minutes

Table 6-7. Conveyance Coefficient, C_v

EXPAND

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried) *	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

EXISTING 5-YEAR RUNOFF CALCULATIONS

Ben Lomand

El Paso County, Colorado

DATE: **2/20/2026**
CALCULATED BY: **BRB**

PROJECT: UNC.MOCO.01
DESIGN STORM: 5-Year

Sub-Basin	Area (acres)	C	C x A	Tc (min)	Intensity* (in/hr)	Qd = CIA (cfs)
E1	46.21	0.10	4.42	27.50	2.61	**11.54**
E2	83.64	0.10	8.60	26.89	2.65	**22.76**
E3	53.51	0.11	5.78	21.17	3.00	**17.36**
E4	33.94	0.13	4.51	22.03	2.94	**13.28**
EOS1	23.84	0.09	2.15	23.06	2.88	**6.17**
EOS2	28.20	0.09	2.54	13.53	3.68	**9.33**
EOS3	6.40	0.09	0.58	13.22	3.71	**2.14**

El Paso Count DCM, Figure 6-5 I_5=-1.50 ln (T_C)+7.583

EXISTING 100-YEAR RUNOFF CALCULATIONS

Ben Lomand

El Paso County, Colorado

DATE: **2/20/2026** **PROJECT: UNC.MOCO.01**

CALCULATED BY: **BRB** **DESIGN STORM:** **100-Year**

Sub-Basin	Area (acres)	C	C x A	Tc (min)	Intensity (in/hr)	Qd = CIA (cfs)
E1	46.21	0.36	16.83	27.50	4.38	**73.76**
E2	83.64	0.37	30.90	26.89	4.44	**137.19**
E3	53.51	0.37	19.97	21.17	5.04	**100.69**
E4	33.94	0.39	13.28	22.03	4.94	**65.65**
EOS1	23.84	0.36	8.58	23.06	4.83	**41.43**
EOS2	28.20	0.36	10.15	13.53	6.17	**62.65**
EOS3	6.40	0.36	2.30	13.22	6.23	**14.35**

El Paso Count DCM, Figure 6-5 I_{100}=-2.52 ln (T_C)+12.735

EXISTING DRAINAGE SUB-BASIN SUMMARY						
Sub-Basin	**Area (acres)**	**Impervious %**	**C_5**	**C_{100}**	**Q_5 (cfs)**	**Q_{100} (cfs)**
E1	46.21	2.7%	0.10	0.36	11.54	73.76
E2	83.64	3.9%	0.10	0.37	22.76	137.19
E3	53.51	4.8%	0.11	0.37	17.36	100.69
E4	33.94	8.3%	0.13	0.39	13.28	65.65
EOS1	23.84	2.0%	0.09	0.36	6.17	41.43
EOS2	28.20	2.0%	0.09	0.36	9.33	62.65
EOS3	6.40	2.0%	0.09	0.36	2.14	14.35

RUNOFF COEFFICIENTS AND IMPERVIOUSNESS
Ben Lomand
El Paso County, Colorado
2/20/2026

Land Use	Runoff Coefficient				Impervious	
	2-Year	5-Year	10-Year	100-Year		
Pavement/Conc	0.89	0.90	0.92	0.96	100.0%	*
Gravel	0.57	0.59	0.63	0.70	80.0%	
Lawn/Open Space	0.03	0.09	0.17	0.36	2.0%	
Residential (2.5 Acre)	0.12	0.20	0.27	0.44	20.0%	**
Pond (HWL)	0.89	0.90	0.92	0.96	100.0%	

See Appendix A for soil descriptions
Hyrdrologic Group: Type B 100%

Runoff Coefficients: El Paso County Drainage Criteria Manual Table 6-6
* Conservatively assume entire ROW as impervious
**Conservatively assumed lot coverage similar to 1 acre lots.

Basin Designation	Total Area (AC)	Pavement/ Concrete/Building (AC)	Gravel (AC)	Lawn/Open Space (AC)	Residential (AC)	Pond HWL (AC)	Composite Runoff Coefficient				Composite Imperviousness (%)
							2-Year	5-Year	10-Year	100-Year	
A-1	20.10	0.32			19.33	0.45	0.15	0.23	0.29	0.46	23.1%
A-2	1.79	1.79					0.89	0.90	0.92	0.96	100.0%
A-3	3.12	1.32			1.80		0.45	0.50	0.55	0.66	53.8%
A-4	17.56	0.48	0.55		16.53		0.16	0.23	0.30	0.46	24.1%
AOS-1	0.40	0.40					0.89	0.90	0.92	0.96	100.0%
AOS-2	8.37	0.40	0.11	3.98	3.88		0.12	0.19	0.26	0.43	16.0%
TOTAL BASIN A	**51.32**	**4.70**	**0.66**	**3.98**	**41.54**	**0.45**	**0.20**	**0.27**	**0.33**	**0.49**	**27.4%**
B-1	20.68	0.12			18.85	1.71	0.19	0.26	0.33	0.49	27.1%
B-2	1.67	1.67					0.89	0.90	0.92	0.96	100.0%
B-3	2.96	0.92			2.05		0.36	0.42	0.47	0.60	44.7%
B-4	19.23				19.23		0.12	0.20	0.27	0.44	20.0%
B-5	0.73	0.73					0.89	0.90	0.92	0.96	100.0%
B-6	18.88	0.71			18.17		0.15	0.23	0.29	0.46	23.0%
B-7	10.22	0.75			9.48		0.18	0.25	0.32	0.48	25.8%
B-8	1.46	1.46					0.89	0.90	0.92	0.96	100.0%
B-9	9.62	1.46			8.15		0.24	0.31	0.37	0.52	32.2%
B-10	0.74	0.74					0.89	0.90	0.92	0.96	100.0%
B-11	0.75	0.75					0.89	0.90	0.92	0.96	100.0%
B-12	1.51	1.51					0.89	0.90	0.92	0.96	99.9%
B-13	1.34	1.34					0.89	0.90	0.92	0.96	100.0%
TOTAL BASIN B	**89.79**	**12.15**	**0.00**	**0.00**	**75.92**	**1.71**	**0.24**	**0.31**	**0.37**	**0.52**	**32.4%**
TOTAL POND 1	**141.11**	**16.85**	**0.66**	**3.98**	**117.46**	**2.17**	**0.22**	**0.29**	**0.36**	**0.51**	**30.6%**
TOTAL POND 1 W/O UNDETAINED	**132.35**	**16.06**	**0.55**	**0.00**	**113.58**	**2.17**	**0.23**	**0.30**	**0.36**	**0.51**	**31.3%**
C-1	8.62	0.19			7.87	0.56	0.19	0.26	0.33	0.49	26.9%
C-2	1.65	1.65					0.89	0.90	0.92	0.96	100.0%
C-3	0.90	0.90					0.89	0.90	0.92	0.96	100.0%
C-4	2.19				2.19		0.12	0.20	0.27	0.44	20.0%
C-5	33.57	2.00			31.57		0.17	0.24	0.31	0.47	24.8%
TOTAL BASIN C	**46.94**	**4.73**	**0.00**	**0.00**	**41.64**	**0.56**	**0.21**	**0.28**	**0.34**	**0.50**	**29.0%**
D-1	9.99	1.13			8.86	0.84	0.28	0.35	0.42	0.58	37.4%
D-2	0.54	0.54					0.89	0.90	0.92	0.96	100.0%
D-3	4.11	1.77			2.34		0.45	0.50	0.55	0.66	54.5%
D-4	18.12	0.47			17.65		0.14	0.22	0.29	0.45	22.1%
D-5	9.14	1.83			7.31		0.27	0.34	0.40	0.54	36.0%
TOTAL BASIN D	**41.90**	**5.74**	**0.00**	**0.00**	**36.16**	**0.84**	**0.24**	**0.31**	**0.38**	**0.53**	**33.0%**
TOTAL POND 2	**88.83**	**10.47**	**0.00**	**0.00**	**77.80**	**1.40**	**0.22**	**0.30**	**0.36**	**0.51**	**30.9%**
TOTAL ONSITE	**229.94**	**27.32**	**0.66**	**3.98**	**195.26**	**3.56**	**0.22**	**0.29**	**0.36**	**0.51**	**30.7%**
OS-1	15.81				15.81		0.12	0.20	0.27	0.44	20.0%
OS-2	24.96				24.96		0.12	0.20	0.27	0.44	20.0%
OS-3	5.02				5.02		0.12	0.20	0.27	0.44	20.0%
TOTAL OS BASINS	**45.79**	**0.00**	**0.00**	**0.00**	**45.79**	**0.00**	**0.12**	**0.20**	**0.27**	**0.44**	**20.0%**

TIME OF CONCENTRATION
Ben Lomand
El Paso County, Colorado

DATE: 2/20/2026 **PROJECT:** UNC.MOCO.01
CALCULATED BY: BRB

			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)					t_c CHECK (URBANIZED BASINS)			FINAL t_c
TRIBUTARY BASINS	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	Conveyance Coefficient	VEL fps (9)	t_t Min. (10)	COMP. t_c (11)	TOTAL LENGTH (12)	t_c CHECK Max. (13)	Min. (14)
A-1	20.10	0.23	300	11.20	12.30	1230	7.20	2.5	0.67	30.56	42.86	1530	18.50	18.50
A-2	1.79	0.90	70	4.80	1.80	2095	4.90	15.0	3.32	10.52	12.32	2165	22.03	12.32
A-3	3.12	0.50	65	4.80	5.24	1800	5.25	15.0	3.44	8.73	13.97	1865	20.36	13.97
A-4	17.56	0.23	300	42.50	7.88	660	15.30	2.5	0.98	11.25	19.13	960	15.33	15.33
AOS-1	0.40	0.90	80	4.80	1.92	365	3.20	15.0	2.68	2.27	4.19	445	12.47	10.00
AOS-2	8.37	0.19	300	21.70	10.35	1130	16.60	2.5	1.02	18.49	28.84	1430	17.94	17.94
B-1	20.68	0.26	300	11.20	11.81	1245	6.80	2.5	0.65	31.83	43.64	1545	18.58	18.58
B-2	1.67	0.90	100	4.80	2.15	1940	5.70	15.0	3.58	9.03	11.18	2040	21.33	11.18
B-3	2.96	0.42	40	3.20	5.32	1095	9.10	15.0	4.52	4.03	9.35	1135	16.31	9.35
B-4	19.23	0.20	300	11.50	12.57	1145	4.90	2.5	0.55	34.48	47.05	1445	18.03	18.03
B-5	0.73	0.90	75	5.00	1.84	305	2.70	15.0	2.46	2.06	3.90	380	12.11	10.00
B-6	18.88	0.23	300	28.80	9.01	955	13.70	2.5	0.93	17.20	26.21	1255	16.97	16.97
B-7	10.22	0.25	300	25.40	9.13	995	5.70	15.0	3.58	4.63	13.76	1295	17.19	13.76
B-8	1.46	0.90	50	2.00	2.03	1575	11.90	20.0	6.90	3.80	5.84	1625	19.03	5.84
B-9	9.62	0.31	35	2.00	6.74	1565	12.10	20.0	6.96	3.75	10.49	1600	18.89	10.49
B-10	0.74	0.90	25	2.00	1.44	835	4.30	20.0	4.15	3.36	4.79	860	14.78	10.00
B-11	0.75	0.90	25	2.00	1.44	835	4.30	20.0	4.15	3.36	4.79	860	14.78	10.00
B-12	1.51	0.90	100	4.00	2.29	1190	5.50	20.0	4.69	4.23	6.52	1290	17.17	6.52
B-13	1.34	0.90	100	4.00	2.29	1190	5.50	20.0	4.69	4.23	6.51	1290	17.17	6.51
C-1	8.62	0.26	300	9.10	12.66	675	5.70	2.5	0.60	18.85	31.51	975	15.42	15.42
C-2	1.65	0.90	65	5.10	1.70	1895	4.40	15.0	3.15	10.04	11.74	1960	20.89	11.74
C-3	0.90	0.90	105	4.70	2.22	925	7.70	15.0	4.16	3.70	5.92	1030	15.72	5.92
C-4	2.19	0.20	300	11.50	12.57	590	6.50	2.5	0.64	15.43	28.00	890	14.94	14.94
C-5	33.57	0.24	300	25.30	9.24	1540	5.00	10.0	2.24	11.48	20.72	1840	20.22	20.22
D-1	9.99	0.35	300	11.90	10.30	420	10.00	2.5	0.79	8.85	19.15	720	14.00	14.00
D-2	0.54	0.90	60	5.10	1.63	580	9.80	15.0	4.70	2.06	3.69	640	13.56	10.00
D-3	4.11	0.50	105	3.40	7.39	1990	8.75	15.0	4.44	7.47	14.87	2095	21.64	14.87
D-4	18.12	0.22	300	16.50	10.93	1415	6.80	2.5	0.65	36.18	47.11	1715	19.53	19.53
D-5	9.14	0.34	300	17.80	9.19	595	11.80	2.5	0.86	11.55	20.74	895	14.97	14.97
OS-1	15.81	0.20	300	11.90	12.43	880	7.25	2.5	0.67	21.79	34.22	1180	16.56	16.56
OS-2	24.96	0.20	300	33.30	8.85	304	19.80	2.5	1.11	4.55	13.41	604	13.36	13.36
OS-3	5.02	0.20	300	15.55	11.38	180	10.90	2.5	0.83	3.63	15.01	480	12.67	12.67

NOTES:

$T_i = [1.8 \times (1.1 - C_5) \times L^{0.5}] / (S^{0.33})$ *S IN %*

$T_t = L / (60 \times V)$

T_C Check = L/180+10

Tc Min = 10 Minutes

Table 6-7. Conveyance Coefficient, C_v

EXPAND

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried) *	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

5-YEAR RUNOFF CALCULATIONS

Ben Lomand

El Paso County, Colorado

DATE: 2/20/2026 **PROJECT: UNC.MOCO.01**

CALCULATED BY: BRB **DESIGN STORM:** 5-Year

Sub-Basin	Area (acres)	C	C x A	Tc (min)	Intensity* (in/hr)	Qd = CIA (cfs)
A-1	20.10	0.23	4.56	18.50	3.21	**14.61**
A-2	1.79	0.90	1.61	12.32	3.82	**6.13**
A-3	3.12	0.50	1.55	13.97	3.63	**5.62**
A-4	17.56	0.23	4.06	15.33	3.49	**14.17**
AOS-1	0.40	0.90	0.36	10.00	4.13	**1.47**
AOS-2	8.37	0.19	1.56	17.94	3.25	**5.06**
B-1	20.68	0.26	5.42	18.58	3.20	**17.33**
B-2	1.67	0.90	1.50	11.18	3.96	**5.95**
B-3	2.96	0.42	1.23	9.35	4.23	**5.22**
B-4	19.23	0.20	3.85	18.03	3.25	**12.48**
B-5	0.73	0.90	0.66	10.00	4.13	**2.71**
B-6	18.88	0.23	4.28	16.97	3.34	**14.26**
B-7	10.22	0.25	2.57	13.76	3.65	**9.37**
B-8	1.46	0.90	1.32	5.84	4.94	**6.50**
B-9	9.62	0.31	2.95	10.49	4.06	**11.96**
B-10	0.74	0.90	0.66	10.00	4.13	**2.74**
B-11	0.75	0.90	0.68	10.00	4.13	**2.80**
B-12	1.51	0.90	1.36	6.52	4.77	**6.48**
B-13	1.34	0.90	1.20	6.51	4.77	**5.74**
C-1	8.62	0.26	2.25	15.42	3.48	**7.83**
C-2	1.65	0.90	1.49	11.74	3.89	**5.77**
C-3	0.90	0.90	0.81	5.92	4.91	**3.97**
C-4	2.19	0.20	0.44	14.94	3.53	**1.55**
C-5	33.57	0.24	8.11	20.22	3.07	**24.92**
D-1	9.99	0.35	3.54	14.00	3.62	**12.84**
D-2	0.54	0.90	0.49	10.00	4.13	**2.02**
D-3	4.11	0.50	2.06	14.87	3.53	**7.28**
D-4	18.12	0.22	3.95	19.53	3.13	**12.36**
D-5	9.14	0.34	3.11	14.97	3.52	**10.95**
OS-1	15.81	0.20	3.16	16.56	3.37	**10.67**
OS-2	24.96	0.20	4.99	13.36	3.70	**18.44**
OS-3	5.02	0.20	1.00	12.67	3.77	**3.79**

El Paso Count DCM, Figure 6-5 I_5=-1.50 ln (T_C)+7.583

100-YEAR RUNOFF CALCULATIONS

Ben Lomand

El Paso County, Colorado

DATE: **2/20/2026** **PROJECT: UNC.MOCO.01**

CALCULATED BY: **BRB** **DESIGN STORM:** **100-Year**

Sub-Basin	Area (acres)	C	C x A	Tc (min)	Intensity (in/hr)	Qd = CIA (cfs)
A-1	20.10	0.46	9.24	18.50	5.38	**49.74**
A-2	1.79	0.96	1.71	12.32	6.41	**10.98**
A-3	3.12	0.66	2.06	13.97	6.09	**12.54**
A-4	17.56	0.46	8.12	15.33	5.86	**47.53**
AOS-1	0.40	0.96	0.38	10.00	6.93	**2.63**
AOS-2	8.37	0.43	3.60	17.94	5.46	**19.65**
B-1	20.68	0.49	10.05	18.58	5.37	**53.97**
B-2	1.67	0.96	1.60	11.18	6.65	**10.66**
B-3	2.96	0.60	1.78	9.35	7.10	**12.64**
B-4	19.23	0.44	8.46	18.03	5.45	**46.08**
B-5	0.73	0.96	0.70	10.00	6.93	**4.86**
B-6	18.88	0.46	8.68	16.97	5.60	**48.59**
B-7	10.22	0.48	4.89	13.76	6.13	**29.95**
B-8	1.46	0.96	1.40	5.84	8.29	**11.64**
B-9	9.62	0.52	4.99	10.49	6.81	**34.00**
B-10	0.74	0.96	0.71	10.00	6.93	**4.91**
B-11	0.75	0.96	0.72	10.00	6.93	**5.02**
B-12	1.51	0.96	1.45	6.52	8.01	**11.60**
B-13	1.34	0.96	1.28	6.51	8.01	**10.28**
C-1	8.62	0.49	4.18	15.42	5.84	**24.44**
C-2	1.65	0.96	1.58	11.74	6.53	**10.34**
C-3	0.90	0.96	0.86	5.92	8.25	**7.11**
C-4	2.19	0.44	0.97	14.94	5.92	**5.71**
C-5	33.57	0.47	15.81	20.22	5.16	**81.54**
D-1	9.99	0.58	5.79	14.00	6.08	**35.20**
D-2	0.54	0.96	0.52	10.00	6.93	**3.61**
D-3	4.11	0.66	2.73	14.87	5.93	**16.18**
D-4	18.12	0.45	8.22	19.53	5.25	**43.11**
D-5	9.14	0.54	4.97	14.97	5.92	**29.41**
OS-1	15.81	0.44	6.96	16.56	5.66	**39.40**
OS-2	24.96	0.44	10.98	13.36	6.20	**68.11**
OS-3	5.02	0.44	2.21	12.67	6.34	**14.00**

El Paso Count DCM, Figure 6-5 I_{100}=-2.52 ln (T_C)+12.735

DRAINAGE SUB-BASIN SUMMARY						
Sub-Basin	**Area (acres)**	**Impervious %**	**C_5**	**C_{100}**	**Q_5 (cfs)**	**Q_{100} (cfs)**
A-1	20.10	23.1%	0.23	0.46	14.61	49.74
A-2	1.79	100.0%	0.90	0.96	6.13	10.98
A-3	3.12	53.8%	0.50	0.66	5.62	12.54
A-4	17.56	24.1%	0.23	0.46	14.17	47.53
AOS-1	0.40	100.0%	0.90	0.96	1.47	2.63
AOS-2	8.37	16.0%	0.19	0.43	5.06	19.65
B-1	20.68	27.1%	0.26	0.49	17.33	53.97
B-2	1.67	100.0%	0.90	0.96	5.95	10.66
B-3	2.96	44.7%	0.42	0.60	5.22	12.64
B-4	19.23	20.0%	0.20	0.44	12.48	46.08
B-5	0.73	100.0%	0.90	0.96	2.71	4.86
B-6	18.88	23.0%	0.23	0.46	14.26	48.59
B-7	10.22	25.8%	0.25	0.48	9.37	29.95
B-8	1.46	100.0%	0.90	0.96	6.50	11.64
B-9	9.62	32.2%	0.31	0.52	11.96	34.00
B-10	0.74	100.0%	0.90	0.96	2.74	4.91
B-11	0.75	100.0%	0.90	0.96	2.80	5.02
B-12	1.51	99.9%	0.90	0.96	6.48	11.60
B-13	1.34	100.0%	0.90	0.96	5.74	10.28
C-1	8.62	26.9%	0.26	0.49	7.83	24.44
C-2	1.65	100.0%	0.90	0.96	5.77	10.34
C-3	0.90	100.0%	0.90	0.96	3.97	7.11
C-4	2.19	20.0%	0.20	0.44	1.55	5.71
C-5	33.57	24.8%	0.24	0.47	24.92	81.54
D-1	9.99	37.4%	0.35	0.58	12.84	35.20
D-2	0.54	100.0%	0.90	0.96	2.02	3.61
D-3	4.11	54.5%	0.50	0.66	7.28	16.18
D-4	18.12	22.1%	0.22	0.45	12.36	43.11
D-5	9.14	36.0%	0.34	0.54	10.95	29.41
OS-1	15.81	20.0%	0.20	0.44	10.67	39.40
OS-2	24.96	20.0%	0.20	0.44	18.44	68.11
OS-3	5.02	20.0%	0.20	0.44	3.79	14.00

APPENDIX C

18" Pipe

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Normal Depth	1.4 ft
Diameter	1.5 ft

Results	
Discharge	11.30 cfs
Flow Area	1.7 ft²
Wetted Perimeter	3.9 ft
Hydraulic Radius	0.4 ft
Top Width	0.75 ft
Critical Depth	1.3 ft
Percent Full	93.3 %
Critical Slope	0.011 ft/ft
Velocity	6.58 ft/s
Velocity Head	0.67 ft
Specific Energy	2.07 ft
Froude Number	0.766
Maximum Discharge	11.30 cfs
Discharge Full	10.50 cfs
Slope Full	0.012 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	72.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	1.3 ft
Channel Slope	0.010 ft/ft
Critical Slope	0.011 ft/ft

24" Pipe

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Normal Depth	1.9 ft
Diameter	2.0 ft

Results	
Discharge	24.31 cfs
Flow Area	3.1 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.6 ft
Top Width	0.87 ft
Critical Depth	1.7 ft
Percent Full	95.0 %
Critical Slope	0.011 ft/ft
Velocity	7.88 ft/s
Velocity Head	0.97 ft
Specific Energy	2.87 ft
Froude Number	0.739
Maximum Discharge	24.33 cfs
Discharge Full	22.62 cfs
Slope Full	0.012 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	72.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.9 ft
Critical Depth	1.7 ft
Channel Slope	0.010 ft/ft
Critical Slope	0.011 ft/ft

30" Pipe

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Normal Depth	2.3 ft
Diameter	2.5 ft

Results	
Discharge	44.02 cfs
Flow Area	4.7 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	0.7 ft
Top Width	1.36 ft
Critical Depth	2.2 ft
Percent Full	92.0 %
Critical Slope	0.010 ft/ft
Velocity	9.32 ft/s
Velocity Head	1.35 ft
Specific Energy	3.65 ft
Froude Number	0.880
Maximum Discharge	44.12 cfs
Discharge Full	41.01 cfs
Slope Full	0.012 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	72.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.3 ft
Critical Depth	2.2 ft
Channel Slope	0.010 ft/ft
Critical Slope	0.010 ft/ft

36" Pipe

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Normal Depth	2.8 ft
Diameter	3.0 ft

Results	
Discharge	71.73 cfs
Flow Area	6.9 ft²
Wetted Perimeter	7.9 ft
Hydraulic Radius	0.9 ft
Top Width	1.50 ft
Critical Depth	2.7 ft
Percent Full	93.3 %
Critical Slope	0.010 ft/ft
Velocity	10.45 ft/s
Velocity Head	1.70 ft
Specific Energy	4.50 ft
Froude Number	0.860
Maximum Discharge	71.74 cfs
Discharge Full	66.69 cfs
Slope Full	0.012 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	72.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.8 ft
Critical Depth	2.7 ft
Channel Slope	0.010 ft/ft
Critical Slope	0.010 ft/ft

42" Pipe

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Normal Depth	3.3 ft
Diameter	3.5 ft

Results	
Discharge	108.20 cfs
Flow Area	9.4 ft²
Wetted Perimeter	9.3 ft
Hydraulic Radius	1.0 ft
Top Width	1.62 ft
Critical Depth	3.2 ft
Percent Full	94.3 %
Critical Slope	0.010 ft/ft
Velocity	11.51 ft/s
Velocity Head	2.06 ft
Specific Energy	5.36 ft
Froude Number	0.843
Maximum Discharge	108.22 cfs
Discharge Full	100.60 cfs
Slope Full	0.012 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	97.1 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.3 ft
Critical Depth	3.2 ft
Channel Slope	0.010 ft/ft
Critical Slope	0.010 ft/ft

Roadside Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.050
Channel Slope	0.050 ft/ft
Normal Depth	2.0 ft
Left Side Slope	4.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	90.59 cfs
Flow Area	14.0 ft²
Wetted Perimeter	14.6 ft
Hydraulic Radius	1.0 ft
Top Width	14.00 ft
Critical Depth	2.1 ft
Critical Slope	0.038 ft/ft
Velocity	6.47 ft/s
Velocity Head	0.65 ft
Specific Energy	2.65 ft
Froude Number	1.141
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.0 ft
Critical Depth	2.1 ft
Channel Slope	0.050 ft/ft
Critical Slope	0.038 ft/ft

Swale A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.050
Channel Slope	0.025 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	5.000 H:V
Bottom Width	2.00 ft
Discharge	120.00 cfs

Results	
Normal Depth	2.0 ft
Flow Area	24.3 ft²
Wetted Perimeter	22.5 ft
Hydraulic Radius	1.1 ft
Top Width	22.13 ft
Critical Depth	1.9 ft
Critical Slope	0.037 ft/ft
Velocity	4.94 ft/s
Velocity Head	0.38 ft
Specific Energy	2.39 ft
Froude Number	0.831
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.0 ft
Critical Depth	1.9 ft
Channel Slope	0.025 ft/ft
Critical Slope	0.037 ft/ft

Swale B2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.010 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	5.000 H:V
Bottom Width	2.00 ft
Discharge	100.00 cfs

Results	
Normal Depth	1.9 ft
Flow Area	22.9 ft²
Wetted Perimeter	21.9 ft
Hydraulic Radius	1.0 ft
Top Width	21.48 ft
Critical Depth	1.7 ft
Critical Slope	0.019 ft/ft
Velocity	4.37 ft/s
Velocity Head	0.30 ft
Specific Energy	2.25 ft
Froude Number	0.747
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	1.9 ft
Critical Depth	1.7 ft
Channel Slope	0.010 ft/ft
Critical Slope	0.019 ft/ft

Swale B3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.050
Channel Slope	0.080 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	5.000 H:V
Bottom Width	2.00 ft
Discharge	100.00 cfs

Results	
Normal Depth	1.5 ft
Flow Area	13.7 ft²
Wetted Perimeter	17.0 ft
Hydraulic Radius	0.8 ft
Top Width	16.68 ft
Critical Depth	1.7 ft
Critical Slope	0.038 ft/ft
Velocity	7.29 ft/s
Velocity Head	0.83 ft
Specific Energy	2.29 ft
Froude Number	1.418
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.5 ft
Critical Depth	1.7 ft
Channel Slope	0.080 ft/ft
Critical Slope	0.038 ft/ft

Swale D1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.050
Channel Slope	0.050 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	5.000 H:V
Bottom Width	2.00 ft
Discharge	95.00 cfs

Results	
Normal Depth	1.6 ft
Flow Area	15.7 ft²
Wetted Perimeter	18.2 ft
Hydraulic Radius	0.9 ft
Top Width	17.85 ft
Critical Depth	1.7 ft
Critical Slope	0.038 ft/ft
Velocity	6.04 ft/s
Velocity Head	0.57 ft
Specific Energy	2.15 ft
Froude Number	1.134
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.6 ft
Critical Depth	1.7 ft
Channel Slope	0.050 ft/ft
Critical Slope	0.038 ft/ft

Swale D2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.050
Channel Slope	0.020 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	5.000 H:V
Bottom Width	2.00 ft
Discharge	45.00 cfs

Results	
Normal Depth	1.4 ft
Flow Area	12.7 ft²
Wetted Perimeter	16.3 ft
Hydraulic Radius	0.8 ft
Top Width	16.04 ft
Critical Depth	1.2 ft
Critical Slope	0.042 ft/ft
Velocity	3.55 ft/s
Velocity Head	0.20 ft
Specific Energy	1.60 ft
Froude Number	0.704
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

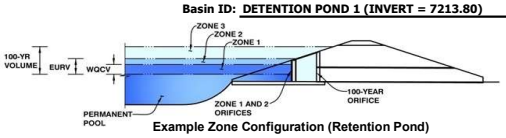
GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	1.2 ft
Channel Slope	0.020 ft/ft
Critical Slope	0.042 ft/ft

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: BEN LOMAND

Basin ID: DETENTION POND 1 (INVERT = 7213.80)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	EDB	
Watershed Area =	141.11	acres
Watershed Length =	3,660	ft
Watershed Length to Centroid =	1,605	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	30.60%	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.

*WQCV and EURV for full site

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	1.803	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	4.438	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.490	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	7.244	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	9.773	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	13.574	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	16.454	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	20.286	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	27.709	acre-feet	inches
Approximate 2-yr Detention Volume =	3.182	acre-feet	
Approximate 5-yr Detention Volume =	4.545	acre-feet	
Approximate 10-yr Detention Volume =	6.601	acre-feet	
Approximate 25-yr Detention Volume =	7.635	acre-feet	
Approximate 50-yr Detention Volume =	8.042	acre-feet	
Approximate 100-yr Detention Volume =	9.489	acre-feet	

Define Zones and Basin Geometry

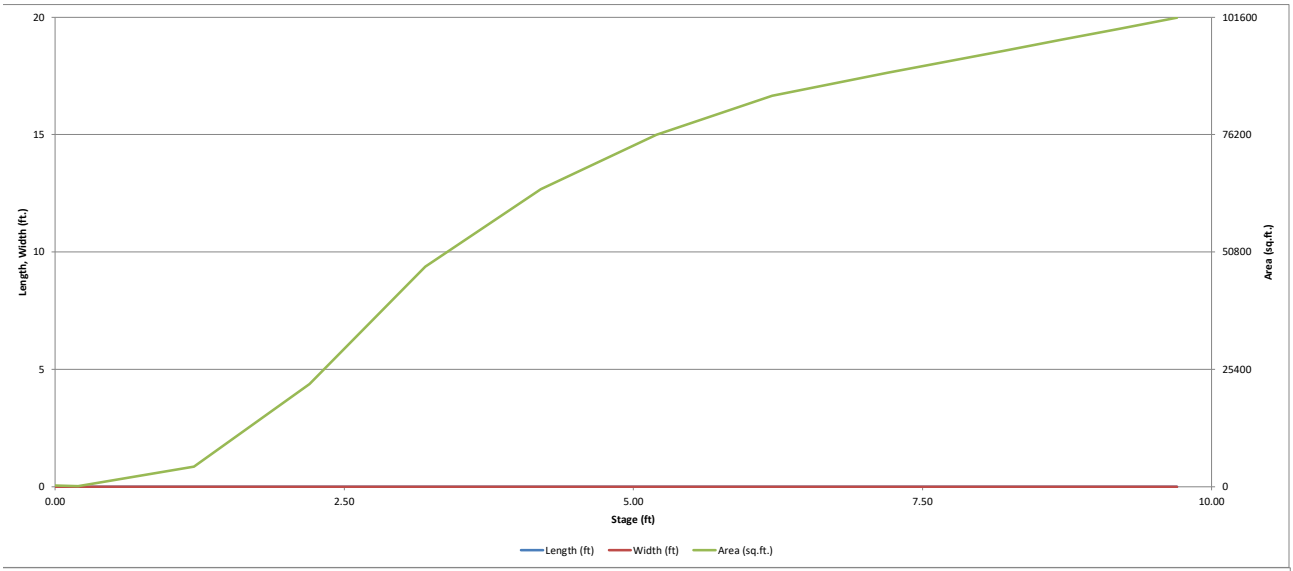
Zone 1 Volume (WQCV) =	1.803	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.635	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	5.952	acre-feet
Total Detention Basin Volume =	10.390	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

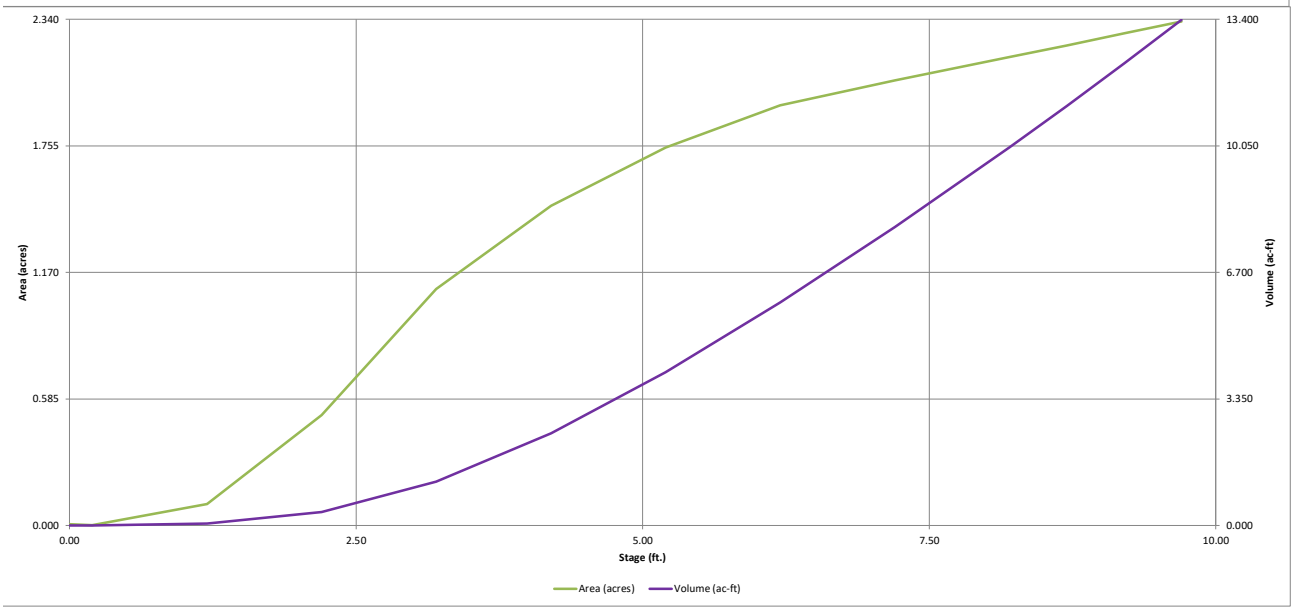
Depth Increment = 1.00 ft

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	--	--	--	250	0.006		
7214	--	0.20	--	--	--	103	0.002	35	0.001
7215	--	1.20	--	--	--	4,332	0.099	2,253	0.052
7216	--	2.20	--	--	--	22,247	0.511	15,542	0.357
7217	--	3.20	--	--	--	47,626	1.093	50,479	1.159
7218	--	4.20	--	--	--	64,393	1.478	106,488	2.445
7219	--	5.20	--	--	--	76,151	1.748	176,760	4.058
7220	--	6.20	--	--	--	84,627	1.943	257,149	5.903
7221	--	7.20	--	--	--	89,653	2.058	344,289	7.904
7222	--	8.20	--	--	--	94,329	2.165	436,280	10.016
7222.5	--	8.70	--	--	--	96,713	2.220	484,040	11.112
7223	--	9.20	--	--	--	99,116	2.275	532,998	12.236
7223.5 (BERM)	--	9.70	--	--	--	101,540	2.331	583,162	13.388

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)



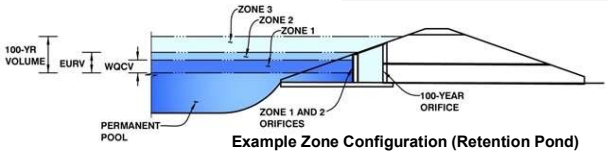


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: BEN LOMAND

Basin ID: DETENTION POND 1 (INVERT = 7213.80)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.74	1.803	Orifice Plate
Zone 2 (EURV)	5.42	2.635	Orifice Plate
3 (100+1/2WQCV)	8.38	5.952	Weir&Pipe (Restrict)
Total (all zones)		10.390	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.681E-02	ft²
Depth at top of Zone using Orifice Plate =	5.42	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	21.70	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.74	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.81	3.61					
Orifice Area (sq. inches)	6.74	6.74	6.74					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.42	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	7.92	N/A	feet
Overflow Weir Front Edge Length =	80.00	N/A	feet	Overflow Weir Slope Length =	10.31	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	29.72	N/A	
Horiz. Length of Weir Sides =	10.00	N/A	feet	Overflow Grate Open Area w/o Debris =	573.94	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	286.97	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	19.31	N/A	ft²
Outlet Pipe Diameter =	66.00	N/A	inches	Outlet Orifice Centroid =	2.30	N/A	feet
Restrictor Plate Height Above Pipe Invert =	50.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.11	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.98	feet
Spillway Crest Length =	100.00	feet	Stage at Top of Freeboard =	9.98	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.33	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	13.39	acre-ft

Calculated Parameters for Spillway

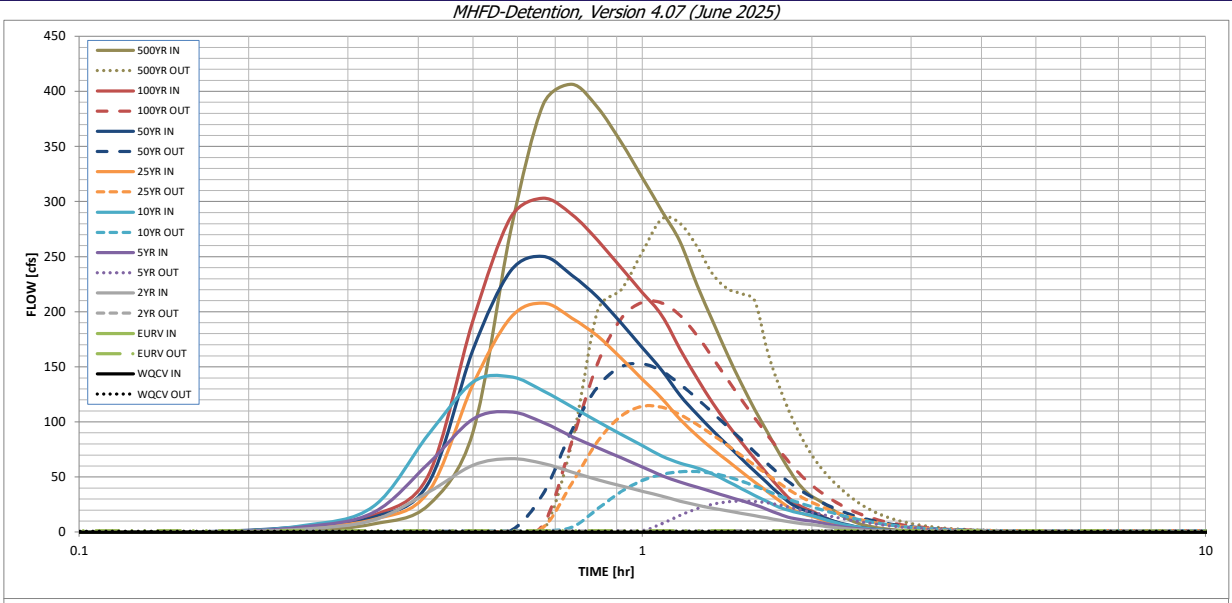
Routed Hydrograph Results

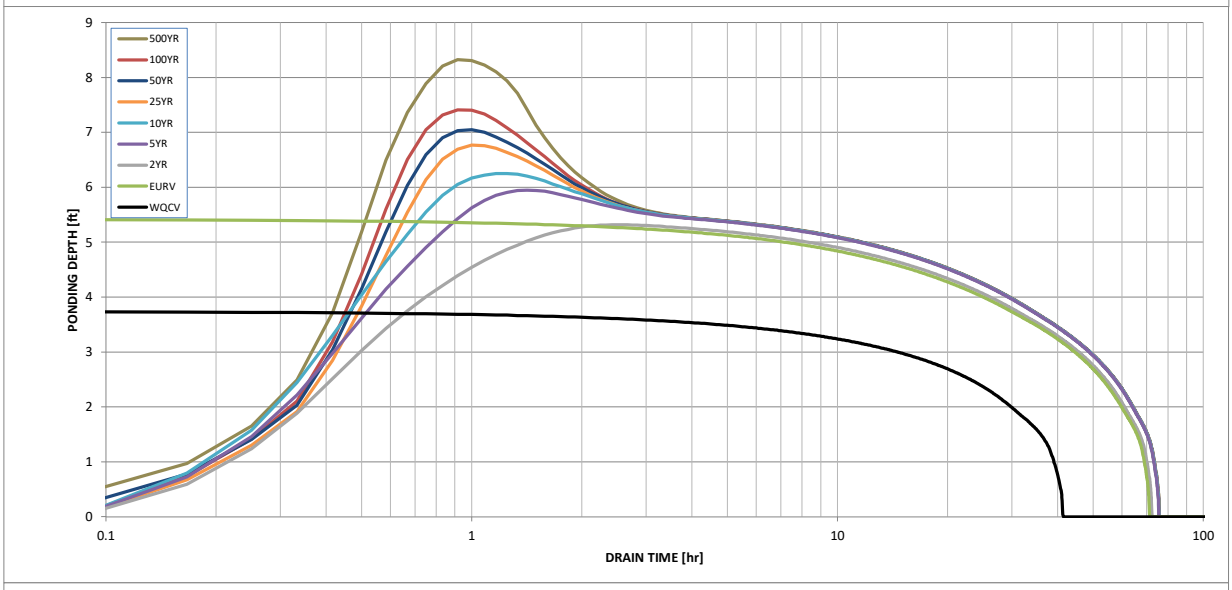
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

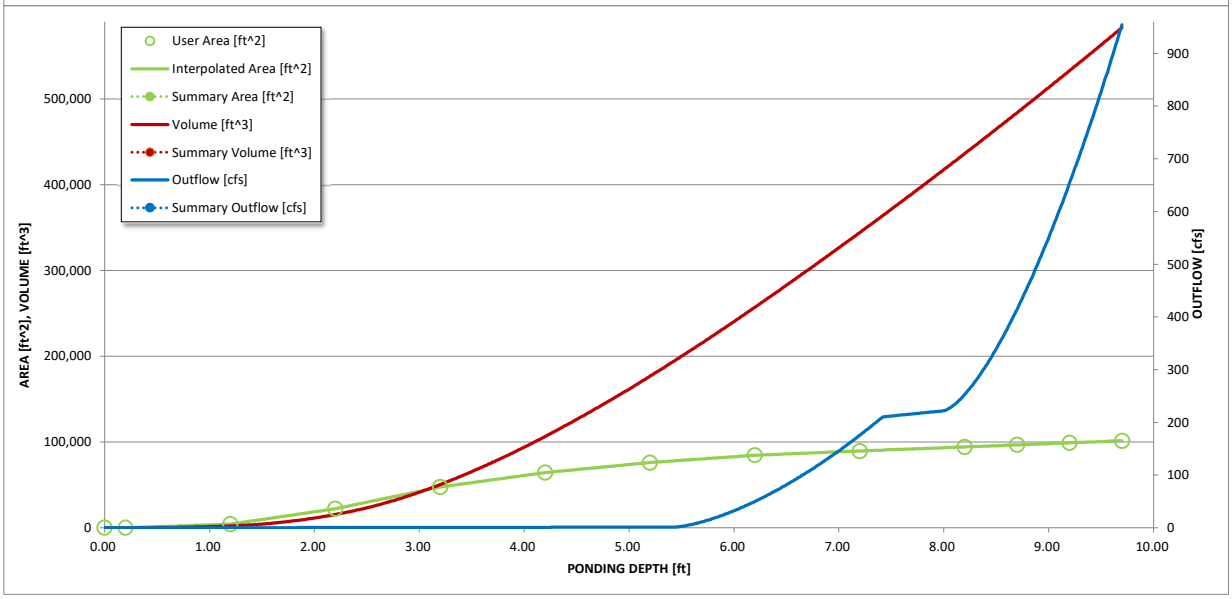
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.803	4.438	4.490	7.244	9.773	13.574	16.454	20.286	27.709
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.490	7.244	9.773	13.574	16.454	20.286	27.709
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	22.5	55.1	81.6	140.1	174.5	221.1	305.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.16	0.39	0.58	0.99	1.24	1.57	2.17
Peak Inflow Q (cfs) =	N/A	N/A	66.7	109.1	141.0	207.8	250.2	303.0	406.4
Peak Outflow Q (cfs) =	0.8	1.3	1.2	28.2	55.0	114.2	152.7	208.5	284.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.7	0.8	0.9	0.9	0.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.1	0.2	0.3	0.4	0.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	65	66	66	63	60	59	56	52
Time to Drain 99% of Inflow Volume (hours) =	**40**	69	70	71	70	69	68	66	64
Maximum Ponding Depth (ft) =	3.74	5.42	5.32	5.95	6.25	6.77	7.05	7.41	8.32
Area at Maximum Ponding Depth (acres) =	1.30	1.79	1.77	1.89	1.95	2.01	2.04	2.08	2.18
Maximum Volume Stored (acre-ft) =	1.805	4.447	4.251	5.405	6.001	7.009	7.576	8.318	10.276

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0	0.00	0.00	0.00	0.00	0.00	0.33	0.03	1.08
	0:15:00	0	0.00	2.82	4.68	5.84	3.95	5.07	4.88	7.42
	0:20:00	0	0.00	11.05	17.75	23.49	11.49	13.59	15.27	24.37
	0:25:00	0	0.00	36.07	62.14	88.41	36.19	43.88	51.38	89.83
	0:30:00	0	0.00	60.69	102.30	135.93	133.53	164.84	191.30	272.16
	0:35:00	0	0.00	66.70	109.12	141.03	194.54	236.81	285.30	387.94
	0:40:00	0	0.00	62.43	99.55	128.18	207.78	250.18	302.97	406.42
	0:45:00	0	0.00	54.58	86.83	113.62	194.26	233.13	288.29	385.36
	0:50:00	0	0.00	47.54	76.62	100.32	177.75	213.07	264.72	353.98
	0:55:00	0	0.00	41.95	67.59	88.87	157.96	189.94	240.04	321.58
	1:00:00	0	0.00	37.15	59.13	78.51	138.69	167.33	217.47	291.47
	1:05:00	0	0.00	32.73	51.31	69.08	121.25	146.71	196.62	263.50
	1:10:00	0	0.00	28.16	45.36	62.52	102.35	124.15	166.08	224.46
	1:15:00	0	0.00	24.52	40.77	58.28	87.62	107.04	139.73	191.43
	1:20:00	0	0.00	21.73	36.46	52.85	75.33	92.13	117.31	161.34
	1:25:00	0	0.00	19.34	32.37	46.10	64.81	79.11	98.09	134.59
	1:30:00	0	0.00	17.12	28.54	39.47	54.76	66.70	81.58	111.52
	1:35:00	0	0.00	14.95	24.87	33.32	45.43	55.22	66.64	90.71
	1:40:00	0	0.00	12.82	20.56	27.67	36.74	44.55	52.83	71.58
	1:45:00	0	0.00	10.84	16.32	22.64	28.62	34.60	40.14	54.32
	1:50:00	0	0.00	9.20	13.07	19.20	21.49	25.95	29.37	40.74
	1:55:00	0	0.00	7.79	11.19	16.97	16.99	20.87	22.98	32.49
	2:00:00	0	0.00	6.80	9.97	14.93	14.29	17.76	18.97	27.21
	2:05:00	0	0.00	5.59	8.24	12.24	11.31	14.14	14.61	21.13
	2:10:00	0	0.00	4.47	6.50	9.68	8.57	10.71	10.72	15.58
	2:15:00	0	0.00	3.52	5.08	7.56	6.49	8.12	7.74	11.30
	2:20:00	0	0.00	2.77	3.98	5.85	4.91	6.12	5.51	8.09
	2:25:00	0	0.00	2.16	3.09	4.47	3.70	4.60	3.97	5.86
	2:30:00	0	0.00	1.69	2.36	3.36	2.80	3.46	3.02	4.40
	2:35:00	0	0.00	1.32	1.78	2.50	2.09	2.58	2.27	3.29
	2:40:00	0	0.00	1.02	1.33	1.88	1.57	1.94	1.74	2.51
	2:45:00	0	0.00	0.78	0.99	1.43	1.19	1.48	1.34	1.94
	2:50:00	0	0.00	0.59	0.72	1.06	0.90	1.11	1.01	1.45
	2:55:00	0	0.00	0.42	0.50	0.75	0.65	0.80	0.72	1.03
	3:00:00	0	0.00	0.28	0.34	0.50	0.44	0.54	0.48	0.68
	3:05:00	0	0.00	0.17	0.21	0.29	0.27	0.33	0.29	0.40
	3:10:00	0	0.00	0.09	0.12	0.15	0.15	0.17	0.15	0.19
	3:15:00	0	0.00	0.04	0.05	0.05	0.06	0.06	0.05	0.06
	3:20:00	0	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00
	3:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Elevation [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on
Sheet 'Basin'.

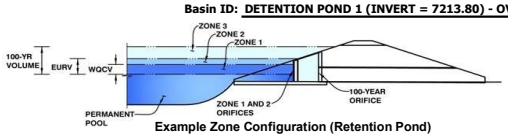
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: BEN LOMAND

Basin ID: DETENTION POND 1 (INVERT = 7213.80) - OVER DETENTION



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	EDB	
Watershed Area =	132.35	acres
Watershed Length =	3,660	ft
Watershed Length to Centroid =	1,605	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	31.30%	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.

*WQCV and EURV are for full site

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.803	acre-feet	1.803	acre-feet
Excess Urban Runoff Volume (EURV) =	4.438	acre-feet	4.438	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.302	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	6.896	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	9.273	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	12.830	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	15.534	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	19.125	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	26.093	acre-feet		inches
Approximate 2-yr Detention Volume =	3.065	acre-feet		
Approximate 5-yr Detention Volume =	4.371	acre-feet		
Approximate 10-yr Detention Volume =	6.316	acre-feet		
Approximate 25-yr Detention Volume =	7.282	acre-feet		
Approximate 50-yr Detention Volume =	7.668	acre-feet		
Approximate 100-yr Detention Volume =	9.026	acre-feet		

Define Zones and Basin Geometry

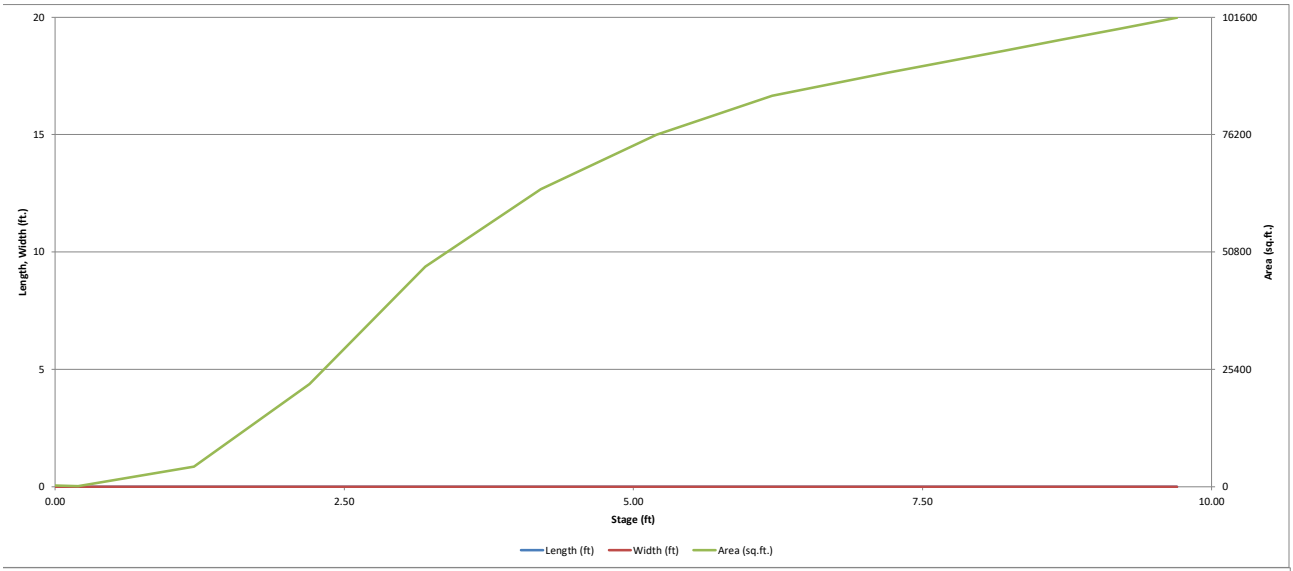
Zone 1 Volume (WQCV) =	1.803	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.635	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	5.490	acre-feet
Total Detention Basin Volume =	9.928	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

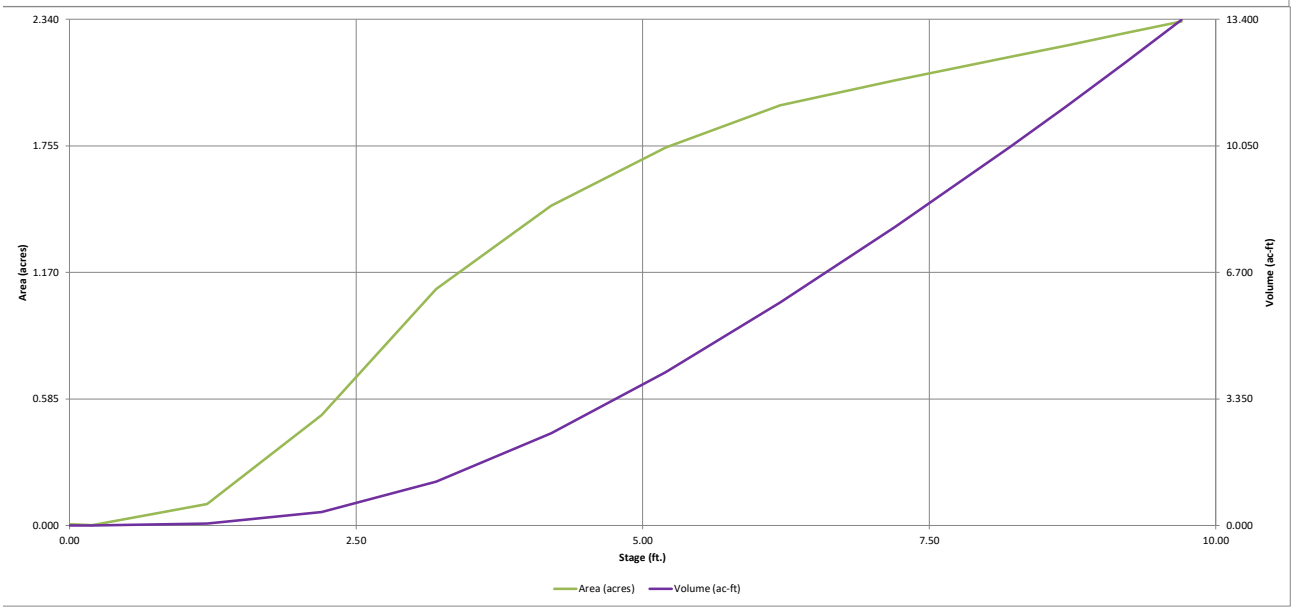
Depth Increment = 1.00 ft

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	--	--	--	250	0.006		
7214	--	0.20	--	--	--	103	0.002	35	0.001
7215	--	1.20	--	--	--	4,332	0.099	2,253	0.052
7216	--	2.20	--	--	--	22,247	0.511	15,542	0.357
7217	--	3.20	--	--	--	47,626	1.093	50,479	1.159
7218	--	4.20	--	--	--	64,393	1.478	106,488	2.445
7219	--	5.20	--	--	--	76,151	1.748	176,760	4.058
7220	--	6.20	--	--	--	84,627	1.943	257,149	5.903
7221	--	7.20	--	--	--	89,653	2.058	344,289	7.904
7222	--	8.20	--	--	--	94,329	2.165	436,280	10.016
7222.5	--	8.70	--	--	--	96,713	2.220	484,040	11.112
7223	--	9.20	--	--	--	99,116	2.275	532,998	12.236
7223.5 (BERM)	--	9.70	--	--	--	101,540	2.331	583,162	13.388

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)



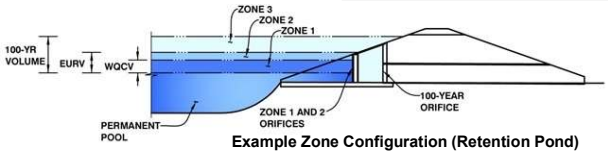


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: BEN LOMAND

Basin ID: DETENTION POND 1 (INVERT = 7213.80) - OVER DETENTION



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.74	1.803	Orifice Plate
Zone 2 (EURV)	5.42	2.635	Orifice Plate
3 (100+1/2WQCV)	8.16	5.490	Weir&Pipe (Restrict)
Total (all zones)		9.928	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =	5.42	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	21.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.81	3.61					
Orifice Area (sq. inches)	5.78	5.78	11.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.43	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.16	N/A	feet
Overflow Weir Front Edge Length =	41.00	N/A	feet	Overflow Weir Slope Length =	3.01	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.36	N/A	
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	85.89	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	42.94	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	13.51	N/A	ft²
Outlet Pipe Diameter =	60.00	N/A	inches	Outlet Orifice Centroid =	1.83	N/A	feet
Restrictor Plate Height Above Pipe Invert =	39.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.88	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	95.00	feet	Stage at Top of Freeboard =	9.97	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.33	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	13.39	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

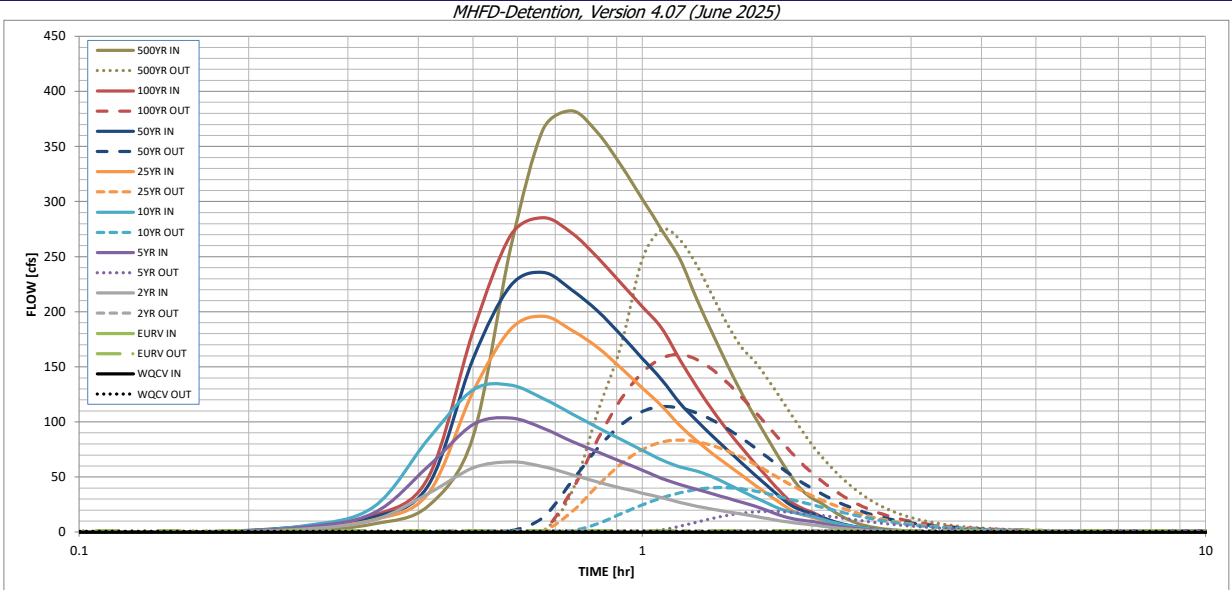
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

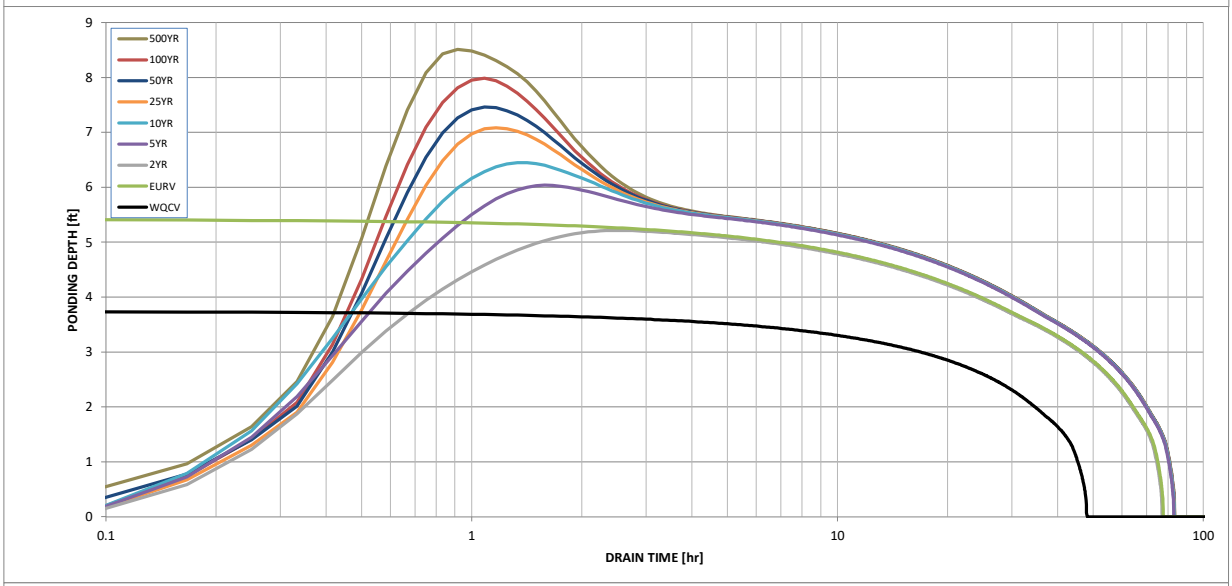
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.803	4.438	4.302	6.896	9.273	12.830	15.534	19.125	26.093
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.302	6.896	9.273	12.830	15.534	19.125	26.093
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	20.8	50.9	75.2	129.7	161.6	204.7	283.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						170.0	
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.16	0.38	0.57	0.98	1.22	1.28	2.14
Peak Inflow Q (cfs) =	N/A	N/A	63.7	103.5	133.4	196.0	235.7	285.2	382.2
Peak Outflow Q (cfs) =	0.8	1.3	1.3	18.9	40.4	83.6	113.9	161.2	274.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.5	0.6	0.7	0.9	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.5	1.0	1.3	1.9	1.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	44	70	70	72	70	66	64	61	56
Time to Drain 99% of Inflow Volume (hours) =	**47**	75	74	78	77	76	75	73	70
Maximum Ponding Depth (ft) =	3.74	5.42	5.21	6.04	6.45	7.09	7.46	7.99	8.51
Area at Maximum Ponding Depth (acres) =	1.30	1.79	1.75	1.91	1.97	2.04	2.09	2.14	2.20
Maximum Volume Stored (acre-ft) =	1.805	4.447	4.075	5.576	6.393	7.658	8.443	9.542	10.692

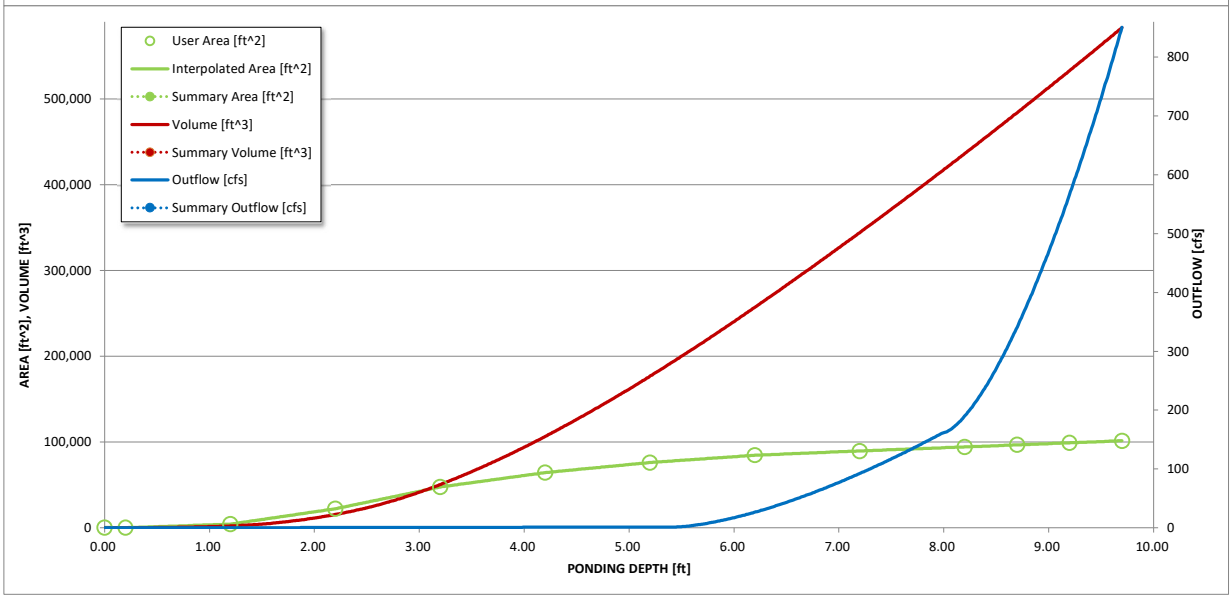
*OVER DETENTION CALCULATION
PRE-DEVELOPMENT FLOW = 204.7 CFS
ALLOWABLE POST-DEVELOPMENT OUTFLOW = 0.9*204.7 = 184.2 CFS
UNDETAINED FLOW (AOS1 & AOS2) = 22.8 CFS
ALLOWABLE POND OUTFLOW = 184.2 - 22.8 = 161.4 CFS
POND RELEASE RATE PER CALCULATION ABOVE = 161.2 CFS

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0	0.00	0.00	0.00	0.00	0.00	0.33	0.03	1.06
	0:15:00	0	0.00	2.79	4.62	5.77	3.90	5.01	4.81	7.32
	0:20:00	0	0.00	10.91	17.27	22.78	11.33	13.39	14.87	23.62
	0:25:00	0	0.00	34.90	59.58	84.36	34.97	42.33	49.39	85.65
	0:30:00	0	0.00	58.17	97.36	128.94	126.85	156.34	181.23	257.21
	0:35:00	0	0.00	63.68	103.51	133.42	183.87	223.54	269.09	365.37
	0:40:00	0	0.00	59.54	94.37	121.22	195.99	235.72	285.23	382.21
	0:45:00	0	0.00	52.05	82.34	107.46	183.14	219.57	271.31	362.30
	0:50:00	0	0.00	45.35	72.70	94.91	167.54	200.64	249.07	332.74
	0:55:00	0	0.00	40.03	64.14	84.09	148.90	178.87	225.85	302.27
	1:00:00	0	0.00	35.44	56.11	74.29	130.72	157.56	204.59	273.94
	1:05:00	0	0.00	31.23	48.70	65.37	114.29	138.13	184.94	247.61
	1:10:00	0	0.00	26.91	43.12	59.25	96.48	116.90	156.18	210.90
	1:15:00	0	0.00	23.47	38.80	55.28	82.70	100.91	131.51	179.97
	1:20:00	0	0.00	20.82	34.71	50.14	71.14	86.90	110.46	151.72
	1:25:00	0	0.00	18.54	30.82	43.73	61.24	74.64	92.37	126.58
	1:30:00	0	0.00	16.41	27.16	37.44	51.74	62.93	76.82	104.90
	1:35:00	0	0.00	14.34	23.68	31.61	42.91	52.09	62.73	85.32
	1:40:00	0	0.00	12.31	19.57	26.25	34.69	42.01	49.72	67.33
	1:45:00	0	0.00	10.42	15.56	21.50	27.02	32.64	37.79	51.14
	1:50:00	0	0.00	8.91	12.54	18.32	20.32	24.51	27.74	38.49
	1:55:00	0	0.00	7.59	10.80	16.25	16.16	19.83	21.81	30.80
	2:00:00	0	0.00	6.63	9.66	14.33	13.66	16.95	18.07	25.87
	2:05:00	0	0.00	5.46	7.98	11.76	10.84	13.51	13.94	20.11
	2:10:00	0	0.00	4.36	6.30	9.30	8.22	10.25	10.24	14.85
	2:15:00	0	0.00	3.44	4.92	7.26	6.24	7.78	7.40	10.78
	2:20:00	0	0.00	2.70	3.85	5.62	4.72	5.86	5.28	7.73
	2:25:00	0	0.00	2.11	2.99	4.29	3.56	4.41	3.82	5.62
	2:30:00	0	0.00	1.64	2.28	3.22	2.69	3.32	2.90	4.22
	2:35:00	0	0.00	1.28	1.72	2.40	2.01	2.48	2.19	3.16
	2:40:00	0	0.00	0.99	1.28	1.80	1.51	1.86	1.67	2.41
	2:45:00	0	0.00	0.76	0.95	1.37	1.15	1.42	1.29	1.86
	2:50:00	0	0.00	0.57	0.69	1.02	0.87	1.07	0.97	1.39
	2:55:00	0	0.00	0.41	0.48	0.72	0.62	0.76	0.69	0.98
	3:00:00	0	0.00	0.27	0.32	0.47	0.42	0.51	0.46	0.65
	3:05:00	0	0.00	0.16	0.20	0.28	0.26	0.31	0.28	0.38
	3:10:00	0	0.00	0.09	0.11	0.14	0.14	0.16	0.14	0.18
	3:15:00	0	0.00	0.04	0.05	0.05	0.05	0.06	0.05	0.06
	3:20:00	0	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00
	3:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Elevation [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on
Sheet 'Basin'.

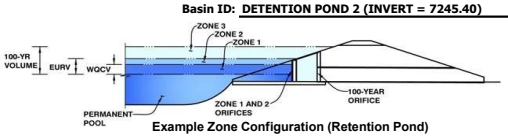
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: BEN LOMAND

Basin ID: DETENTION POND 2 (INVERT = 7245.40)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	EDB	
Watershed Area =	88.83	acres
Watershed Length =	2,715	ft
Watershed Length to Centroid =	1,935	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	30.90%	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) =	1.142	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.824	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.850	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	4.589	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	6.185	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	8.579	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	10.397	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	12.814	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	17.501	acre-feet	inches
Approximate 2-yr Detention Volume =	2.026	acre-feet	
Approximate 5-yr Detention Volume =	2.892	acre-feet	
Approximate 10-yr Detention Volume =	4.191	acre-feet	
Approximate 25-yr Detention Volume =	4.841	acre-feet	
Approximate 50-yr Detention Volume =	5.099	acre-feet	
Approximate 100-yr Detention Volume =	6.010	acre-feet	

Define Zones and Basin Geometry

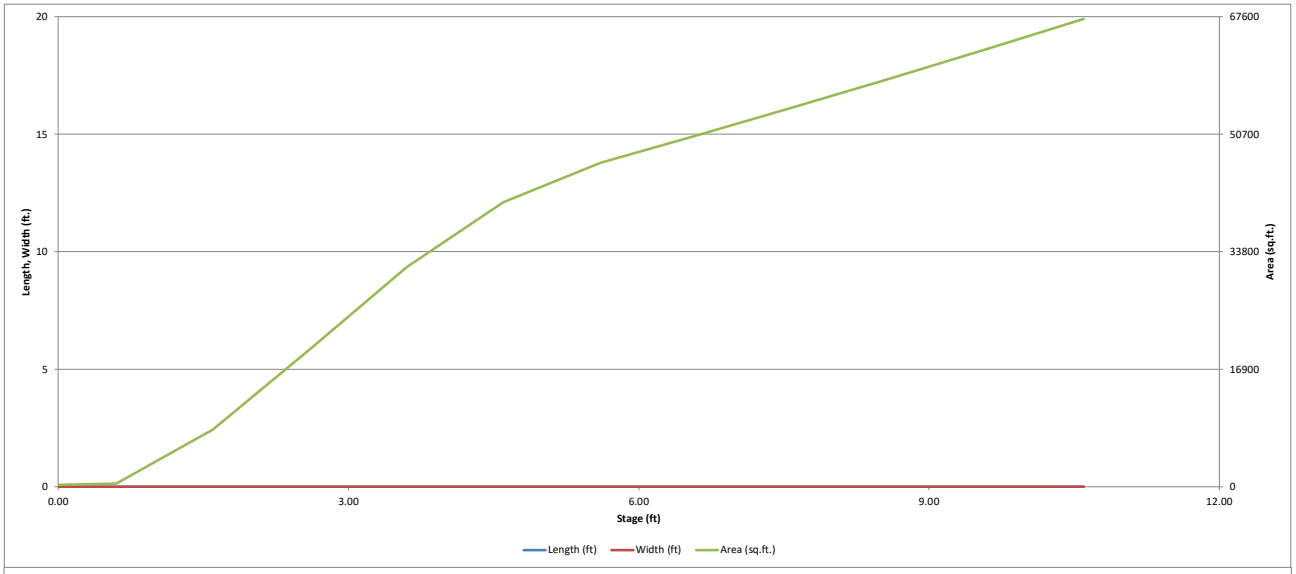
Zone 1 Volume (WQCV) =	1.142	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.682	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	3.757	acre-feet
Total Detention Basin Volume =	6.581	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

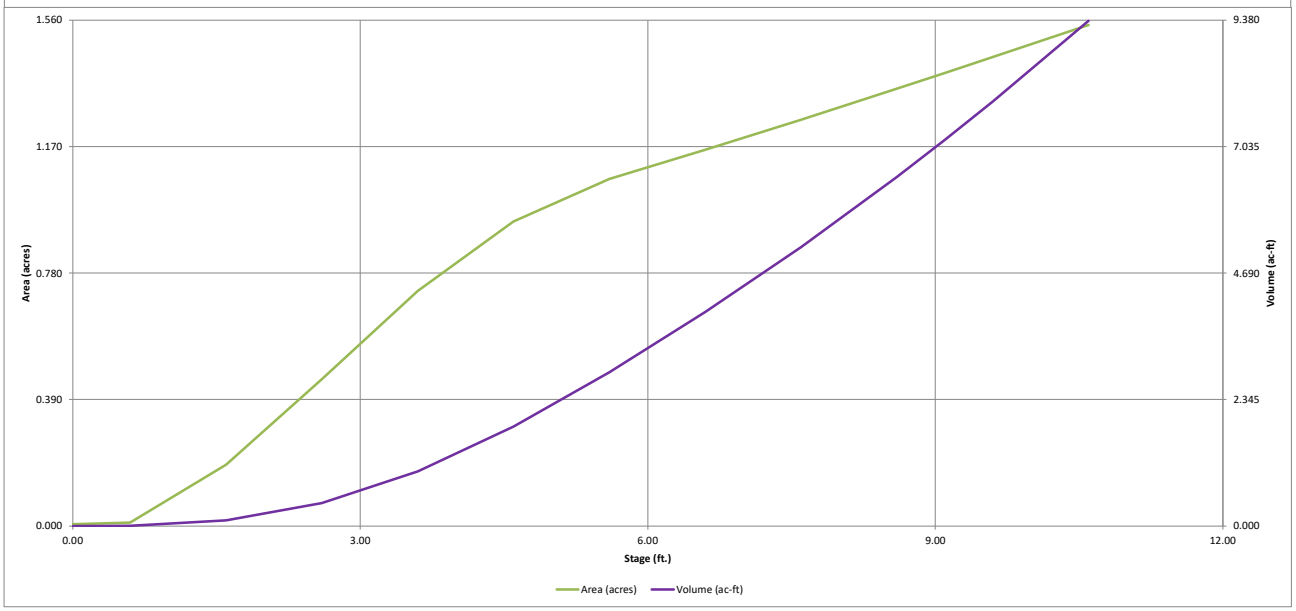
Depth Increment = 1.00 ft

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	--	--	--	250	0.006		
7246	--	0.60	--	--	--	468	0.011	215	0.005
7247	--	1.60	--	--	--	8,236	0.189	4,567	0.105
7248	--	2.60	--	--	--	19,722	0.453	18,546	0.426
7249	--	3.60	--	--	--	31,563	0.725	44,189	1.014
7250	--	4.60	--	--	--	40,879	0.938	80,410	1.846
7251	--	5.60	--	--	--	46,597	1.070	124,148	2.850
7252	--	6.60	--	--	--	50,537	1.160	172,715	3.965
7253	--	7.60	--	--	--	54,577	1.253	225,272	5.172
7254	--	8.60	--	--	--	58,719	1.348	281,920	6.472
7254.5 (100 YEAR)	--	9.10	--	--	--	60,836	1.397	311,808	7.158
7255	--	9.60	--	--	--	62,963	1.445	342,758	7.869
7256 (BERM)	--	10.60	--	--	--	67,302	1.545	407,891	9.364

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)



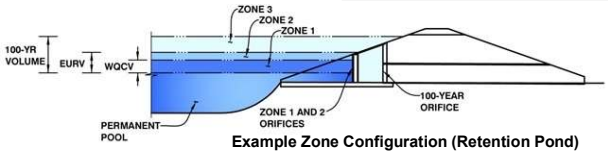


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: **BEN LOMAND**

Basin ID: **DETENTION POND 2 (INVERT = 7245.40)**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.78	1.142	Orifice Plate
Zone 2 (EURV)	5.58	1.682	Orifice Plate
3 (100+1/2WQCV)	8.69	3.757	Weir&Pipe (Restrict)
Total (all zones)		6.581	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	3.125E-02	ft^2
Depth at top of Zone using Orifice Plate =	5.58	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	22.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	4.50	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.86	3.72					
Orifice Area (sq. inches)	4.50	4.50	4.50					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.58	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.31	N/A	feet
Overflow Weir Front Edge Length =	38.00	N/A	feet	Overflow Weir Slope Length =	3.01	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	7.87	N/A	
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	79.60	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	39.80	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	10.11	N/A	ft^2
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	1.66	N/A	feet
Restrictor Plate Height Above Pipe Invert =	36.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.09	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	59.00	feet	Stage at Top of Freeboard =	9.76	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.46	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	8.10	acre-ft

Calculated Parameters for Spillway

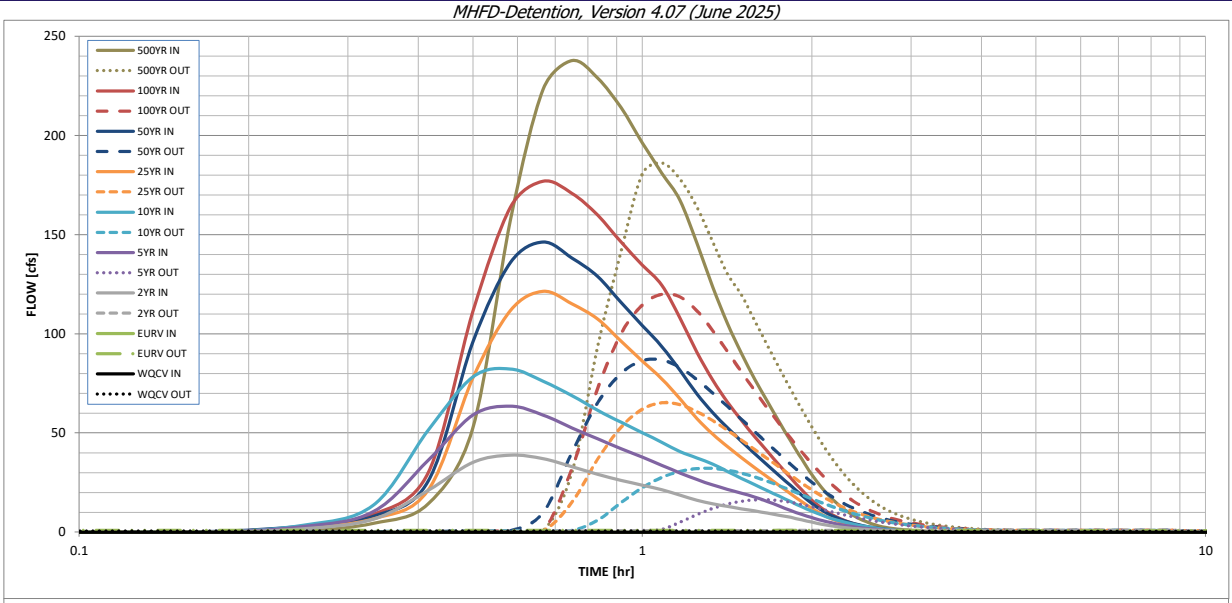
Routed Hydrograph Results

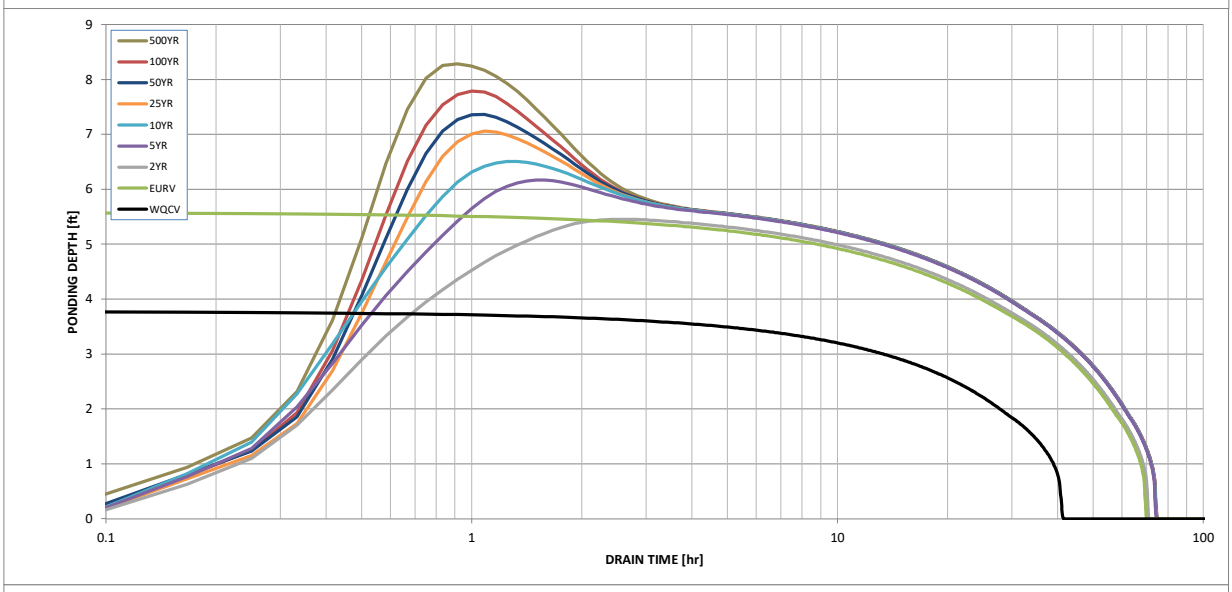
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

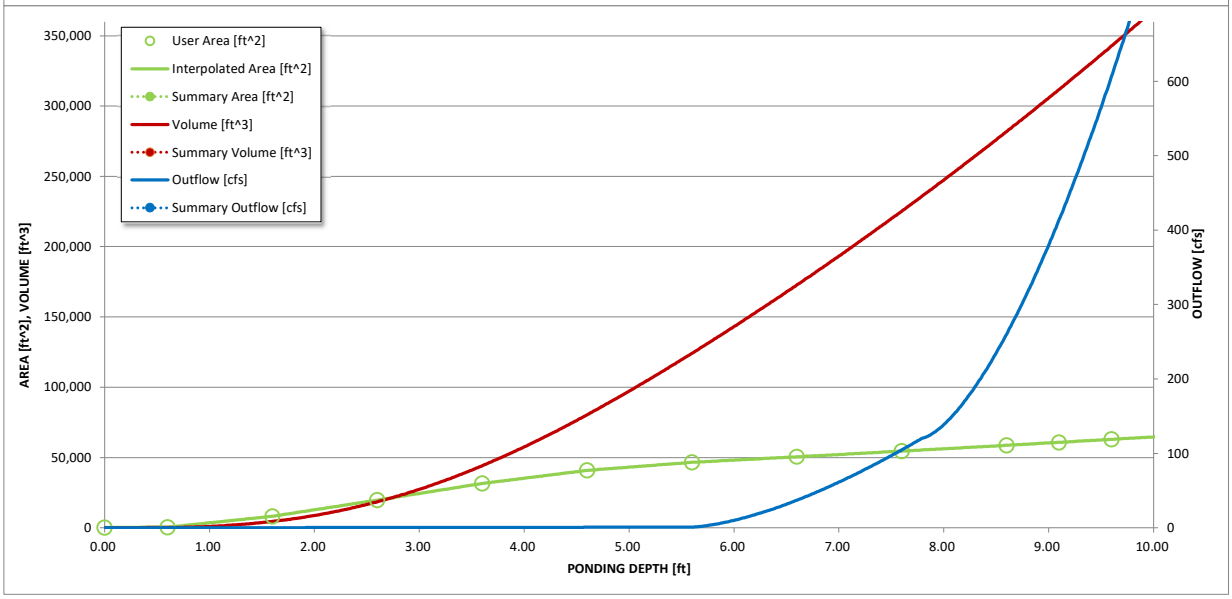
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.142	2.824	2.850	4.589	6.185	8.579	10.397	12.814	17.501
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.850	4.589	6.185	8.579	10.397	12.814	17.501
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	12.8	31.5	46.3	80.7	100.7	127.5	176.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.35	0.52	0.91	1.13	1.44	1.99
Peak Inflow Q (cfs) =	N/A	N/A	38.9	63.5	82.3	121.4	146.3	176.9	237.7
Peak Outflow Q (cfs) =	0.5	0.8	0.8	16.3	32.1	65.2	86.8	120.0	186.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.7	0.8	0.9	0.9	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.4	0.8	1.1	1.5	1.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	63	64	64	62	59	57	54	50
Time to Drain 99% of Inflow Volume (hours) =	**40**	67	68	70	69	68	67	65	62
Maximum Ponding Depth (ft) =	3.78	5.58	5.45	6.17	6.51	7.06	7.36	7.79	8.28
Area at Maximum Ponding Depth (acres) =	0.76	1.07	1.05	1.12	1.15	1.20	1.23	1.27	1.32
Maximum Volume Stored (acre-ft) =	1.148	2.829	2.691	3.463	3.849	4.496	4.873	5.399	6.045

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0	0.00	0.00	0.00	0.00	0.00	0.20	0.02	0.64
	0:15:00	0	0.00	1.67	2.78	3.47	2.34	3.00	2.89	4.38
	0:20:00	0	0.00	6.50	10.37	13.71	6.73	7.96	8.91	14.23
	0:25:00	0	0.00	21.08	36.20	51.41	21.17	25.67	29.99	52.26
	0:30:00	0	0.00	35.14	59.02	78.20	77.55	95.67	110.95	157.46
	0:35:00	0	0.00	38.88	63.55	82.29	111.77	135.96	163.86	223.18
	0:40:00	0	0.00	37.01	59.05	76.12	121.39	146.26	176.89	237.75
	0:45:00	0	0.00	32.95	52.54	68.84	115.07	138.20	170.83	228.92
	0:50:00	0	0.00	29.14	46.98	61.42	107.43	128.91	159.77	213.95
	0:55:00	0	0.00	26.09	42.07	55.39	96.26	115.80	146.20	196.28
	1:00:00	0	0.00	23.66	37.78	50.18	86.26	104.13	134.65	181.00
	1:05:00	0	0.00	21.36	33.67	45.25	77.28	93.58	124.42	167.24
	1:10:00	0	0.00	18.62	29.85	40.65	67.18	81.49	107.90	145.58
	1:15:00	0	0.00	16.12	26.49	37.44	57.28	69.68	90.68	123.67
	1:20:00	0	0.00	14.29	23.83	34.25	49.39	60.27	76.72	105.29
	1:25:00	0	0.00	12.94	21.62	30.63	43.19	52.69	65.67	90.16
	1:30:00	0	0.00	11.76	19.63	27.11	37.59	45.81	56.32	77.20
	1:35:00	0	0.00	10.67	17.76	23.92	32.49	39.55	48.22	65.92
	1:40:00	0	0.00	9.59	15.48	20.93	27.86	33.87	40.79	55.59
	1:45:00	0	0.00	8.52	13.14	18.09	23.51	28.52	33.82	45.94
	1:50:00	0	0.00	7.48	10.90	15.39	19.37	23.46	27.34	36.98
	1:55:00	0	0.00	6.22	8.90	12.76	15.49	18.72	21.41	28.97
	2:00:00	0	0.00	5.04	7.29	10.58	12.00	14.49	16.12	22.37
	2:05:00	0	0.00	3.97	5.85	8.59	9.02	11.07	12.11	17.09
	2:10:00	0	0.00	3.18	4.69	6.93	6.78	8.39	9.04	12.88
	2:15:00	0	0.00	2.55	3.75	5.56	5.15	6.41	6.68	9.59
	2:20:00	0	0.00	2.07	3.01	4.46	3.93	4.89	4.92	7.11
	2:25:00	0	0.00	1.66	2.40	3.54	3.03	3.77	3.59	5.21
	2:30:00	0	0.00	1.33	1.91	2.78	2.32	2.88	2.58	3.77
	2:35:00	0	0.00	1.05	1.50	2.14	1.76	2.17	1.86	2.73
	2:40:00	0	0.00	0.83	1.15	1.62	1.34	1.65	1.43	2.07
	2:45:00	0	0.00	0.66	0.88	1.23	1.02	1.25	1.10	1.58
	2:50:00	0	0.00	0.52	0.68	0.95	0.79	0.98	0.88	1.26
	2:55:00	0	0.00	0.41	0.51	0.73	0.61	0.75	0.68	0.98
	3:00:00	0	0.00	0.31	0.37	0.54	0.46	0.56	0.51	0.73
	3:05:00	0	0.00	0.22	0.26	0.39	0.33	0.41	0.36	0.52
	3:10:00	0	0.00	0.15	0.17	0.25	0.23	0.27	0.24	0.34
	3:15:00	0	0.00	0.09	0.11	0.15	0.14	0.17	0.15	0.20
	3:20:00	0	0.00	0.05	0.06	0.08	0.07	0.09	0.07	0.10
	3:25:00	0	0.00	0.02	0.03	0.03	0.03	0.03	0.02	0.03
	3:30:00	0	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	3:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Elevation [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on
Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

APPENDIX D

COUNTY LINE ROAD

EOS1 23.84 AC 0.09 0.36

E-1 46.21 AC 0.10 0.36

E-2 83.64 AC 0.10 0.37

E-3 53.51 AC 0.11 0.37

E-4 33.94 AC 0.13 0.39

EOS3 6.40 AC 0.09 0.36

EOS2 28.20 AC 0.09 0.36

DRAINAGE SUB-BASIN SUMMARY						
Sub-Basin	Area (acres)	Impervious %	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
E1	46.21	2.7%	0.10	0.36	11.54	73.76
E2	83.64	3.9%	0.10	0.37	22.76	137.19
E3	53.51	4.8%	0.11	0.37	17.36	100.69
E4	33.94	8.3%	0.13	0.39	13.28	65.65
EOS1	23.84	2.0%	0.09	0.36	6.17	41.43
EOS2	28.20	2.0%	0.09	0.36	9.33	62.65
EOS3	6.40	2.0%	0.09	0.36	2.14	14.35

LEGEND

BASIN / AREA AC. / C100 — PROPOSED DRAINAGE BASIN

MAJOR DRAINAGE BASIN OUTLINE

DESIGN POINT

PROPOSED FLOW PATH

EXISTING FLOW PATH

PROPOSED EMERGENCY OVERFLOW PATH

EXISTING STORM DRAIN

EXISTING STORM DRAIN INLET

PROPOSED STORM DRAIN

PROPOSED STORM DRAIN INLET

PROPOSED CURB AND GUTTER

LOT NUMBER

LOT TYPE

PROPOSED MAJOR CONTOUR

PROPOSED MINOR CONTOUR

5280 EXISTING MAJOR CONTOUR

EXISTING MINOR CONTOUR

N

0 100 200 400

SCALE: 1"=200

REVISIONS			DRAWN BY
DATE			
1	2/27/26	FIRST PRELIMINARY SUBMITTAL	BRB

Manhard CONSULTING
7600 East Orchard Road, Suite 150-N, Greenwood Village, CO 80111 ph: 303.708.0500 manhard.com
Civil Engineering & Consulting | Surveying | Geotechnical
Water Resource Management | Construction Management

BEN LOMAND MOUTAIN VILLAGE

EL PASO COUNTY, COLORADO

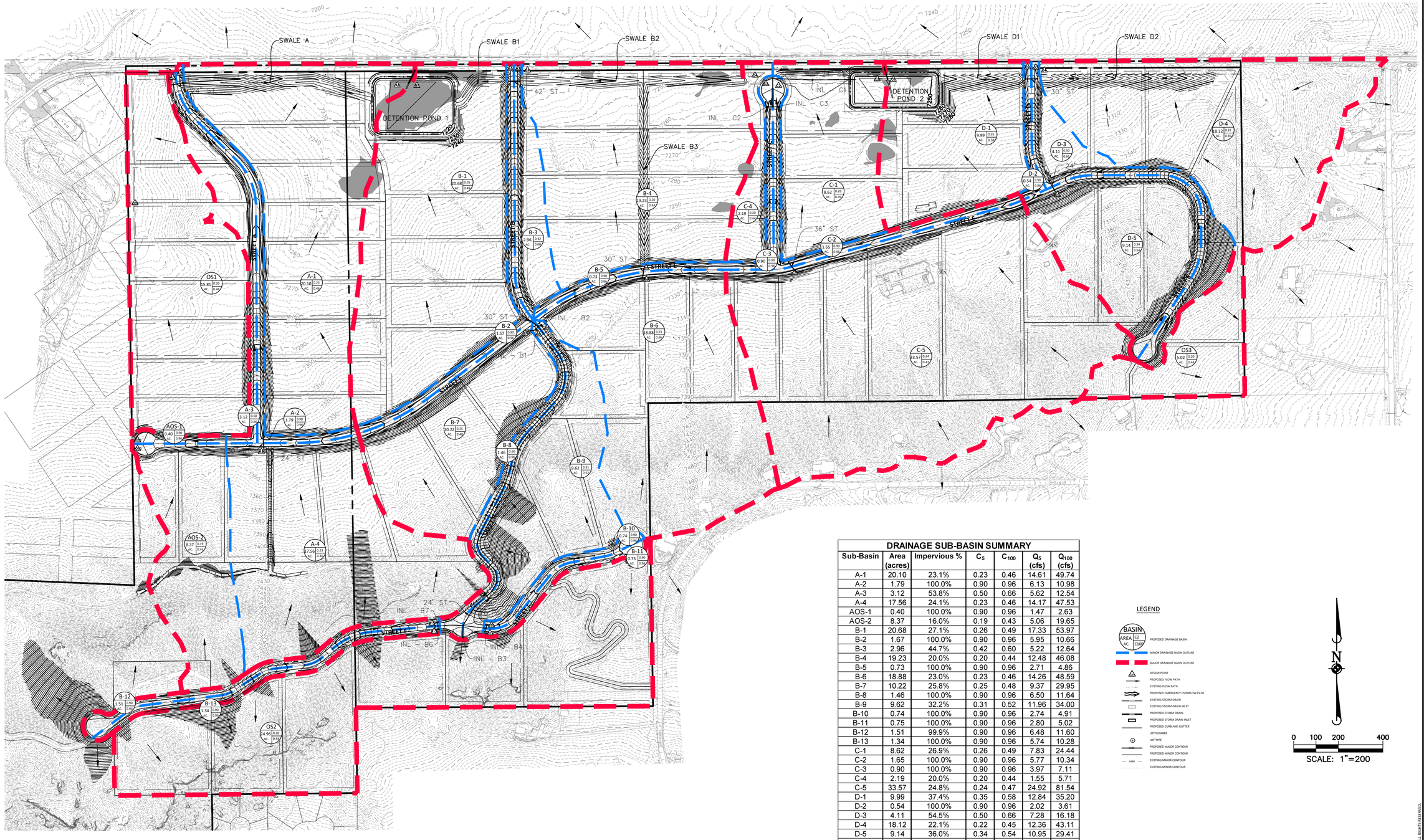
EXISTING DRAINAGE PLAN

PROJ. MGR.: DJM
PROJ. ASSOC.: BRB
DRAWN BY: BRB
DATE: 2/27/26

SHEET 1 OF 1

UNC.MOCO01

Plotted: 2/25/2026 2:23 PM Dwg Name: P:\Uncmoco01\Dwg\3StormWater\Preliminary Reports\Existing Drainage Basins.dwg Updated By: bhalter



DRAINAGE SUB-BASIN SUMMARY

Sub-Basin	Area (acres)	Impervious %	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
A-1	20.10	23.1%	0.23	0.46	14.61	49.74
A-2	1.79	100.0%	0.90	0.96	6.13	10.98
A-3	3.12	53.8%	0.50	0.66	5.62	12.54
A-4	17.56	24.1%	0.23	0.46	14.17	47.53
AOS-1	0.40	100.0%	0.90	0.96	1.47	2.63
AOS-2	8.37	16.0%	0.19	0.43	5.06	19.65
B-1	20.68	27.1%	0.26	0.49	17.33	53.97
B-2	1.67	100.0%	0.90	0.96	5.95	10.66
B-3	2.96	44.7%	0.42	0.60	5.22	12.64
B-4	19.23	20.0%	0.20	0.44	12.48	46.08
B-5	0.73	100.0%	0.90	0.96	2.71	4.86
B-6	18.88	23.0%	0.23	0.46	14.26	48.59
B-7	10.22	25.8%	0.25	0.48	9.37	29.95
B-8	1.46	100.0%	0.90	0.96	6.50	11.64
B-9	9.62	32.2%	0.31	0.52	11.96	34.00
B-10	0.74	100.0%	0.90	0.96	2.74	4.91
B-11	0.75	100.0%	0.90	0.96	2.80	5.02
B-12	1.51	99.9%	0.90	0.96	6.48	11.60
B-13	1.34	100.0%	0.90	0.96	5.74	10.28
C-1	8.62	26.9%	0.26	0.49	7.83	24.44
C-2	1.65	100.0%	0.90	0.96	5.77	10.34
C-3	0.90	100.0%	0.90	0.96	3.97	7.11
C-4	2.19	20.0%	0.20	0.44	1.55	5.71
C-5	33.57	24.8%	0.24	0.47	24.92	81.54
D-1	9.99	37.4%	0.35	0.58	12.84	35.20
D-2	0.54	100.0%	0.90	0.96	2.02	3.61
D-3	4.11	54.5%	0.50	0.66	7.28	16.18
D-4	18.12	22.1%	0.22	0.45	12.36	43.11
D-5	9.14	36.0%	0.34	0.54	10.95	29.41
OS-1	15.81	20.0%	0.20	0.44	10.67	39.40
OS-2	24.96	20.0%	0.20	0.44	18.44	68.11
OS-3	5.02	20.0%	0.20	0.44	3.79	14.00

LEGEND

- PROPOSED DRAINAGE BASIN
- MINOR DRAINAGE BASIN OUTLINE
- MAJOR DRAINAGE BASIN OUTLINE
- DESIGN POINT
- PROPOSED FLOW PATH
- EXISTING FLOW PATH
- PROPOSED EMERGENCY OVERFLOW PATH
- EXISTING STORM DRAIN
- EXISTING STORM DRAIN INLET
- PROPOSED STORM DRAIN
- PROPOSED STORM DRAIN INLET
- PROPOSED CURB AND GUTTER
- LOT NUMBER
- LOT TYPE
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

N

0 100 200 400

SCALE: 1"=200

REVISIONS	DATE	DRAWN BY
1	2/27/26	FIRST PRELIMINARY SUBMITTAL	BRB

Manhard CONSULTING

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Civil Engineering | Land Planning & Development | Surveying
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BEN LOMAND MOUTAIN VILLAGE

EL PASO COUNTY, COLORADO

PRELIMINARY DRAINAGE PLAN

PROJ. MGR.: DJM
PROJ. ASSOC.: BRB
DRAWN BY: BRB
DATE: 2/27/26

SHEET 1 OF 1

UNC.MOCO01

Plotted: 2/23/2026 2:58 PM Dwg Name: P:\Unc\moco01\dwg\StormWater\Preliminary Reports\Proposed Drainage Basins.dwg Updated By: bbaltzer