

Meadow Lake Airport

100% Drainage Report

Falcon, CO
June 2026

Prepared for:
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Meadow Lake Airport CO
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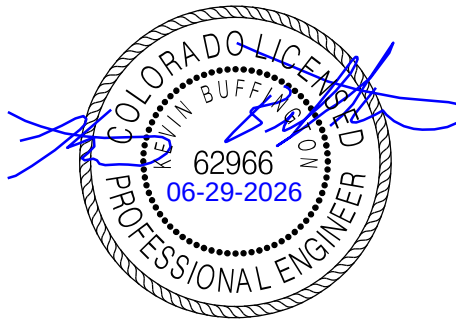
Certification

Design Engineer's Statement:

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. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Kevin Buffington, PE

Registered Professional Engineer
State of Colorado No. 62966



Owner/Developer's Statement:

I, _____, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

Fill and execute the developer signature block.

Owner's Signature and Date

El Paso County

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

Name County Engineer/ECM Administrator

Delete this

Signature County Engineer/ECM Administrator

Date

Add here "Joshua J. Palmer, P.E."

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I. Location and Description

The Meadow Lake Airport Apron reconstruction project is located at Meadow Lake Airport in the Town of Falcon, El Paso County, Colorado. The proposed improvements include reconstruction of additional taxiway and aircraft parking areas. The project site lies within Section 05, Township 13 South, Range 64 West of the 6th Principal Meridian. Meadow Lake Airport is situated in the eastern portion of El Paso County, northeast of the Colorado Springs metropolitan area.

The airport is surrounded by a mix of residential airpark, residential lots, and US Highway 24. The Meadow Lake Estates are integrated with the airport. Other, nearby platted subdivisions include Woodmen Hills, Falcon Heights, and Saddlehorn Ranch.

Figure 1 shows the project location.



Figure 1: Vicinity Map

Soils within the project area are classified as Hydrologic Soil Group A. This classification indicates a high infiltration rate and correspondingly lower runoff potential. The Natural Resources Conservation Service (NRCS) Web Soil Survey report is included in Appendix A.

No mapped floodplains exist within the project limits. The entirety of this project is located within “Zone X” (areas with less than a 0.2% chance of flood) on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panel 08041C0554G, revised December 7, 2018. The referenced FEMA

Please label and discuss which WQ exclusion you are utilizing here.

FIRM panel is included in Appendix A. No construction activities or disturbance in the floodplain will be allowed as part of these improvements.

No irrigation facilities are present on or in the vicinity of the site. No other significant utilities or encumbrances are known in the vicinity of the site.

Appendix I of the El Paso County Engineering Criteria Manual requires water quality and detention for all new developments and redevelopments that disturb more than 1.0 acre of land. This project is anticipated to disturb approximately 4.05 acres and will increase the impervious area by approximately 0.45 acres. These improvements meet the base design standard requirements by providing the water quality capture volume. The County may exclude up to 20 percent, not to exceed one acre of the site from the water quality capture volume. Table 1 provides a summary of the water quality treatment areas.

Total Disturbed Area (ac)	Total Proposed Treated Area (ac)	Total Proposed Disturbed Area Excluded from WQ (ac)	Allowable Excluded Area (ac) (20% Not to Exceed 1.0 acre*)	Required Area of Treatment (ac)	Net (Surplus) Treatment (ac)	Remarks:
4.05	3.49	0.56	0.81	3.24	0.25	
* Per I.6.3.A(1) of the El Paso Engineering Criteria Manual: The base design standard requirement for a water quality capture volume allows up to 20% of the applicable development site (not to exceed 1.0 acre) to be excluded when the County has determined that it is not practicable to capture runoff from portions of the site that will not drain to an applicable permanent control measure.						

Table 1: Water Quality Treatment Summary Table

Clearly delineate both excluded areas on your drainage map (using shading/colors)

Major Basin Descriptions

The Meadow Lake Airport is located within the Solberg Ranch Basin of the Chico Creek watershed. Regional drainage patterns are characterized by broad, shallow overland flow with intermittent channels typical of the High Plains environment. The land is mostly flat prairie (slopes of 1-5%) with grass, brush, and shrubs.

Surface runoff in the project vicinity generally flows from north to southeast. Drainage is conveyed by unnamed swales and channels that ultimately form a tributary to Chico Creek. Chico Creek eventually joins the Arkansas River near Avondale, Colorado. No master plan appears to exist for the Solberg Ranch Basin.

Minimal offsite flow is tributary to the site. The proposed improvements will perpetuate existing and historic drainage patterns.

The project site is divided into five proposed subbasins and two outfalls which eventually combine before leaving the airport's property.

By utilizing on-site detention, the proposed peak discharge will not have a negative impact on the existing outfall system capacity.

Please include the Four-Step Process (DCMv2 Chap 4.1.)

Discuss the suitability of this outfall in more detail. Because previously some of the flows made it to this outfall as sheet flows and/or came via different culverts/swales. But now all of those flows are arriving at this outfall point via one pipe. So that change needs to be discussed.

Please discuss the depth to groundwater. Groundwater is a big issue with some ponds in and around Falcon, so that needs to be factored into the design of this pond.

Subbasin Descriptions

EX1 is located in the northwest quadrant of the site. It is 1.80 acres in size with a minor and major runoff coefficient of 0.41 and 0.54, respectively. It is comprised of the roadside ditch along Judge Orr Road, native vegetation, existing pavement, and the roof of the aircraft shelter. Flow travels overland, joins the roadside ditch, and continues east along Judge Orr Road.

EX2 is located in the central quadrant of the site. It is 4.94 acres in size with a minor and major runoff coefficient of 0.48 and 0.59, respectively. It is comprised of the existing, paved, airplane tiedown areas with a checkerboard pattern of mowed grasses between. Flow travels overland from west to east where it joins a ditch (future Taxilane C Pond) and continues through a culvert to the south side of Taxilane C.

EX3 is located at the southwest corner of the site. It is 0.65 acres in size with a minor and major runoff coefficient of 0.44 and 0.56, respectively. It is comprised of Taxilane C pavement and mowed grasses. Flow travels overland from west to southeast and continues offsite.

PR1 is located in the northwest quadrant of the site. It is 1.80 acres in size with a minor and major runoff coefficient of 0.41 and 0.54, respectively. It is comprised of the roadside ditch along Judge Orr Road, native vegetation, existing pavement, and the roof of the aircraft shelter. Flow travels overland, joins the roadside ditch, and continues east along Judge Orr Road.

PR2 is located in the central quadrant of the site. It is 4.94 acres in size with a minor and major runoff coefficient of 0.67 and 0.74, respectively. It will be comprised of pavement for the aircraft tiedowns. Flow travels overland from west to east where it joins a ditch (future Taxilane C Pond) and continues through a culvert to the south side of Taxilane C.

PR2.1 is located at the western side of the site. It is 4.94 acres in size with a minor and major runoff coefficient of 0.14 and 0.28, respectively. It is comprised of a grassed depression. Overland flow will collect in the depression and will continue south along the runway.

PR2.2 is located at the south edge of the site, it is 0.82 acres in size with a minor and major runoff coefficient of 0.65 and 0.72, respectively. It is comprised of Taxilane C pavement, hangar access pavement, and a grassed swale which passes through the hanger accesses. Overland flow collects in the swale and continues to the east.

PR3 is located at the southwest corner of the site. It is 0.64 acres in size with a minor and major runoff coefficient of 0.44 and 0.55, respectively. It is comprised of Taxilane C pavement and mowed grasses. Flow travels overland from west to southeast and continues offsite.

PR2 Interim is located in the central quadrant of the site. It is 4.94 acres in size with a minor and major runoff coefficient of 0.59 and 0.68, respectively. It is be comprised of existing pavement for the aircraft tiedowns, proposed pavement for the future aircraft tiedowns, and a checkerboard of grassed areas. Flow travels overland from west to east where it joins a ditch (future Taxilane C Pond) and continues through a culvert to the south side of Taxilane C.

Criteria

The design criteria for this project were established in accordance with the El Paso County Engineering Criteria Manual (ECM), the El Paso County Drainage Criteria Manual (DCM), the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual (USDCM, Volumes 1–3), FAA AC 150/5320-5, and FAA AC 150/5300-13.

Peak runoff for the project was estimated using the Rational Method. Rainfall intensity values were obtained from NOAA Atlas 14, based on 1-hour storm durations. A summary of the 1-hour precipitation depths used in the analysis is provided in Table 2. In accordance with the El Paso County Drainage

Criteria Manual (Section III, Chapter 6, Section 6.3.1), a 10-year recurrence interval was selected for the minor storm event, while a 100-year recurrence interval was selected for the major storm event.

2-year	5-year	10-year	50-year	100-year
0.94	1.22	1.47	2.18	2.52

Table 2: 1-hour Rainfall Depths and Intensity Coefficients

The Rational Method incorporates a runoff coefficient (C) and rainfall intensity (I), expressed in inches per hour, corresponding to a selected storm frequency and a duration equal to the time of concentration (T_c). A detailed description of the Rational Method is provided in the MHFD USDCM.

The runoff coefficient represents the fraction of precipitation that becomes surface runoff and is expressed as a value between 0 and 1. This coefficient varies based on imperviousness and underlying soil conditions. Runoff coefficients for the roadway sub-basins were determined using the procedures outlined in the MHFD USDCM, Volume 1.

The time of concentration is defined as the travel time associated with the hydraulically longest flow path within a drainage basin. It is calculated as the sum of travel times for sheet flow, shallow concentrated flow, and concentrated flow in channels or storm conveyance systems. T_c values were calculated in accordance with Equations 6-2 through 6-5 of the MHFD USDCM, Volume 1, Chapter 6. Consistent with USDCM guidance, minimum T_c values of 5 minutes for urban basins and 10 minutes for non-urban basins were applied. Detailed hydrologic calculations are provided in Appendix B.

Pipe Criteria

Storm sewer pipe systems shall be designed in accordance with the El Paso County Drainage Criteria Manual (DCM) to provide safe and efficient conveyance of stormwater runoff. Pipe systems are typically sized to convey the major storm event.

Pipes should be designed to flow under open-channel (gravity) conditions and should not operate under pressure except during major storm events. During the major event, the hydraulic grade line (HGL) must remain one foot below finished grade, and the energy grade line (EGL) must remain below finished grade.

Maximum allowable velocities are limited to prevent pipe damage and downstream erosion, and energy dissipation measures shall be provided at outfalls where necessary. Pipes must be covered with a minimum of 18" of soil and pavement, or for anticipated loading conditions (whichever is greater).

Outfall conditions must not cause erosion, flooding, or adverse impacts to downstream properties.

Deviations from Criteria

These improvements are being made on an existing site, which pose both topographic and manmade constraints. A complete explanation of the deviation request from criteria is included in Appendix A of this report. Appendix I.3 of the El Paso Engineering Criteria Manual states that it has adopted sections of the City of Colorado Springs and Volume 2 of the Mile High Flood District Drainage Criteria Manuals (DCM). The following two deviations are not directly stated in the EPC manuals, but rather are stated in the Colorado Springs DCM:

1. Chapter 13, Section 5.5 states *"The minimum freeboard for detention facilities is 1.0 foot above the computed water surface elevation when the emergency spillway is conveying its design flow..."*. The proposed design provides 0.25' of freeboard.

- Chapter 3, Section 6.5 states, *"Unless an alternative detention concept is approved through the master planning process, the full spectrum detention approach...shall be implemented as the standard detention approach"*. The proposed outlet structure releases at or below existing rates.

Software and Methods

Detention discharge and storage calculations were performed using the Mile High Flood District (MHFD) Detention Design Workbook v4.07, which applies the Colorado Urban Hydrograph Procedure (CUHP) based on a unit hydrograph approach. This method is used to develop inflow and outflow hydrographs and to size detention storage by routing storm runoff through the proposed facility to achieve the desired rate of discharge.

We need a name associated with this pond for our post-construction tracking. Are you going with "Taxiway Pond C?" That is what is called out in a few places on the Subbasin Descriptions two pages above. If so, please add that label/name to all maps and plans and where appropriate in this report text (you don't have to say the full name everytime it's mentioned, sometime just "pond" or "drainage facility" is fine how you have it now.

II. Drainage Facility Design

Stormwater runoff associated with the proposed development has been evaluated with consideration of both on-site and off-site drainage conditions. The proposed design maintains compatibility with historic drainage patterns and conveys upstream runoff through the site without adverse impacts to adjacent properties or downstream facilities.

Hydrologic analyses were performed to quantify existing and proposed runoff conditions. Drainage basin boundaries were delineated based on topography and proposed grading, and peak flow rates were calculated for the minor and major storm events.

A four-step process has been incorporated into the site design to address stormwater management objectives. First, runoff reduction has been considered through site design techniques that minimize unnecessary impervious areas. Second, stabilization of drainageways has been evaluated, and drainageways are considered stable under expected flow conditions. Third, a Stormwater Quality Capture Volume (WQCV) has been provided to improve water quality by capturing and treating runoff from the site. Finally, appropriate Best Management Practices (BMPs), in the form of a full-spectrum detention pond, will be implemented to help ensure that stormwater discharges from the site meet applicable water quality standards.

For consistency across all docs, clarify in this section that Interim Condition = Phase 1 and Ultimate Condition = Phase 2 (if that's the naming convention you want to use).

Interim Drainage Conditions

The proposed improvements are intended to take place during two separate phases of construction. The pond and drainage infrastructure are sized for the ultimate condition. An indeterminate amount of time may pass between these phases, so this design has also considered the interim drainage conditions. Supporting calculations demonstrate that the pond's outlet structure and orifice plate will be suitable for interim and ultimate conditions.

Maintenance and Access

Access to all onsite drainage infrastructure is provided via existing and proposed drainage easements. These easements ensure permanent, unobstructed ingress and egress for municipal or private maintenance equipment. Drainage easements must remain clear of permanent structures, fences that impede equipment, or deep-rooted woody vegetation that could compromise the integrity of the basin or conveyance piping.

The detention facility is configured to allow access for inspection, maintenance, and sediment removal activities. The design considers long-term operation and maintenance requirements to ensure that all facilities remain serviceable. Notable design elements of the pond's outlet structure include access hinges, stairs, removable orifice plates, and is located in close proximity to Taxiway C. The pond also includes a forebay and concrete lined trickle channel for easy sediment removal.

no detail provided in plans for this, please provide. Also forebay sizing calcs are needed in this FDR, please use MHFD's SCM Design spreadsheet for this.

The airport district will be responsible for maintaining all drainage facilities and infrastructure located on the site. A separate operations and maintenance (O&M) agreement is included as part of the submittal package to the County.

Interface with Natural Resources

The proposed pond will have several benefits for the surrounding natural resources. First, hydraulic attenuation of peak flow will reduce erosion in downstream portions of the watershed. Second, detaining and releasing the WQCV over a period of 40 hours increases infiltration and can support a localized micro-habitat for different plants, pollinators, amphibians, and invertebrates.

The U.S. Fish and Wildlife Service identifies several riverine wetlands in the vicinity of the site. Both areas are contained within the existing, natural drainageways and are designated as R4SBC (riverine, intermittent, streambed, seasonally flooded). None of these wetlands fall within the project limits, and no impacts are anticipated as a result of these improvements.

III. Conclusion

This preliminary Hydrology and Hydraulics Report documents the drainage evaluation completed for the Meadow Lake Airport Transient Apron Reconstruction project. Hydrologic analyses were performed using NOAA Atlas 14 precipitation data and the Rational Method in accordance with the El Paso County Engineering Criteria Manual and Drainage Criteria Manual, the Mile High Flood District USDCM, and applicable FAA guidance. Based on the proposed grading and drainage concepts, stormwater runoff will be conveyed through defined overland and piped systems and managed with on-site detention and water quality facilities so that peak discharges are controlled. The proposed improvements are not located within a mapped FEMA floodplain and are not anticipated to impact nearby wetlands.

IV. References

- National Oceanic and Atmospheric Administration (NOAA), National Weather Service. *Atlas 14 Point Precipitation Frequency Estimates* (Precipitation Frequency Data Server). Hydrometeorological Design Studies Center.
- Mile High Flood District (MHFD). *Urban Storm Drainage Criteria Manual (USDCM)*, Volumes 1–3. Denver, Colorado.
- Federal Emergency Management Agency (FEMA). *Flood Insurance Rate Map (FIRM)*, El Paso County, Colorado and Incorporated Areas, Panel 08041C0554G, effective December 7, 2018.
- El Paso County Department of Public Works. *Engineering Criteria Manual (ECM)*. El Paso County, Colorado.
- El Paso County Department of Public Works. *Drainage Criteria Manual (DCM)*. El Paso County, Colorado.
- Federal Aviation Administration (FAA). *Advisory Circular (AC) 150/5320-5, Surface Drainage Design*. Washington, DC.
- Federal Aviation Administration (FAA). *Advisory Circular (AC) 150/5300-13, Airport Design*. Washington, DC.
- Natural Resources Conservation Service (NRCS). *Web Soil Survey*. United States Department of Agriculture.

Include a cost estimate for each PCM with line items for all components (ex: riprap, road base, forebay, trickle channel, outlet structure, outlet pipe, spillway, etc). Input the total value into the FAE form under "Permanent Pond/BMP (provide engineer's estimate)" in Section 1, **currently at \$45,000**. The total should not include grading, which is a separate line item in Section 1: "Earthwork." The cost estimate should include labor costs (as a separate line item or added into the cost of each component).

Appendix A: General Site Information

El Paso County Checklist

NOAA Atlas 14 Precipitation

FEMA FIRM Panels

El Paso County Drainage Basin Map

NRCS Soil Report and Map

Deviation Request Form



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**EL PASO COUNTY PLANNING AND
COMMUNITY DEVELOPMENT
DEPARTMENT**

FINAL DRAINAGE REPORT (FDR) CHECKLIST

Revised: January 2022

Final Drainage Report		
The purpose of the Final Drainage Report is to finalize concepts and to present the final design details for the drainage facilities presented in the PDR, including any changes to the preliminary design. The FDR shall contain all components of the PDR checklist plus additional necessary information relating to the final design of specific facilities associated with the development.		
	Applicant	PCD
Please confirm each item below has been included by placing a check mark in the "Applicant" column. See right for an example. The "PCD" column is for office use only.	✓	Office use only
Report Contents		
1 Table of contents, pages numbered	✓	
2 Existing/Historic and Developed Conditions Plans at the end of the report	✓	
General Location		
1 City and County, and local streets within and adjacent to the subdivision	✓	
2 Township, Range, Section, 1/4 section	✓	
3 Major drainage ways and existing facilities	✓	
4 Names of surrounding platted developments	✓	
Description of Property		
1 Area in acres	✓	
2 Ground cover, (type of trees, shrubs, vegetation)	✓	
3 General topography	✓	
4 General soil conditions	✓	
5 Major drainageways	✓	
6 Irrigation facilities	✓	
7 Utilities and other encumbrances	✓	
Major Basin Descriptions		
1 Reference should be made to major drainageway planning studies; Such as Drainage Basin Planning Studies; Flood Hazard delineation reports, and flood insurance studies or maps if available.	✓	
2 A floodplain statement shall be provided indicating whether any portion of the development is in a designated floodplain as delineated on the current FEMA mapping.	✓	
3 Major basin drainage characteristics	✓	
4 Identification of all nearby irrigation facilities and other obstructions which could influence or be influenced by local drainage.	✓	
Sub-Basin Descriptions		
1 Discussion of historic drainage patterns of the property in question	✓	
2 Discussion of offsite drainage flow patterns and their impact on the development	✓	
Drainage Design Criteria		
1 Reference all criteria, master plans, and technical information used for report preparation and design; any deviation from such material must be discussed and justified.	✓	
2 Discussion of previous drainage studies (i.e. PDR, drainage basin planning studies, master plans, flood insurance studies) for the site in question that influence or are influenced by the drainage design and how the studies affect drainage design for the site	✓	
Four Step Process		
1 Runoff reduction proposed	✓	
2 Stabilization of drainage ways proposed/discussed	✓	
3 Proposed Stormwater Quality Capture Volume (WQCV) proposed	✓	
4 Identify Best Management Practices (BMP's) to be used to control industrial and commercial pollutants	✓	

I didn't see this included
in the report text above



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EL PASO COUNTY PLANNING AND COMMUNITY DEVELOPMENT DEPARTMENT

FINAL DRAINAGE REPORT (FDR) CHECKLIST

Revised: January 2022

Hydrologic Criteria		
1	Identify design rainfall	✓
2	Identify runoff calculation method	✓
3	Identify design storm recurrence intervals	✓
4	Identify detention discharge and storage calculation method	✓
5	Note ECM Appendix I Full Spectrum Detention (FSD) requirement	✓
Drainage Facility Design - General Concept		
1	Discussion of compliance with offsite runoff considerations	✓
2	Discussion of anticipated and proposed drainage patterns	✓
3	Discussion of the content of tables, charts, figures, plates or drawings presented in the report	✓
Drainage Facility Design - Specific Details		
1	Presentation of existing and proposed hydrologic conditions including approximate flow rates entering and exiting the subdivision with all necessary calculations.	✓
2	Presentation of approach to accommodate drainage impacts on existing or proposed improvements and facilities.	✓
3	Presentation of proposed facilities with respect to alignment, material and structure type.	✓
4	Discussion of drainage impact of site constraints such as streets, utilities, existing and proposed structures.	✓
5	Environmental features and issues shall be presented if applicable.	✓
6	Discussion of maintenance access and aspects of the design.	✓
7	Discussion and analysis of existing and proposed downstream drainage facilities and their ability to convey developed runoff from the proposed development.	✓
8	Presentation of detention storage and outlet design (including reservoir routings) when applicable. Note that the Engineering Criteria Manual Appendix I requires Full Spectrum Detention.	✓
9	Presentations of all hydrologic and hydraulic calculations including hydraulic grade line computations as appropriate. Recommended use of Mile High Flood District (MHFD / UDFCD) spreadsheets and calculations to properly meet this requirement, however other commonly used software may be acceptable.	✓
10	Presentation of an accurate, complete current estimate of cost of proposed facilities.	✓
11	Presentation of all drainage basin fees and bridge fees for the property in question as applicable.	N/A
Other Government agency requirements		
1	Federal Emergency Management Agency (FEMA)	✓
2	Army Corps of Engineers (COE)	✓
3	Colorado State Engineer	✓
4	Colorado Water Conservation Board (CWCB)	✓
5	Others	N/A



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FINAL DRAINAGE REPORT (FDR) CHECKLIST

Revised: January 2022

Drawing Contents, two maps/plans are required, existing conditions & the proposed plans			
1	General Location Map: A map shall be provided in sufficient detail to identify drainage flows entering and leaving the development and general drainage patterns. The map should be at a scale of 1"=50' to 1"=2000'. The map shall identify any major construction (i.e. development, irrigation ditches, existing detention facilities, culverts, storm sewers, etc.) that shall influence or be influenced by the subdivision.		
2	Drainage Plan: Map(s) of the proposed development at a scale of 1"=20' to 1"=200' shall be included to identify existing and proposed conditions on or adjacent to the site in question. It shall include a minimum of:	✓	
	Existing and proposed contours at 2 feet maximum intervals. For subdivisions involving rural lots greater than 1.0 acre, the maximum interval may be 5 feet where approved. In terrain greater than 10% the intervals should be 10 foot intervals.	✓	
	Property lines and existing or proposed easements with purposes noted.		
	All Streets	✓	
	Existing drainage facilities and structures, including irrigation ditches roadside ditches, drainageways, gutters and culverts, all indicating flow direction. All pertinent information such as material, size, shape, slope and locations shall also be included.	✓	
	Overall drainage area boundary and drainage sub-area boundaries relating to the subdivision.	✓	
	Proposed type of street sections (i.e., vertical or ramp curb and gutters, roadside ditch, gutter flow and/or cross pans).	✓	
	Proposed storm sewers and open drainageways, including inlets, manholes, culverts, and other appurtenances.	✓	
	Proposed outfall point for runoff from the developed area and facilities to convey flows to the final outfall point without damage to downstream properties.	✓	
	Routing and summary of initial and major flow rates at various design points for all storm runoff associated with the property.		
	Path (s) chosen for computation of time of concentration.		
	Details of and design computations for detention storage facilities including outlet.	✓	
	Location and elevations of all defined 100-year floodplains affecting the property.	N/A	
	Location of all existing and proposed utilities affected by or affecting the drainage design.	✓	



NOAA Atlas 14, Volume 8, Version 2
Location name: Peyton, Colorado, USA*
Latitude: 38.9528°, Longitude: -104.573°
Elevation: 6866 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.238 (0.191-0.300)	0.291 (0.233-0.366)	0.381 (0.304-0.481)	0.460 (0.365-0.583)	0.577 (0.445-0.762)	0.672 (0.505-0.898)	0.772 (0.560-1.06)	0.878 (0.611-1.23)	1.03 (0.686-1.48)	1.14 (0.742-1.66)
10-min	0.349 (0.280-0.439)	0.426 (0.341-0.536)	0.558 (0.445-0.704)	0.674 (0.535-0.854)	0.845 (0.651-1.12)	0.984 (0.739-1.32)	1.13 (0.820-1.55)	1.28 (0.894-1.80)	1.50 (1.00-2.16)	1.67 (1.09-2.44)
15-min	0.426 (0.341-0.535)	0.519 (0.415-0.653)	0.680 (0.543-0.858)	0.822 (0.652-1.04)	1.03 (0.794-1.36)	1.20 (0.901-1.60)	1.38 (1.00-1.88)	1.57 (1.09-2.20)	1.83 (1.22-2.64)	2.04 (1.33-2.97)
30-min	0.610 (0.489-0.767)	0.743 (0.595-0.935)	0.973 (0.776-1.23)	1.18 (0.932-1.49)	1.47 (1.13-1.94)	1.71 (1.28-2.28)	1.96 (1.42-2.68)	2.23 (1.55-3.13)	2.60 (1.74-3.75)	2.90 (1.88-4.22)
60-min	0.783 (0.627-0.984)	0.940 (0.752-1.18)	1.22 (0.973-1.54)	1.47 (1.17-1.87)	1.86 (1.44-2.47)	2.18 (1.64-2.92)	2.52 (1.83-3.46)	2.89 (2.02-4.08)	3.42 (2.29-4.94)	3.85 (2.50-5.60)
2-hr	0.955 (0.772-1.19)	1.14 (0.916-1.42)	1.47 (1.18-1.83)	1.77 (1.42-2.23)	2.24 (1.76-2.97)	2.65 (2.01-3.53)	3.08 (2.26-4.21)	3.56 (2.50-4.99)	4.24 (2.87-6.10)	4.80 (3.14-6.93)
3-hr	1.05 (0.850-1.30)	1.23 (0.998-1.53)	1.58 (1.28-1.97)	1.91 (1.53-2.39)	2.43 (1.92-3.22)	2.89 (2.21-3.85)	3.39 (2.50-4.62)	3.94 (2.79-5.51)	4.74 (3.22-6.80)	5.40 (3.55-7.78)
6-hr	1.21 (0.991-1.49)	1.41 (1.15-1.74)	1.79 (1.46-2.21)	2.17 (1.76-2.69)	2.78 (2.21-3.66)	3.31 (2.56-4.40)	3.90 (2.92-5.30)	4.57 (3.27-6.36)	5.54 (3.81-7.91)	6.35 (4.21-9.08)
12-hr	1.39 (1.15-1.70)	1.62 (1.34-1.98)	2.06 (1.69-2.53)	2.49 (2.03-3.06)	3.17 (2.55-4.14)	3.77 (2.94-4.96)	4.43 (3.33-5.96)	5.16 (3.72-7.13)	6.23 (4.32-8.83)	7.12 (4.77-10.1)
24-hr	1.60 (1.33-1.94)	1.88 (1.56-2.27)	2.39 (1.98-2.90)	2.87 (2.36-3.50)	3.62 (2.92-4.66)	4.26 (3.34-5.54)	4.96 (3.76-6.61)	5.73 (4.16-7.84)	6.84 (4.77-9.61)	7.75 (5.24-10.9)
2-day	1.85 (1.55-2.22)	2.18 (1.82-2.62)	2.77 (2.31-3.33)	3.31 (2.74-4.00)	4.12 (3.34-5.24)	4.81 (3.79-6.18)	5.54 (4.22-7.30)	6.34 (4.63-8.58)	7.48 (5.25-10.4)	8.40 (5.72-11.8)
3-day	2.03 (1.71-2.42)	2.39 (2.01-2.86)	3.03 (2.54-3.63)	3.60 (3.00-4.34)	4.47 (3.63-5.64)	5.19 (4.11-6.63)	5.97 (4.56-7.82)	6.80 (4.99-9.16)	7.98 (5.63-11.0)	8.93 (6.12-12.5)
4-day	2.18 (1.84-2.60)	2.56 (2.16-3.05)	3.23 (2.71-3.85)	3.83 (3.20-4.59)	4.73 (3.86-5.95)	5.48 (4.36-6.98)	6.28 (4.82-8.20)	7.15 (5.26-9.59)	8.37 (5.93-11.6)	9.35 (6.43-13.0)
7-day	2.59 (2.20-3.06)	2.99 (2.54-3.53)	3.70 (3.13-4.38)	4.34 (3.65-5.17)	5.30 (4.35-6.61)	6.10 (4.88-7.70)	6.95 (5.37-9.01)	7.87 (5.84-10.5)	9.17 (6.54-12.6)	10.2 (7.08-14.2)
10-day	2.94 (2.51-3.46)	3.38 (2.88-3.97)	4.14 (3.52-4.89)	4.83 (4.08-5.72)	5.84 (4.81-7.25)	6.69 (5.37-8.40)	7.58 (5.88-9.78)	8.54 (6.36-11.3)	9.89 (7.09-13.5)	11.0 (7.64-15.2)
20-day	3.91 (3.37-4.56)	4.52 (3.88-5.27)	5.53 (4.73-6.46)	6.39 (5.44-7.51)	7.62 (6.30-9.31)	8.61 (6.94-10.7)	9.62 (7.50-12.2)	10.7 (7.99-14.0)	12.1 (8.73-16.3)	13.2 (9.29-18.1)
30-day	4.70 (4.07-5.46)	5.44 (4.70-6.32)	6.65 (5.72-7.74)	7.66 (6.56-8.96)	9.05 (7.49-10.9)	10.1 (8.20-12.4)	11.2 (8.78-14.2)	12.3 (9.26-16.0)	13.8 (9.98-18.5)	14.9 (10.5-20.4)
45-day	5.69 (4.95-6.57)	6.58 (5.71-7.59)	8.00 (6.92-9.26)	9.15 (7.87-10.6)	10.7 (8.88-12.8)	11.9 (9.65-14.5)	13.0 (10.2-16.3)	14.2 (10.7-18.3)	15.6 (11.4-20.8)	16.7 (11.9-22.8)
60-day	6.53 (5.69-7.50)	7.51 (6.54-8.64)	9.08 (7.88-10.5)	10.3 (8.92-12.0)	12.0 (9.97-14.3)	13.2 (10.8-16.0)	14.4 (11.3-18.0)	15.6 (11.8-20.0)	17.0 (12.4-22.6)	18.1 (12.9-24.5)

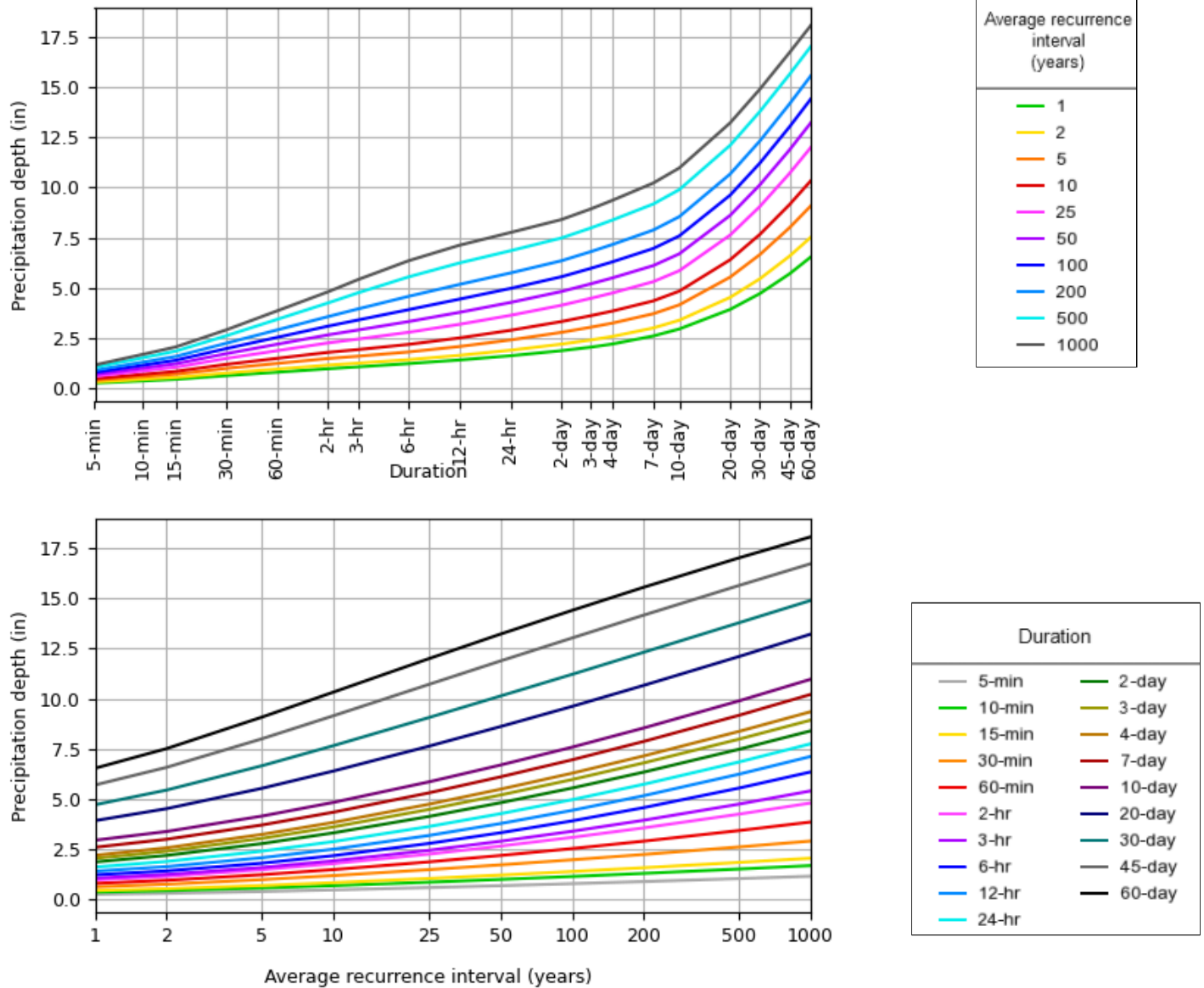
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
 Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based depth-duration-frequency (DDF) curves

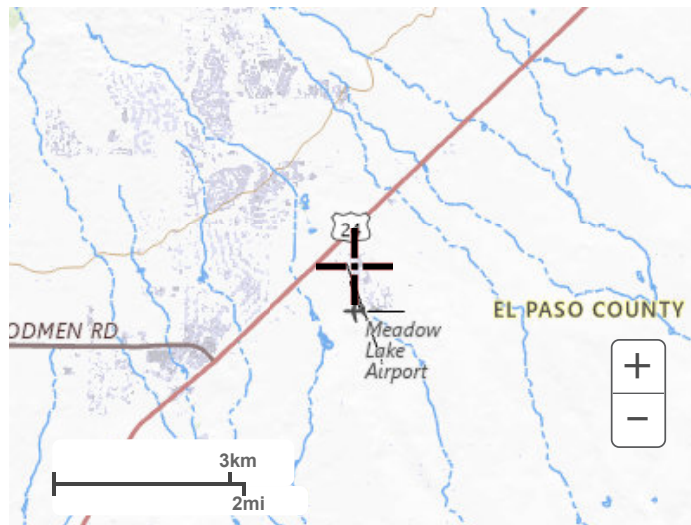
Latitude: 38.9528°, Longitude: -104.5730°



NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Thu May 7 15:21:12 2026

[Back to Top](#)**Maps & aerials****Small scale terrain**



Large scale terrain



Large scale map



Large scale aerial



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[National Weather Service](#)
[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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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 to 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, NINGS12
National Geodetic Survey
SSM/C-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.

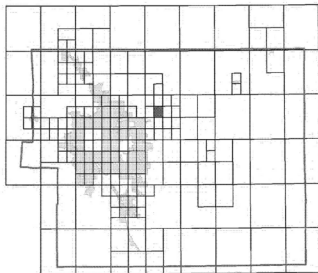
Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-356-9620 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/nfp>.

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	

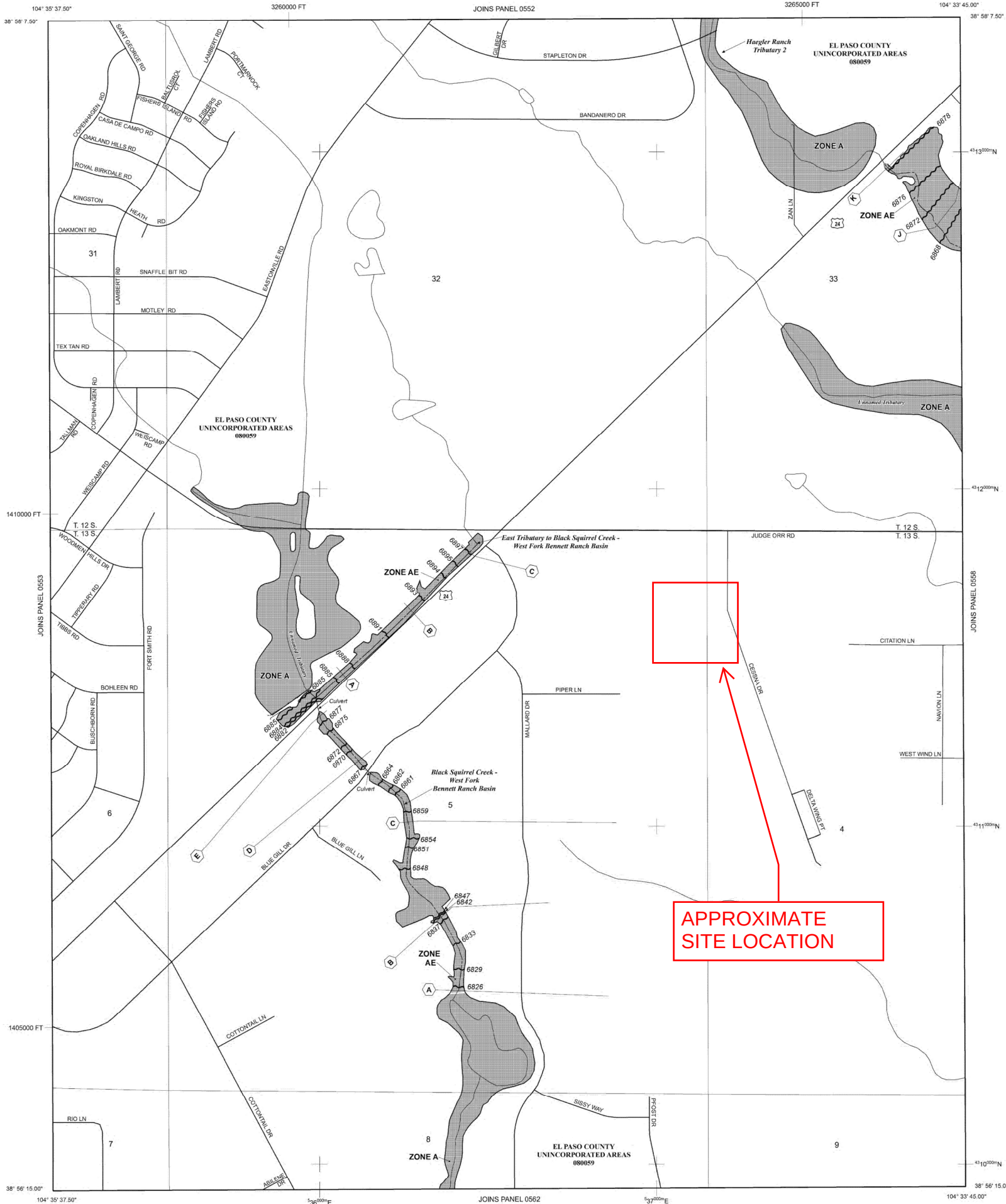
Panel Location Map



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 12 SOUTH, RANGE 64 WEST, AND TOWNSHIP 13 SOUTH, RANGE 64 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.
- 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** Cross section line
- 23** Transect line
- 97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4750000N 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

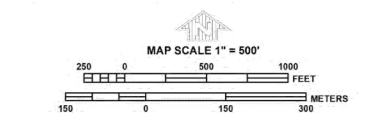
MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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.



NFP
PANEL 0554G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 554 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	08059	0554	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.

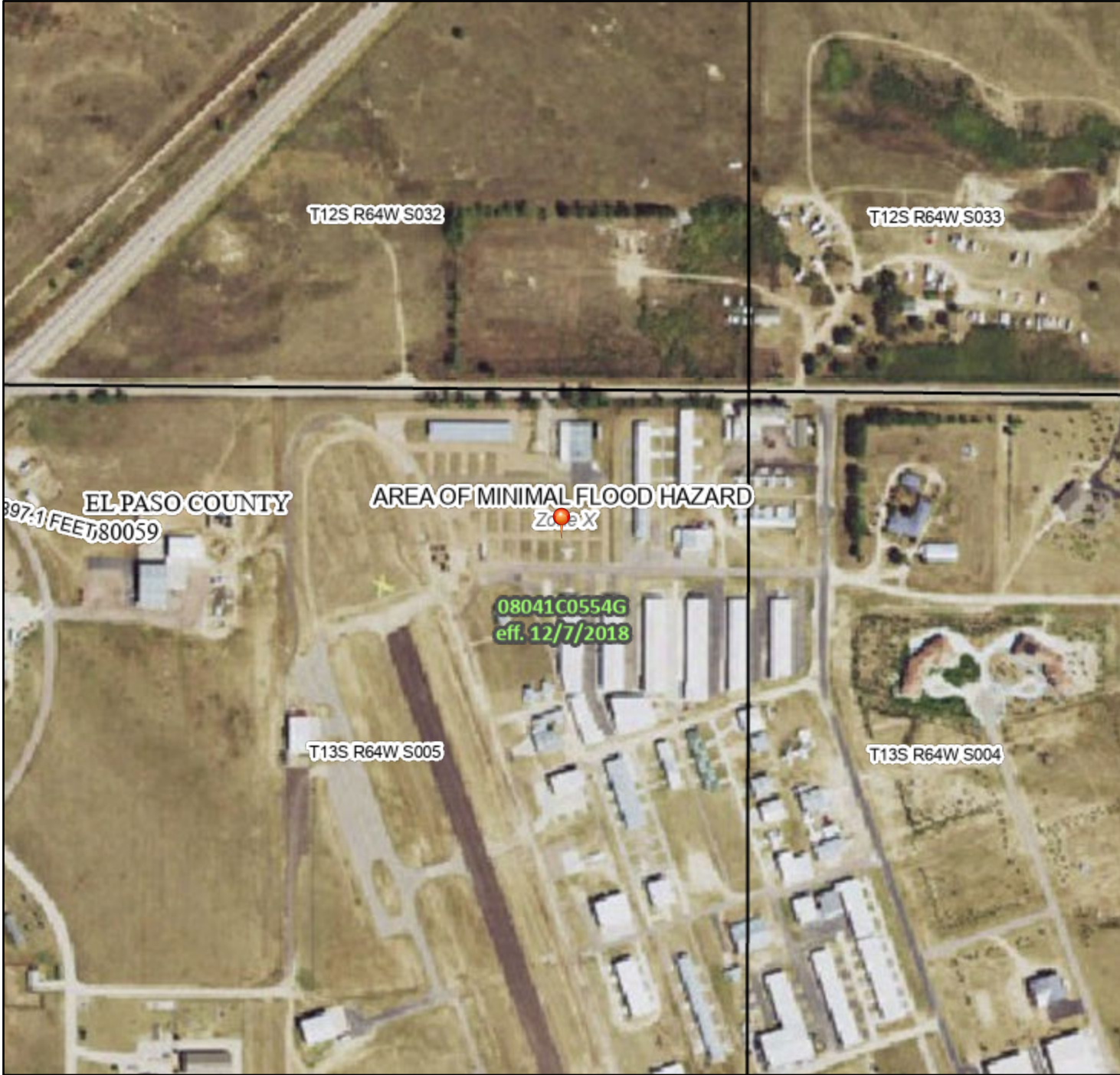
MAP NUMBER
08041C0554G

MAP REVISED
DECEMBER 7, 2018
Federal Emergency Management Agency

National Flood Hazard Layer FIRMMette



104°34'42"W 38°57'28"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



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

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/5/2026 at 9:33 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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



U.S. Fish and Wildlife Service

National Wetlands Inventory

MEADOW LAKE AIRPORT WETLANDS



May 7, 2026

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for El Paso County Area, Colorado



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

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

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	38.6	100.0%
Totals for Area of Interest		38.6	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Fans, Fan terraces, Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquolls

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Custom Soil Resource Report

Other soils

Percent of map unit: 1 percent

Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent

Landform: Depressions

Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Erosion Factors

Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

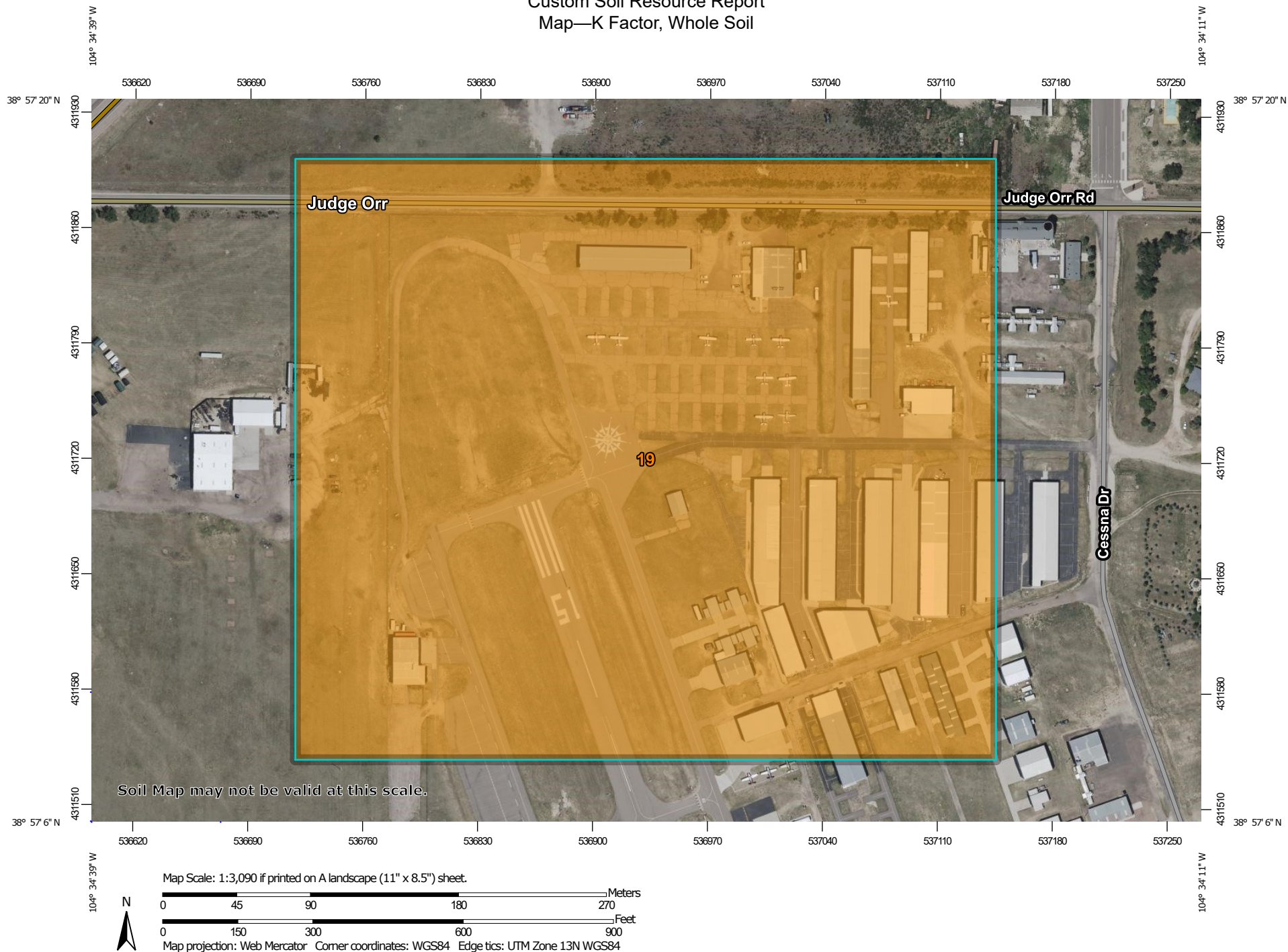
K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Factor K does not apply to organic horizons and is not reported for those layers.

Custom Soil Resource Report
Map—K Factor, Whole Soil



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

	.02
	.05
	.10
	.15
	.17
	.20
	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Soil Rating Lines

	.02
	.05
	.10
	.15
	.17
	.20

	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Soil Rating Points

	.02
	.05
	.10
	.15
	.17
	.20
	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Water Features

	Streams and Canals
	Rails
	Interstate Highways
	US Routes
	Major Roads
	Local Roads
	Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	.10	38.6	100.0%
Totals for Area of Interest			38.6	100.0%

Rating Options—K Factor, Whole Soil

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

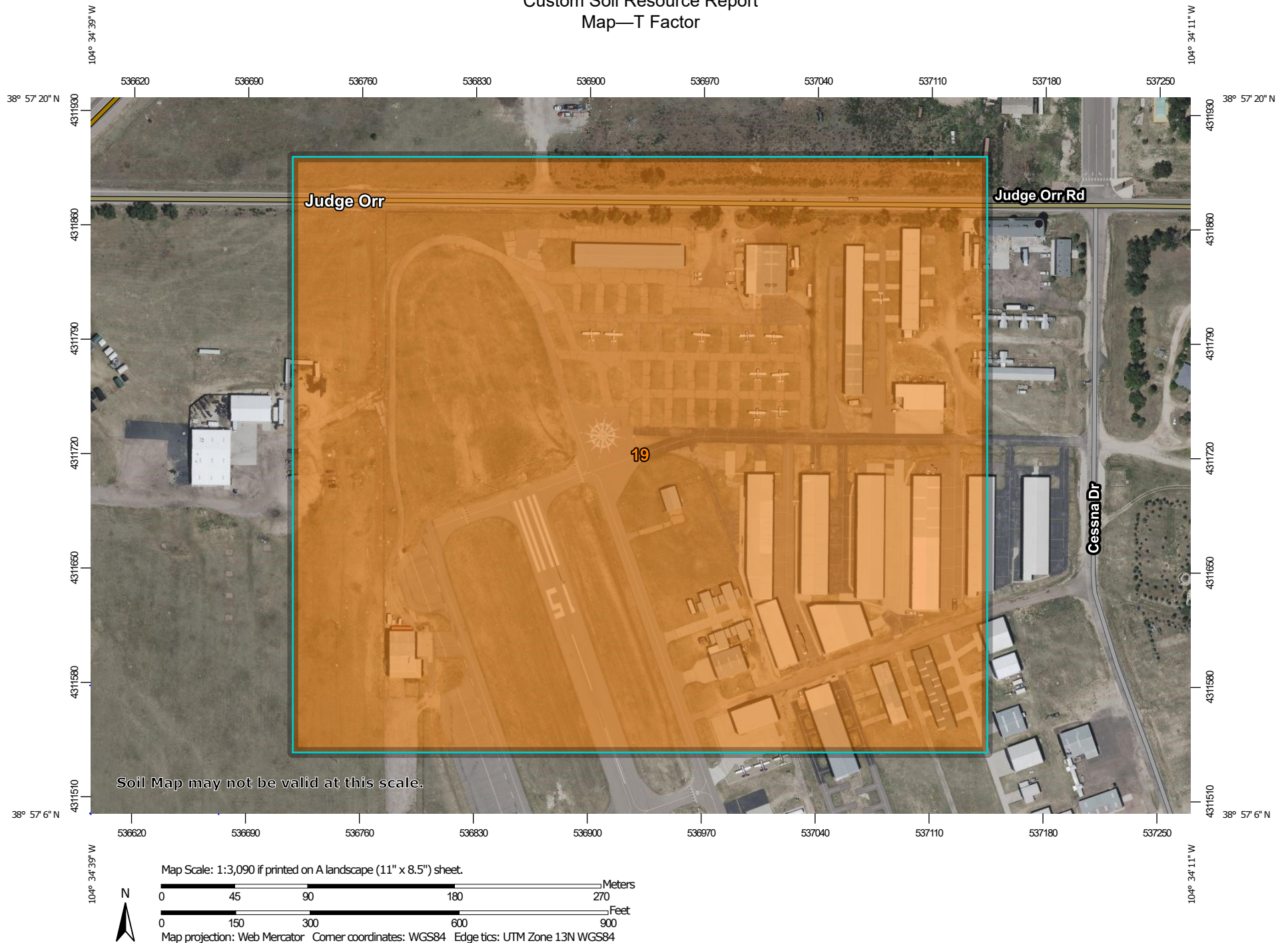
Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

T Factor

The T factor is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Custom Soil Resource Report Map—T Factor



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 1
 2
 3
 4
 5
 Not rated or not available

Soil Rating Lines

 1
 2
 3
 4
 5
 Not rated or not available

Soil Rating Points

 1
 2
 3
 4
 5
 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

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Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

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Table—T Factor

Map unit symbol	Map unit name	Rating (tons per acre per year)	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	2	38.6	100.0%
Totals for Area of Interest			38.6	100.0%

Rating Options—T Factor

Units of Measure: tons per acre per year

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

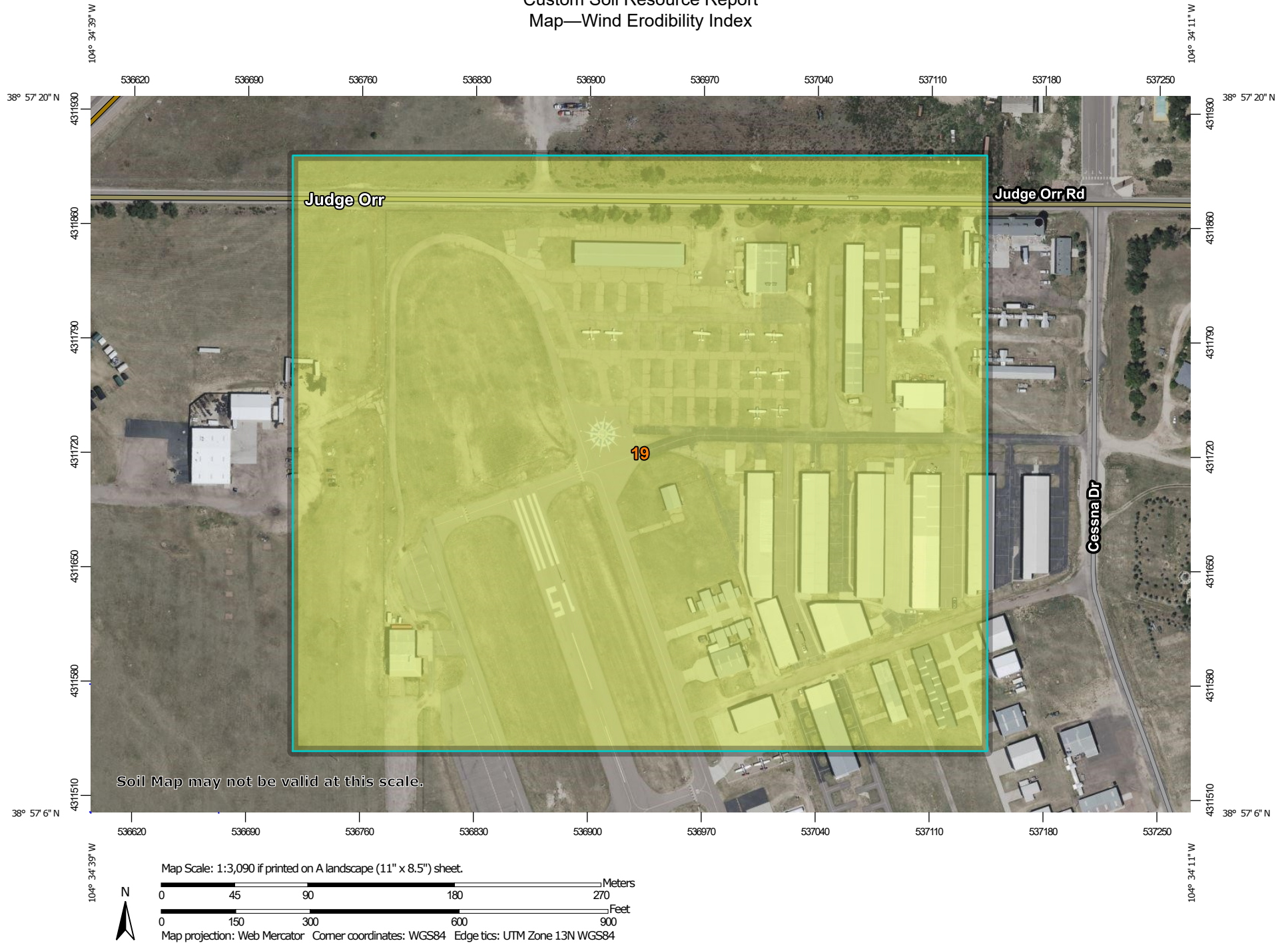
Tie-break Rule: Lower

Interpret Nulls as Zero: No

Wind Erodibility Index

The wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Custom Soil Resource Report
Map—Wind Erodibility Index



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

	0
	38
	48
	56
	86
	134
	160
	180
	220
	250
	310
	Not rated or not available

Soil Rating Lines

	0
	38
	48
	56
	86
	134
	160
	180
	220

 250

 310

 Not rated or not available

Soil Rating Points

	0
	38
	48
	56
	86
	134
	160
	180
	220
	250
	310
	Not rated or not available

Water Features

 Streams and Canals

Transportation

	Rails
	Interstate Highways
	US Routes
	Major Roads
	Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—Wind Erodibility Index

Map unit symbol	Map unit name	Rating (tons per acre per year)	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	86	38.6	100.0%
Totals for Area of Interest			38.6	100.0%

Rating Options—Wind Erodibility Index

Units of Measure: tons per acre per year

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

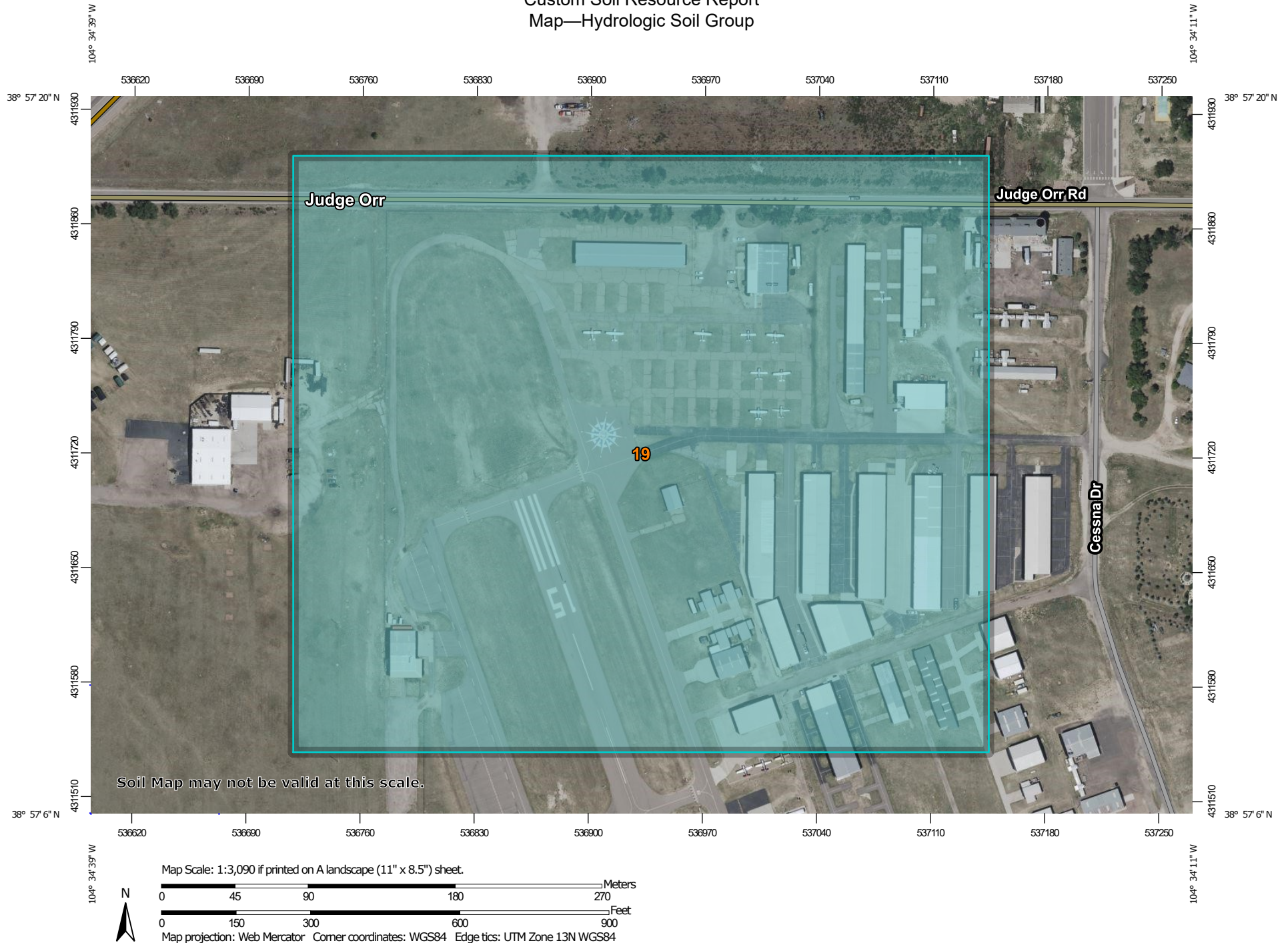
Custom Soil Resource Report

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Custom Soil Resource Report

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

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	38.6	100.0%
Totals for Area of Interest			38.6	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Please remove this from the drainage report since it is uploaded to EDARP as a separate document.



Planning and Community
Development Department
2880 International Circle
Colorado Springs, Colorado 80910
Phone: 719.520.6300
Fax: 719.520.6695
Website www.elpasoco.com

DEVIATION REQUEST
AND DECISION FORM

Updated: 6/26/2019

PROJECT INFORMATION

Project Name :	Meadow Lake Airport Transient Ramp Reconstruction
Schedule No.(s) :	
Legal Description :	LOT 6 BLK 2 MEADOW LAKE AIRPORT FIL NO 1 EX S 50 FT TO TAXIWAY IMP LOC. 43050-05-110

APPLICANT INFORMATION

Company :	Meadow Lake Airport
Name :	Dave Elliott
	☒ Owner ☐ Consultant ☐ Contractor
Mailing Address :	13625 Judge Orr Road Peyton, CO 80831
Phone Number :	719.339.0928
FAX Number :	
Email Address :	Falcon20Flier@MSN.com

ENGINEER INFORMATION

Company :	Bolton-Menk	Colorado P.E. Number :	62966
Name :	Kevin Buffington, PE		
Mailing Address :	5670 Greenwood Plaza Drive Suite W505 Denver, CO 80111		
Phone Number :	303.531.8848		
FAX Number :			
Email Address :	Kevin.Buffington@Bolton-Menk.com		

OWNER, APPLICANT, AND ENGINEER DECLARATION

To the best of my knowledge, the information on this application and all additional or supplemental documentation is true, factual and complete. I am fully aware that any misrepresentation of any information on this application may be grounds for denial. I have familiarized myself with the rules, regulations and procedures with respect to preparing and filing this application. I also understand that an incorrect submittal will be cause to have the project removed from the agenda of the Planning Commission, Board of County Commissioners and/or Board of Adjustment or delay review until corrections are made, and that any approval of this application is based on the representations made in the application and may be revoked on any breach of representation or condition(s) of approval.

Signature of owner (or authorized representative) _____ Date _____

Engineer's Seal, Signature _____
And Date of Signature _____

L J

DEVIATION REQUEST (Attach diagrams, figures, and other documentation to clarify request)

A deviation from the standards of or in Section **Appendix I.3** of the Engineering Criteria Manual (ECM) is requested.

Identify the specific ECM standard which a deviation is requested:

Appendix I.3 of the El Paso Engineering Criteria Manual states that it has adopted sections of the City of Colorado Springs and Volume 2 of the Mile High Flood District Drainage Criteria Manuals (DCM). The following deviations are not directly stated in the EPC manuals but rather are stated in the Colorado Springs DCM.

1. Colorado Springs DCM | Chapter 13, Section 5.5
 - a. This section states "*The minimum freeboard for detention facilities is 1.0 foot above the computed water surface elevation when the emergency spillway is conveying its design flow...*".
2. Colorado Springs DCM | Chapter 3, Section 6.5
 - a. This section states, "*Unless an alternative detention concept is approved through the master planning process, the full spectrum detention approach...shall be implemented as the standard detention approach*".

State the reason for the requested deviation:

1. Colorado Springs DCM | Chapter 13, Section 5.5
 - a. The proposed improvements are occurring on an existing site which is both horizontally and vertically constrained. Strict compliance is physically unfeasible because it would require roughly double the footprint of the pond. Additional vertical berming to provide freeboard is also not possible because the Federal Aviation Administration (FAA) does not allow vertical intrusions in specific clear zones adjacent to taxiways. In lieu of the 1.0', 0.25' of freeboard is provided.
2. Colorado Springs DCM | Chapter 3, Section 6.5
 - a. These improvements request a deviation from the standard Full Spectrum Detention (FSD) requirement to instead detain post-development runoff strictly to match existing pre-development peak release rates. Due to the horizontal constraints of the existing site, horizontal footprint required for full 100-year FSD volume physically impossible to construct. To mitigate downstream impacts, the basin will utilize a custom multi-stage outlet structure to ensure zero net increase in peak stormwater discharge for storm events, while still fully capturing and treating the standard Water Quality Capture Volume (WQCV).

Explain the proposed alternative and compare to the ECM standards (May provide applicable regional or national standards used as basis):

1. Colorado Springs DCM | Chapter 13, Section 5.5
 - a. Due to vertical constraints, strict compliance is physically unfeasible because it would require roughly double the footprint of the pond. Additional, offsite land and additional storm conveyance upgrades would be necessary to convey flow.
2. Colorado Springs DCM | Chapter 3, Section 6.5
 - a. Due to vertical constraints, strict compliance is physically unfeasible because it would require roughly double the footprint of the pond. Additional, offsite land and additional storm conveyance upgrades would be necessary to convey flow.

LIMITS OF CONSIDERATION

(At least one of the conditions listed below must be met for this deviation request to be considered.)

- ☐ The ECM standard is inapplicable to the particular situation.
- ☒ Topography, right-of-way, or other geographical conditions or impediments impose an undue hardship and an equivalent alternative that can accomplish the same design objective is available and does not compromise public safety or accessibility.
- ☐ A change to a standard is required to address a specific design or construction problem, and if not modified, the standard will impose an undue hardship on the applicant with little or no material benefit to the public.

Provide justification:

To provide safe ground travel for aircraft, airports are flat by design. Sharp grade breaks within the pavement, drop-offs adjacent to the pavement, or other vertical intrusions can block or make ground travel unsafe. The FAA has strict guidance on taxilane clear zones. Taxilane C must provide a 79' clear zone where the maximum allowable slope is limited to 5.0%. Similarly, the ditches near the hangers were constructed to be as shallow as practical, which means the allowable depth of the pond is constrained from being deeper. Above-grade berms around the pond are not possible due to the FAA taxilane guidance. The proposed pond footprint was selected to balance the horizontal and vertical site constraints to provide the maximum possible volume.

CRITERIA FOR APPROVAL

Per ECM section 5.8.7 the request for a deviation may be considered if the request is **not based exclusively on financial considerations**. The deviation must not be detrimental to public safety or surrounding property. The applicant must include supporting information demonstrating compliance with **all of the following criteria**:

The deviation will achieve the intended result with a comparable or superior design and quality of improvement.

The proposed design attenuates flow to a peak rate from all design-storms that is less than the existing condition. 0.25 foot of freeboard has been provided for this pond.

The deviation will not adversely affect safety or operations.

In the event of a failure, the flat nature of the site, adjacent pavement, and below-grade portions of the pond will limit damage and peak volume released.

The deviation will not adversely affect maintenance and its associated cost.

No increase in maintenance costs is associated with these deviations.

The deviation will not adversely affect aesthetic appearance.

These deviations do not adversely impact the aesthetic appearance of the site.

The deviation meets the design intent and purpose of the ECM standards.

The current impervious area on the site was constructed circa 1970. While the proposed design does not detain to historical conditions, it releases at a smaller rate than the previous 50+ years.

The deviation meets the control measure requirements of Part I.E.3 and Part I.E.4 of the County's MS4 permit, as applicable.

The proposed pond provides water quality capture volume which meets the County's MS4 permit.

REVIEW AND RECOMMENDATION:

Approved by the ECM Administrator

This request has been determined to have met the criteria for approval. A deviation from Section _____ of the ECM is hereby granted based on the justification provided.

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Denied by the ECM Administrator

This request has been determined not to have met criteria for approval. A deviation from Section _____ of the ECM is hereby denied.

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ECM ADMINISTRATOR COMMENTS/CONDITIONS:

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1.1. PURPOSE

The purpose of this resource is to provide a form for documenting the findings and decision by the ECM Administrator concerning a deviation request. The form is used to document the review and decision concerning a requested deviation. The request and decision concerning each deviation from a specific section of the ECM shall be recorded on a separate form.

1.2. BACKGROUND

A deviation is a critical aspect of the review process and needs to be documented to ensure that the deviations granted are applied to a specific development application in conformance with the criteria for approval and that the action is documented as such requests can point to potential needed revisions to the ECM.

1.3. APPLICABLE STATUTES AND REGULATIONS

Section 5.8 of the ECM establishes a mechanism whereby an engineering design standard can be modified when if strictly adhered to, would cause unnecessary hardship or unsafe design because of topographical or other conditions particular to the site, and that a departure may be made without destroying the intent of such provision.

1.4. APPLICABILITY

All provisions of the ECM are subject to deviation by the ECM Administrator provided that one of the following conditions is met:

- The ECM standard is inapplicable to a particular situation.
- Topography, right-of-way, or other geographical conditions or impediments impose an undue hardship on the applicant, and an equivalent alternative that can accomplish the same design objective is available and does not compromise public safety or accessibility.
- A change to a standard is required to address a specific design or construction problem, and if not modified, the standard will impose an undue hardship on the applicant with little or no material benefit to the public.

1.5. TECHNICAL GUIDANCE

The review shall ensure all criteria for approval are adequately considered and that justification for the deviation is properly documented.

1.6. LIMITS OF APPROVAL

Whether a request for deviation is approved as proposed or with conditions, the approval is for project-specific use and shall not constitute a precedent or general deviation from these Standards.

1.7. REVIEW FEES

A Deviation Review Fee shall be paid in full at the time of submission of a request for deviation. The fee for Deviation Review shall be as determined by resolution of the BoCC.

Appendix B: Hydrology

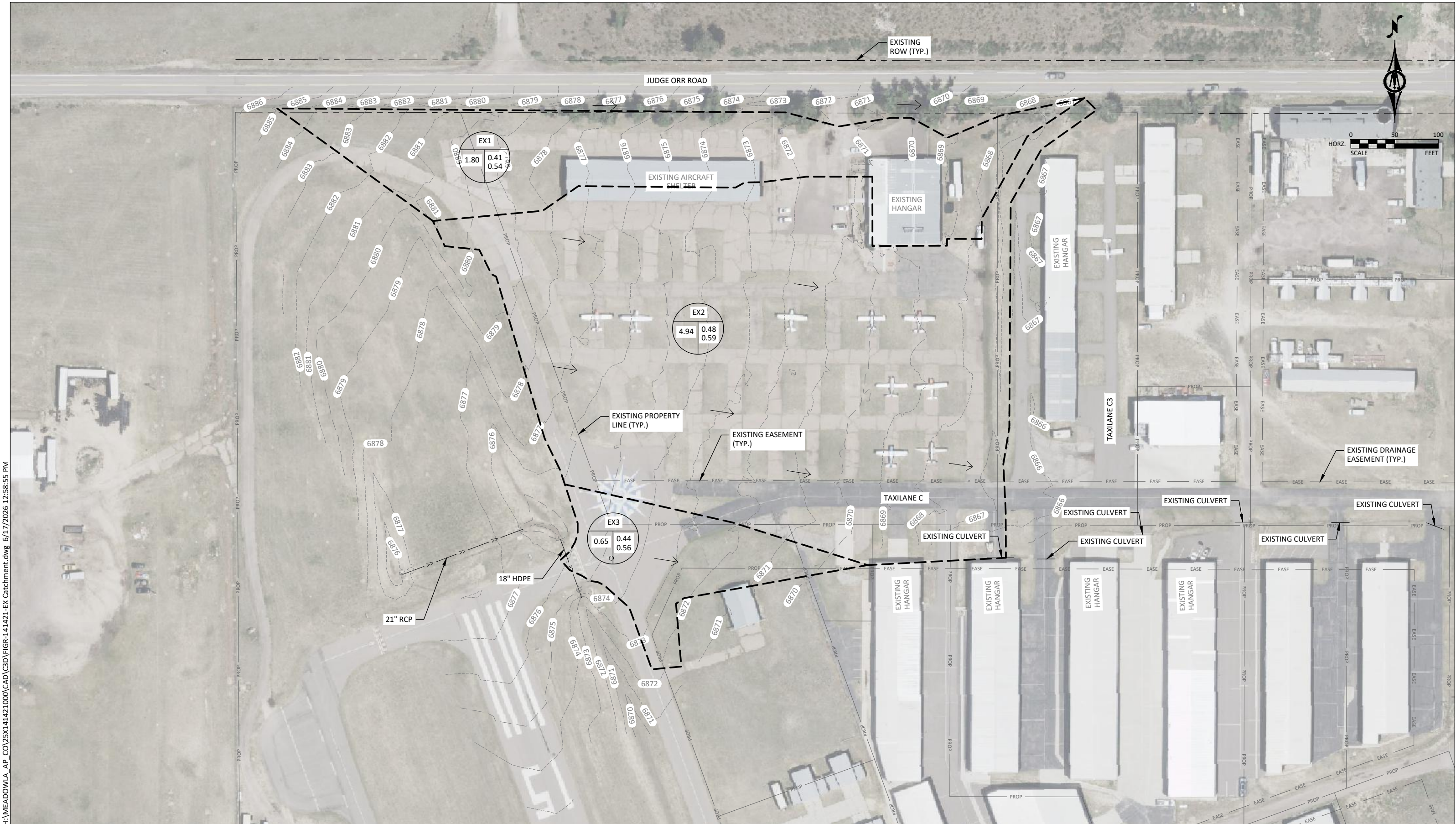
Basin Maps

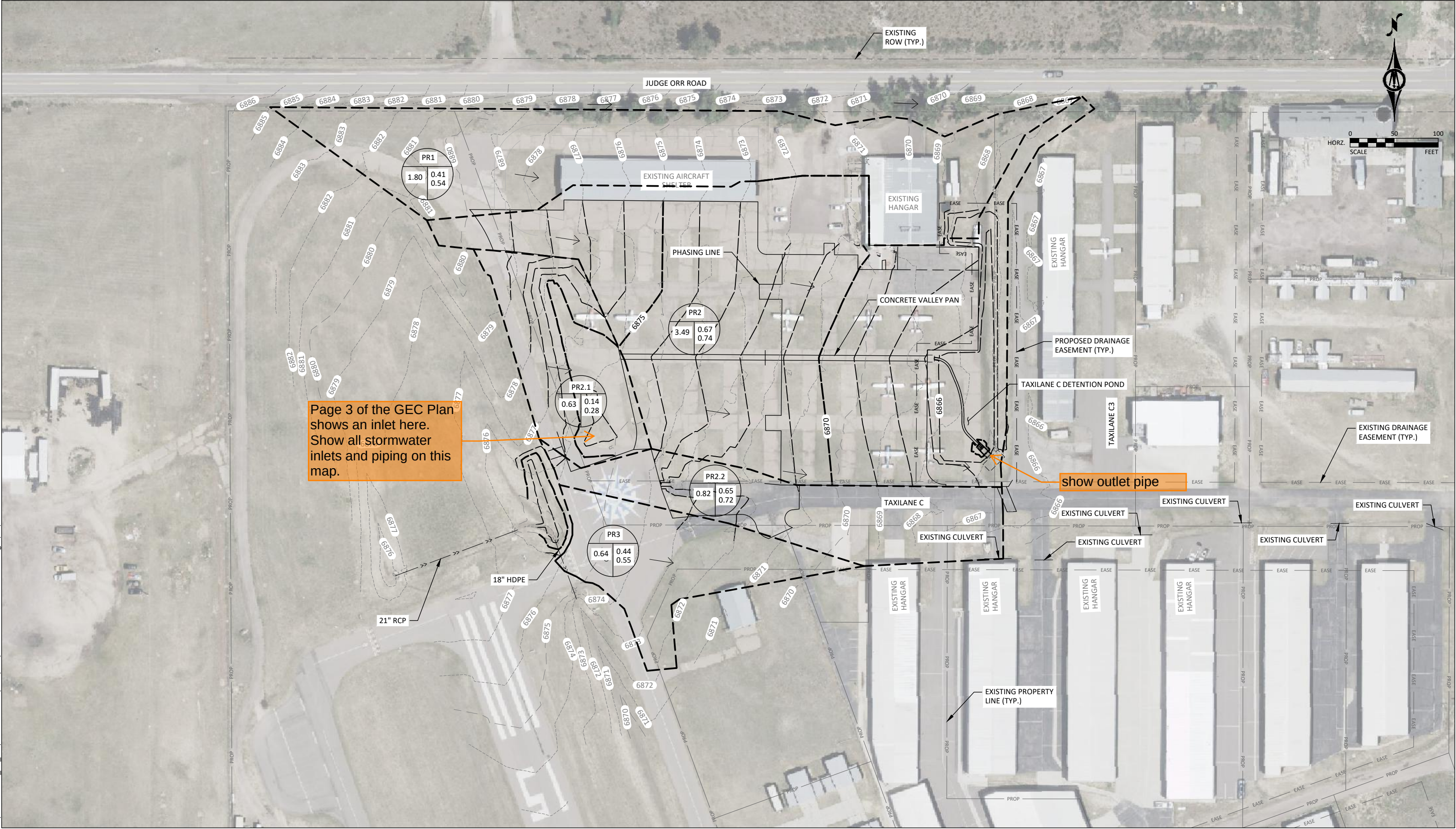
Hydrological Calculations

MEADOW LAKE AIRPORT

APPENDIX B - EXISTING BASIN MAP

JUNE 2026







**BOLTON
& MENK**

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Calculation of Peak Runoff using Rational Method

Computation of Runoff Coefficients

Computed By: KRB

Date: 3/20/2026

Checked By: -

Date: -

Project Name: Meadow Lake Airport

TABLE 6-5. RUNOFF COEFFICIENT EQUATIONS BASED ON NRCS HSG AND STORM RETURN PERIOD

NRCS HSG	STORM RETURN PERIOD						
	WQE & 2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.840I^{1.302}$	$C_A = 0.861I^{1.276}$	$C_A = 0.873I^{1.232}$	$C_A = 0.884I^{1.124}$	$C_A = 0.854I + 0.025$	$C_A = 0.779I + 0.110$	$C_A = 0.645I + 0.254$
B	$C_B = 0.835I^{1.169}$	$C_B = 0.857I^{1.088}$	$C_B = 0.807I + 0.057$	$C_B = 0.628I + 0.249$	$C_B = 0.558I + 0.328$	$C_B = 0.465I + 0.426$	$C_B = 0.366I + 0.536$
C/D	$C_{C/D} = 0.834I^{1.122}$	$C_{C/D} = 0.815I + 0.035$	$C_{C/D} = 0.735I + 0.132$	$C_{C/D} = 0.560I + 0.319$	$C_{C/D} = 0.494I + 0.393$	$C_{C/D} = 0.409I + 0.484$	$C_{C/D} = 0.315I + 0.588$

BASIN ID	AREA (Acres)	COMPOSITE IMPERVIOUSNESS										SOIL GROUP			RUNOFF COEFFICIENT				
		Asphalt and Concrete Pavement 95%	Roofs 95%	Gravel (low traffic) 60%	Gravel (high traffic) 80%	Turf Grass and Lanscaping 20%	Native Grass and Open Space 5%	Water Surfaces 100%	Spare #1 0%	Spare #2 0%	Composite Imperviousness (%)	A (%)	B (%)	C/D (%)	2-yr	5-yr	10-yr	50-yr	100-yr
EX1	1.80	0.99					0.81				54.5	100			0.38	0.40	0.41	0.49	0.54
EX2	4.94	3.09					1.85				61.3	100			0.44	0.46	0.48	0.55	0.59
EX3	0.65	0.38					0.27				57.6	100			0.41	0.43	0.44	0.52	0.56
											-				-	-	-	-	-
											-				-	-	-	-	-
PR1	1.80	0.99					0.81				54.5	100			0.38	0.40	0.41	0.49	0.54
PR2	3.49	2.95					0.54				81.1	100			0.64	0.66	0.67	0.72	0.74
PR3	0.64	0.37					0.27				57.0	100			0.40	0.42	0.44	0.51	0.55
PR2.1	0.63	0.12					0.51				22.1	100			0.12	0.13	0.14	0.21	0.28
PR2.2	0.82	0.67					0.15				78.5	100			0.61	0.63	0.65	0.70	0.72
											-				-	-	-	-	-
PR2 Interim	4.94	3.71					1.23				72.6	100			0.55	0.57	0.59	0.64	0.68
											-				-	-	-	-	-
											-				-	-	-	-	-
											-				-	-	-	-	-



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Calculation of Peak Runoff using Rational Method
Time of Concentration Computations

Computed By: KRB
Checked By: -
Project Name: Meadow Lake Airport

Date: 3/20/2026
Date: -

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

Computed $t_c = t_i + t_t$

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

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

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

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

TYPE OF LAND SURFACE	CONVEYANCE FACTOR, K
Heavy Meadow	2.5
Tillage/Field	5
Short Pasture and Lawns	7
Nearly Bare Ground	10
Grassed Waterway	15
Paved Areas & Shallow Paved Swales	20

BASIN DATA			OVERLAND (INITIAL) TIME, t_i					CHANNELIZED (TRAVEL) FLOW TIME t_t							TIME OF CONCENTRATION t_c		
BASIN ID	C5	AREA (Acres)	Overland Flow Length L_i (ft)	U/S Elevation (ft)	D/S Elevation (ft)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft)	D/S Elevation (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized FlowTime t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)
EX1	0.40	1.80	358.0	6883.0	6878.0	0.014	21.42	500.0	6878.0	6867.0	0.022	15	2.22	3.75	25.16	20.11	20.11
EX2	0.46	4.94	652.0	6881.0	6868.0	0.020	23.50	100.0	6868.0	6866.5	0.015	20	2.45	0.68	24.18	16.35	16.35
EX3	0.43	0.65	219.0	6876.0	6872.0	0.018	14.67	20.0			0.010	20	2.00	0.17	14.84	16.40	14.84
-	-	-				-	-				-		-	-	-	-	-
-	-	-				-	-				-		-	-	-	-	-
PR1	0.40	1.80	358.0	6883.0	6878.0	0.014	21.42	500.0	6878.0	6867.0	0.022	15	2.22	3.75	25.16	20.11	20.11
PR2	0.66	3.49	652.0	6881.0	6868.0	0.020	16.15	100.0	6868.0	6866.5	0.015	20	2.45	0.68	16.83	12.89	12.89
PR3	0.42	0.64	219.0	6876.0	6872.0	0.018	14.89	20.0			0.010	20	2.00	0.17	15.06	16.50	15.06
PR2.1	0.13	0.63					-						-	-	-	-	5.00
PR2.2	0.63	0.82					-						-	-	-	-	-
-	-	-					-						-	-	-	-	-
PR2 Interim	0.57	4.94	652.0			0.020	23.50	100.0			0.015	20	2.45	0.68	24.18	14.37	14.37
-	-	-					-						-	-	-	-	-
-	-	-					-						-	-	-	-	-
-	-	-					-						-	-	-	-	-



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Calculation of Peak Runoff using Rational Method
Computation of Peak Runoff

Computed By: KRB Date: 3/20/2026
Checked By: - Date: -
Project Name: Meadow Lake Airport

	2-yr	5-yr	10-yr	50-yr	100-yr
1-hour depth (in)	0.940	1.22	1.47	2.18	2.52

	a	b	c
Rainfall Intensity Coefficients:	28.50	10.00	0.786

$Q(cfs) = CIA$

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

BASIN DATA			RUNOFF COEFFICIENT					RAINFALL INTENSITY, I (inches/hour)					Peak Flow, Q (cfs)					
BASIN ID	AREA (Acres)	TIME OF CONCENTRATION t _c	2-yr	5-yr	10-yr	50-yr	100-yr	2-yr	5-yr	10-yr	50-yr	100-yr	2-yr	5-yr	10-yr	50-yr	100-yr	REMARKS
EX1	1.80	20.11	0.38	0.40	0.41	0.49	0.54	1.84	2.39	2.88	4.28	4.94	1.26	1.72	2.13	3.77	4.80	
EX2	4.94	16.35	0.44	0.46	0.48	0.55	0.59	2.05	2.66	3.20	4.75	5.49	4.45	6.04	7.59	12.90	16.00	
EX3	0.65	14.84	0.41	0.43	0.44	0.52	0.56	2.14	2.78	3.35	4.97	5.75	0.57	0.78	0.96	1.68	2.09	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
PR1	1.80	20.11	0.38	0.40	0.41	0.49	0.54	1.84	2.39	2.88	4.28	4.94	1.26	1.72	2.13	3.77	4.80	
PR2	3.49	12.89	0.64	0.66	0.67	0.72	0.74	2.29	2.97	3.58	5.30	6.13	5.11	6.84	8.36	13.33	15.84	17.7-15.2=2.5
PR3	0.64	15.06	0.40	0.42	0.44	0.51	0.55	2.13	2.76	3.33	4.94	5.71	0.55	0.74	0.94	1.61	2.01	
PR2.1	0.63	5.00	0.12	0.13	0.14	0.21	0.28	3.19	4.14	4.99	7.39	8.55	0.24	0.34	0.44	0.98	1.51	Diverted along runway
PR2.2	0.82	-	0.61	0.63	0.65	0.70	0.72	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
PR2 Interim	4.94	14.37	0.55	0.57	0.59	0.64	0.68	2.18	2.83	3.40	5.05	5.84	5.92	7.96	9.92	15.96	19.61	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	



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& MENK**

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Calculation of Peak Runoff using Rational Method

Computation of Runoff Coefficients

Computed By: KRB

Date: 3/20/2026

Checked By: -

Date: -

Project Name: Meadow Lake Airport

TABLE 6-5. RUNOFF COEFFICIENT EQUATIONS BASED ON NRCS HSG AND STORM RETURN PERIOD

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	WQE & 2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.840I^{1.302}$	$C_A = 0.861I^{1.276}$	$C_A = 0.873I^{1.232}$	$C_A = 0.884I^{1.124}$	$C_A = 0.854I + 0.025$	$C_A = 0.779I + 0.110$	$C_A = 0.645I + 0.254$
B	$C_B = 0.835I^{1.169}$	$C_B = 0.857I^{1.088}$	$C_B = 0.807I + 0.057$	$C_B = 0.628I + 0.249$	$C_B = 0.558I + 0.328$	$C_B = 0.465I + 0.426$	$C_B = 0.366I + 0.536$
C/D	$C_{C/D} = 0.834I^{1.122}$	$C_{C/D} = 0.815I + 0.035$	$C_{C/D} = 0.735I + 0.132$	$C_{C/D} = 0.560I + 0.319$	$C_{C/D} = 0.494I + 0.393$	$C_{C/D} = 0.409I + 0.484$	$C_{C/D} = 0.315I + 0.588$

BASIN ID	AREA (Acres)	COMPOSITE IMPERVIOUSNESS										SOIL GROUP			RUNOFF COEFFICIENT				
		Asphalt and Concrete Pavement 95%	Roofs 95%	Gravel (low traffic) 60%	Gravel (high traffic) 80%	Turf Grass and Lanscaping 20%	Native Grass and Open Space 5%	Water Surfaces 100%	Spare #1 0%	Spare #2 0%	Composite Imperviousness (%)	A (%)	B (%)	C/D (%)	2-yr	5-yr	10-yr	50-yr	100-yr
EX1	1.80	0.99					0.81				54.5	100			0.38	0.40	0.41	0.49	0.54
EX2	4.94	3.09					1.85				61.3	100			0.44	0.46	0.48	0.55	0.59
EX3	0.65	0.38					0.27				57.6	100			0.41	0.43	0.44	0.52	0.56
											-				-	-	-	-	-
											-				-	-	-	-	-
PR1	1.80	0.99					0.81				54.5	100			0.38	0.40	0.41	0.49	0.54
PR2	3.49	2.95					0.54				81.1	100			0.64	0.66	0.67	0.72	0.74
PR3	0.64	0.37					0.27				57.0	100			0.40	0.42	0.44	0.51	0.55
PR2.1	0.63	0.12					0.51				22.1	100			0.12	0.13	0.14	0.21	0.28
PR2.2	0.82	0.67					0.15				78.5	100			0.61	0.63	0.65	0.70	0.72
											-				-	-	-	-	-
PR2 Interim	4.94	3.71					1.23				72.6	100			0.55	0.57	0.59	0.64	0.68
											-				-	-	-	-	-
											-				-	-	-	-	-
											-				-	-	-	-	-



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Calculation of Peak Runoff using Rational Method
Time of Concentration Computations

Computed By: KRB
Checked By: -
Project Name: Meadow Lake Airport

Date: 3/20/2026
Date: -

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

Computed $t_c = t_i + t_t$

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

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

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

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

TYPE OF LAND SURFACE	CONVEYANCE FACTOR, K
Heavy Meadow	2.5
Tillage/Field	5
Short Pasture and Lawns	7
Nearly Bare Ground	10
Grassed Waterway	15
Paved Areas & Shallow Paved Swales	20

BASIN DATA			OVERLAND (INITIAL) TIME, t_i					CHANNELIZED (TRAVEL) FLOW TIME t_t							TIME OF CONCENTRATION t_c		
BASIN ID	C5	AREA (Acres)	Overland Flow Length L_i (ft)	U/S Elevation (ft)	D/S Elevation (ft)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft)	D/S Elevation (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized FlowTime t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)
EX1	0.40	1.80	358.0	6883.0	6878.0	0.014	21.42	500.0	6878.0	6867.0	0.022	15	2.22	3.75	25.16	20.11	20.11
EX2	0.46	4.94	652.0	6881.0	6868.0	0.020	23.50	100.0	6868.0	6866.5	0.015	20	2.45	0.68	24.18	16.35	16.35
EX3	0.43	0.65	219.0	6876.0	6872.0	0.018	14.67	20.0			0.010	20	2.00	0.17	14.84	16.40	14.84
-	-	-				-	-				-		-	-	-	-	-
-	-	-				-	-				-		-	-	-	-	-
PR1	0.40	1.80	358.0	6883.0	6878.0	0.014	21.42	500.0	6878.0	6867.0	0.022	15	2.22	3.75	25.16	20.11	20.11
PR2	0.66	3.49	652.0	6881.0	6868.0	0.020	16.15	100.0	6868.0	6866.5	0.015	20	2.45	0.68	16.83	12.89	12.89
PR3	0.42	0.64	219.0	6876.0	6872.0	0.018	14.89	20.0			0.010	20	2.00	0.17	15.06	16.50	15.06
PR2.1	0.13	0.63					-						-	-	-	-	5.00
PR2.2	0.63	0.82					-						-	-	-	-	-
-	-	-					-						-	-	-	-	-
PR2 Interim	0.57	4.94	652.0			0.020	23.50	100.0			0.015	20	2.45	0.68	24.18	14.37	14.37
-	-	-					-						-	-	-	-	-
-	-	-					-						-	-	-	-	-
-	-	-					-						-	-	-	-	-



Real People. Real Solutions.

Calculation of Peak Runoff using Rational Method
Computation of Peak Runoff

Computed By: KRB Date: 3/20/2026
Checked By: - Date: -
Project Name: Meadow Lake Airport

	2-yr	5-yr	10-yr	50-yr	100-yr
1-hour depth (in)	0.940	1.22	1.47	2.18	2.52

	a	b	c
Rainfall Intensity Coefficients:	28.50	10.00	0.786

$Q(cfs) = CIA$

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

BASIN DATA			RUNOFF COEFFICIENT					RAINFALL INTENSITY, I (inches/hour)					Peak Flow, Q (cfs)					
BASIN ID	AREA (Acres)	TIME OF CONCENTRATION t _c	2-yr	5-yr	10-yr	50-yr	100-yr	2-yr	5-yr	10-yr	50-yr	100-yr	2-yr	5-yr	10-yr	50-yr	100-yr	REMARKS
EX1	1.80	20.11	0.38	0.40	0.41	0.49	0.54	1.84	2.39	2.88	4.28	4.94	1.26	1.72	2.13	3.77	4.80	
EX2	4.94	16.35	0.44	0.46	0.48	0.55	0.59	2.05	2.66	3.20	4.75	5.49	4.45	6.04	7.59	12.90	16.00	
EX3	0.65	14.84	0.41	0.43	0.44	0.52	0.56	2.14	2.78	3.35	4.97	5.75	0.57	0.78	0.96	1.68	2.09	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
PR1	1.80	20.11	0.38	0.40	0.41	0.49	0.54	1.84	2.39	2.88	4.28	4.94	1.26	1.72	2.13	3.77	4.80	
PR2	3.49	12.89	0.64	0.66	0.67	0.72	0.74	2.29	2.97	3.58	5.30	6.13	5.11	6.84	8.36	13.33	15.84	17.7-15.2=2.5
PR3	0.64	15.06	0.40	0.42	0.44	0.51	0.55	2.13	2.76	3.33	4.94	5.71	0.55	0.74	0.94	1.61	2.01	
PR2.1	0.63	5.00	0.12	0.13	0.14	0.21	0.28	3.19	4.14	4.99	7.39	8.55	0.24	0.34	0.44	0.98	1.51	Diverted along runway
PR2.2	0.82	-	0.61	0.63	0.65	0.70	0.72	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
PR2 Interim	4.94	14.37	0.55	0.57	0.59	0.64	0.68	2.18	2.83	3.40	5.05	5.84	5.92	7.96	9.92	15.96	19.61	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Appendix C: Detention and Water Quality

MHFD Detention Calculations

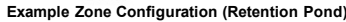
Water Quality Map

In the 2nd deviation you mention the pre-development and the post-development method to be used instead of the Full Spectrum Detention method (you already provided the calculations for the Full Spectrum Detention method).

Please provide the calculations for the pre and post development method (maybe you don't need the 2nd deviation requests).

MHFD-Detention, Version 4.08 (April 2026)

Basin ID: Taxilane C Pond | Existing Conditions

Depth Increment =

Optional User Overrides

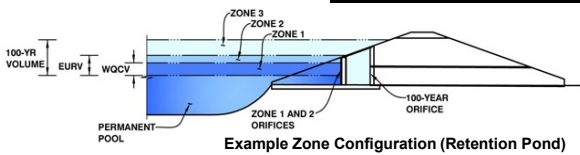
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.08 (April 2026)

Project: Meadow Lake Airport

Basin ID: Taxilane C Pond | Existing Conditions



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1			
Zone 2			
Zone 3			
Total (all zones)			

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

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

Calculated Parameters for Underdrain
Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

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

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches

Calculated Parameters for Plate
WQ Orifice Area per Row = N/A ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

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

	Row 1 (optional)	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)								
Orifice Area (sq. inches)								

	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)

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

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = Not Selected Not Selected ft²
Vertical Orifice Centroid = Not Selected Not Selected feet

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

Overflow Weir Front Edge Height, H_o = Not Selected Not Selected ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Gate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Gate Type =
Debris Clogging % = %

Calculated Parameters for Overflow Weir
Height of Gate Upper Edge, H_u = Not Selected Not Selected feet
Overflow Weir Slope Length = feet
Gate Open Area / 100-yr Orifice Area =
Overflow Gate Open Area w/o Debris = ft²
Overflow Gate Open Area w/ Debris = ft²

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

Depth to Invert of Outlet Pipe = Not Selected Not Selected ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter = inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = Not Selected Not Selected ft²
Outlet Orifice Centroid = Not Selected Not Selected feet
Half-Central Angle of Restrictor Plate on Pipe = N/A N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway
Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = acre-ft

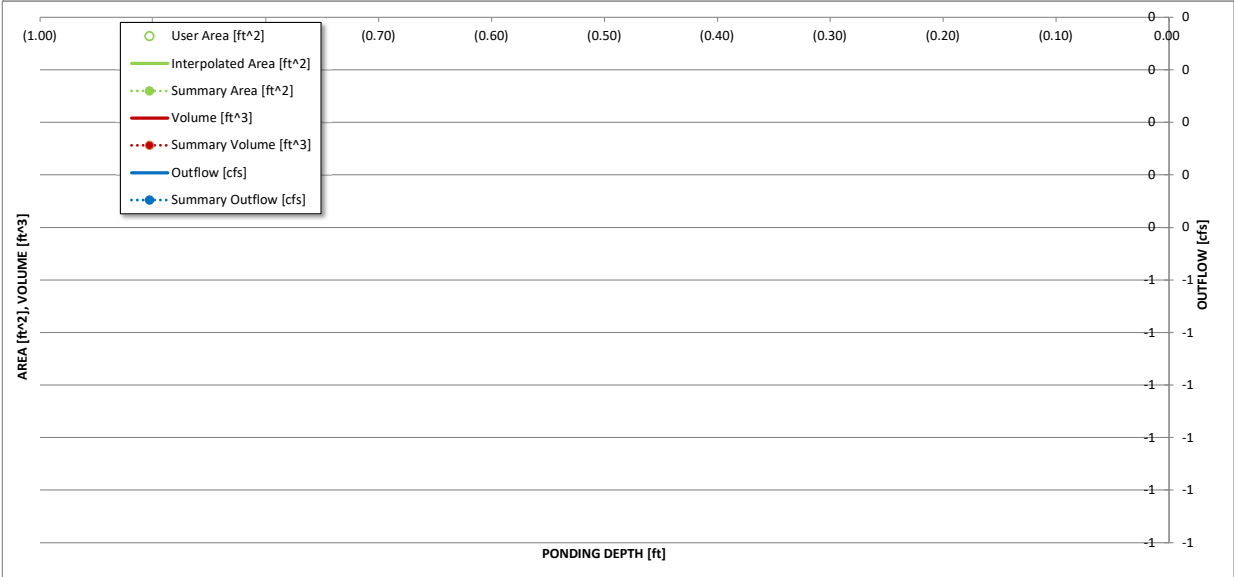
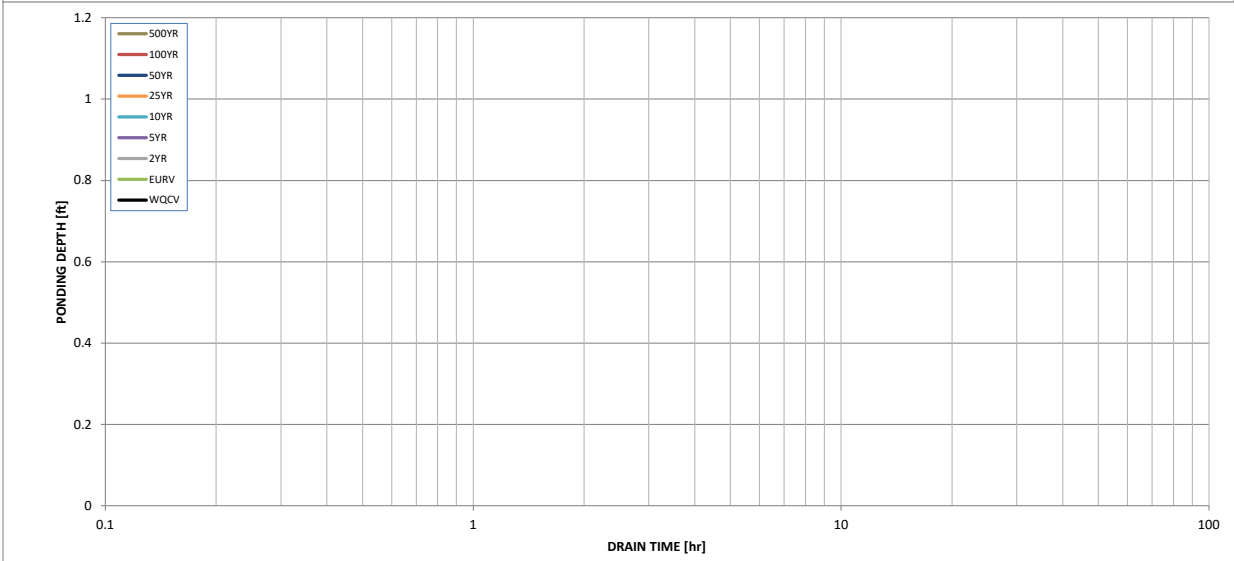
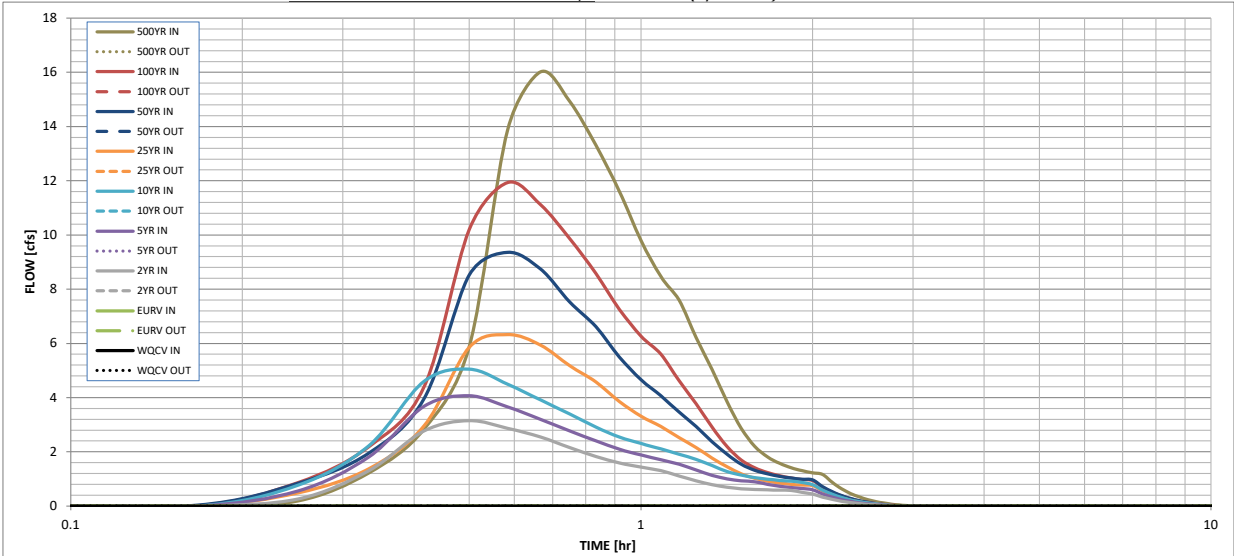
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.94	1.22	1.47	1.69	2.18	2.52	3.14
One-Hour Rainfall Depth (in) =	N/A	N/A	0.205	0.273	0.340	0.406	0.572	0.706	0.946
CUHP Runoff Volume (acre-ft) =	0.099	0.370	0.205	0.273	0.340	0.406	0.572	0.706	0.946
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.205	0.273	0.340	0.406	0.572	0.706	0.946
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.2	0.3	1.7	3.0	5.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.02	0.03	0.05	0.34	0.61	1.06
Peak Inflow Q (cfs) =	N/A	N/A	3.1	4.1	5.0	6.3	9.4	11.9	16.0
Peak Outflow Q (cfs) =									
Ratio Peak Outflow to Predevelopment Q =									
Structure Controlling Flow =									
Max Velocity through Gate 1 (fps) =									
Max Velocity through Gate 2 (fps) =									
Time to Drain 97% of Inflow Volume (hours) =									
Time to Drain 99% of Inflow Volume (hours) =									
Maximum Ponding Depth (ft) =									
Area at Maximum Ponding Depth (acres) =									
Maximum Volume Stored (acre-ft) =									

DETENTION BASIN OUTLET STRUCTURE DESIGN

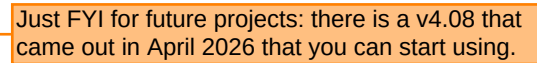
MHFD- Detention, Version 4.08 (April 2026)



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

MHFD-Detention, Version 4.07 (June 2025)

Basin ID: Taxilane C Pond | Interim Conditions



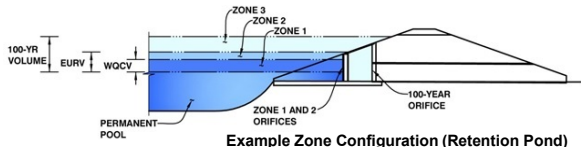
- ✓ = calcs match details in plans
✗ = calcs do not match details in plans

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: Meadow Lake Airport

Basin ID: Taxilane C Pond | Interim Conditions



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.53	0.118	Orifice Plate
Zone 2 (User)			Orifice Plate
Zone 3 (User)			Weir&Pipe (Restrict)
Total (all zones)		0.118	

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 Diameter = N/A inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = N/A ft²
Underdrain Orifice Centroid = N/A feet

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

Calculated Parameters for Plate

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 1.42 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = N/A inches
Orifice Plate: Orifice Area per Row = N/A sq. inches
WQ Orifice Area per Row = N/A ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
✓ Stage of Orifice Centroid (ft)	0.00	0.60						
✓ Orifice Area (sq. inches)	0.52	0.44						

	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)

Calculated Parameters for Vertical Orifice

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

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

Calculated Parameters for Overflow Weir

✓ Overflow Weir Front Edge Height, H_o = 1.42 ft (relative to basin bottom at Stage = 0 ft)
✓ Overflow Weir Front Edge Length = 4.00 feet
✓ Overflow Weir Gate Slope = 0.00 H:V
? Horiz. Length of Weir Sides = 4.00 feet
Overflow Gate Type = Close Mesh Gate
Debris Clogging % = 0%
Height of Gate Upper Edge, H_u = 1.42 feet
Overflow Weir Slope Length = 4.00 feet
Gate Open Area / 100-yr Orifice Area = 16.11
Overflow Gate Open Area w/o Debris = 12.66 ft²
Overflow Gate Open Area w/ Debris = 12.66 ft²

Dim not shown on plans

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

✗ Depth to Invert of Outlet Pipe = 0.33 ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = 12.00 inches
Restrictor Plate Height Above Pipe Invert = 12.00 inches
Outlet Orifice Area = 0.79 ft²
Outlet Orifice Centroid = 0.50 feet
Half-Central Angle of Restrictor Plate on Pipe = 3.14 radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

✓ Spillway Invert Stage = 2.00 ft (relative to basin bottom at Stage = 0 ft)
✗ Spillway Crest Length = 4.00 feet
✓ Spillway End Slopes = 4.00 H:V
✗ Freeboard above Max Water Surface = 0.00 feet
Spillway Design Flow Depth = 0.65 feet
Stage at Top of Freeboard = 2.65 feet
Basin Area at Top of Freeboard = 0.32 acres
Basin Volume at Top of Freeboard = 0.31 acre-ft

see my note on page 28 of CDs

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).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	0.94	1.22	1.47	1.69	2.18	2.52	3.14
One-Hour Rainfall Depth (in)	N/A	N/A	0.246	0.329	0.407	0.481	0.658	0.796	1.041
CUHP Runoff Volume (acre-ft)	N/A	N/A	0.246	0.329	0.407	0.481	0.658	0.796	1.041
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.0	0.1	0.2	0.3	1.7	3.0	5.2
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.63	0.83	1.07	1.28	1.90	2.41	3.24
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A	3.1	4.1	5.0	6.3	9.4	11.9	16.0
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	4.0	5.3	6.4	7.9	11.1	13.9	18.1
Peak Inflow Q (cfs)	N/A	N/A	2.0	3.2	4.3	4.8	5.5	7.3	7.3
Peak Outflow Q (cfs)	N/A	N/A	0.8	0.8	0.9	0.8	0.6	0.6	0.5
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Structure Controlling Flow	Overflow Weir 1	N/A	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway	N/A	N/A
Max Velocity through Gate 1 (fps)	0.15	0.43	0.15	0.2	0.3	0.4	0.4	0.4	0.4
Max Velocity through Gate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	40	36	40	39	38	37	34	32	29
Time to Drain 99% of Inflow Volume (hours)	42	40	43	43	42	42	41	40	39
Maximum Ponding Depth (ft)	1.53	2.25	1.53	1.57	1.61	1.75	2.08	2.25	2.25
Area at Maximum Ponding Depth (acres)	0.22	0.32	0.22	0.22	0.22	0.24	0.29	0.32	0.32
Maximum Volume Stored (acre-ft)	0.120	0.311	0.120	0.129	0.136	0.171	0.256	0.311	0.311

Please add a comment to the bottom of this page explaining the use of these optional overrides: where did the values come from and why did you feel it necessary to utilize them. We just need this for documentation purposes. Thanks.

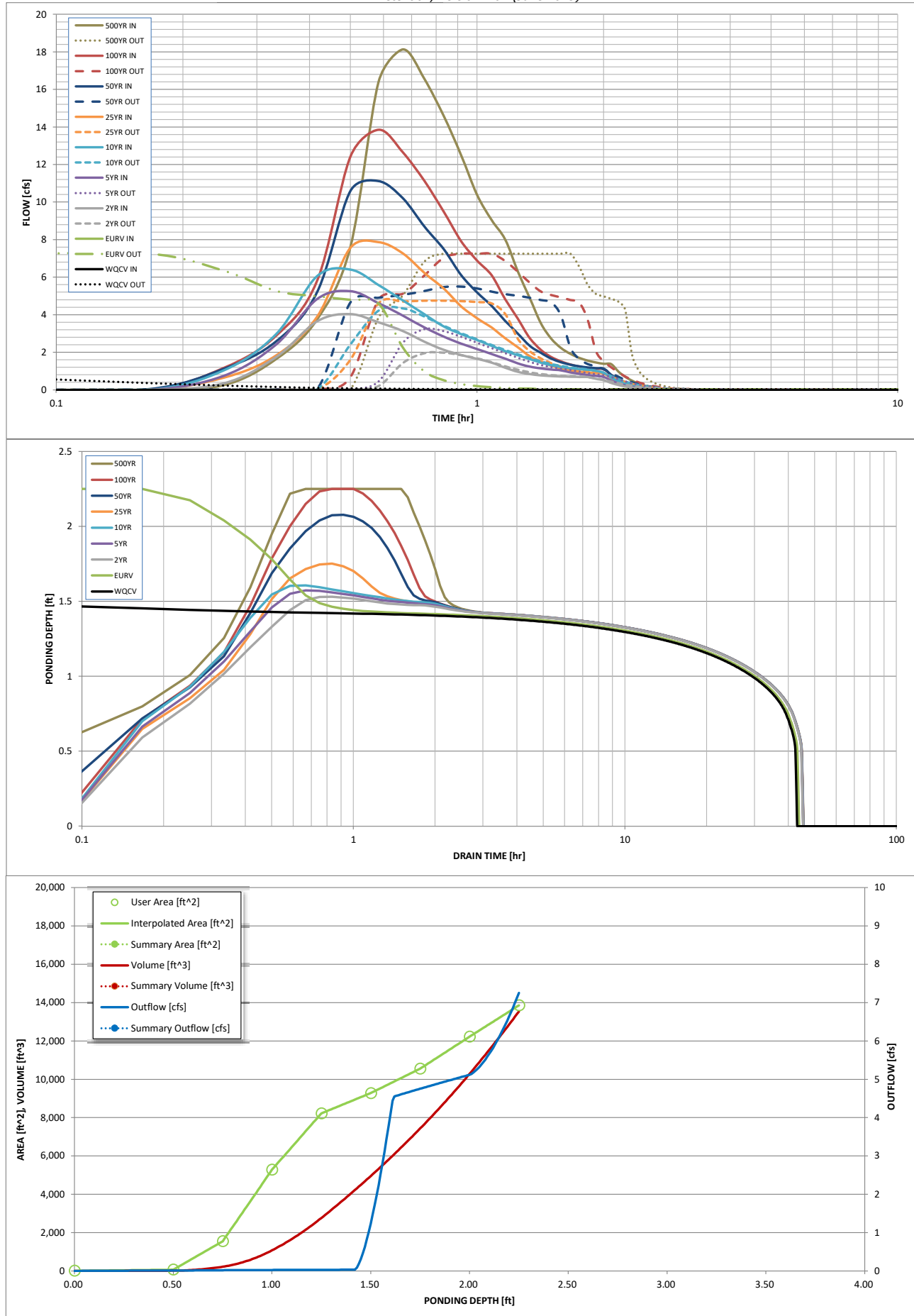
Freeboard should be 1ft above the Spillway Design Flow Depth. Revise on the Calcs and show both on page 28 of CDs.

I now see your note on PDF page 8 above about this. And I now remember our convo's about this. So instead revise this input to 0.25ft and still show both on plans per the first part of my comment above.

It's preferred if the spillway is only activated in the 100yr event. See what input adjustments you can make to fix this.

DETENTION BASIN OUTLET STRUCTURE DESIGN

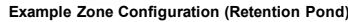
MHFD-Detention, Version 4.07 (June 2025)



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

MHFD-Detention, Version 4.07 (June 2025)

Basin ID: Taxilane C Pond | Ultimate Conditions

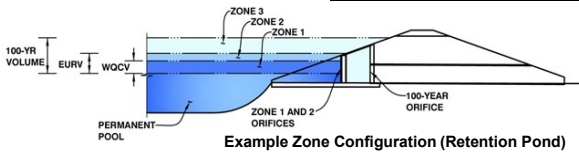


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: Meadow Lake Airport

Basin ID: Taxilane C Pond | Ultimate Conditions



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.42	0.095	Orifice Plate
Zone 2 (User)	1.42	0.000	Orifice Plate
Zone 3 (User)	1.42	0.000	Weir&Pipe (Restrict)
Total (all zones)		0.095	

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

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

Calculated Parameters for Underdrain
Underdrain Orifice Area = N/A ft²
Underdrain Orifice Centroid = N/A feet

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

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 1.42 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = N/A inches
Orifice Plate: Orifice Area per Row = N/A sq. inches

Calculated Parameters for Plate
WQ Orifice Area per Row = N/A ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.60						
Orifice Area (sq. inches)	0.52	0.44						

	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	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = N/A ft²
Vertical Orifice Centroid = N/A feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.42	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Close Mesh Grate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir
Height of Grate Upper Edge, H_u = 1.42 feet
Overflow Weir Slope Length = 4.00 feet
Grate Open Area / 100-yr Orifice Area = 16.11
Overflow Grate Open Area w/o Debris = 12.66 ft²
Overflow Grate Open Area w/ Debris = 12.66 ft²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	12.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = 0.79 ft²
Outlet Orifice Centroid = 0.50 feet
Half-Central Angle of Restrictor Plate on Pipe = 3.14 radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	2.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	23.50	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.00	feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = 0.26 feet
Stage at Top of Freeboard = 2.26 feet
Basin Area at Top of Freeboard = 0.32 acres
Basin Volume at Top of Freeboard = 0.31 acre-ft

Routed Hydrograph Results

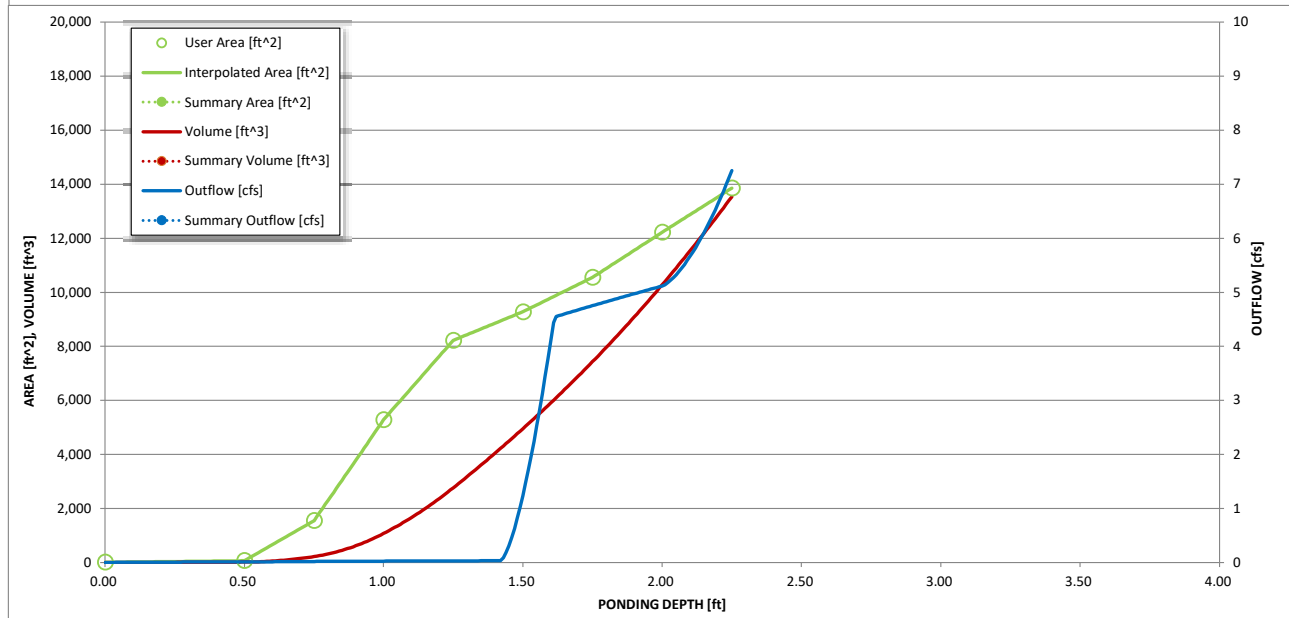
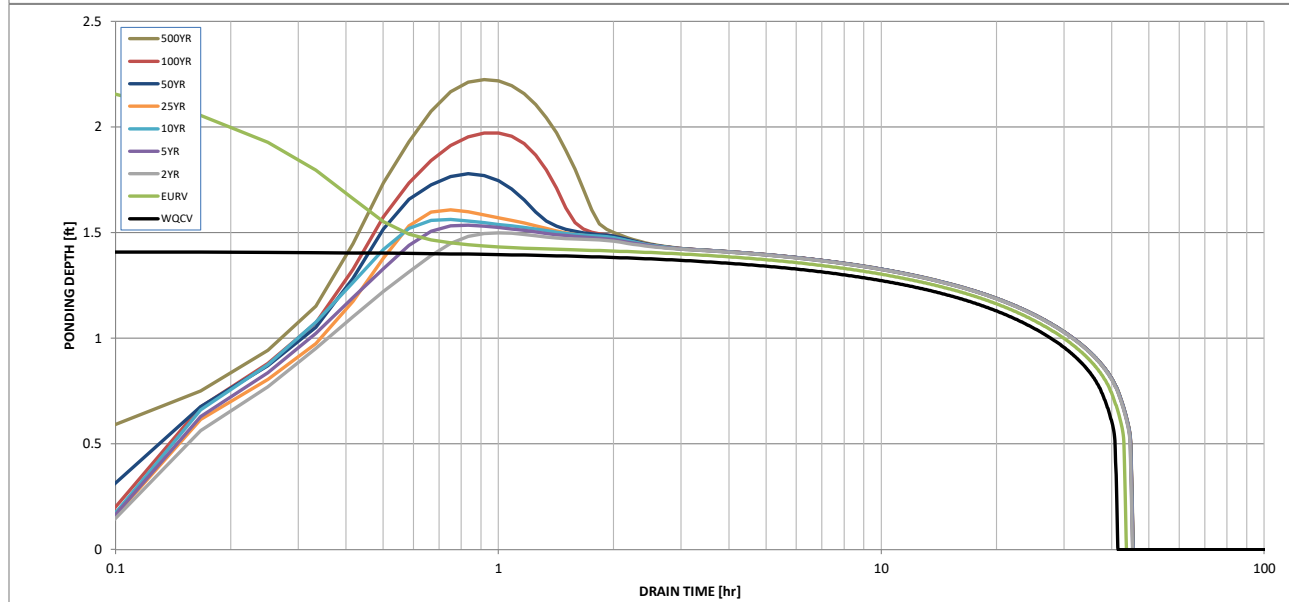
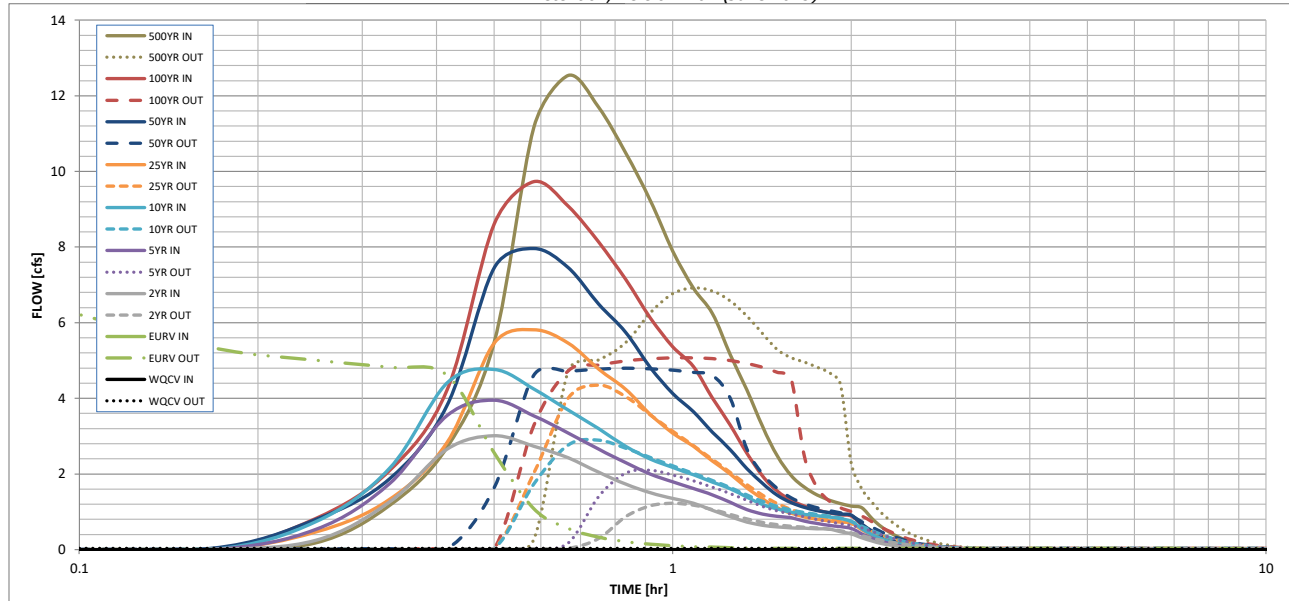
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.94	1.22	1.47	1.69	2.18	2.52	3.14
One-Hour Rainfall Depth (in) =	N/A	N/A	0.195	0.261	0.321	0.378	0.509	0.607	0.782
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.195	0.261	0.321	0.378	0.509	0.607	0.782
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.1	0.1	0.2	1.0	1.8	3.2
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	3.1	4.1	5.0	6.3	9.4	11.9	16.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	0.91	1.20	1.47	1.85	2.76	3.49	4.69
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	3.0	4.0	4.8	5.8	8.0	9.7	12.5
Peak Inflow Q (cfs) =	0.0	14.6	1.2	2.1	2.9	4.4	4.8	5.1	8.5
Peak Outflow Q (cfs) =	N/A	N/A	N/A	0.5	0.6	0.7	0.5	0.4	0.5
Ratio Peak Outflow to Predevelopment Q =	Overflow Weir 1	Spillway	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Structure Controlling Flow =	N/A	0.40	0.10	0.2	0.2	0.3	0.4	0.4	0.4
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	39	37	41	40	39	38	36	35	32
Time to Drain 97% of Inflow Volume (hours) =	40	41	43	43	43	42	42	41	40
Time to Drain 99% of Inflow Volume (hours) =	1.42	2.03	1.50	1.53	1.56	1.61	1.78	1.97	2.13
Maximum Ponding Depth (ft) =	0.21	0.29	0.21	0.22	0.22	0.22	0.25	0.28	0.30
Area at Maximum Ponding Depth (acres) =	0.097	0.244	0.112	0.120	0.127	0.136	0.175	0.228	0.271
Maximum Volume Stored (acre-ft) =									

Put a large disclaimer on here, something like:
"Note: no modifications to pond required from Interim to Ultimate Condition"

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			



Standard Operation Procedures for Inspection and Maintenance of Extended Detention Basin(s)

Meadow Lake Airport

Transient Apron Reconstruction

Taxilane C Pond

Owner:

**MEADOW LAKE AIRPORT ASSOC., INC.
13625 JUDGE ORR ROAD
PEYTON, CO 80831
Phone 719-339-0928**

El Paso County Department of Public Works
3275 Akers Drive
Colorado Springs, CO 80922

dotweb@elpasoco.com
719-520-6900

Introduction

This plan addresses operation and maintenance of public detention / water quality facilities (**Taxilane C Pond**) constructed as part of the **Transient Apron Reconstruction** development project at the **northeastern corner of the runway (bound by Taxilane C, Taxilane C3, and Judge Orr Road)**. (EPC PCD projects number(s): **[XX-XX-XXX]**). The plat number of **Meadow Lake Airport Filing 1** is **R03250**.

Background

The State of Colorado Department of Public Health and Environment, Water Quality Control Division (CDPHE), has implemented federal regulations within the State of Colorado through permitting, and has included El Paso County as one of numerous Municipal Separate Storm Sewer Systems (MS4s) required to be permitted in compliance with National Pollutant Discharge Elimination System (NPDES) Phase 2 Regulations, as defined within Colorado's Phase 2 Municipal Guidance.

NPDES Phase 2 MS4s stormwater discharges are covered under a general permit under the Colorado Discharge Permit System (CDPS) under Regulation 61, and as a minimum require the MS4's operator (e.g., El Paso County) to develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants to the maximum extent practicable to protect water quality requirements of the Colorado Water Quality Control Act, Colorado Code of Regulations [CCR] 61.8(11)(a)(i).

This Stormwater Facilities Operation and Maintenance Plan (O&M Plan) is for public subregional detention facilities (**Taxilane C Pond**) constructed as part of the development project referenced above.

Associated Agreements

N/A

Funding for and Organization of Facility Operation and Maintenance

Meadow Lake Airport Association, will be responsible for operations and maintenance of the **Taxilane C** detention facility upon acceptance of the facilities.

Site and Facilities Description

- 1) The aforementioned pond is located within LOT 6 BLK 2 MEADOW LAKE AIRPORT FIL NO 1 EX S 50 FT TO TAXIWAY IMP LOCATED ON 43050-05-110 AND LOT 5 EX SLY 50 FT BLK 2 MEADOW LAKE AIRPORT FIL NO 1
- 2) Access to the facility is as follows: From the public ROW on Judge Orr Road continue south along Cessna Drive, turn west along taxilane C, and finally north into the dedicated drainage easement for the Taxilane C Pond
- 3) The location of emergency spillway is on the south side of the pond. Overflows are conveyed southerly over Taxilane C and then easterly through the ditch and culverts which parallel Taxilane C.
- 4) The pond components include the connection of the valley pan (which conveys runoff from the airplane tiedown area) to the forebay, trickle channel, outlet structure, 12" outlet pipe, and spillway. Stormwater from the outlet structure is conveyed south under Taxilane C and then east along the existing ditch.

Extended Detention Basin (EDB) Description

The subsections below describe general EDB operations and maintenance.

EDB-1 GENERAL EDB CONCEPT

Extended Detention Basins (EDBs) are one of the most common types of permanent stormwater control measures utilized within the Front Range of Colorado. An EDB is a sedimentation basin designed to “extend” the runoff detention time, but to drain completely sometime after stormwater runoff ends. An EDB’s drain time for the water quality portion of the facility is typically 40 hours. The basins are considered to be “dry” because the majority of the basin is designed not to have a significant permanent pool of water remaining between runoff events.

EDBs are an adaptation of a detention basin used for flood control, with the primary difference being the addition of forebays, micropools and a slow release outlet design. Forebays are shallow concrete “pans” located at the inflow points to the basin and are provided to facilitate sediment removal within a contained area prior to releasing into the pond. The forebays collect and briefly hold stormwater runoff resulting in a process called sedimentation, dropping sediment out of the stormwater. The stormwater is then routed from the forebay into the concrete trickle channel and upper basin, the large grassy portion of the basin. The EDB includes an outlet structure that extends the drain time of frequently occurring runoff events to facilitate pollutant removal. An EDB also includes a small micropool just upstream of the outlet structure or built into the outlet structure. The micropool is designed to hold a small amount of water to keep sediment and floatables from blocking the outlet orifices.

EDB-2 INSPECTING EXTENDED DETENTION BASINS (EDBs)

EDB-2.1 Access and Easements

Inspection and maintenance personnel may utilize the attached stormwater facility map containing the location(s) of the access points and maintenance easements of the EDB(s) within this development.

EDB-2.2 Stormwater Management Facilities Locations

Inspection and maintenance personnel may utilize the attached stormwater facility map located in containing the location(s) of the EDB(s) within this development.

EDB-2.3 Extended Detention Basin (EDB) Features

EDBs have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. For example, if a forebay is not properly maintained, it could negatively affect the performance of a downstream feature (trickle channel, micropool, etc.).

Therefore, it is critical that each feature of the EDB is properly inspected and maintained to ensure that the overall facility functions as it was intended. Below is a list and description of the most common features within an EDB and the corresponding maintenance inspection items that can be anticipated:

Table EDB-1: Typical Inspection & Maintenance Requirements Matrix

EDB Features	Sediment Removal	Mowing/ Weed Control	Trash & Debris Removal	Erosion	Over-grown Vegetation Removal	Standing Water (mosquito/ algae control)	Structure Repair
Inflow Points (outfalls)	X		X	X			X
Forebays	X		X				X
Low-Flow Channel	X		X	X	X		X
Bottom Stage	X	X	X	X	X	X	
Micropool	X		X		X	X	X
Outlet Works	X		X				X
Emergency Spillway			X	X	X		X
Upper Stage			X	X			
Embankment		X		X	X		

EDB-2.3.1 Inflow Points

Inflow Points or Outfalls into EDBs are the point source of the stormwater discharge into the facility. An inflow point is commonly a storm sewer pipe with a flared end section that discharges into the EDB. In some instances, an inflow point could be a drainage channel or ditch that flows into the facility.

An energy dissipater (riprap or hard armor protection) is typically immediately downstream of the discharge point into the EDB to protect from erosion. In some cases, the storm sewer outfall can have a toe- wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

The typical maintenance items that are found with inflow points are as follows:

- a. Riprap Displaced* – Many times, because the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented.
- b. Erosion Present/Outfall Undercut* – In some situations, the energy dissipater may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.
- c. Sediment Accumulation* – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in hydraulic performance of the upstream infrastructure, sediment that accumulates in this area must be removed in a timely manner.
- d. Structural Damage* – Structural damage can occur at any time during the life of the facility. Typically, for an inflow, the structural damage occurs to the pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.
- e. Woody Growth/Weeds Present* – Undesirable vegetation can grow in and around

the inflow area to an EDB that can significantly affect the performance of the drainage facilities discharging into the facility. This type of vegetation includes trees (typically cottonwoods) and dense areas of shrubs (willows). If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in blockage of the discharge. Also, tree roots can cause damage to the structural components of the inflow. Routine maintenance is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree). In addition, noxious weeds growing in the facility can result in the loss of desirable native vegetation and impact adjacent open spaces/land.

EDB-2.3.2 Forebay

A forebay is a solid surface (pad), typically constructed of concrete, immediately downstream of the inflow point. The forebay is designed to capture larger particles and trash to prevent them from entering the main portion of the EDB. The solid surface is designed to facilitate mechanical sediment removal (via a skid steer or shovel). The forebay typically includes a small diameter discharge pipe or weir on the downstream end, which is designed to drain the forebay in a specified period of time to promote sedimentation. Forebays vary in size and depth depending on the design and site constraints.

The typical maintenance items that are found with forebays are as follows:

- a. Sediment/Debris Accumulation* – Because this feature of the EDB is designed to provide the initial sedimentation, debris and sediment frequently accumulate in this area. If the sediment and debris is not removed from the forebay on a regular basis, it can significantly affect the function of other features within the EDB. Routine sediment removal from the forebay can significantly reduce the need for dredging of the main portion of the EDB using specialized equipment (long reach excavators). Routine removal of sediment from the forebay can substantially decrease the long-term sediment removal costs of an EDB.
- b. Concrete Cracking/Failing* – The forebay is primarily constructed of concrete, which cracks, spalls, and settles. Damage to the forebay can result in decreased performance and impact maintenance efforts.
- c. Drain Pipe/Weir Clogged* – Many times the drainpipe or weir can be clogged with debris, and prevent the forebay from draining properly. If standing water is present in the forebay (and there is not a base flow), the forebay is most likely not draining properly. This can result in a decrease in performance and create potential nuisances with stagnant water (mosquitoes).
- d. Weir/Drain Pipe Damaged* – Routine maintenance activities, vandalism, or age may cause the weir or drain pipe in the forebay to become damaged. Weirs are typically constructed of concrete, which cracks and spalls. The drainpipe is typically constructed with plastic, which can fracture.

EDB-2.3.3 Trickle Channel (Low-Flow)

The trickle channel conveys stormwater from the forebay to the micro- pool of the EDB. The trickle channel is typically made of concrete.

However, grass lined (riprap sides protected) is also common and can provide for an additional means of water quality within the EDB. The trickle channel is typically 6-9 inches in depth and can vary in width.

The typical maintenance items that are found with trickle channels are as follows:

- a. Sediment/Debris Accumulation* – Trickle channels are typically designed with a relatively flat slope that can promote sedimentation and the collection of debris. Also, if a trickle channel is grass lined it can accumulate sediment and debris at a much quicker rate. Routine removal of accumulated sediment and debris is essential in preventing flows from circumventing the trickle channel and affecting the dry storage portion of the pond.
- b. Concrete/Riprap Damage* – Concrete can crack, spall, and settle and must be repaired to ensure proper function of the trickle channel. Riprap can also shift over time and must be replaced/repared as necessary.
- c. Woody Growth/Weeds Present* – Because of the constant moisture in the area surrounding the trickle channel, woody growth (cottonwoods/willows) can become a problem. Trees and dense shrub type vegetation can affect the capacity of the trickle channel and can allow flows to circumvent the feature.
- d. Erosion Outside of Channel* – In larger precipitation events, the trickle channel capacity will likely be exceeded. This can result in erosion immediately adjacent to the trickle channel and must be repaired to prevent further damage to the structural components of the EDB.

EDB-2.3.4 Bottom Stage (Initial Surge)

The bottom stage is at least 4 inches deeper than the upper stage and is located directly in front of the outlet works structure, and typically above the permanent water surface of the micropool and the invert of the trickle channel. The bottom stage is designed to store the smaller runoff events, assists in keeping the majority of the basin bottom dry resulting in easier maintenance operations, and enhances the facility's pollutant removal capabilities. This area of the EDB may develop wetland vegetation.

The typical maintenance items that are found with the bottom stage are as follows:

- a. Sediment/Debris Accumulation* – The micropool can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.
- b. Woody Growth/Weeds Present* – Because of the constant moisture in the soil surrounding the micropool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micropool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and less disruptive than removing a mature tree).
- c. Bank Erosion* – The micropool is usually a couple feet deeper than the other areas of the ponds. Erosion can be caused by water dropping into the micropool if

adequate protection/armor is not present. Erosion in this area must be mitigated to prevent sediment transport and other EDB feature damage.

d. Mosquitoes/Algae Treatment – Nuisance created by stagnant water can result from improper maintenance/treatment of the micropool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micropool may be necessary to reduce these impacts to adjacent homeowners.

e. Petroleum/Chemical Sheen – Many indicators of illicit discharges into the storm sewer systems will be present in the micropool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact County Stormwater immediately. Proper removal/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

EDB-2.3.5 Micropool

The micropool is a concrete or grouted boulder walled structure directly in front of the outlet works. At a minimum, the micropool is 2.5 feet deep and is designed to hold water. The micropool is critical in the proper function of the EDB; it allows suspended sediment to be deposited at the bottom of the micropool and prevents these sediments from being deposited in front of the outlet works causing clogging of the outlet structure, which results in marshy areas within the top and bottom stages.

The typical maintenance items that are found with micropools are as follows:

a. Sediment/Debris Accumulation – The micropool can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.

b. Woody Growth/Weeds Present – Because of the constant moisture in the soil surrounding the micropool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micropool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and less disruptive than removing a mature tree).

c. Mosquitoes/Algae Treatment – Nuisance created by stagnant water can result from improper maintenance/treatment of the micropool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micropool may be necessary to reduce these impacts to adjacent homeowners.

d. Petroleum/Chemical Sheen – Many indicators of illicit discharges into the storm sewer systems will be present in the micropool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact the supervisor immediately. Proper removal of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

EDB-2.3.6 Outlet Works

The outlet works is the feature that drains the EDB in specified release rates and periods of time. The outlet works is typically constructed of reinforced concrete into the embankment of the EDB. The concrete structure typically has steel orifice plates anchored/embedded into it to control stormwater release rates. The larger openings for flood control on the outlet structure typically have trash racks over them to prevent clogging. The water quality orifice plate with small diameter holes will typically have a well screen covering it to prevent smaller materials from clogging it. The outlet structure is the single-most important feature in the EDB operation. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the EDB.

The typical maintenance items that are found with the outlet works are as follows:

- a. Trash Rack/Well Screen Clogged* – Floatable material that enters the EDB will most likely make its way to the outlet structure. This material is trapped against the trash racks and well screens on the outlet structure (which is why they are there). This material must be removed on a routine basis to ensure the outlet structure drains in the specified design period.
- b. Structural Damage* – The outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel trash racks and well screens are also susceptible to damage.
- c. Orifice Plate Missing/Not Secure* – Many times residents, property owners, or maintenance personnel will remove or loosen orifice plates if they believe the pond is not draining properly. Any modification to the orifice plate(s) will significantly affect the designed discharge rates for water quality and/or flood control. Modification of the orifice plates is not allowed without EPC approval.
- d. Manhole Access* – Access to the outlet structure is necessary to properly inspect and maintain the facility. If access is difficult or not available to inspect the structure, chances are it will be difficult to maintain as well.
- e. Woody Growth/Weeds Present* – Because of the constant moisture in the soil surrounding the outlet works, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate around the outlet works, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and less disruptive than removing a mature tree).

EDB-2.3.7 Emergency Spillway

An emergency spillway is typical of all EDBs and designed to serve as the overflow in the event the volume of the pond is exceeded. The emergency spillway is typically armored with riprap (or other hard armor) and is sometimes buried with soil. The emergency spillway is typically a weir (notch) in the pond embankment. Proper function of the emergency spillway is essential to ensure flooding does not affect adjacent properties.

The typical maintenance items that are found with emergency spillways are as follows:

- a. Riprap Displaced* – As mentioned before, the emergency spillway is typically armored with riprap to provide erosion protection. Over the life of an EDB, the riprap may shift or dislodge due to flow.

- b. Erosion Present* – Although the spillway is typically armored, stormwater flowing through the spillway can cause erosion damage. Erosion must be repaired to ensure the integrity of the basin embankment, and proper function of the spillway.
- c. Woody Growth/Weeds Present* – Management of woody vegetation is essential in the proper long-term function of the spillway. Larger trees or dense shrubs can capture larger debris entering the EDB and reduce the capacity of the spillway.
- d. Obstruction Debris* – The spillway must be cleared of any obstruction (man-made or natural) to ensure the proper design capacity.

EDB-2.3.8 Upper Stage (Dry Storage)

The upper stage of the EDB provides the majority of the water quality flood detention volume. This area of the EDB is higher than the micro- pool and typically stays dry, except during storm events. The upper stage is the largest feature/area of the basin. Sometimes, the upper stage can be utilized for park space and other uses in larger EDBs.

With proper maintenance of the micropool and forebay(s), the upper stage should not experience much sedimentation; however, bottom elevations should be monitored to ensure adequate volume.

The typical maintenance items that are found with upper stages are as follows:

- a. Vegetation Sparse* – The upper basin is the most visible part of the EDB, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance and acceptance of the EDB by the public. In addition, vegetation can reduce the potential for erosion and subsequent sediment transport to the other areas of the pond.
- b. Woody Growth/Undesirable Vegetation* – Although some trees and woody vegetation may be acceptable in the upper basin, some thinning of cottonwoods and willows may be necessary. Remember, the basin will have to be dredged to ensure volume, and large trees and shrubs will be difficult to protect during that operation.
- c. Standing Water/Boggy Areas* – Standing water or boggy areas in the upper stage is typically a sign that some other feature in the pond is not functioning properly. Routine maintenance (mowing, trash removal, etc.) can be extremely difficult for the upper stage if the ground is saturated. If this inspection item is checked, make sure you have identified the root cause of the problem.
- d. Sediment Accumulation* – Although other features within the EDB are designed to capture sediment, the upper storage area will collect sediment over time. Excessive amounts of sedimentation will result in a loss of storage volume. It may be more difficult to determine if this area has accumulated sediment without conducting a field survey.

Below is a list of indicators:

1. Ground adjacent to the trickle channel appears to be several inches higher than concrete/riprap
2. Standing water or boggy areas in upper stage
3. Uneven grades or mounds
4. Micropool or Forebay has excessive amounts of sediment

e. *Erosion (banks and bottom)* – The bottom grades of the dry storage are typically flat enough that erosion should not occur. However, inadequate vegetative cover may result in erosion of the upper stage. Erosion that occurs in the upper stage can result in increased dredging/maintenance of the micropool.

f. *Trash/Debris* – Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can accumulate and clog the EDB outlet works.

g. *Maintenance Access* – Most EDBs typically have a gravel/concrete maintenance access path to either the upper stage, outlet works, and/or forebay. This access path should be inspected to ensure the surface is still drivable. Some of the smaller EDBs may not have maintenance access paths; however, the inspector should verify that access is available from adjacent properties.

EDB-2.3.9 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the EDB. This category on the inspection form is for maintenance items that are commonly found in the EDB but may not be attributed to an individual feature.

a. *Encroachment in Easement Area* – Private lots/property can sometimes be located very close to the EDBs, even though they are required to be located in tracts with drainage easements. Property owners may place landscaping, trash, fencing, or other items within the easement area that may affect maintenance or the operation of the facility.

b. *Graffiti/Vandalism* – Damage to the EDB infrastructure can be caused by vandals. If criminal mischief is evident, the inspector should forward this information to the local Sheriff's Office.

c. *Public Hazards* – Public hazards include items such as vertical drops of greater than 4-feet, containers of unknown/suspicious substances, exposed metal/jagged concrete on structures. If any hazard is found within the facility area that poses an immediate threat to public safety, contact the Sheriff at 911 immediately!

d. *Burrowing Animals/Pests* – Prairie dogs and other burrowing rodents may cause damage to the EDB features and negatively affect the vegetation within the EDB. Consult EPC Environmental Division if this becomes an issue.

e. *Other* – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

EDB-3 MAINTAINING EXTENDED DETENTION BASINS (EDBS)

EDB-3.1 Maintenance Personnel

Maintenance personnel must be qualified to properly maintain EDBs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

EDB-3.2 Equipment

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on an EDB:

- 1.) Loppers/Tree Trimming Tools
- 2.) Mowing Tractors

- 3.) Trimmers (extra string)
- 4.) Shovels
- 5.) Rakes
- 6.) All Surface Vehicle (ASVs)
- 7.) Skid Steer
- 8.) Backhoe
- 9.) Track Hoe/Long Reach Excavator
- 10.) Dump Truck
- 11.) Jet-Vac Machine
- 12.) Engineers Level (laser)
- 13.) Riprap (Minimum - Type M)
- 14.) Filter Fabric
- 15.) Erosion Control Blanket(s)
- 16.) Seed Mix (Native)
- 17.) Illicit Discharge Cleanup Kits
- 18.) Trash Bags
- 19.) Tools (wrenches, screw drivers, hammers, etc.)
- 20.) Chain Saw
- 21.) Confined Space Entry Equipment
- 22.) Approved Stormwater Facility Operation and Maintenance Manual

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

EDB-3.3 Safety

Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is identified within the EDB that is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

EDB-3.4 Maintenance Categories and Activities

A typical EDB Maintenance Program will consist of three broad categories of work: routine, minor, and major maintenance activities. Within each category of work, a variety of maintenance activities can be performed on an EDB. A maintenance activity can be specific to each feature within the EDB, or general to the overall facility. A variety of maintenance activities are typical of EDBs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of drainage infrastructure. The following three sub-sections (3.5, 3.6, and 3.7) explain each of the categories and briefly describes the typical maintenance activities for an EDB, including the objectives and frequency of actions.

EDB-3.5 Routine Maintenance Activities

The majority of this work consists of regularly scheduled mowing and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities will normally be performed numerous times during the year. These items can be completed without any prior correspondence with the EPC Stormwater; however, completed

inspection and maintenance forms shall be retained for each inspection and maintenance activity.

The Maintenance Activities are summarized below, and further described in the following sub-sections.

TABLE – EDB-2 Summary of Routine Maintenance Activities

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR	MAINTENANCE ACTION
Mowing	Twice annually	Excessive grass height/aesthetics	Mow grass to a height of 4" to 6"
Trash/Debris Removal	Twice annually	Trash & debris in EDB	Remove and dispose of trash and debris
Outlet Works Cleaning	As needed – after significant rain events – twice annually at a minimum	Clogged outlet structure; ponding water	Remove and dispose of debris/trash/sediment to allow outlet to function properly
Weed control	Minimum twice annually	Noxious weeds; Unwanted vegetation	Treat w/ herbicide or hand pull; Consult the local weed specialist
Mosquito Treatment	As needed	Standing water/ mosquito habitat	Treat w/ EPA approved chemicals
Algae Treatment	As needed	Standing water/ Algal growth/green color	Treat w/ EPA approved chemicals

EDB-3.5.1 Mowing

Occasional mowing is necessary to limit unwanted vegetation and to improve the overall appearance of the EDB. Native vegetation should be mowed to a height of 4-to-6 inches tall. Grass clippings should be collected and disposed of properly.

Frequency – Routine - Minimum of twice annually or depending on aesthetics.

EDB-3.5.2 Trash/Debris Removal

Trash and debris must be removed from the entire EDB area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

Frequency – Routine – Prior to mowing operations and minimum of twice annually.

EDB-3.5.3 Outlet Works Cleaning

Debris and other materials can clog the outlet work's well screen, orifice plate(s), and trash rack. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.

Frequency - Routine – After significant rainfall event or concurrently with other maintenance activities.

EDB-3.5.4 Weed Control

Noxious weeds and other unwanted vegetation must be treated as needed throughout the EDB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the Environmental Division at 719-520-7878 is highly recommended prior to the use of herbicide.

Frequency – Routine – As needed based on inspections.

EDB-3.5.5 Mosquito/Algae Treatment

Treatment of permanent pools is necessary to control mosquitoes and undesirable aquatic vegetation that can create nuisances. Only EPA approved chemicals/materials can be used in areas that are warranted.

Frequency – As needed.

EDB- 3.6 Minor Maintenance Activities

This work consists of a variety of isolated or small-scale maintenance or operational problems. Most of this work can be completed by a small crew, tools, and small equipment. These items may require prior correspondence with EPC Stormwater and require completed inspection and maintenance forms to be submitted to EPC upon request for each inspection and maintenance activity.

Table – EDB-3 Summary of Minor Maintenance Activities

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR	MAINTENANCE ACTION
Sediment Removal	As needed; typically every 1–2 years	Sediment build-up; decrease in pond volume	Remove and dispose of sediment
Erosion Repair	As needed, based upon inspection	Rills/gullies forming on side slopes, trickle channel, other areas	Repair eroded areas Revegetate; address source of erosion
Vegetation Removal/Tree Thinning	As needed, based upon inspection	Large trees/wood vegetation in lower stage of pond	Remove vegetation; restore grade and surface
Drain Cleaning/Jet Vac	As needed, based upon inspection	Sediment build-up/ non draining system	Clean drains; Jet Vac if needed

EDB-3.6.1 Sediment Removal

Sediment removal is necessary to maintain the original design volume of the EDB and to ensure proper function of the infrastructure. Regular sediment removal (minor) from the forebay, inflow(s), and trickle channel can significantly reduce the frequency of major sediment removal activities (dredging) in the upper and lower stages. The minor sediment removal activities can typically be addressed with shovels and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. The major sediment activities will also require surveying with an engineer's level, and consultation with EPC Stormwater Staff to ensure design volumes/grades are achieved.

Stormwater sediments removed from EDBs do not meet the criteria of "hazardous waste". However, these sediments are contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments from permanent pools must be carefully removed to minimize turbidity, further sedimentation, or other adverse water quality impacts. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a landfill for proper disposal. Prompt and thorough cleanup is important should a spill occur during transportation.

Frequency – Nonroutine – As necessary based upon inspections. Sediment removal in the

forebay and trickle channel may be necessary as frequently as every 1-2 years.

EDB-3.6.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper function of the EDB, minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to trickle channels, energy dissipaters, and rilling to major gullies in the embankments and spillways. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, erosion control blankets, and turf reinforcement mats. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with EPC Stormwater Staff.

Frequency – Nonroutine – As necessary based upon inspections.

EDB-3.6.3 Vegetation Removal/Tree Thinning

Dense stands of woody vegetation (willows, shrubs, etc) or trees can create maintenance problems for the infrastructure within an EDB. Tree roots can damage structures and invade pipes/channels thereby blocking flows. Also, trees growing in the upper and lower stages of the EDB will most likely have to be removed when sediment/dredging operations occur. A small tree is easier to remove than a large tree, therefore, regular removal/thinning is preferred. All trees and woody vegetation that is growing in the bottom of the EDB or near structures (inflows, trickle channels, outlet works, emergency spillways, etc) should be removed. Any trees or woody vegetation in the EDB should be limited to the upper portions of the pond banks.

Frequency – Nonroutine – As necessary based upon inspections.

EDB-3.6.4 Clearing Drains/Jet-Vac

An EDB contains many structures, openings, and pipes that can be frequently clogged with debris. These blockages can result in a decrease of hydraulic capacity and create standing water in areas outside of the micropool. Often the blockage to this infrastructure can be difficult to access and/or clean. Specialized equipment (jet-vac machines) may be necessary to clear debris from these difficult areas.

Frequency – Nonroutine – As necessary based upon inspections.

EDB-3.7 Major Maintenance Activities

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with EPC Stormwater Staff to ensure the proper maintenance is performed. This work requires that the staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. **An ESQCP permit may be required for major maintenance activities.** This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.

Table – EDB-4 Summary of Major Maintenance Activities

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR	MAINTENANCE ACTION
Major Sediment Removal	As needed – based upon scheduled inspections	Large quantities of sediment; reduced pond capacity	Remove and dispose of sediment. Repair vegetation as needed
Major Erosion Repair	As needed – based upon scheduled inspections	Severe erosion including gullies, excessive soil displacement, areas of settlement, holes	Repair erosion – find cause of problem and address to avoid future erosion
Structural Repair	As needed – based upon scheduled inspections	Deterioration and/or damage to structural components – broken concrete, damaged pipes, outlet works	Structural repair to restore the structure to its original design

EDB-3.7.1 Major Sediment Removal

Major sediment removal consists of removal of large quantities of sediment or removal of sediment from vegetated areas. Care shall be given when removing large quantities of sediment and sediment deposited in vegetated areas. Large quantities of sediment need to be carefully removed, transported and disposed of. Vegetated areas need special care to ensure design volumes and grades are preserved.

Frequency – Nonroutine – Repair as needed based upon inspections.

EDB-3.7.2 Major Erosion Repair

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved.

Frequency – Nonroutine – Repair as needed based upon inspections.

EDB-3.7.3 Structural Repair

An EDB includes a variety of structures that can deteriorate or be damaged during the course of routine maintenance. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time.

These structures include items like outlet works, trickle channels, forebays, inflows, and other features. In-house operations staff can perform some of the minor structural repairs. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with EPC Stormwater Staff should take place prior to all structural repairs.

Frequency – Nonroutine – Repair as needed based upon inspections.

Reference:

This manual is adapted from SEMSWA and the Town of Parker, Colorado, STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL, October 2004

For additional resources and contact info, visit the EPC Stormwater website:

<https://publicworks.elpasoco.com/stormwater/>