BLUE 3-65 33-32-31 1BH, 2AH, 2BH, 3AH, 3BH, 4AH, & 4BH OIL & GAS WELLS

PRELIMINARY DRAINAGE REPORT

NW1/4 SW1/4 SECTION 34, TOWNSHIP 3 SOUTH, RANGE 65 WEST, 6TH P.M.

Approved For One Year From This Date	
______________	
City Engineer	Date
Water Department	Date

Prepared For:

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I. PROJECT DATA

A. INTRODUCTION

The Blue 3-65 33-32-31 oil & gas well site access road will connect to the existing access road to the Mustang Compressor Station, which extends north to access off the south side of E. 26th Ave., approximately 0.5 miles east of the intersection of E. 26th Ave. and Monaghan Rd. The well site is located in the northwest quarter of the southwest quarter of Section 34, Township 3 South, Range 65 West, 6th P.M. The proposed improvements will be constructed in one phase in support of drilling a total of seven (7) oil and gas wells. The drill pad will be a graded 460'L x 605'W flat pad with production facilities located on the north side of the well pad. After drilling operations are completed, the south end of the drill pad will be interim reclaimed, reducing the size to a 345'L x 605'W flat pad to support the production facility.

A topsoil stockpile (visual mitigation berm) will be located along the south edge of the drill pad and will provide visual mitigation from Interstate 70. The visual mitigation berm will be 8 feet high with 4H:1V side slopes and will remain in place until it is partially used and relocated during the interim reclamation of the well pad.

The well pad will have an approximately 23'W x 1,470'L gravel access road that will connect to the existing access road to the Mustang Compressor Station as previously mentioned. The road cross section will have a 2% crown to divert the water off each side of the road. The road structure will be comprised of four inches of CDOT Class 6 Aggregate Base used as a surfacing gravel. Reference Appendix A for a vicinity map of the well pad location.

SOILS INFORMATION

Using the US Department of Agriculture's web soil survey, four soil classifications are represented onsite.

Table 1 - NRCS Hydrologic Soil Group

Soil Type	Average Slope	Hydrologic Soil Group	Percent of AOI
Adena-Colby association	gently sloping	C	26.8%
Adena-Colby association	moderately sloping	C	2.1%
Platner loam	3 to 5 percent slopes	C	70.8%
Weld loam	1 to 3 percent slopes	C	0.3%

The soils are categorized as Hydrologic Soil Group C. Hydrologic Soil Group C is classified as having a slow infiltration rate when thoroughly wet.

The soils at the project location have a K factor ranging from 0.28 to 0.43. The K factor indicates the susceptibility of a soil to sheet and rill erosion by water and varies from 0.02 (low susceptibility) to 0.69 (high susceptibility). Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. The weighted average K factor for the site is 0.34. Refer to the attached soils map in Appendix B.

The existing landscape could be characterized as rangeland or dryland row crops.

PROPOSED DEVELOPMENT

The total disturbed area during construction of the drill pad is 13.3 acres, which does not include the access road disturbance of 1.7 acres. A temporary sediment basin will be constructed east of the proposed drill pad and is sized to capture and treat the on-site stormwater runoff for the bare soil areas, which are the cut and fill slopes of the drill pad. After the drilling operations are completed, the site will be interim reclaimed to a smaller production facility pad with a total disturbed area of 9.9 acres. The sediment basin will be removed and an extended detention basin will be constructed east of the proposed production facility pad and is sized to capture and treat the on-site stormwater runoff for the bare soil areas, which are the cut and fill slopes of the production facility pad.

The access road cross-section will be constructed with a 2% crown to divert the stormwater runoff to each side of the road and collect into roadside swales.

The drill pad, access road, and sediment basin will be graded by removing the topsoil and stockpiling it along the south edge of the proposed drill pad as an 8 ft high visual mitigation berm to Interstate 70. The site will then be excavated to the finished grade elevation using the excavated soil as fill to balance the earthwork, leaving no spoils to be stockpiled. During interim reclamation, inert fill material will need to be hauled to the site and placed in the cut areas of the drill pad in order to return the site to its natural contours, or as close as possible. Topsoil from the visual mitigation berm will then be evenly placed over the reclaimed area, and the remaining topsoil will be relocated and stockpiled in an 8 ft high berm along the south edge of the production facility pad to provide visual mitigation from Interstate 70.

VARIANCES

1. The proposed development is seeking a variance from the City to allow the drainage swales with a flow line grade that will be less than 2% (0.5% minimum). This variance is requested as a result of the existing grades of the natural topography are less than the 2% minimum..

B. HISTORIC DRAINAGE

The existing topography generally drains from southwest to northeast towards a tributary of Prairie Dog Draw at an existing grade of approximately 3%. There are seven (7) horizontal wells planned to be drilled from this pad. The western most wellhead is 493 feet east of the west section line, 232 feet from the west edge of the drill pad, 364 feet south of the quarter section line, and 245 feet from the north edge of the drill pad. The wellheads run in an east-west direction spaced 20 feet apart. The site is located within the Coyote Run watershed and near tributaries of Prairie Dog Draw, and lies outside of any floodplains. Stormwater runoff from the existing site generally collects into a natural swale running through the site, which eventually outfalls into Prairie Dog Draw. No other non-storm water sources are contemplated at this project site.

100-YR FLOODPLAIN

The location of the well pad site is not within any mapped FEMA 100-year floodplain. The nearest edge of the Prairie Dog Draw Floodplain is approximately 1.0 mile northeast of the site. There are no springs or irrigation ditches on the site. Reference the Floodplain Exhibits in Appendix A for depiction of the project location in relation to the floodplain.

OFF-SITE BASINS

The existing site drainage flows from the southwest to the northeast towards the tributaries of Prairie Dog Draw.

There are four offsite drainage basins around the site. Basin OS-1 is located west of the site and flows east towards Offsite Ditch-1 and is then conveyed north to outlet into the historic drainage basin north of the site. Basin OS-2 is located south of the site and flows northeast towards Offsite Ditch-2 and is then conveyed east to discharge into Basin OS-4 east of the site. Basin OS-3 is located east of the site and flows northeast towards Pad Ditch-3 and is then conveyed east and discharges into the sediment basin. OS-4, as mentioned earlier, is located east of the site and flows northeast towards the Mustang Compressor Station, where it follows the contours of the compressor station landscaping and is conveyed northeast to Culvert-2, which conveys the stormwater runoff and the sediment basin overflow under the proposed access road, discharging north of the access road into a short ditch that outfalls to the historic drainage basin northeast of the pad. Existing flow patterns will be altered by diverting the offsite flows around the site, but eventually discharging into the historic drainage path on the downstream side of the site.

C. Design Criteria

References

This drainage report references the following documents that provide design criteria, calculation methodology, and drainage reports that are impacted by or impact the proposed site development:

1. City of Aurora – Storm Drainage Design and Technical Criteria, dated September 2010.

2. Mile High Flood District (Urban Drainage and Flood Control District) – Urban Drainage Criteria Manual, Vols I-III, most recent edition.

Hydrologic Criteria

The site is located in the non-urban area of Aurora and Adams County. The minor precipitation intensity was obtained from the *Urban Storm Drainage Criteria Manual, Volume 1, January 2016* in *Figure 5-1 – Rainfall depth-duration-frequency: 2-year, 1-hour rainfall* (previously, Figure RA-1). The 2-Year 1-Hour rainfall intensity for the project location is 1.0 in/hr. The major precipitation intensity was obtained from the same location in *Figure 5-6 – Rainfall depth-duration-frequency: 100-year, 1-hour rainfall* (previously, Figure RA-6). The 100-Year 1-Hour rainfall intensity for the project location is 2.7 in/hr. The location of the proposed site is depicted on the accompanying Drainage Plan included with this report submittal.

The Rational Method is used to compute peak runoff flows for the minor (2-year) and major (100-year) storm events for the on-site and off-site drainage basins. Initially, a weighted Rational coefficient calculation is performed for each of the basins, following the recommended Runoff Coefficient (C) values from *Table 1 – Runoff Coefficients and Percent Impervious* of the City of Aurora – *Storm Drainage Design and Technical Criteria Manual*. The non-urban peak runoff flow is then calculated using the Rational Method Equation Q = CIA as specified in the City of Aurora's *Storm Drainage Design and Technical Criteria Manual* and using the *UD-Rational* excel spreadsheet, as provided by the *Mile High Flood District*.

The Non-Urban Computed Time of Concentration is calculated following the equations listed in the City of Aurora's *Storm Drainage Design and Technical Criteria Manual.* The peak runoff flow calculation for each basin, at the "Computed T_C", are printed from the UD-Rational spreadsheet and is included in this letter in Appendix D, for reference.

HYDRAULIC CRITERIA

The hydraulic criteria used to evaluate, analyze, and design hydraulic structures follow the criteria and guidance provided in the *City of Aurora – Storm Drainage Design and Technical Criteria Manual* and *Mile High Flood District – Urban Storm Drainage Criteria Manual, Volume 2, latest adopted edition*, where referenced.

Culverts are designed to convey the 100-year major storm event without overtopping any roadways nor exceeding 1.5 times the culvert diameter (per section 6.61 of the SDDTCM). The emergency overflow path will be identified on the plans and evaluated to determine capacity. In the case of available culvert capacity, a conveyance calculation will be used to show that the emergency overflow will be contained within the designed culvert. In the case that the culvert is close to capacity, the culvert and roadway structure will be evaluated to show the culvert flow under headwater conditions and any remaining emergency flow will be shown to overtop the roadway as a weir structure. The roadway weir overtopping calculation will be performed using Bentley CulvertMaster software and actual roadway profile conditions. Swales and/or Diversion Ditches are designed to convey the 100-year major storm event providing 12 inches of freeboard.

D. DRAINAGE PLAN

GENERAL CONCEPT

The offsite drainage basins located west and south of the site will be diverted and conveyed around the edges of the site development and eventually discharge into the historic drainage path. There are four offsite drainage basins planned, OS-1, OS-2, OS-3, and OS-4. The onsite stormwater runoff from Basins A, B and C will be routed through ditches constructed around the perimeter of the well pad, which will discharge into the Extended Detention Basin located east of the site. These areas include the cut and fill slopes of the well pad, the ditches, and the visual mitigation berm.

The discharge from the temporary sediment basin (drilling operations) and the permanent Extended Detention Basin will discharge into the diversion ditch running along the south side of the access road to Culvert-2 under the access road, and discharging into the historic drainage northeast of the site. The Mustang Compressor Station site is located to the east of the proposed well pad. The stormwater runoff discharge from the site will discharge into the historic drainage located north of the Mustang Compressor Station site. The flow from the proposed Extended Detention Basin will not impact the existing Mustang Compressor Station site as it will flow within the historic drainage located north of the site.

Stormwater runoff from the south half of the access road will be routed through the ditches along the access road as previously mentioned, discharging into the historic drainage northeast of the site. Stormwater runoff from the north half of the access road will be treated by a grass buffer before discharging into the historic drainage northeast of the site. Reference the Grass Buffer spreadsheet in Appendix F.

OFF-SITE DRAINAGE BASINS

Basin OS-1 is located west of the site and flows east towards Offsite Ditch-1 and is then conveyed north to outlet into the historic drainage basin north of the site. Basin OS-2 is located south of the site and flows northeast towards Offsite Ditch-2 and is then conveyed east to discharge into Basin OS-4 east of the site. Basin OS-3 is located east of the site and flows northeast towards Pad Ditch-3 and is then conveyed east and discharges into the temporary sediment basin and extended detention basin. OS-4, as mentioned earlier, is located east of the site and flows northeast towards the Mustang Compressor Station, where it follows the contours of the compressor station landscaping and is conveyed northeast to Culvert-2, which conveys the stormwater runoff and the extended detention basin outlet under the proposed access road, discharging north of the access road into a short ditch that outfalls to the historic drainage basin northeast of the pad. Reference the off-site drainage plan D-1 included in this report.

ON-SITE DRAINAGE BASINS

Basins A, B and C are drainage basins of the on-site pad areas. Basin A includes the onsite runoff from the western and northern areas of the site that include the cut and fill slopes of the pad. Basin A runoff flows towards Pad Ditch-1 along the west and north edges of the pad. Pad Ditch-1 conveys the runoff through Culvert-1 on the north end of the pad under the access road, discharging into Basin C and Pad Ditch-3. Basin B includes the onsite runoff from the southern and eastern areas of the site which includes the cut and fill slopes of the pad, and capturing the runoff from the visual mitigation berm (topsoil stockpile) south of the pad. Basin B runoff is conveyed east and north by Pad Ditch-2 along the south and east edges of the pad where it outfalls into Basin C and Pad Ditch-3. Basin C east of the site includes Pad Ditch-3, the extended detention basin, and the runoff from a portion of the access road. Pad Ditch-3 conveys the total onsite runoff, and runoff from OS-3, along the south edge of the access road where it outfalls into the temporary sediment basin (drilling operations) and the permanent Extended Detention Basin. Reference the on-site drainage plans D-2 & D-3 accompanying this report.

The peak runoff flows for each basin are shown in the table below:

Table 2 – Peak Runoff Flow (cfs)

Basin ID	**Basin Area (Acres)**	**Imperv. (%)**	**2-yr (C)**	**100-yr (C)**	**2-yr Peak Runoff Flow (cfs)**	**100-yr Peak Runoff Flow (cfs)**
A (DRILL PHASE)	4.41	31.03	0.14	0.53	1.00	9.83
B (DRILL PHASE)	5.11	26.44	0.14	0.46	1.12	9.83
C (DRILL PHASE)	0.94	38.88	0.38	0.50	0.83	2.96
OS-1 (DRILL PHASE)	28.51	5.00	0.18	0.22	6.46	21.31
OS-2 (DRILL PHASE)	13.94	5.00	0.18	0.22	3.42	11.28
OS-3 (DRILL PHASE)	1.90	5.00	0.18	0.22	0.64	2.11
OS-4 (DRILL PHASE)	27.50	5.22	0.18	0.22	3.80	12.69
A (PROD PHASE)	3.45	29.25	0.14	0.50	0.77	7.30
B (PROD PHASE)	2.79	26.58	0.14	0.47	0.70	6.15
C (PROD PHASE)	1.12	47.54	0.43	0.54	1.11	3.73
OS-1 (PROD PHASE)	19.32	5.00	0.18	0.22	4.43	14.63
OS-2 (PROD PHASE)	22.67	5.00	0.18	0.22	4.90	16.18
OS-3 (PROD PHASE)	2.47	5.00	0.18	0.22	0.74	2.44
OS-4 (PROD PHASE)	30.53	5.16	0.18	0.22	4.22	14.05

CONVEYANCES

The minor and major storm routing through the site will be managed through the use of swales. The swales are designed to convey the 100-year stormwater runoff flows. Due to the flat grades of the existing ground, through the area of the swales, the minimum grade proposed for the swales varies from 0.25% to 1.50%, depending on the swale location. As a result, the swales will be constructed with an underdrain as shown in the detail on the Drainage Plans D-2 and D-3. It was determined that an underdrain outlet was not necessary, as only a small amount of water at the end of the swale would pond within the pipe and gravel, then over a period of time would infiltrate into the surrounding soil. The swales will be constructed with a 2-foot wide flat bottom and 4:1 side slopes. The depth of the swale will be 24 inches, which will provide a minimum of 1-foot of freeboard above the 100-yr water surface elevation.

EXTENDED DETENTION BASIN

The proposed Extended Detention Basin will be located east of the proposed well pad site and will collect on-site stormwater runoff from the graveled pad area and from the slopes of the constructed well pad. The Extended Detention Basin will be privately maintained by the landowner. The detention basin outlet will outfall to the east by way of an Outlet Pipe which will discharge into the outlet ditch running along the south side of the access road to Culvert-2 under the proposed access road, discharging north of the access road into a short ditch that outfalls to the historic drainage basin northeast of the pad. The emergency overflow for the detention pond will discharge east of the detention basin into the same ditch as the outlet pipe described above. The detention basin will be constructed with 4H:1V side slopes for drivable maintenance access.

The area tributary to the Extended Detention Basin includes the graveled production facility pad, the cut/fill slopes of the pad and ditches, and the EDB water surface. The tributary drainage area to the EDB is 7.36 acres. The cut/fill slopes of the pad and ditches were assumed to have an imperviousness of 5%, and the graveled area of the pad was assumed to have an imperviousness of 40%. The EDB water surface was assumed to have an imperviousness of 100%.

Based on a tributary drainage area of greater than 5 acres, the EDB is required to detain the 100-yr Detention Volume plus 1/2EURV. The EDB size was calculated using the MHFD – UD-Detention v4.04 (February 2021) spreadsheet, as well as the COA SDDTC V=KA equation to calculate the detention requirement, and selecting the greater value of the calculated volume and adding 1/2EURV. Reference the calculations included with this report in Appendix E.

The following table includes the extended detention basin design details:

Table 3 - Extended Detention Basin Summary

Tributary Drainage Area:	7.36 Ac.
Percent Imperviousness:	29.93%
1/2EURV:	0.100 ac-ft
10-Yr Detention Volume	0.314 ac-ft
100-Yr Detention Volume, V100 (MHFD):	0.514 ac-ft
100-Yr Detention Volume, V100 (COA V=KA):	0.392 ac-ft
Total Required Detention Volume = V100 + 1/2EURV:	0.614 ac-ft

Forebay Volume Req'd (3% of WQCV):	122 cuft
10-Yr Allowable Release Rate (0.30 cfs/ac - SDDTCM Sec. 6.33):	2.21 cfs (C)
100-Yr Allowable Release Rate (1.00 cfs/ac - SDDTCM Sec. 6.33):	7.36 cfs (C)

The inlet forebay will be sized to store 3% of the water quality capture volume (WQCV) at a maximum depth of 1.5 feet. The outlet structure will be designed to discharge at the 10-year and 100-year historic stormwater runoff rates utilizing a restrictor plate on the outlet pipe. The WQCV will be drained through an orifice plate installed on the outlet structure to drain at a slow rate over 40 hours. The EURV water volume will be drained through the outlet structure orifice plate and restrictor plate and will drain the volume within 72 hours.

E. Conclusions

The site hydrology and hydraulic conveyances will be designed to route and manage the 100-year stormwater runoff around and through the site and discharge into the historic drainage outfalls to the north of the site (eventually reaching the tributaries of Prairie Dog Draw and ultimately Coyote Run). As discussed earlier in this report, the location of the well pad site is not within any mapped FEMA 100-year floodplain. Onsite stormwater will be stored in an on-site Extended Detention Basin designed in accordance with the City of Aurora – Storm Drainage Design and Technical Criteria Manual to include the 100-year Runoff Volume plus 1/2EURV.

No adverse short term or long-term drainage impacts, resulting from the construction of the pad site or access road, are anticipated.

If the drainage patterns or imperviousness characteristics substantially deviate from what was considered in this drainage letter, and the accompanying Stormwater Management Plan and Site Plan, the City of Aurora shall be notified.

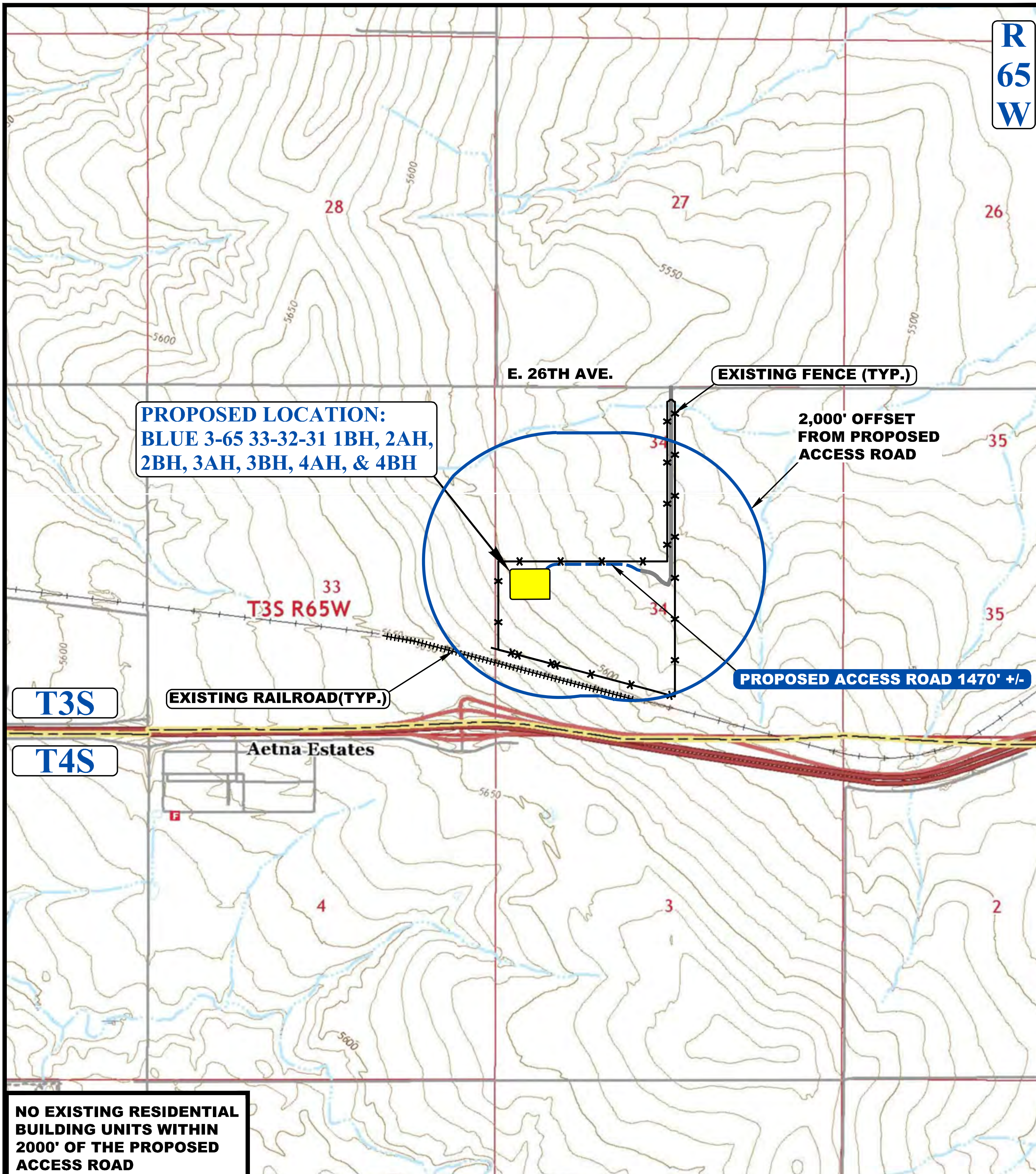
F. References

This drainage report references the following documents that provide design criteria, calculation methodology, and drainage reports that are impacted by or impact the proposed site development:

1. *City of Aurora – Storm Drainage Design and Technical Criteria*, dated September 2010.
2. *Mile High Flood District (Urban Drainage and Flood Control District) – Urban Drainage Criteria Manual*, Vols I-III, most recent edition.

II. APPENDIX

APPENDIX A – VICINITY MAP, FLOODPLAIN MAP



LEGEND:

- WORKING PAD SURFACE
- EXISTING ROAD
- PROPOSED ACCESS ROAD
- EXISTING RAILROAD
- EXISTING FENCE

UINTAH
ENGINEERING & LAND SURVEYING

UELS, LLC
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Vernal, UT 84078 * (435) 789-1017

N

CRESTONE PEAK RESOURCES OPERATING LLC

BLUE 3-65 33-32-31 1BH, 2AH, 2BH, 3AH, 3BH, 4AH, & 4BH
NW 1/4 SW 1/4, SECTION 34, T3S, R65W, 6th P.M.
ADAMS COUNTY, COLORADO

SURVEYED BY	M.M., O.R.	10-21-20	SCALE
DRAWN BY	C.IVIE	11-24-20	1 : 24,000

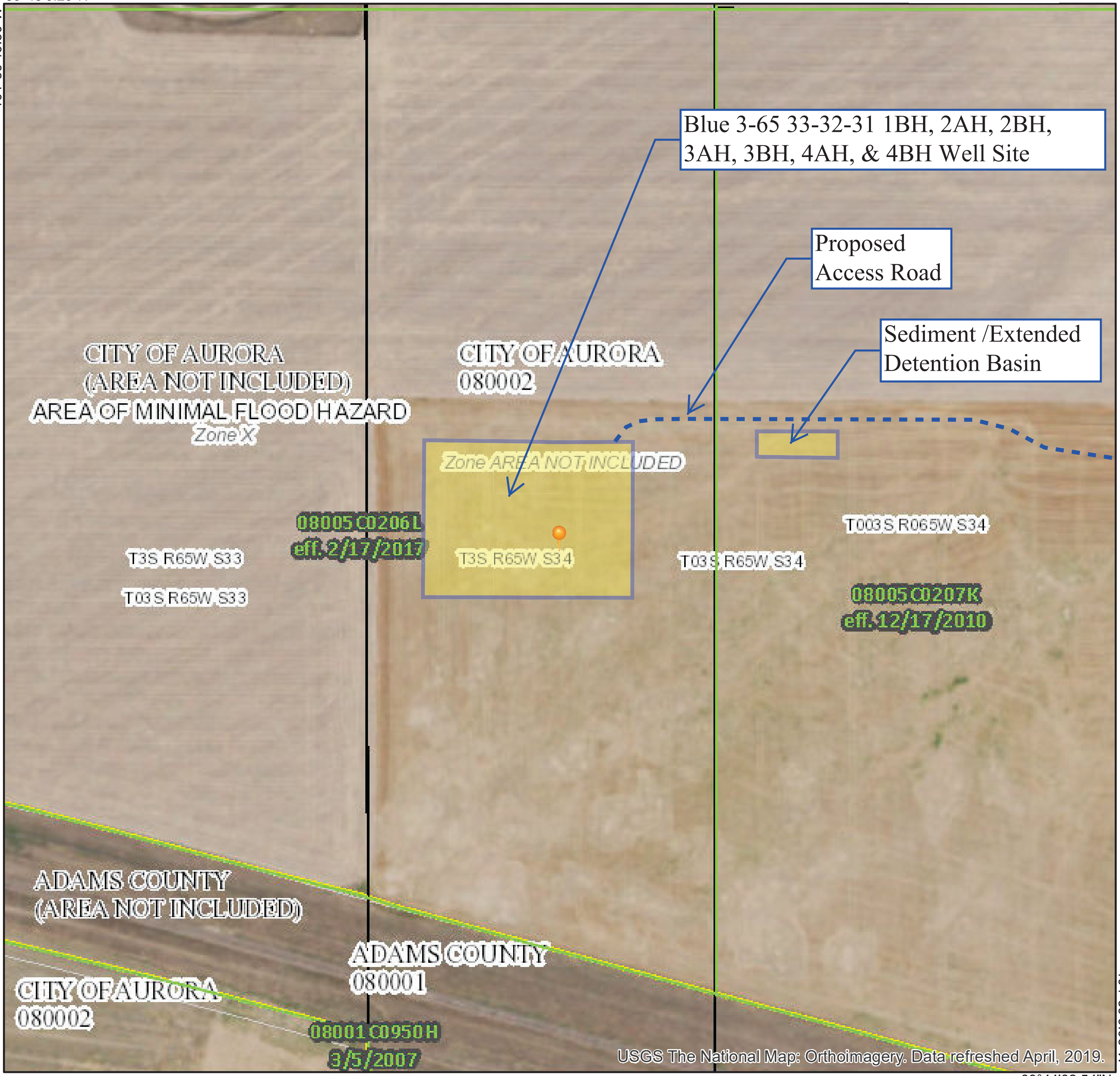
ACCESS ROAD MAP

National Flood Hazard Layer FIRMette

FEMA

39°45'0.20"N

104°39'46.50"W



104°39'9.05"W

39°44'32.54"N

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

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
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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 12/4/2019 at 2:02:05 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.

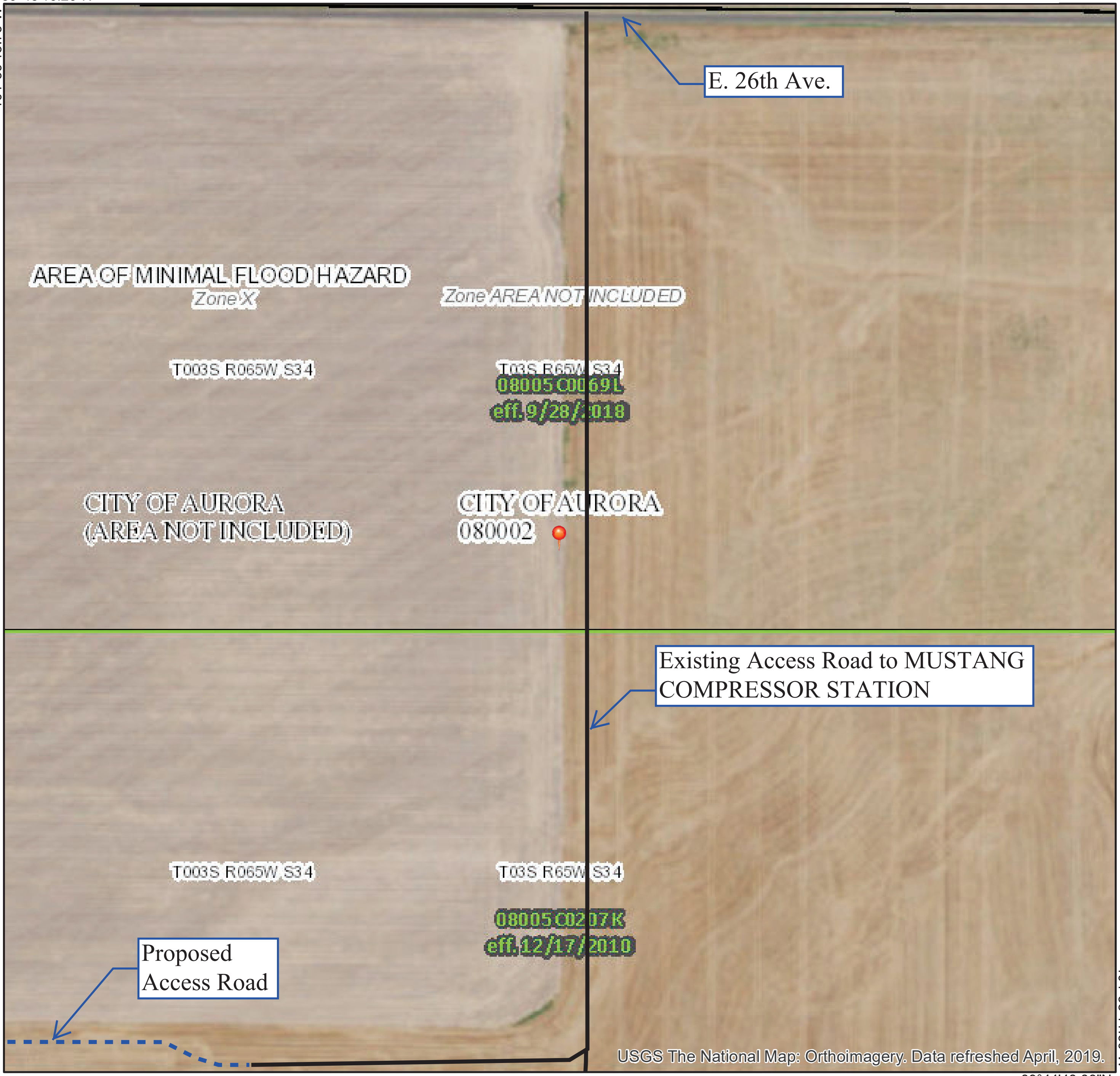
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory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

National Flood Hazard Layer FIRMette

FEMA

39°45'16.29"N

104°39'18.75"W



104°38'41.30"W

39°44'48.63"N

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

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*
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GENERAL STRUCTURES
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- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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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.

APPENDIX B – NRCS SOIL TYPE MAP


104° 39' 59" W
104° 39' 4" W
39° 44' 54" N
39° 44' 27" N
528600
528700
528800
528900
529000
529100
529200
529300
529400
529500
529600
529700
529800
4399900
4399800
4399700
4399600
4399500
4399400
4399300
4399200
4399100
Blue 3-65 33-32-31
Well Site
AcC
PIC
AcD
PIC
AcC
WmB
Smith Rd
Smith
36
Soil Map may not be valid at this scale.
Map Scale: 1:5,900 if printed on A landscape (11" x 8.5") sheet.
N
0 50 100 200 300 Meters
0 250 500 1000 1500 Feet
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Adams County Area, Parts of Adams and Denver Counties, Colorado
Survey Area Data: Version 16, Sep 12, 2019

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

Date(s) aerial images were photographed: Jul 17, 2015—Oct 2, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AcC	Adena-Colby association, gently sloping	C	22.4	26.8%
AcD	Adena-Colby association, moderately sloping	C	1.7	2.1%
PlC	Platner loam, 3 to 5 percent slopes	C	59.1	70.8%
WmB	Weld loam, 1 to 3 percent slopes	C	0.2	0.3%
Totals for Area of Interest			**83.4**	**100.0%**

Description

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

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

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

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

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

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

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

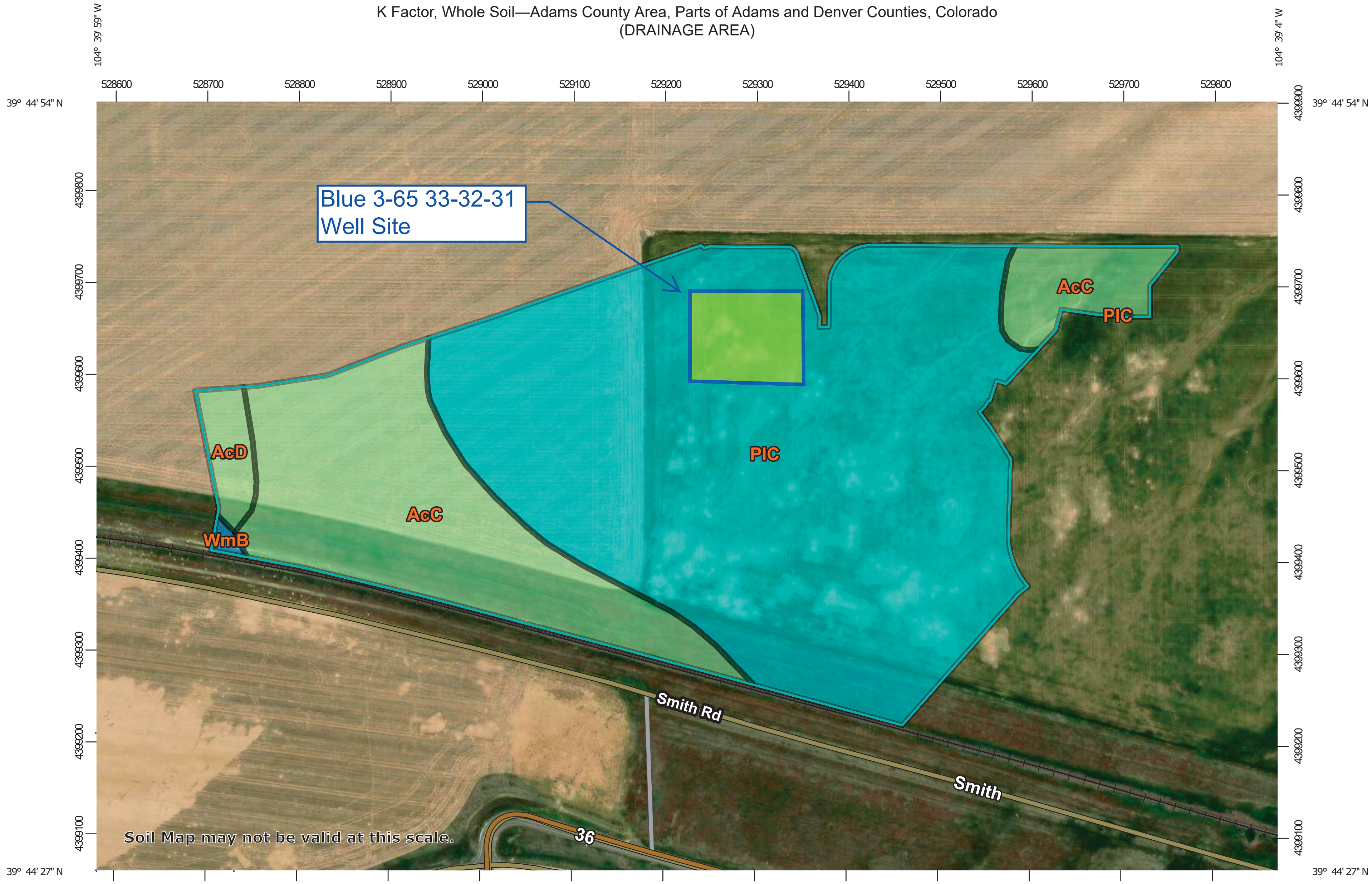
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

K Factor, Whole Soil—Adams County Area, Parts of Adams and Denver Counties, Colorado
(DRAINAGE AREA)



Map Scale: 1:5,900 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

N

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.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

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Adams County Area, Parts of Adams and Denver Counties, Colorado
Survey Area Data: Version 16, Sep 12, 2019

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

Date(s) aerial images were photographed: Jul 17, 2015—Oct 2, 2017

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.

K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AcC	Adena-Colby association, gently sloping	.28	22.4	26.8%
AcD	Adena-Colby association, moderately sloping	.28	1.7	2.1%
PlC	Platner loam, 3 to 5 percent slopes	.37	59.1	70.8%
WmB	Weld loam, 1 to 3 percent slopes	.43	0.2	0.3%
Totals for Area of Interest			**83.4**	**100.0%**

Description

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.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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

APPENDIX C – USDCM RAINFALL INTENSITY MAPS

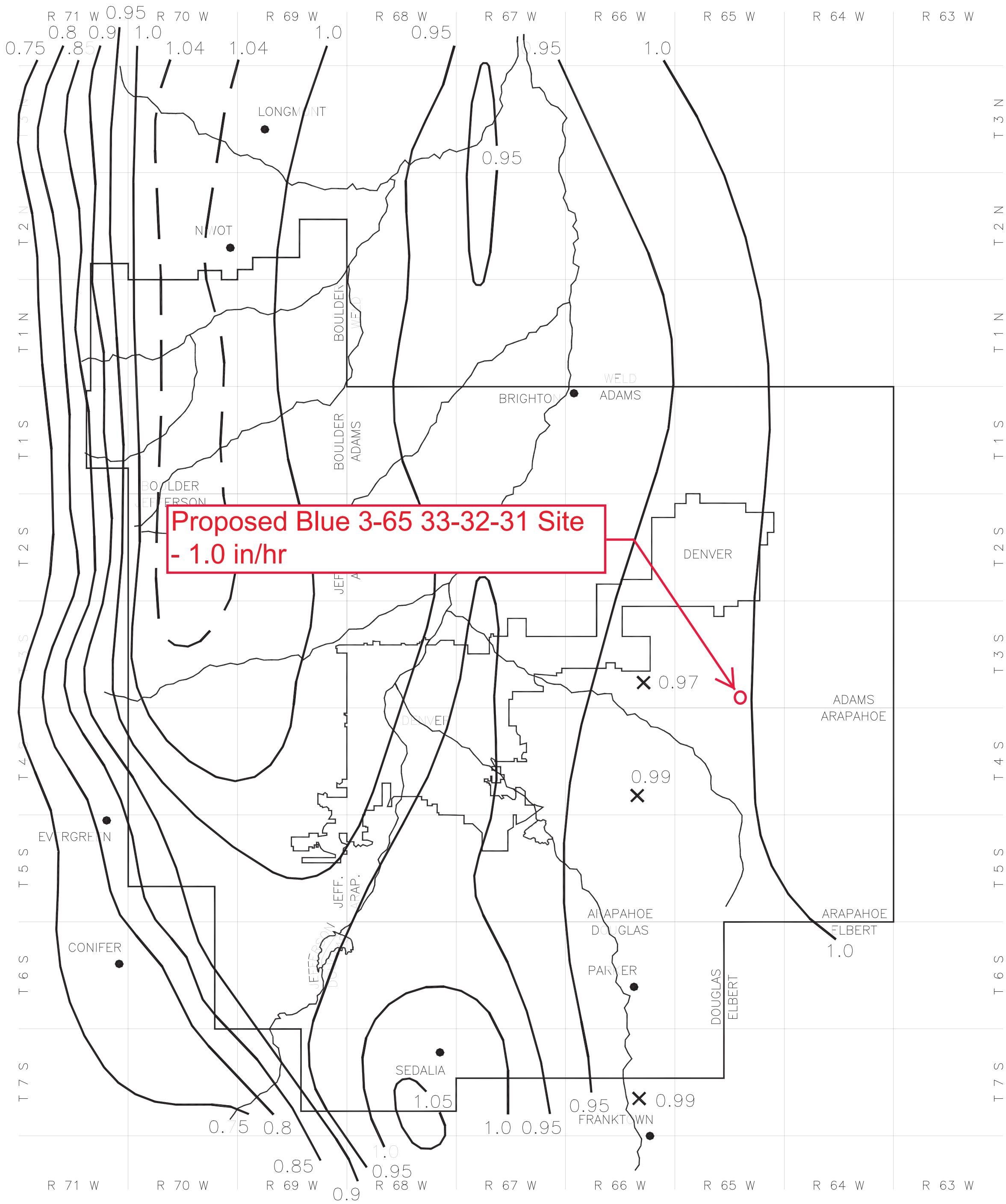


Figure 5-1. Rainfall depth-duration-frequency: 2-year, 1-hour rainfall

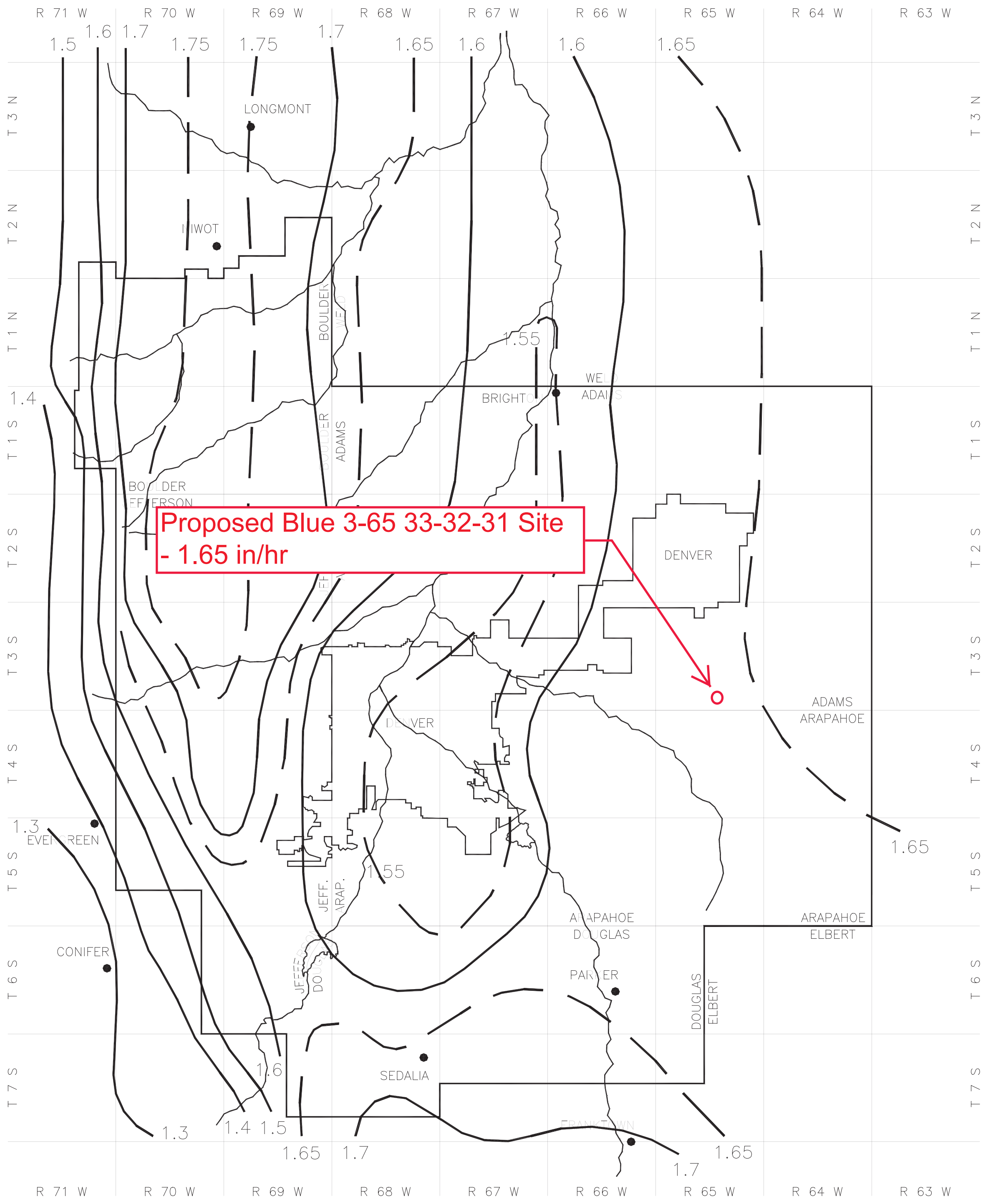


Figure 5-3. Rainfall depth-duration-frequency: 10-year, 1-hour rainfall

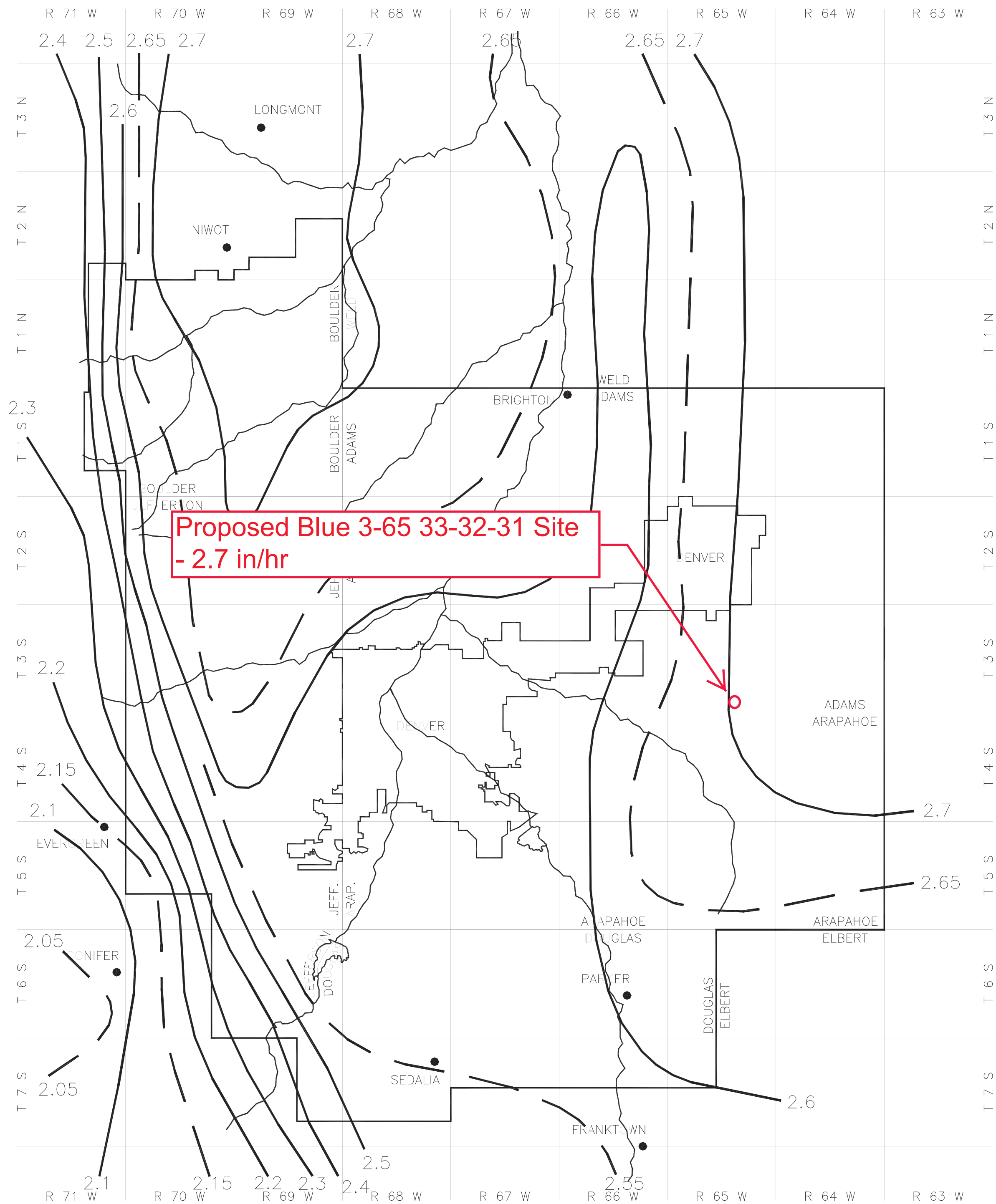
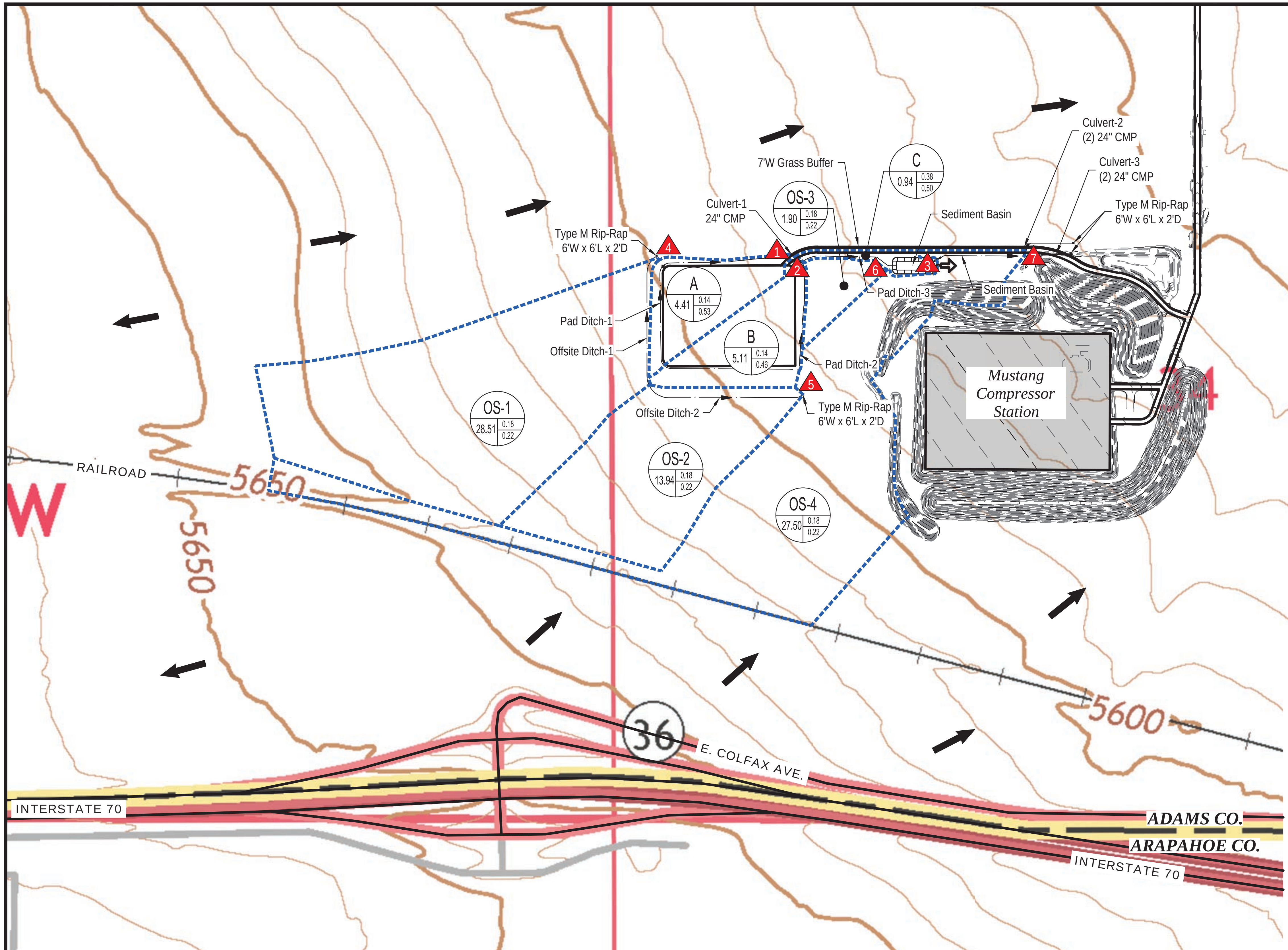


Figure 5-6. Rainfall depth-duration-frequency: 100-year, 1-hour rainfall

Appendix D – Offsite Drainage Plan



SUMMARY RUNOFF TABLE

BASIN	BASIN AREA (Ac)	IMPERV. (%)	2-YR (C)	100-YR (C)	2-YR PEAK FLOW (cfs)	100-YR PEAK FLOW (cfs)
A	4.41	31.03	0.14	0.53	1.00	9.83
B	5.11	26.44	0.14	0.46	1.12	9.83
C	0.94	38.88	0.38	0.50	0.83	2.96
OS-1	28.51	5.00	0.18	0.22	6.46	21.31
OS-2	13.94	5.00	0.18	0.22	3.42	11.28
OS-3	1.90	5.00	0.18	0.22	0.64	2.11
OS-4	27.50	5.22	0.18	0.22	3.80	12.69

SYMBOL LEGEND

0 DESIGN POINT

A-0 — DRAINAGE BASIN DESIGNATION
C-2 — 2-YR WEIGHTED RUNOFF COEFFICIENT
C-100 — 100-YR WEIGHTED RUNOFF COEFFICIENT
AC — DRAINAGE BASIN AREA (ACRES)

PLAN NOTES:

1. SEE THE STANDARD NOTES AND DETAILS IN FIELD WIDE REPORT, REVISED JANUARY 2010 (3 SHEETS) FOR ALL STANDARD DETAILS & CITY OF AURORA RULES AND REGULATIONS REGARDING STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES, NOTES AND LEGENDS OF BMP NAMES AND SYMBOLS.
2. ALL DIVERSION DITCHES ARE ANTICIPATED TO BE UNLINED.
3. ENSURE THAT THE PROVISIONS OF CRS 37-92-602, AS AMENDED BY SENATE BILL 15-212, REGARDING NOTIFICATION OF DOWNSTREAM WATER RIGHTS HOLDERS ARE UPHELD.
4. SEE GENERAL NOTE #2 ON COVER SHEET FOR BMP PHASING.
5. PROJECT AREA IS FOUND ON FIRM PANELS 08005C0206L DATED FEBRUARY 7, 2017, AND 08005C0207K DATED DECEMBER 17, 2010, AND IS LOCATED IN FLOOD ZONE X.
6. SEE SITE PLAN FOR WILDLIFE FENCE DETAIL
7. ECB IS PROPOSED ON 3:1 SLOPES EXCEEDING 10 VERTICAL FEET. SCL ARE PROPOSED ON 3:1 SLOPES BETWEEN 5 & 10 VERTICAL FEET, SEE GENERAL NOTE #7 ON COVER SHEET. IF SM IS NOT ADEQUATE FOR 3:1 SLOPES NOT MEETING THE ABOVE DESCRIBED CRITERIA, ADDITIONAL ECB AND/OR SCL MAY BE NECESSARY.
8. ALL STORM INFRASTRUCTURE IS SIZED FOR THE 100-YR EVENT AND WILL BE PRIVATELY MAINTAINED.
9. THE DRAINAGE SWALES AND EMERGENCY SPILLWAY ARE DESIGNED FOR THE 100-YR EVENT.

Approved For One Year From This Date

CITY ENGINEER — DATE

AURORA WATER DEPARTMENT — DATE

LEGEND:

DIRECTION OF FLOW ARROW
OUTFLOW
DRAINAGE BASIN AREA BOUNDARY

SURVEY BENCHMARK

COA ID: 3S6528SE001
DESCRIPTION: 3" DIAM. BRASS CAP (STAMPED COA BM, E-120A) ATOP A 30" LONG STL. PIPE IN CONC. @ COR. OF E. 26TH AVE. (PAVED) & MONAGHAN RD., BEING 1FT. N.W. OF PWR. POLE HAVING A STOP SIGN ON IT.
LATITUDE: 39° 45' 16.16759" N
LONGITUDE: 104° 39' 33.95273" W (NAD 83)
ELEV: 5584.96' (NAVD 88)
*DO NOT USE FOR PAD LOCATION.

UINTAH ENGINEERING & LAND SURVEYING

UELS, LLC
Corporate Office * 85 South 200 East
Vernal, UT 84078 * (435) 789-1017

N

0' 250' 500'
1" = 500'
SCALE

CITY OF AURORA NOTE:

2.03.6.01 CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, OF DIMENSIONS AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. THE CITY OF AURORA, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

CRESTONE PEAK RESOURCES OPERATING, LLC

BLUE 3-65 33-32-31 1BH, 2AH, 2BH, 3AH, 3BH, 4AH, & 4BH
NW 1/4 SW 1/4 SEC. 34, T3S, R65W, 6TH P.M.
CITY OF AURORA, ADAMS COUNTY, COLORADO

DRAWN BY: C.D.C.	DATE DRAWN: 02-17-2021
SCALE: 1" = 500'	REVISED: 08-30-2021 C.D.C.
OFF-SITE DRAINAGE PLAN	D-1

Appendix E – Drainage Basin Hydrology Calculations

Calculation of Peak Runoff using Rational Method

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/2/2021
Project: Drill Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO

Version 2.00 released May 2017

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

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

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

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

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

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

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

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

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.00	1.40	1.65	2.05	2.35	2.70	3.52

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

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

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C: 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A	4.41	C	31.03	0.22	0.29	0.36	0.49	0.55	0.61	0.69
				0.14	0.22	0.30			0.53	
B	5.11	C	26.44	0.19	0.25	0.33	0.47	0.52	0.59	0.67
				0.14	0.21	0.27			0.46	
C	0.94	C	38.88	0.29	0.35	0.42	0.54	0.59	0.64	0.71
				0.38	0.41	0.43			0.50	
OS-1	28.51	C	5.00	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.18	0.19	0.20			0.22	
OS-2	13.94	C	5.00	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.18	0.19	0.20			0.22	
OS-3	1.90	C	5.00	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.18	0.19	0.20			0.22	
OS-4	27.50	C	5.22	0.03	0.08	0.17	0.35	0.42	0.51	0.60
				0.18	0.19	0.20			0.22	

Subcatchment Name	Overland (Initial) Flow Time: Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized (Travel) Flow Time: Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)
A	300.00			0.051	14.84	791.00			0.009	10	0.94	14.05
					16.05							
B	300.00			0.051	15.53	893.00			0.010	10	1.00	14.81
					16.32							
C	150.00			0.024	12.35	290.00			0.032	10	1.79	2.69
					11.47							
OS-1	300.00			0.031	22.17	1709.00			0.031	7	1.22	23.26
					19.70							
OS-2	300.00			0.037	20.86	1333.00			0.027	7	1.15	19.35
					18.53							
OS-3	186.00			0.022	19.38	314.00			0.025	7	1.10	4.74
					17.17							
OS-4	300.00			0.033	21.50	4250.00			0.021	7	1.01	70.16
					19.13							

Subcatchment Name	Time of Concentration: Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	Rainfall Intensity, I (in/hr): 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A	28.90	31.26	28.90	1.60	2.25	2.65	3.29	3.77	4.33	5.65
	30.11		30.11	1.57	2.19	2.58	3.21	3.68	4.23	5.51
B	30.34	33.16	30.34	1.56	2.18	2.57	3.20	3.66	4.21	5.49
	31.13		31.13	1.54	2.15	2.53	3.15	3.61	4.14	5.40
C	15.04	21.26	15.04	2.27	3.17	3.74	4.65	5.33	6.12	7.98
	14.16		14.16	2.33	3.26	3.85	4.78	5.48	6.30	8.21
OS-1	45.43	41.94	41.94	1.28	1.79	2.11	2.62	3.00	3.45	4.50
	42.96		42.96	1.26	1.76	2.08	2.58	2.96	3.40	4.43
OS-2	40.21	39.11	39.11	1.34	1.87	2.20	2.74	3.14	3.61	4.70
	37.88		37.88	1.36	1.91	2.25	2.79	3.20	3.68	4.79
OS-3	24.13	28.57	24.13	1.78	2.49	2.93	3.64	4.18	4.80	6.26
	21.91		21.91	1.87	2.62	3.09	3.84	4.40	5.06	6.60
OS-4	91.66	75.59	75.59	0.86	1.21	1.42	1.77	2.03	2.33	3.04
	89.29		89.29	0.77	1.08	1.27	1.57	1.80	2.07	2.70

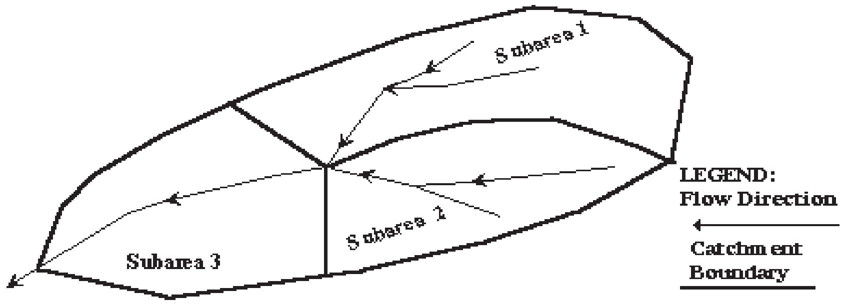
Subcatchment Name	Peak Flow, Q (cfs): 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A	1.59	2.85	4.20	7.14	9.08	11.67	17.07
	1.00	2.14	3.40	6.98	8.86	9.83	16.67
B	1.49	2.79	4.29	7.63	9.80	12.73	18.82
	1.12	2.28	3.53	7.51	9.65	9.83	18.54
C	0.62	1.05	1.47	2.34	2.93	3.70	5.33
	0.83	1.24	1.56	2.41	3.01	2.96	5.48
OS-1	1.05	3.86	10.14	25.92	35.76	49.62	77.42
	6.46	9.54	11.84	25.52	35.22	21.31	76.25
OS-2	0.54	1.97	5.18	13.24	18.27	25.35	39.56
	3.42	5.05	6.27	13.51	18.64	11.28	40.36
OS-3	0.10	0.36	0.94	2.40	3.32	4.60	7.18
	0.64	0.96	1.17	2.53	3.49	2.11	7.57
OS-4	0.72	2.58	6.67	16.94	23.35	32.38	50.49
	3.80	5.63	7.00	15.07	20.78	12.69	44.93

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Drill Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



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Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

Subcatchment Name
Basin A

See sheet "Design Info" for imperviousness-based runoff coefficient values.

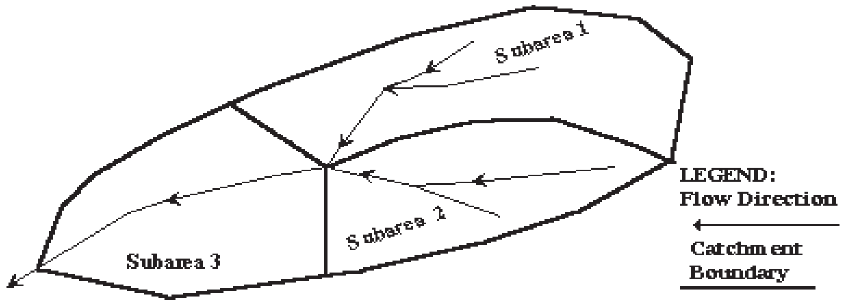
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	3.28	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2%Si - Cut/Fill	1.13	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.13	0.14	0.15			0.17	
Total Area (ac)	4.41		Area-Weighted C	0.23	0.29	0.36	0.49	0.55	0.61	0.69
			Area-Weighted Override C	0.14	0.22	0.30	0.49	0.55	0.53	0.69

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Drill Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



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

Subcatchment Name
Basin B

See sheet "Design Info" for imperviousness-based runoff coefficient values.

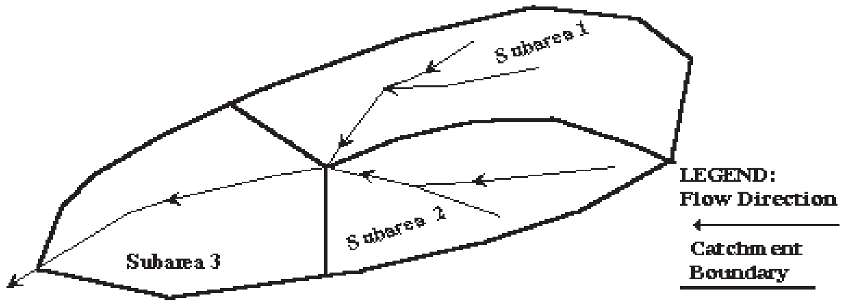
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	3.13	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2%Si - Cut/Fill	1.98	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.13	0.14	0.15			0.17	
Total Area (ac)	**5.11**		**Area-Weighted C**	**0.19**	**0.25**	**0.33**	**0.47**	**0.52**	**0.59**	**0.67**
			Area-Weighted Override C	**0.14**	**0.21**	**0.27**	**0.47**	**0.52**	**0.46**	**0.67**

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Drill Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



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

Subcatchment Name
Basin C

See sheet "Design Info" for imperviousness-based runoff coefficient values.

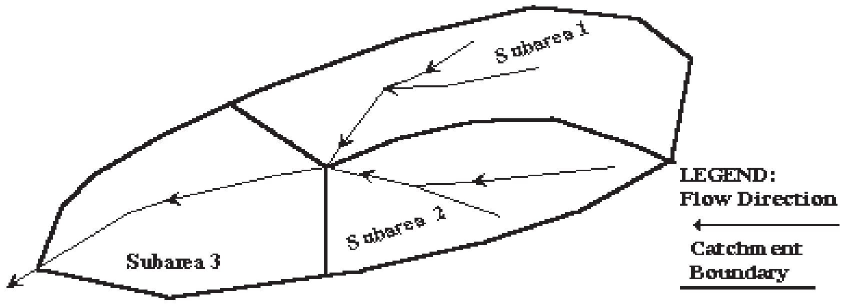
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	0.15	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2-7%Si - Cut/Fill	0.51	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.18	0.19	0.20			0.22	
Pond	0.28	C	100.0	0.83	0.85	0.87	0.88	0.89	0.89	0.90
				0.87	0.88	0.90			0.93	
Total Area (ac)	0.94		Area-Weighted C	0.31	0.35	0.42	0.54	0.59	0.64	0.71
			Area-Weighted Override C	0.38	0.41	0.43	0.54	0.59	0.50	0.71

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Drill Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



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Cells of this color are for calculated results based on overrides

Subcatchment Name
OS-4

See sheet "Design Info" for imperviousness-based runoff coefficient values.

Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	0.17	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2-7%Si - Cut/Fill	27.86	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.18	0.19	0.20			0.22	
Total Area (ac)	**28.03**		**Area-Weighted C**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.51**	**0.60**
			Area-Weighted Override C	**0.18**	**0.19**	**0.20**	**0.35**	**0.42**	**0.22**	**0.60**

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Calculation of Peak Runoff using Rational Method

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/2/2021
Project: Prod Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO

Version 2.00 released May 2017

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

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

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

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

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

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

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

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.00	1.40	1.65	2.05	2.35	2.70	3.52

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

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

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C: 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland (Initial) Flow Time: Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)
A	3.45	C	29.25	0.21	0.27	0.35	0.48	0.54	0.60	0.68	300.00			0.043	15.97
				0.14	0.22	0.29			0.50						17.08
B	2.79	C	26.58	0.19	0.25	0.33	0.47	0.52	0.59	0.67	300.00			0.042	16.54
				0.14	0.21	0.27			0.47						17.39
C	1.12	C	47.54	0.36	0.42	0.48	0.59	0.63	0.68	0.74	140.00			0.025	10.74
				0.43	0.45	0.48			0.54						10.28
OS-1	19.32	C	5.00	0.03	0.08	0.17	0.35	0.42	0.50	0.60	300.00			0.035	21.18
				0.18	0.19	0.20			0.22						18.82
OS-2	22.67	C	5.00	0.03	0.08	0.17	0.35	0.42	0.50	0.60	300.00			0.040	20.27
				0.18	0.19	0.20			0.22						18.01
OS-3	2.47	C	5.00	0.03	0.08	0.17	0.35	0.42	0.50	0.60	258.00			0.023	22.53
				0.18	0.19	0.20			0.22						20.02
OS-4	30.53	C	5.16	0.03	0.08	0.17	0.35	0.42	0.51	0.60	300.00			0.033	21.51
				0.18	0.19	0.20			0.22						19.13
EDB Overflow	9.83	C	24.48	0.17	0.23	0.31	0.46	0.51	0.58	0.67	300.00			0.040	17.09
				0.17	0.22	0.27			0.41						17.35

Subcatchment Name	Channelized (Travel) Flow Time: Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Time of Concentration: Computed t_c (min)	Regional t_c (min)	Selected t_c (min)
A	758.00			0.009	10	0.95	13.24	29.22	31.14	29.22
								30.32		30.32
B	564.00			0.016	10	1.28	7.34	23.88	27.25	23.88
								24.73		24.73
C	285.00			0.013	10	1.13	4.22	14.96	20.61	14.96
								14.51		14.51
OS-1	1709.00			0.031	7	1.22	23.26	44.45	41.94	41.94
								42.08		42.08
OS-2	1886.00			0.025	7	1.12	28.18	48.45	45.48	45.48
								46.19		46.19
OS-3	459.00			0.023	7	1.07	7.14	29.67	30.30	29.67
								27.16		27.16
OS-4	4250.00			0.021	7	1.01	70.16	91.67	75.64	75.64
								89.29		89.29
EDB Overflow	1283.00			0.015	10	1.21	17.70	34.78	36.08	34.78
								35.04		35.04

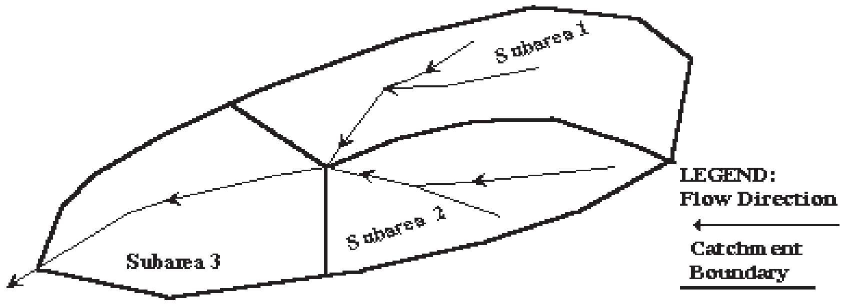
Subcatchment Name	Rainfall Intensity, I (in/hr): 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Peak Flow, Q (cfs): 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A	1.59	2.23	2.63	3.27	3.74	4.30	5.61	1.15	2.10	3.15	5.44	6.94	8.96	13.16
	1.56	2.18	2.57	3.20	3.66	4.21	5.49	0.77	1.63	2.56	5.32	6.79	7.30	12.88
B	1.79	2.50	2.95	3.67	4.20	4.83	6.29	0.94	1.76	2.69	4.78	6.15	7.98	11.79
	1.75	2.45	2.89	3.59	4.12	4.73	6.17	0.70	1.42	2.21	4.69	6.03	6.15	11.57
C	2.27	3.18	3.75	4.66	5.34	6.14	8.00	0.92	1.51	2.02	3.05	3.76	4.66	6.61
	2.31	3.23	3.81	4.73	5.42	6.23	8.12	1.11	1.63	2.03	3.10	3.81	3.73	6.71
OS-1	1.28	1.79	2.11	2.62	3.00	3.45	4.50	0.71	2.62	6.87	17.56	24.23	33.63	52.47
	1.28	1.79	2.10	2.61	3.00	3.44	4.49	4.43	6.55	8.13	17.52	24.18	14.63	52.35
OS-2	1.21	1.70	2.00	2.49	2.85	3.28	4.27	0.80	2.92	7.66	19.56	27.00	37.46	58.45
	1.20	1.68	1.98	2.46	2.82	3.24	4.23	4.90	7.24	8.99	19.37	26.73	16.18	57.87
OS-3	1.58	2.21	2.61	3.24	3.71	4.26	5.56	0.11	0.41	1.09	2.77	3.83	5.31	8.29
	1.66	2.33	2.74	3.41	3.91	4.49	5.85	0.74	1.09	1.36	2.92	4.03	2.44	8.73
OS-4	0.86	1.21	1.42	1.77	2.03	2.33	3.04	0.79	2.84	7.38	18.78	25.90	35.91	56.01
	0.77	1.07	1.27	1.57	1.80	2.07	2.70	4.22	6.24	7.76	16.72	23.05	14.05	49.86
EDB Overflow	1.44	2.01	2.37	2.94	3.37	3.88	5.05	2.43	4.63	7.26	13.20	17.04	22.26	33.04
	1.43	2.00	2.36	2.93	3.36	3.86	5.03	2.42	4.36	6.28	13.14	16.97	15.64	32.89

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Prod Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



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Subcatchment Name
Basin A

See sheet "Design Info" for imperviousness-based runoff coefficient values.

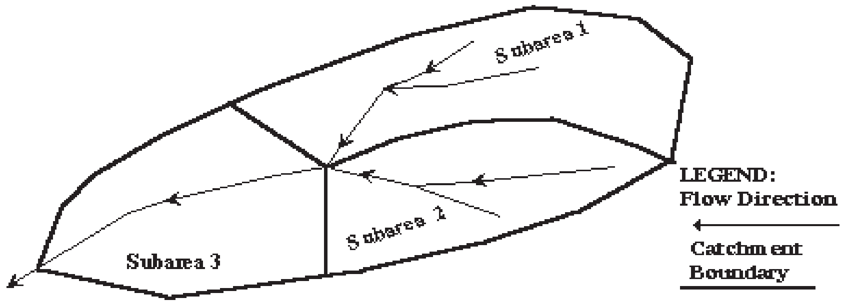
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	2.39	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2%Si - Cut/Fill	1.06	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.13	0.14	0.15			0.17	
Total Area (ac)	3.45		Area-Weighted C	0.22	0.27	0.35	0.48	0.54	0.60	0.68
			Area-Weighted Override C	0.14	0.22	0.29	0.48	0.54	0.50	0.68

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Prod Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



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Subcatchment Name
Basin B

See sheet "Design Info" for imperviousness-based runoff coefficient values.

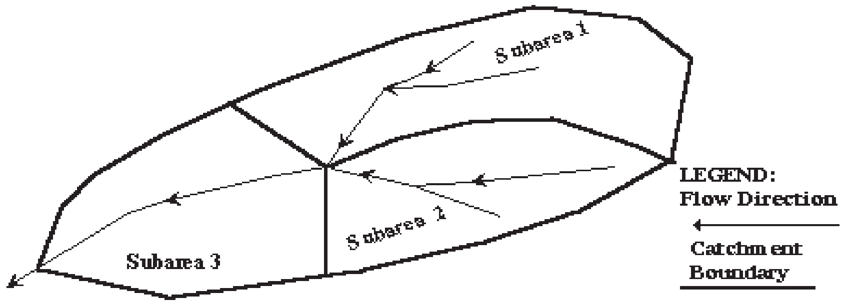
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	1.72	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2%Si - Cut/Fill	1.07	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.13	0.14	0.15			0.17	
Total Area (ac)	**2.79**		**Area-Weighted C**	**0.20**	**0.25**	**0.33**	**0.47**	**0.52**	**0.59**	**0.67**
			Area-Weighted Override C	**0.14**	**0.21**	**0.27**	**0.47**	**0.52**	**0.47**	**0.67**

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Prod Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



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Subcatchment Name
Basin C

See sheet "Design Info" for imperviousness-based runoff coefficient values.

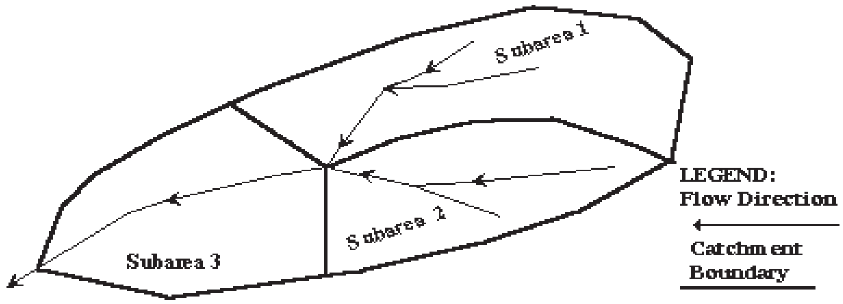
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	0.14	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2%Si - Cut/Fill	0.53	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.13	0.14	0.15			0.17	
EDB WSE	0.45	C	100.0	0.83	0.85	0.87	0.88	0.89	0.89	0.90
				0.87	0.88	0.90			0.93	
Total Area (ac)	1.12		Area-Weighted C	0.39	0.42	0.48	0.59	0.63	0.68	0.74
			Area-Weighted Override C	0.43	0.45	0.48	0.59	0.63	0.54	0.74

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Prod Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



Subcatchment Name
OS-4

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See sheet "Design Info" for imperviousness-based runoff coefficient values.

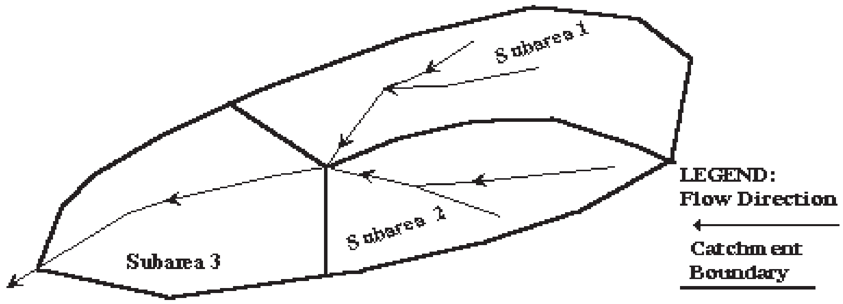
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	0.14	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2-7%Si - Cut/Fill	30.39	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.18	0.19	0.20			0.22	
Total Area (ac)	30.53		Area-Weighted C	0.03	0.08	0.17	0.35	0.42	0.51	0.60
			Area-Weighted Override C	0.18	0.19	0.20	0.35	0.42	0.22	0.60

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: UELS - cdc
Company: Crestone Peak Resources
Date: 9/1/2021
Project: Prod Pad - Blue 3-65 33-32-31 Pad
Location: City of Aurora, Adams Co., CO



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Subcatchment Name
EDB Overflow

See sheet "Design Info" for imperviousness-based runoff coefficient values.

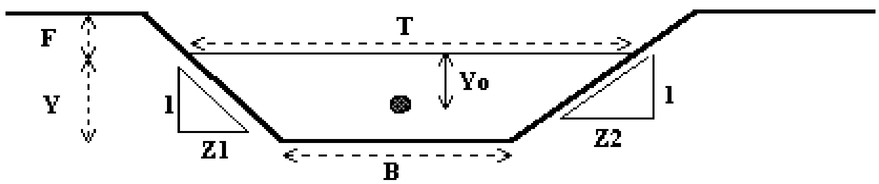
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Gravel	4.25	C	40.0	0.30	0.36	0.43	0.54	0.59	0.65	0.71
				0.15	0.25	0.35			0.65	
2%Si - Cut/Fill	5.13	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60
				0.13	0.14	0.15			0.17	
EDB	0.45	C	100.0	0.83	0.85	0.87	0.88	0.89	0.89	0.90
				0.87	0.88	0.90			0.93	
Total Area (ac)	9.83		Area-Weighted C	0.18	0.23	0.31	0.46	0.51	0.58	0.67
			Area-Weighted Override C	0.17	0.22	0.27	0.46	0.51	0.41	0.67

City of Aurora Storm Drainage Design and Technical Criteria, Table 1 values for Runoff Coefficients and Percents Impervious were used in these calculations.

APPENDIX F – CONVEYANCE HYDRAULIC CALCULATIONS

Normal Flow Analysis - Trapezoidal Channel

Project: Blue 3-65 33-32-31 Pad
Channel ID: Basin A - Q100 = 9.83 cfs, Basin B - Q100 = 9.83 cfs

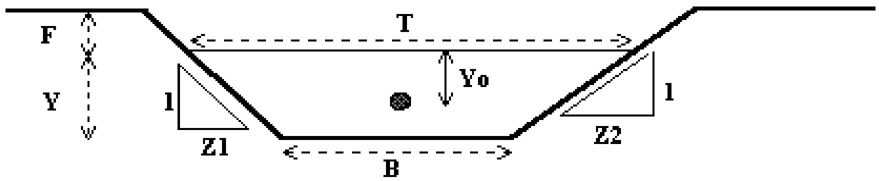


Design Information (Input)			
Channel Invert Slope	So =	0.0025	ft/ft
Manning's n	n =	0.020	
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.00**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**15.64**	cfs
Froude Number	**Fr =**	**0.59**	
Flow Velocity	**V =**	**2.61**	fps
Flow Area	A =	6.00	sq ft
Top Width	T =	10.00	ft
Wetted Perimeter	P =	10.25	ft
Hydraulic Radius	R =	0.59	ft
Hydraulic Depth	D =	0.60	ft
Specific Energy	Es =	1.11	ft
Centroid of Flow Area	Yo =	0.39	ft
Specific Force	Fs =	0.22	kip

Normal Flow Analysis - Trapezoidal Channel

Project: Blue 3-65 33-32-31 Pad
Channel ID: Basin OS-1 - Q100 = 21.31 cfs   Basin OS-2 - Q100 = 11.28 cfs

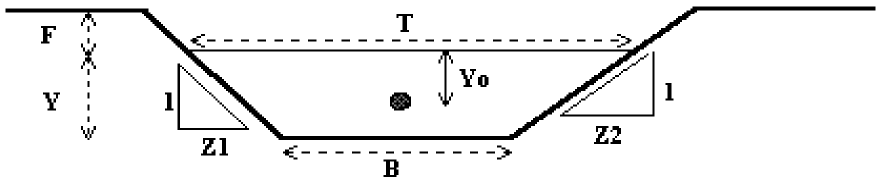


Design Information (Input)			
Channel Invert Slope	So =	0.0120	ft/ft
Manning's n	n =	0.020	
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.00**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**34.27**	cfs
Froude Number	**Fr =**	**1.30**	
Flow Velocity	**V =**	**5.71**	fps
Flow Area	A =	6.00	sq ft
Top Width	T =	10.00	ft
Wetted Perimeter	P =	10.25	ft
Hydraulic Radius	R =	0.59	ft
Hydraulic Depth	D =	0.60	ft
Specific Energy	Es =	1.51	ft
Centroid of Flow Area	Yo =	0.39	ft
Specific Force	Fs =	0.52	kip

Normal Flow Analysis - Trapezoidal Channel

Project: Blue 3-65 33-32-31 Pad
Channel ID: Basin A+B+C+OS3 - Q100 = 28.60 cfs

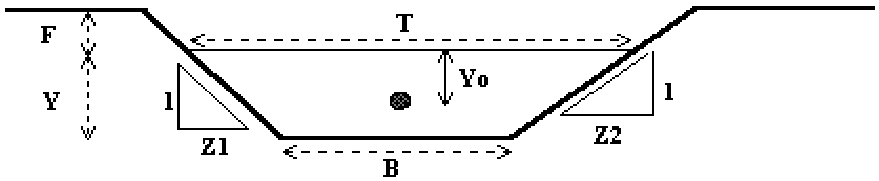


Design Information (Input)			
Channel Invert Slope	So =	0.0150	ft/ft
Manning's n	n =	0.020	
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.00**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**38.32**	cfs
Froude Number	**Fr =**	**1.45**	
Flow Velocity	**V =**	**6.39**	fps
Flow Area	A =	6.00	sq ft
Top Width	T =	10.00	ft
Wetted Perimeter	P =	10.25	ft
Hydraulic Radius	R =	0.59	ft
Hydraulic Depth	D =	0.60	ft
Specific Energy	Es =	1.63	ft
Centroid of Flow Area	Yo =	0.39	ft
Specific Force	Fs =	0.62	kip

Normal Flow Analysis - Trapezoidal Channel

Project: Blue 3-65 33-32-31 Pad
Channel ID: Prod. - Basin OS-2 - Q100 = 16.18 cfs

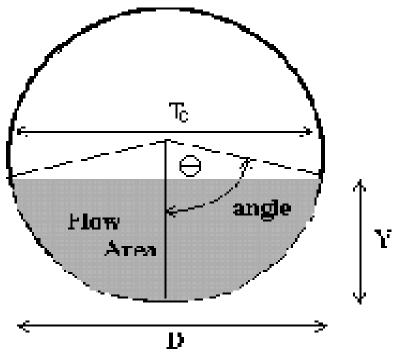


Design Information (Input)			
Channel Invert Slope	So =	0.0070	ft/ft
Manning's n	n =	0.020	
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.00**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**26.18**	cfs
Froude Number	**Fr =**	**0.99**	
Flow Velocity	**V =**	**4.36**	fps
Flow Area	A =	6.00	sq ft
Top Width	T =	10.00	ft
Wetted Perimeter	P =	10.25	ft
Hydraulic Radius	R =	0.59	ft
Hydraulic Depth	D =	0.60	ft
Specific Energy	Es =	1.30	ft
Centroid of Flow Area	Yo =	0.39	ft
Specific Force	Fs =	0.37	kip

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

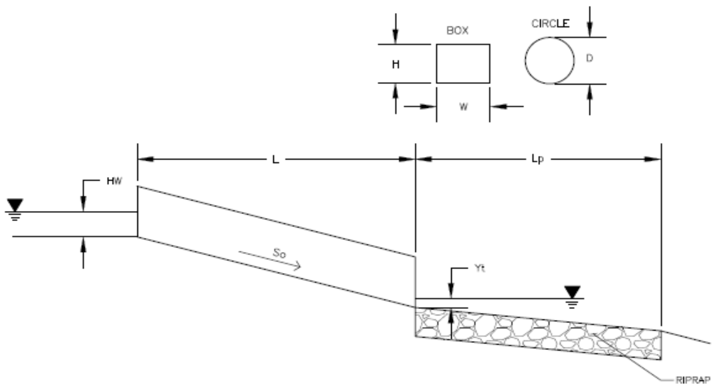
Project: **Blue 3-65 33-32-31 Well Site**
Pipe ID: **Culvert 1 - (1) 24"x94' CMP - Q100=9.83 cfs**



Design Information (Input)			
Pipe Invert Slope	So =	0.0174	ft/ft
Pipe Manning's n-value	n =	0.0150	
Pipe Diameter	D =	24.00	inches
Design discharge	**Q =**	**9.83**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	25.93	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.42	radians
Flow area	An =	1.28	sq ft
Top width	Tn =	1.98	ft
Wetted perimeter	Pn =	2.85	ft
Flow depth	Yn =	0.85	ft
Flow velocity	Vn =	7.68	fps
Discharge	Qn =	9.83	cfs
Percent Full Flow	Flow =	37.9%	of full flow
Normal Depth Froude Number	Fr_n =	1.68	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.69	radians
Critical flow area	Ac =	1.81	sq ft
Critical top width	Tc =	1.99	ft
Critical flow depth	Yc =	1.12	ft
Critical flow velocity	Vc =	5.42	fps
Critical Depth Froude Number	Fr_c =	1.00	

Determination of Culvert Headwater and Outlet Protection

Project: Blue cells are for user data entry
Basin ID: Green cells are calculated values



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Design Information (Input):

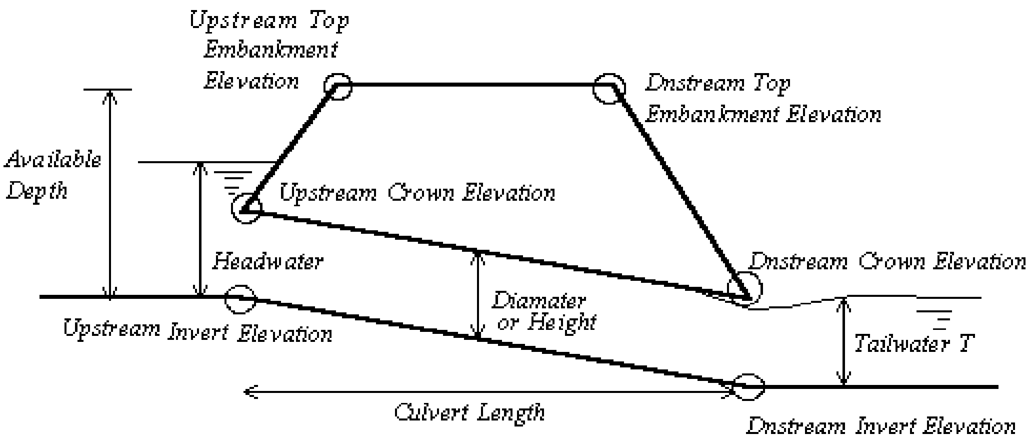
Design Discharge	Q =	9.83	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		1.5 : 1 Beveled Edge	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft.
Barrel Width (Span) in Feet	Width (Span) =		ft.
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	5583.21	ft
Outlet Elevation **OR** Slope	Elev OUT =	5581.57	ft
Culvert Length	L =	94	ft
Manning's Roughness	n =	0.015	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Y_t =		ft.

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.80	ft
Max Allowable Channel Velocity	V =	7.00	ft/s
Flow Area at Max Channel Velocity	A_t =	1.40	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.55	
Sum of All Losses Coefficients	k_s =	2.75	ft
Culvert Normal Depth	Y_n =	0.85	ft
Culvert Critical Depth	Y_c =	1.12	ft
Tailwater Depth for Design	d =	1.56	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.43	ft
Expansion Factor	1/(2*tan(Θ)) =	6.01	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	1.74	$ft^{0.5}/s$
Tailwater/Diameter **OR** Tailwater/Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	1.60	ft
Outlet Control Headwater	HW_O =	0.34	ft
Design Headwater Elevation	**HW =**	**5,584.81**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.80**	
Minimum Theoretical Riprap Size	d_{50} =	3	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**6**	**ft**

Vertical Profile for the Culvert

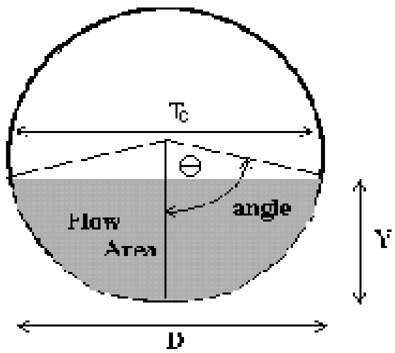
Project = **Blue 3-65 33-32-31 Well Site**
Box ID = **Culvert 1 - (1) 24"x94' CMP - Q100=9.83 cfs**



Culvert Information (Input)			
Barrel Diameter or Height	D or H =	24.00	inches
Barrel Length	L =	94.00	ft
Barrel Invert Slope	So =	0.0174	ft/ft
Downstream Invert Elevation	EDI =	5581.57	ft
Downstream Top Embankment Elevation	EDT =	5590.83	ft
Upstream Top Embankment Elevation	EUT =	5591.18	ft
Design Headwater Depth (not elev.)	Hw =	1.60	ft
Tailwater Depth (not elev.)	Yt =	0.80	ft
Culvert Hydraulics (Calculated)			
Available Headwater Depth	HW-a =	7.97	ft
Design Hw/D ratio	Hw/D =	0.80	
Culvert Vertical Profile			
Upstream Invert Elevation	EUI =	5583.21	ft
Upstream Crown Elevation	EUC =	5585.21	ft
Upstream Soil Cover Depth	Upsoil =	5.97	ft
Downstream Invert Elevation	EDI =	5581.57	ft
Downstream Crown Elevation	EDC =	5583.57	ft
Downstream Soil Cover Depth	Dnsoil =	7.61	ft

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

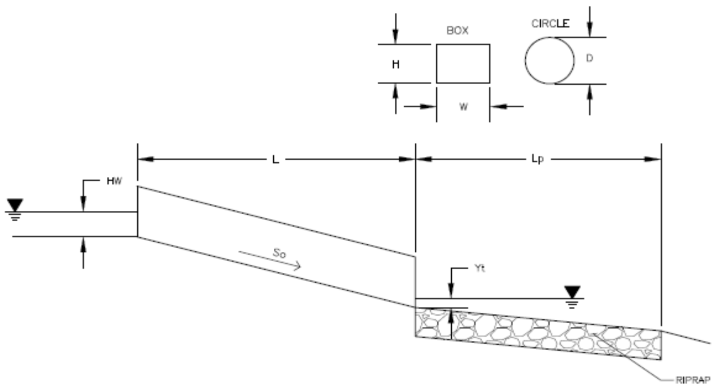
Project: **Blue 3-65 33-32-31 Well Site**
Pipe ID: **Culvert 2 - (2) 24"x58' CMP - Q100=23.7 cfs (11.85 cfs/culvert)**



Design Information (Input)			
Pipe Invert Slope	So =	0.0118	ft/ft
Pipe Manning's n-value	n =	0.0150	
Pipe Diameter	D =	24.00	inches
Design discharge	**Q =**	**11.85**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	21.35	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.64	radians
Flow area	An =	1.70	sq ft
Top width	Tn =	2.00	ft
Wetted perimeter	Pn =	3.27	ft
Flow depth	Yn =	1.06	ft
Flow velocity	Vn =	6.97	fps
Discharge	Qn =	11.85	cfs
Percent Full Flow	Flow =	55.5%	of full flow
Normal Depth Froude Number	Fr_n =	1.33	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.81	radians
Critical flow area	Ac =	2.04	sq ft
Critical top width	Tc =	1.94	ft
Critical flow depth	Yc =	1.24	ft
Critical flow velocity	Vc =	5.81	fps
Critical Depth Froude Number	Fr_c =	1.00	

Determination of Culvert Headwater and Outlet Protection

Project: Blue cells are for user data entry
Basin ID: Green cells are calculated values



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Design Information (Input):

Design Discharge	Q =	23.7	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		1.5 : 1 Beveled Edge	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft.
Barrel Width (Span) in Feet	Width (Span) =		ft.
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	2	
Inlet Elevation	Elev IN =	5560.85	ft
Outlet Elevation **OR** Slope	Elev OUT =	5560.17	ft
Culvert Length	L =	58	ft
Manning's Roughness	n =	0.015	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Y_t =		ft.

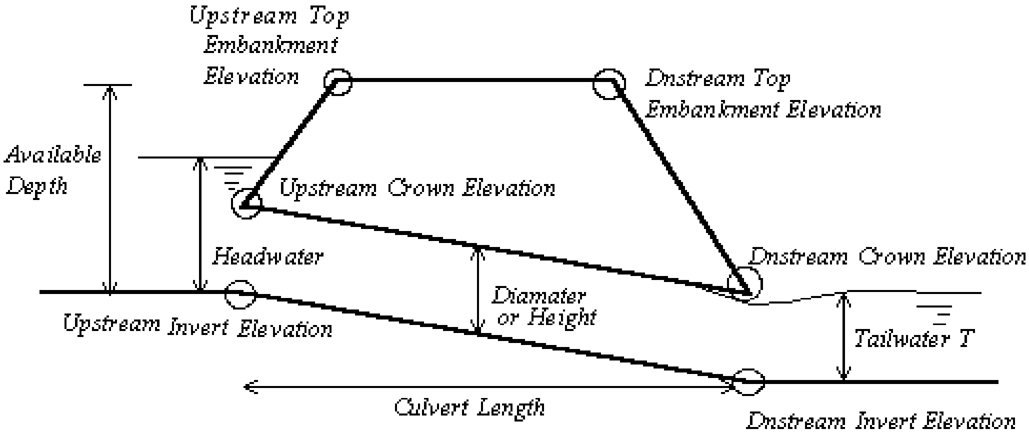
Required Protection (Output):

Tailwater Surface Height	Y_t =	0.80	ft
Max Allowable Channel Velocity	V =	7.00	ft/s
Flow Area at Max Channel Velocity	A_t =	1.69	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.95	
Sum of All Losses Coefficients	k_s =	2.15	ft
Culvert Normal Depth	Y_n =	1.07	ft
Culvert Critical Depth	Y_c =	1.24	ft
Tailwater Depth for Design	d =	1.62	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.53	ft
Expansion Factor	1/(2*tan(Θ)) =	5.64	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	2.09	$ft^{0.5}/s$
Tailwater/Diameter **OR** Tailwater/Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	1.80	ft
Outlet Control Headwater	HW_O =	1.41	ft
Design Headwater Elevation	**HW =**	**5,562.65**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.90**	
Minimum Theoretical Riprap Size	d_{50} =	3	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	L_p **=**	**6**	**ft**

Vertical Profile for the Culvert

Project = **Blue 3-65 33-32-31 Well Site**

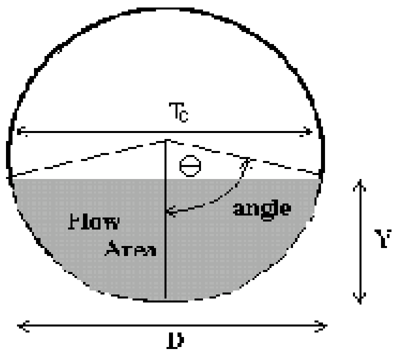
Box ID = **Culvert 2 - (2) 24"x58' CMP - Q100=23.7 cfs (11.85 cfs/culvert)**



Culvert Information (Input)			
Barrel Diameter or Height	D or H =	24.00	inches
Barrel Length	L =	58.00	ft
Barrel Invert Slope	So =	0.0117	ft/ft
Downstream Invert Elevation	EDI =	5560.17	ft
Downstream Top Embankment Elevation	EDT =	5564.77	ft
Upstream Top Embankment Elevation	EUT =	5564.85	ft
Design Headwater Depth (not elev.)	Hw =	1.80	ft
Tailwater Depth (not elev.)	Yt =	0.80	ft
Culvert Hydraulics (Calculated)			
Available Headwater Depth	HW-a =	4.00	ft
Design Hw/D ratio	Hw/D =	0.90	
Culvert Vertical Profile			
Upstream Invert Elevation	EUI =	5560.85	ft
Upstream Crown Elevation	EUC =	5562.85	ft
Upstream Soil Cover Depth	Upsoil =	2.00	ft
Downstream Invert Elevation	EDI =	5560.17	ft
Downstream Crown Elevation	EDC =	5562.17	ft
Downstream Soil Cover Depth	Dnsoil =	2.68	ft

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

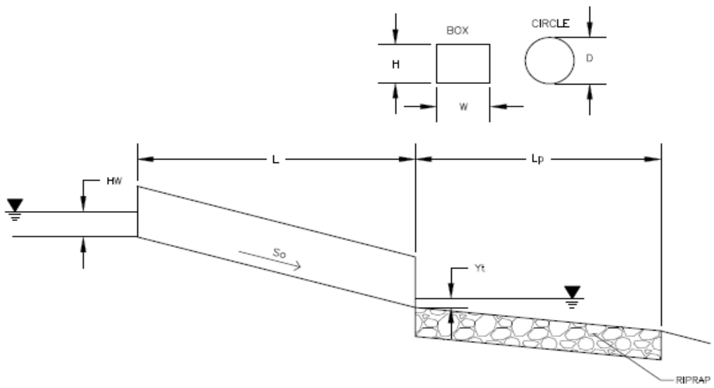
Project: **Blue 3-65 33-32-31 Well Site**
Pipe ID: **Culvert 3 - (2) 24"x138' CMP - Q100=44.03 cfs (22.02 cfs/culvert)**



Design Information (Input)			
Pipe Invert Slope	So =	0.0232	ft/ft
Pipe Manning's n-value	n =	0.0150	
Pipe Diameter	D =	24.00	inches
Design discharge	**Q =**	**22.02**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	29.94	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.85	radians
Flow area	An =	2.11	sq ft
Top width	Tn =	1.92	ft
Wetted perimeter	Pn =	3.70	ft
Flow depth	Yn =	1.27	ft
Flow velocity	Vn =	10.42	fps
Discharge	Qn =	22.02	cfs
Percent Full Flow	Flow =	73.5%	of full flow
Normal Depth Froude Number	Fr_n =	1.75	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.31	radians
Critical flow area	Ac =	2.81	sq ft
Critical top width	Tc =	1.47	ft
Critical flow depth	Yc =	1.68	ft
Critical flow velocity	Vc =	7.83	fps
Critical Depth Froude Number	Fr_c =	1.00	

Determination of Culvert Headwater and Outlet Protection

Project: Blue cells are for user data entry
Basin ID: Green cells are calculated values



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Design Information (Input):

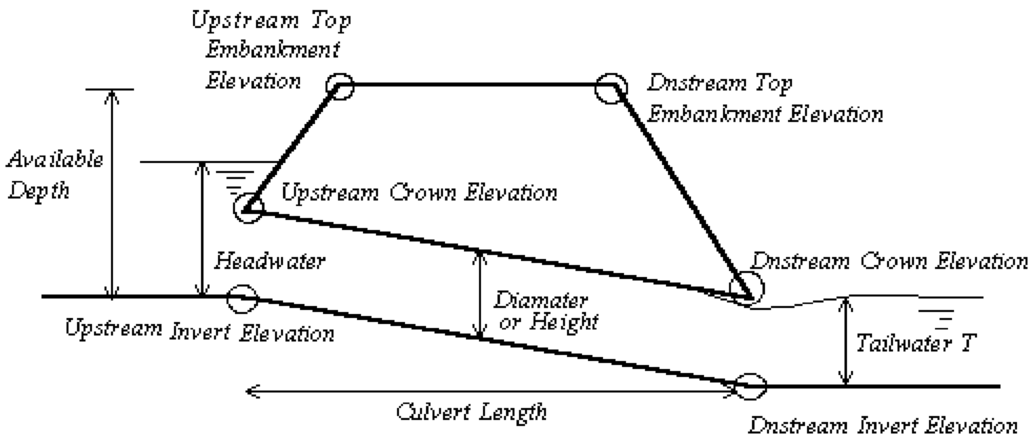
Design Discharge	Q =	44.03	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		1.5 : 1 Beveled Edge	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft.
Barrel Width (Span) in Feet	Width (Span) =		ft.
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	2	
Inlet Elevation	Elev IN =	5561.89	ft
Outlet Elevation **OR** Slope	Elev OUT =	5558.7	ft
Culvert Length	L =	138	ft
Manning's Roughness	n =	0.015	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Y_t =		ft.

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.80	ft
Max Allowable Channel Velocity	V =	7.00	ft/s
Flow Area at Max Channel Velocity	A_t =	3.14	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	2.27	
Sum of All Losses Coefficients	k_s =	3.47	ft
Culvert Normal Depth	Y_n =	1.28	ft
Culvert Critical Depth	Y_c =	1.68	ft
Tailwater Depth for Design	d =	1.84	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.64	ft
Expansion Factor	1/(2*tan(Θ)) =	3.62	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	3.89	$ft^{0.5}/s$
Tailwater/Diameter **OR** Tailwater/Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	2.82	ft
Outlet Control Headwater	HW_O =	1.29	ft
Design Headwater Elevation	**HW =**	**5,564.71**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.41**	
Minimum Theoretical Riprap Size	d_{50} =	6	in
Nominal Riprap Size	d_{50} =	9	in
UDFCD Riprap Type	**Type =**	**L**	
Length of Protection	**L_p =**	**7**	**ft**

Vertical Profile for the Culvert

Project = **Blue 3-65 33-32-31 Well Site**
Box ID = **Culvert 3 - (2) 24"x138' CMP - Q100=44.03 cfs (22.02 cfs/culvert)**



Culvert Information (Input)			
Barrel Diameter or Height	D or H =	24.00	inches
Barrel Length	L =	138.00	ft
Barrel Invert Slope	So =	0.0232	ft/ft
Downstream Invert Elevation	EDI =	5558.70	ft
Downstream Top Embankment Elevation	EDT =	5562.63	ft
Upstream Top Embankment Elevation	EUT =	5563.63	ft
Design Headwater Depth (not elev.)	Hw =	2.82	ft
Tailwater Depth (not elev.)	Yt =	0.80	ft
Culvert Hydraulics (Calculated)			
Available Headwater Depth	HW-a =	1.73	ft
Design Hw/D ratio	Hw/D =	1.41	
Culvert Vertical Profile			
Upstream Invert Elevation	EUI =	5561.90	ft
Upstream Crown Elevation	EUC =	5563.90	ft
Upstream Soil Cover Depth	Upsoil =	-0.27	ft
Downstream Invert Elevation	EDI =	5558.70	ft
Downstream Crown Elevation	EDC =	5560.70	ft
Downstream Soil Cover Depth	Dnsoil =	2.93	ft

Design Procedure Form: Grass Buffer (GB)

UD-BMP (Version 3.07, March 2018)

Designer:	**UELS - cdc**
Company:	**Crestone Peak Resources**
Date:	**September 2, 2021**
Project:	**Blue 3-65 33-32-31 Pad**
Location:	**City of Aurora, Adams County**

1. Design Discharge A) 2-Year Peak Flow Rate of the Area Draining to the Grass Buffer	Q_2 = 0.4 cfs
2. Minimum Width of Grass Buffer	W_G = 7 ft
3. Length of Grass Buffer (14' or greater recommended)	L_G = 1,470 ft
4. Buffer Slope (in the direction of flow, not to exceed 0.1 ft / ft)	S_G = 0.090 ft / ft
5. Flow Characteristics (sheet or concentrated) A) Does runoff flow into the grass buffer across the entire width of the buffer? B) Watershed Flow Length C) Interface Slope (normal to flow) D) Type of Flow Sheet Flow: $F_L * S_I \leq 1$ Concentrated Flow: $F_L * S_I > 1$	Choose One ◉ Yes ○ No F_L= 17 ft S_I= 0.020 ft / ft SHEET FLOW
6. Flow Distribution for Concentrated Flows	Choose One ◉ None (sheet flow) ○ Slotted Curbing ○ Level Spreader ○ Other (Explain):
7 Soil Preparation (Describe soil amendment)	Use on-site topsoil.
8 Vegetation (Check the type used or describe "Other")	Choose One ◉ Existing Xeric Turf Grass ○ Irrigated Turf Grass ○ Other (Explain):
9. Irrigation (*Select None if existing buffer area has 80% vegetation AND will not be disturbed during construction.)	Choose One ◉ Temporary ○ Permanent ○ None*
10. Outflow Collection (Check the type used or describe "Other")	Choose One ○ Grass Swale ○ Street Gutter ○ Storm Sewer Inlet ◉ Other (Explain):

Notes: After treatment in the grass buffer, stormwater will be conveyed along the fill slope of the road into the historic drainage path north of the site.

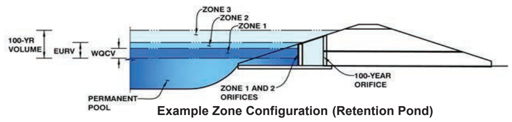
APPENDIX G – EXTENDED DETENTION POND CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Crestone Peak Resources Operating, LLC - Blue 3-65 33-32-31 Well Pad

Basin ID: Extended Detention Basin 1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	7.36	acres		
Watershed Length =	1,120	ft		
Watershed Length to Centroid =	400	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	29.93%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	100.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths = User Input				

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.093	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.200	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1 in.) =	0.176	acre-feet	1.00	inches
5-yr Runoff Volume (P1 = 1.4 in.) =	0.376	acre-feet	1.40	inches
10-yr Runoff Volume (P1 = 1.65 in.) =	0.521	acre-feet	1.65	inches
25-yr Runoff Volume (P1 = 2.05 in.) =	0.795	acre-feet	2.05	inches
50-yr Runoff Volume (P1 = 2.35 in.) =	0.981	acre-feet	2.35	inches
100-yr Runoff Volume (P1 = 2.7 in.) =	1.232	acre-feet	2.70	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.510	acre-feet		inches
Approximate 2-yr Detention Volume =	0.144	acre-feet		
Approximate 5-yr Detention Volume =	0.268	acre-feet		
Approximate 10-yr Detention Volume =	0.314	acre-feet		
Approximate 25-yr Detention Volume =	0.384	acre-feet		
Approximate 50-yr Detention Volume =	0.409	acre-feet		
Approximate 100-yr Detention Volume =	0.514	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.093	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.107	acre-feet
Zone 3 Volume (User Defined - Zones 1 & 2) =	0.414	acre-feet
Total Detention Basin Volume =	0.614	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	6	0.000		
5567.4	--	0.10	--	--	--	45	0.001	3	0.000
5567.5	--	0.20	--	--	--	333	0.008	21	0.000
5567.6	--	0.30	--	--	--	870	0.020	82	0.002
5567.7	--	0.40	--	--	--	1,656	0.038	208	0.005
5567.8	--	0.50	--	--	--	2,690	0.062	425	0.010
5567.9	--	0.60	--	--	--	3,973	0.091	758	0.017
5568.0	--	0.70	--	--	--	5,463	0.125	1,230	0.028
5568.1	--	0.80	--	--	--	6,988	0.160	1,853	0.043
5568.2	--	0.90	--	--	--	8,531	0.196	2,629	0.060
5568.3	--	1.00	--	--	--	9,973	0.229	3,554	0.082
WQCV - 5568.4	--	1.10	--	--	--	11,192	0.257	4,612	0.106
5568.5	--	1.20	--	--	--	12,191	0.280	5,781	0.133
5568.6	--	1.30	--	--	--	12,969	0.298	7,039	0.162
5568.7	--	1.40	--	--	--	13,525	0.310	8,364	0.192
ZONE 2 - 5568.8	--	1.50	--	--	--	13,860	0.318	9,733	0.223
5568.9	--	1.60	--	--	--	14,085	0.323	11,130	0.256
5569.0	--	1.70	--	--	--	14,311	0.329	12,550	0.288
5569.1	--	1.80	--	--	--	14,538	0.334	13,993	0.321
5569.2	--	1.90	--	--	--	14,766	0.339	15,458	0.355
5569.3	--	2.00	--	--	--	14,995	0.344	16,946	0.389
5569.4	--	2.10	--	--	--	15,225	0.350	18,457	0.424
5569.5	--	2.20	--	--	--	15,456	0.355	19,991	0.459
5569.6	--	2.30	--	--	--	15,688	0.360	21,548	0.495
5569.7	--	2.40	--	--	--	15,921	0.365	23,129	0.531
5569.8	--	2.50	--	--	--	16,155	0.371	24,732	0.568
5569.9	--	2.60	--	--	--	16,390	0.376	26,360	0.605
ZONE 3 - 5570	--	2.70	--	--	--	16,626	0.382	28,010	0.643
5570.1	--	2.80	--	--	--	16,862	0.387	29,685	0.681
5570.2	--	2.90	--	--	--	17,100	0.393	31,383	0.720
5570.3	--	3.00	--	--	--	17,339	0.398	33,105	0.760
5570.4	--	3.10	--	--	--	17,579	0.404	34,851	0.800
5570.5	--	3.20	--	--	--	17,820	0.409	36,621	0.841
5570.6	--	3.30	--	--	--	18,062	0.415	38,415	0.882
5570.7	--	3.40	--	--	--	18,305	0.420	40,233	0.924
5570.8	--	3.50	--	--	--	18,549	0.426	42,076	0.966
5570.9	--	3.60	--	--	--	18,794	0.431	43,943	1.009
5571.0	--	3.70	--	--	--	19,039	0.437	45,835	1.052
5571.1	--	3.80	--	--	--	19,286	0.443	47,751	1.096
5571.2	--	3.90	--	--	--	19,534	0.448	49,692	1.141
5571.3	--	4.00	--	--	--	19,783	0.454	51,658	1.186
Spillway-5571.4	--	4.10	--	--	--	20,033	0.460	53,649	1.232
5571.5	--	4.20	--	--	--	20,284	0.466	55,664	1.278
5571.6	--	4.30	--	--	--	20,535	0.471	57,705	1.325
5571.7	--	4.40	--	--	--	20,788	0.477	59,771	1.372
Q100 - 5571.8	--	4.50	--	--	--	21,042	0.483	61,863	1.420
5571.9	--	4.60	--	--	--	21,297	0.489	63,980	1.469
5572.0	--	4.70	--	--	--	21,553	0.495	66,122	1.518
5572.1	--	4.80	--	--	--	21,809	0.501	68,291	1.568
5572.2	--	4.90	--	--	--	22,067	0.507	70,484	1.618
5572.3	--	5.00	--	--	--	22,326	0.513	72,704	1.669
5572.4	--	5.10	--	--	--	22,586	0.518	74,950	1.721
5572.5	--	5.20	--	--	--	22,847	0.524	77,221	1.773
5572.6	--	5.30	--	--	--	23,108	0.530	79,519	1.826
5572.7	--	5.40	--	--	--	23,371	0.537	81,843	1.879
Top of EDB-5572.8	--	5.50	--	--	--	23,635	0.543	84,193	1.933
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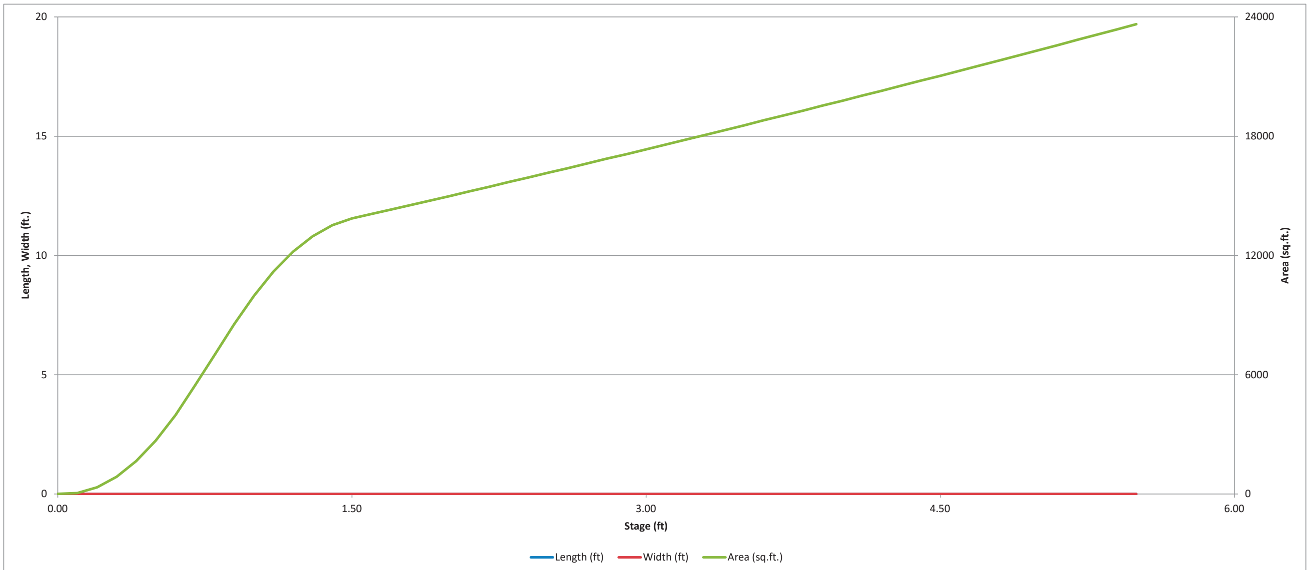
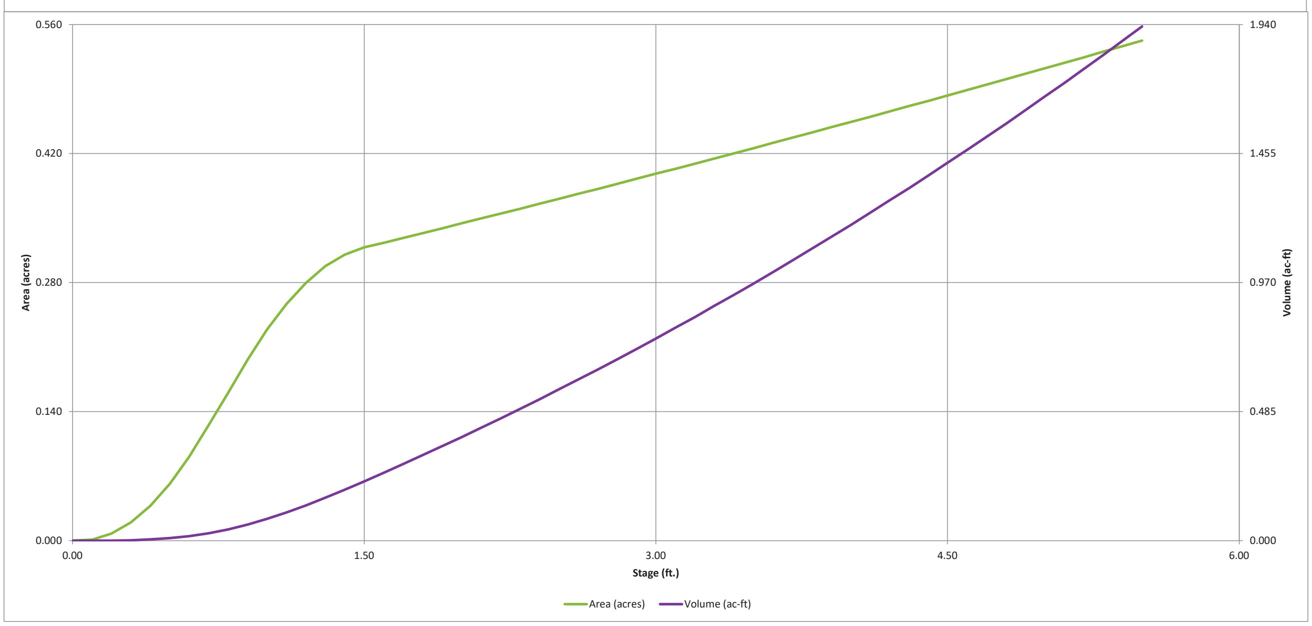

Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

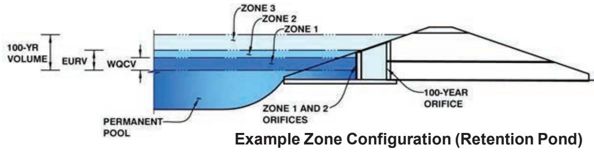

Area (acres)
Volume (ac-ft)
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Crestone Peak Resources Operating, LLC - Blue 3-65 33-32-31 Well Pad

Basin ID: Extended Detention Basin 1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.05	0.093	Orifice Plate
Zone 2 (EURV)	1.43	0.107	Orifice Plate
Zone 3 (User)	2.63	0.414	Weir&Pipe (Restrict)
Total (all zones)		0.614	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
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 BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.13	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.50	inches
Orifice Plate: Orifice Area per Row =	0.33	sq. inches (diameter = 5/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.292E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.71	1.42					
Orifice Area (sq. inches)	0.33	0.33	0.33					

	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 Orif

	Not Selected	Not Selected
Vertical Orifice Area =	N/A	N/A
Vertical Orifice Centroid =	N/A	N/A

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 =	2.13	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			
Overflow Weir Grate Slope =			
Horiz. Length of Weir Sides =			
Overflow Grate Type =			
Debris Clogging % =			

Calculated Parameters for Overflow W

	Zone 3 Weir	Not Selected
Height of Grate Upper Edge, H_t =		N/A
=		N/A
=		N/A
=		N/A
=		N/A

THIS SHEET PROVIDED ONLY TO SHOW SIZING OF THE SPILLWAY.

User Input: Outlet Pipe w/ Flow Restriction Plate

Depth to Invert of Outlet Pipe =	
Outlet Pipe Diameter =	
Restrictor Plate Height Above Pipe Invert =	

ters for Outlet Pipe w/ Flow Restriction Pla

	Zone 3 Restrictor	Not Selected
=		N/A
=		N/A
=		N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.10	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.36	feet
Stage at Top of Freeboard =	5.46	feet
Basin Area at Top of Freeboard =	0.54	acres
Basin Volume at Top of Freeboard =	1.91	acre-ft

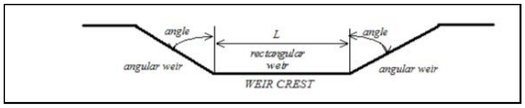
Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.00	1.40	1.65	2.05	2.35	2.70
CUHP Runoff Volume (acre-ft) =	0.093	0.200	0.176	0.376	0.521	0.795	0.981	1.232
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.176	0.376	0.521	0.795	0.981	1.232
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	2.3	3.3	6.4	8.0	10.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.05	0.31	0.45	0.86	1.09	1.42
Peak Inflow Q (cfs) =	N/A	N/A	1.9	4.3	5.7	9.3	11.3	14.0
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	92	>120	>120	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**96**	>120	>120	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	1.05	1.43	1.33	1.94	2.35	3.06	3.51	4.07
Area at Maximum Ponding Depth (acres) =	0.24	0.31	0.30	0.34	0.36	0.40	0.43	0.46
Maximum Volume Stored (acre-ft) =	0.093	0.201	0.171	0.368	0.509	0.784	0.966	1.218

STAGE-DISCHARGE SIZING OF THE SPILLWAY

Project: Blue 3-65 33-32-31 Pad
Basin ID: EDB-1



Design Information (input):

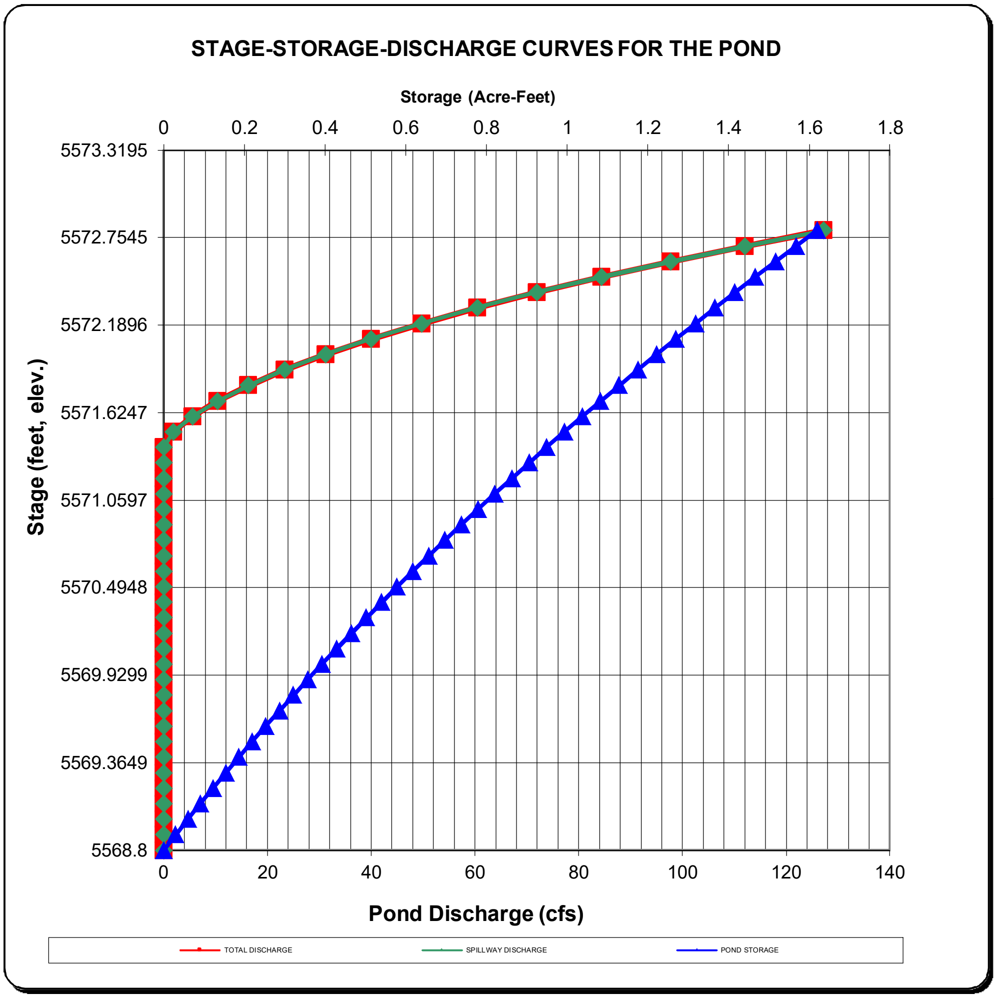
Bottom Length of Weir	L =	20.00	feet
Angle of Side Slope Weir	Angle =	75.96	degrees
Elev. for Weir Crest	EL. Crest =	5,571.40	feet
Coef. for Rectangular Weir	C_w =	3.00	
Coef. for Trapezoidal Weir	C_t =	3.00	

Calculation of Spillway Capacity (output):

Water Surface Elevation ft. (linked)	Rect. Weir Flowrate cfs (output)	Triangle Weir Flowrate cfs (output)	Total Spillway Release cfs (output)	Total Pond Release cfs (output)	
5568.80	0.00	0.00	0.00	0.00	
5568.90	0.00	0.00	0.00	0.00	
5569.00	0.00	0.00	0.00	0.00	
5569.10	0.00	0.00	0.00	0.00	
5569.20	0.00	0.00	0.00	0.00	
5569.30	0.00	0.00	0.00	0.00	
5569.40	0.00	0.00	0.00	0.00	
5569.50	0.00	0.00	0.00	0.00	
5569.60	0.00	0.00	0.00	0.00	
5569.70	0.00	0.00	0.00	0.00	
5569.80	0.00	0.00	0.00	0.00	
5569.90	0.00	0.00	0.00	0.00	
5570.00	0.00	0.00	0.00	0.00	
5570.10	0.00	0.00	0.00	0.00	
5570.20	0.00	0.00	0.00	0.00	
5570.30	0.00	0.00	0.00	0.00	
5570.40	0.00	0.00	0.00	0.00	
5570.50	0.00	0.00	0.00	0.00	
5570.60	0.00	0.00	0.00	0.00	
5570.70	0.00	0.00	0.00	0.00	
5570.80	0.00	0.00	0.00	0.00	
5570.90	0.00	0.00	0.00	0.00	
5571.00	0.00	0.00	0.00	0.00	
5571.10	0.00	0.00	0.00	0.00	
5571.20	0.00	0.00	0.00	0.00	
5571.30	0.00	0.00	0.00	0.00	
5571.40	0.00	0.00	0.00	0.00	SPILLWAY
5571.50	1.90	0.04	1.94	1.94	
5571.60	5.37	0.21	5.58	5.58	
5571.70	9.86	0.59	10.45	10.45	
5571.80	15.18	1.21	16.39	16.39	Q100 - 15.64 CFS
5571.90	21.21	2.12	23.33	23.33	
5572.00	27.89	3.35	31.23	31.23	
5572.10	35.14	4.92	40.06	40.06	
5572.20	42.93	6.87	49.80	49.80	
5572.30	51.23	9.22	60.45	60.45	
5572.40	60.00	12.00	72.00	72.00	
5572.50	69.22	15.22	84.45	84.45	
5572.60	78.87	18.92	97.80	97.80	
5572.70	88.93	23.12	112.05	112.05	
5572.80	99.39	27.82	127.21	127.21	TOP OF EDB
#N/A	#N/A	#N/A	#N/A	#N/A	
#N/A	#N/A	#N/A	#N/A	#N/A	
#N/A	#N/A	#N/A	#N/A	#N/A	

STAGE-DISCHARGE SIZING OF THE SPILLWAY

Project: Blue 3-65 33-32-31 Pad
Basin ID: EDB-1



Crestone Peak Resources Operating, LLC
Blue 3-65 33-32-31 Pad

Minimum Detention Volume
City of Aurora SDDTC, Section 6.33

$A = 7.36$ — Tributary Area (acres)
$I = 29.93$ — Developed basin Imperviousness (%)

$K_{100} = 0.05325$ — Equation 6.1
$V_{100} = K_{100} * A = 0.392$ — acre-ft (17072 cubic-feet)

$K_{10} = 0.02653$ — Equation 6.2
$V_{10} = K_{10} * A = 0.195$ — acre-ft (8507 cubic-feet)

$V = KA$

For the 100-year, $K_{100} = (1.78I - 0.002I^2 - 3.56)/900$ (6.1)

For the 10-year, $K_{10} = (0.95I - 1.90)/1000$ (6.2)

Where V = required volume for the 100- or 10-year storm (acre-feet)

I = Developed basin imperviousness (%)

A = Tributary area (acres)