MORNING GUN EXPLORATION
CASTOR 7-59 10 OIL & GAS WELL PAD

DRAINAGE REPORT

SECTION 10, TOWNSHIP 7 NORTH, RANGE 59 WEST, 6TH P.M.
WELD COUNTY, COLORADO

Prepared For:
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Weld County Drainage Code
Certificate of Compliance

Weld County Case Number: _____

Parcel Number: 072110000006

Legal Description, Section/Township/Range: SE 1/4 of Sec. 10, T7N, R59W, 6th PM

Date: 12-13-2021

I Christopher Clark, PE, Consultant Engineer for Morning Gun Exploration (Applicant), understand and acknowledge that the applicant is seeking land use approval of the case and parcel in the description above. I have designed or reviewed the design for the proposed land use set for in the application. I hereby certify, on behalf of the applicant, that the design will meet all applicable drainage requirements of the Weld County Code with the exception of the variance(s) described on the attached exhibits. This certification is not a guarantee or warranty either expressed or implied.

Engineer's Stamp:

COLORADO LICENSED
CHRISTOPHER J. CLARK
45606
PROFESSIONAL ENGINEER

12-13-2021

_____
Engineer of Record Signature

Variance Request (If Applicable)

1. Describe the hardship for which the variance is being requested.
2. List the design criteria of the Weld County Code of which a variance is being requested.
3. Describe the proposed alternative with engineering rationale which supports the intent of the Weld County Code. Demonstrate that granting of the variance will still adequately protect public health, safety, and general welfare and that there are no adverse impacts from stormwater runoff to the public rights-of-way and/or offsite properties as a result of the project.

_____
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Public Works Director/Designee Review (If Applicable)

_____ _____
Public Works Director/Designee Name Signature

_____
Date of Signature

☐ Approved ☐ Denied

Comments: _____
_____

I. INTRODUCTION

The purpose of this report is to present the proposed storm drainage improvements for the Morning Gun Exploration, Castor 7-59 10 Oil & Gas Well Pad Project. This project consists of the development of infrastructure to support drilling and production operations for an oil & gas well site located in the SE 1/4 of Section 10, Township 7 North , Range 59 West, 6th Principal Meridian. The proposed site developments are expected to increase the impervious ground cover resulting in an increase in peak storm water runoff. This report examines the undeveloped flow patterns of on- and off-site drainage basins and the proposed storm water facilities designed to mitigate the downstream impact of increased storm water runoff. The contents of this report are prepared in accordance with the Weld County Code for a Drainage Report.

II. GENERAL LOCATION AND DESCRIPTION

A. LOCATION AND EXISTING CONDITIONS

The project is located on a 160-acre parcel of land owned by Castor Lands, LLC. The project is approximately 0.6 miles west of the intersection of Weld County Road 115 and Weld County Road 82. A vicinity map is included with this report in Appendix A. This parcel is zoned Agricultural and the existing land use is grazing land.

This site is located in a portion of the range land with a slope of 2% from the southeast to the northwest. The site is located south of the S. Pawnee Creek drainage. The site is not within any FEMA flood plain. Drainage plans depicting the on- and off- site drainage for the proposed drill site and the production site are included with this report in Appendix B. The site is not within any mapped wetlands according to the current National Wetlands Inventory.

B. PROPOSED DEVELOPMENT

The site is located within the Non-Urbanizing area of Weld County. The proposed development will include construction of infrastructure to construct and oil and gas well site to support drilling and production operations for oil and gas wells. The on-site drainage areas will be approximately 8.69 acres during the Drill Phase and 6.75 acres during the Production Phase of this project. A new access road will be constructed that connects to Weld County Road 115. The proposed pad surface will be surfaced with gravel. A topsoil stockpile will be located to the north of the pad.

On-site pad perimeter berms will be constructed to collect and detain on-site drainage within the pad area. The detention pond was sized to detain the 100-year runoff volumes from the newly developed area and release the stormwater at a flow rate equivalent to the 10-year historic (pre-development) runoff flow rate. The flow rate will be managed by the use of a restrictor plate on the outlet pipe. An emergency spillway was sized to release the 100-year runoff flow rate. Off-site diversion ditches will be constructed to divert off-site drainage away from on-site drainage areas.

The Drill Phase will be the initial phase of the project and remain until all the wells have been drilled and completed. The Production Phase will be the final phase of the project and will include an “interim” reclamation of the site to a smaller production facility that will remain for the duration of the life of the wells (20-30 years). The interim reclaimed area around the new production pad will be returned to its natural grade and contour (close to pre-development contour and vegetation) and any runoff from the reclaimed area will be diverted away

from the proposed production pad.

As noted above, drainage plans depicting the on- and off-site drainage for the proposed drill site and the proposed production site are included with this report in Appendix B.

III. DRAINAGE BASINS AND SUBBASINS

A. MAJOR BASIN DESCRIPTION

The project is located in rural Weld County and is surrounded by rangeland. The project does not lie in a 100-year FEMA designated flood area. The site is in the FEMA designated Zone D, used for "Area of Undetermined Flood Hazard" as derived from the Flood Insurance Rate Map (FIRM) Community Panel No. 08123C1400E. A FIRMette is attached to this report in Appendix C.

According to the NRCS Web Soil Survey, the on- and off- site basins consist of approximately 100% Platner Loam, 0 to 3 percent slopes. The Platner loam soil group consists of having a slow infiltration rate when thoroughly wet. The hydrologic soil group type for this site is categorized as 100% 'C'. A NRCS Web Soil Survey report is included with this report in Appendix D.

B. OFF-SITE DRAINAGE BASINS

The off-site drainage basins will require diversion ditches and diversion berms to divert the off-site runoff to the historic drainage basins to the west and east of the site. Off-Site Basin 1 (OS-1) is located to the south of the site. Runoff from OS-1 will be diverted north and west by Off-Site Ditch-1 located on the west side of the site. Off-Site Ditch-1 will end along the west side of the site and discharge to the northwest in the historical drainage basin away from the site. Off-Site Basin 2 (OS-2) is located to the south of the site and encompasses a small area tributary to the access road cut down to the pad. Runoff from OS-2 will flow onto the pad and is planned to route through the on-site detention pond and flow over the spillway. Off-Site Basin 3 (OS-3) is located to the southeast of the site. Runoff from OS-3 will be diverted north and east by Off-Site Ditch-2 located on the east side of the site. Off-Site Ditch-2 will end along the east side of the site and discharge to the northeast in the historical drainage basin away from the site.

Peak runoff flows for the 5-year and 100-year storm events for the off-site drainage basins have been calculated and are provided in the table below.

Table 1 - Off-site Drainage Basin Peak Runoff Flows.

Basin ID	**Basin Size (Ac)**	**Peak Flow 5-Yr (cfs)**	**Peak Flow 100-Yr (cfs)**	**Design Point**
OS-1	4.45	1.6	10.7	2
OS-2	3.04	1.3	8.6	3
OS-3	11.41	4.5	29.9	4

The off-site drainage basins are shown on the drainage plans in Appendix B.

IV. DRAINAGE DESIGN CRITERIA

This report is prepared in compliance with the *Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3; Weld County Code;* and the *Weld County Storm Drainage Criteria Addendum to the Urban Storm Drainage Criteria Manuals Volumes 1, 2, and 3.* Based on this criterion, a 100-year storm is used as the major storm event and a 5-year storm is used as the minor storm event when evaluating existing and proposed drainage facilities.

Runoff Calculations: For drainage basins less than 160 acres in area, the Rational Method was used to calculate the stormwater runoff. The time of concentration for the basins was estimated using the methods detailed within *Urban Storm Drainage Criteria Manual, Volume 1, Ch. 5*. Detailed hydrologic runoff calculations and time of concentration calculations are included with this report in Appendix F.

Rainfall Data: Site rainfall depth information was obtained from the *National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2, Precipitation-Frequency Atlas of the United States* (2013). This data supersedes the default rainfall depth information provided in the *Urban Storm Drainage Criteria Manual*. The current NOAA data was used for the determination of the point rainfall data. The NOAA data formed the basis of the inflow-duration-frequency (IDF) calculations for other storm frequencies and durations using Urban Drainage methods. Rainfall data is included with this report in Appendix E.

Pipe and Culvert Sizing: Site storm infrastructure capacities have been evaluated using Manning's Equation. The culverts on-site are sized to convey the 5-year storm event. Culverts in existing natural drainage channels that intersect the proposed road are sized to convey the 100-year storm event. Additionally, the outlet pipe from the detention pond is sized for a specific flow rate of the 10-year historic flow with the use of a restrictor plate. Erosion control devices will be provided at all culvert and swale outlets to protect against downstream erosion. Detailed hydraulic calculations for pipe and culvert sizing are included in this report in Appendix F.

Drainage Diversion Berm Sizing: Diversion berms will be used to divert the off-site runoff around the site and to the historic drainage paths. Hydraulic capacities of the channel formed between berm and upstream slopes have been evaluated using Manning's Equation. The channel capacities were calculated and checked to verify that they will divert the 100-year runoff flows away from the site. All berms will have a minimum height of 24" regardless of the calculated hydraulic depth. Detailed hydraulic calculations for diversion berms are included with this report in Appendix F.

Drainage Channel Sizing: Drainage ditch capacities have been evaluated using Manning's Equation. The channels are sized to convey the 5-year storm event runoff flows and the 100-year runoff flows were calculated and checked to verify that the combined perimeter ditch and berm will divert the 100-year runoff flows around the pad area. All channels will have a minimum depth of 12" regardless of the calculated runoff flow rate. Detailed hydraulic calculations for the drainage channels are included with this report in Appendix F.

Detention Pond Sizing: The detention pond volume has been determined using the UDFCD's *Detention Design – UD-Detention v2.34* spreadsheet. Detention Ponds are sized to detain the 100-year developed storm event runoff from the site's drainage basins (refer to the drainage plans in Appendix B). The detention pond is configured to release no more than the 10-year historic flow at the points of analysis in accordance with Weld County criteria. A minimum of one foot of freeboard will be provided for the detention pond. The required water quality capture volume (WQCV) will be contained within the detention volume of the detention pond. An

emergency spillway, in the form of a concrete weir and armored slope, is proposed to convey the 100-year flow rate under a plugged orifice condition. Detailed detention pond calculations are included with this report in Appendix G.

Water Quality Pond Sizing: The WQCV for both the Drill Phase and the Production Phase was calculated for this project. The WQCV will be contained within detention pond volume and released at the detention pond's flow rate. Detailed WQCV calculations are included with this report in Appendix G.

V. DRAINAGE FACILITY DESIGN

A. ON-SITE DRAINAGE

The project's stormwater management will include using the proposed pad as a detention pond. Stormwater management has been accounted for on both the Drill Phase and the Production Phase of this project. The detention outfall and runoff conveyance structures constructed during the Drill Phase will be re-used and modified for the Production Phase. Runoff flow rates and detention volumes have been re-calculated for the Production Phase to ensure that the detention pond modifications will be adequate for the Production Phase.

The detention pond is sized to accommodate the 100-year runoff volumes from the newly developed area and release the stormwater at a flow rate equivalent to the 10-year historic (pre-development) runoff flow rate of the Production Phase area for consistency in outlet structure design. The flow rate will be managed by the use of a restrictor plate on the outlet pipe.

The pad has been designed to route and detain runoff around the inside perimeter of the pad. The detained runoff will outlet on the southeast side of the pad into the historic drainage basin to the southeast. Portions of the pad around the well heads and the access road to the well heads will be raised above the 100-year storm event to avoid wet and muddy pad conditions. A pad culvert will be placed at the intersection of the proposed access road and the pad perimeter berm to equalize the 100-year detention under the raised access road.

The on-site improvements for both the Drill Phase and the Production Phase will be contained within a single drainage basin 'A'. The following table presents a summary of the on-site drainage basin calculations for each phase.

Table 2 – On-Site Drainage Basin Calculations

Basin ID	**Basin Size (Ac)**	**Pre-Development Peak Flow 10-YR (cfs)**	**Post-Development Peak Flow 100-YR (cfs)**	**Design Point**
A-Drill	8.69	5.6	15.4	1
A-Production	6.75	5.6	10.7	1

B. CONVEYANCE CALCULATIONS (HYDRAULIC CAPACITIES)

The conveyance structures will consist of diversion ditches and berms for the off-site basins. The off-site ditches were sized to convey the 5-year storm event runoff flows and the 100-year runoff flows were checked to verify that the pad berm will divert the 100-year runoff flows from the pad area. The hydraulic calculations for the conveyance structures are included with this report in Appendix F. The geometric and hydraulic details are shown in the table below.

Ditch outlets will be armored with a rip-rap apron to dissipate energy and reduce erosion at the outfall locations. Based on the flow and velocities from the culverts, the rip-rap will consist of a Type M rip-rap (D_{50} – 12"). The aprons will be 6 feet wide (or to a horizontal plane at 2' depth) by 6 feet long by 24" thick minimum. The rip-rap aprons were sized according to Section 8.1.1 of the Urban Storm Drainage Criteria Manual, Volume 1 method. Refer to the construction plans in Appendix H for apron locations and Appendix F for rip-rap calculations.

Table 3 - Conveyance Geometric and Hydraulic Details

Conveyance	Geometric Details	Min. Slope (%)	Peak Flow 5-Yr (cfs)	Peak Flow 100-Yr (cfs)	Design Flow Depth (ft)
Off-Site Ditch-1	3:1 V-Ditch 12"D Min.	0.25%	1.6	10.7	0.4
Off-Site Ditch-2	3:1 V-Ditch 12"D Min.	0.25%	4.5	29.9	0.6

C. WATER QUALITY AND DETENTION

The proposed bermed perimeter and inside area of the pad will be the water quality feature and detention structure for this project. As stated above, the pond was designed to route and detain the 100-year runoff and release the 10-year historic (pre-development) runoff flow rate. For the detention pond's weighted impervious surface calculations, the pond area was included in the gravel pad area since these areas coincide for this site. Water quality and detention were sized in accordance with the *Urban Storm Drainage Criteria Manual, Volume 1, 2, and 3.*

Per Weld County requirements, the WQCV will be provided and included within the 100-year storage requirement. The proposed WQCV drain time is 40 hours. The WQCV will be released with the developed runoff flows at the 10-year historic (pre-development) runoff flow rate. The WQCV is included in the detention pond volume for each phase. Detailed WQCV calculations are included with this report in Appendix G.

A detention pond summary for the Drill Phase and Production Phase is provided in the table below.

Table 4 - Detention Pond Summary

Drill Phase Detention Pond Calculations

Drainage Area (acres)	8.69
% Impervious of Drainage Area	56.8
Time of Concentration (minutes)	59
Water Quality Capture Volume (ac-ft)	0.284
Total Required Storage (ac-ft)	0.861
Total Storage (ac-ft)	3.226

Production Phase Detention Pond Calculations

Drainage Area (acres)	6.75
% Impervious of Drainage Area	54.0
Time of Concentration (minutes)	68
Water Quality Capture Volume (ac-ft)	0.213
Total Required Storage (ac-ft)	0.529
Total Storage (ac-ft)	1.571

As discussed above, the detention outfall and runoff conveyance structures constructed during the Drill Phase will be re-used and modified for the Production Phase of the project. The originally installed detention outfall pipe and spillway structure was sized for a higher runoff flow rate and, once maintained, will be more than adequate at a lower flow rate. A Production Phase outlet restrictor plate will replace the Drill Phase outlet restrictor plate. The Production Phase outlet restrictor plate will ensure that the existing pond outfall pipe will release at the allowed flow rate.

The Drill Phase and Production Phase detention pond calculations, including outfall design and emergency spillway design, are included with this report in Appendix G. As required by C.R.S. 37-92-602(8), the detention pond is required to drain 97% of its volume within 72 hours. The detention pond spreadsheet shows the Drill Phase detention pond will drain in approximately 8.7 hours and the Production Phase detention pond will also drain in approximately 5.5 hours at the allowed 10-year historic flow rate of 5.6 cfs (Production Phase area for consistency in the outlet structure, respectively (reference detention pond calculations in Appendix G).

VI. DRAINAGE FACILITY MAINTENANCE

The drainage structures shall be maintained and inspected by the owner of the facility regularly. The detention pond grades, pad culvert, pond outlet, and berms shall be maintained to ensure sediment, erosion, and debris do not build up and hinder the designed function of these structures.

The following shall be ongoing inspection and maintenance items to be completed during the service life of the project.

1. The outlet works and detention pad culvert shall be inspected, and cleared of any debris, sediment, weeds, rock, etc. Inspections and maintenance should be addressed monthly at a minimum and logged in an inspection and maintenance report.
2. The detention pond berms and spillway shall be maintained, and any erosion or damage repaired. Keep grasses low and prevent the growth of native shrubs or noxious weeds. Maintenance may include re-grading and compacting, mowing, and spraying the area with an herbicide. Inspections and maintenance should be addressed monthly at a minimum and logged in an inspection and maintenance report.
3. The detention pond area shall be inspected and maintained annually. Silt will accumulate in the pond area especially around the perimeter of the pad and against the berms. This will reduce the pond's capacity and could prevent the outlet works from functioning properly. The pond area should be cleaned from trash, debris, and silt buildup. Maintenance may include re-grading and compacting, placement of additional gravel, and spraying the area with an herbicide. Inspections and maintenance should be addressed annually at a minimum and after large storm events over the 1-year event. It is recommended that the annual maintenance be scheduled to take place after the spring runoff and logged in an inspection and maintenance report.
4. All access road culverts shall be inspected and maintained and any debris from inlet and outlets removed. Rip-rap aprons shall also be inspected and maintained of any erosion or sedimentation. Inspections and maintenance should be addressed annually at a minimum and logged in an inspection and maintenance report.
5. All diversion berms shall be inspected and maintained, and sedimentation, erosion, and debris

addressed. Maintenance may include re-grading and compacting and revegetation. Inspections and maintenance should be addressed annually at a minimum and logged in an inspection and maintenance report.

A. Special Maintenance Instructions

The owner shall make repairs to the pond, outlet works, pad culvert, spillway, berms, and any other drainage structures if damage occurs. Inspection reports should be prepared and maintained with the owner of the facility. The regular inspections and maintenance schedules above are a minimum and should be increased if needed. During construction all drainage structures shall be inspected monthly and after every storm event. If a 50-year or larger storm event occurs, the pond should be inspected following that storm event to ensure that the pond and outlet works are functioning properly. If the pond is not completely drained within 70 hours of any storm event, the pond shall be drained by either clearing obstructions from the outlet structure or manually pumping the pond.

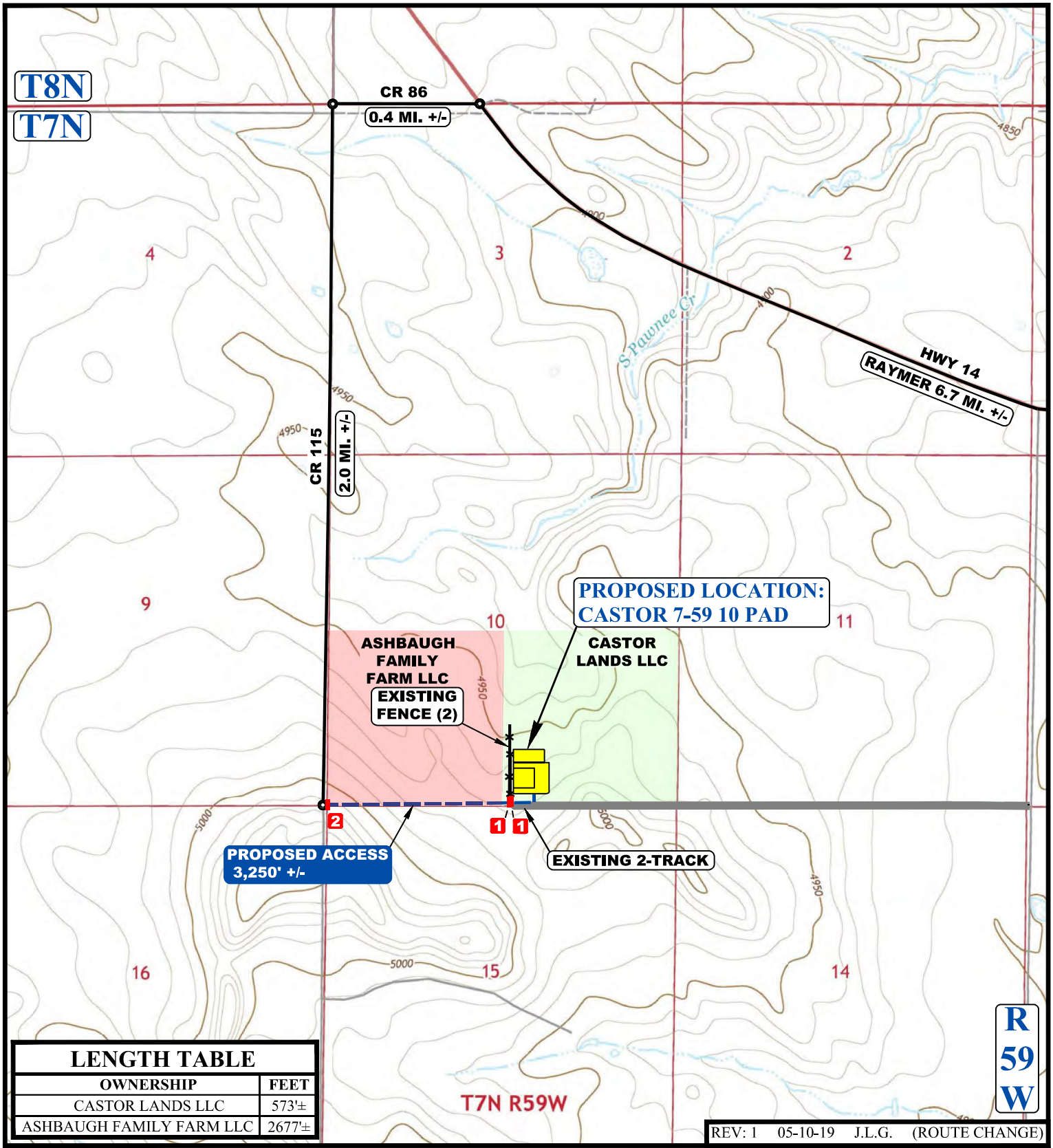
VII. CONCLUSION

This report was prepared in compliance with the Weld County Code and the Weld County Storm Drainage Criteria Addendum to the Urban Storm Drainage Criteria Manual Volumes, 1, 2, and 3. The proposed drainage system for the improvements to the Castor 7-59 10 Oil & Gas Well Pad project will provide detention for the 100-year storm event to meet the requirements of Weld County and will release flows at the 10-year historic flow rate. Discharge points are as near to the historic flow paths as practical and are not expected to increase or cause adverse impacts on downstream property owners.

This Drainage Report is being submitted to Weld County for review and approval.

VIII. APPENDIX

APPENDIX A – VICINITY MAP



LENGTH TABLE	
OWNERSHIP	FEET
CASTOR LANDS LLC	573'±
ASHBAUGH FAMILY FARM LLC	2677'±

REV: 1 05-10-19 J.L.G. (ROUTE CHANGE)

NOTE: PARCEL DATA SHOWN HAS BEEN OBTAINED FROM VARIOUS SOURCES AND SHOULD BE USED FOR MAPPING, GRAPHIC AND PLANNING PURPOSES ONLY. NO WARRANTY IS MADE BY UINTAH ENGINEERING AND LAND SURVEYING (UELS) FOR ACCURACY OF THE PARCEL DATA.

LEGEND:

- EXISTING ROAD
- PROPOSED
- EXISTING PIPELINE
- EXISTING FENCE
- 1 INSTALL CATTLE GUARD
- 2 INSTALL 18" CULVERT

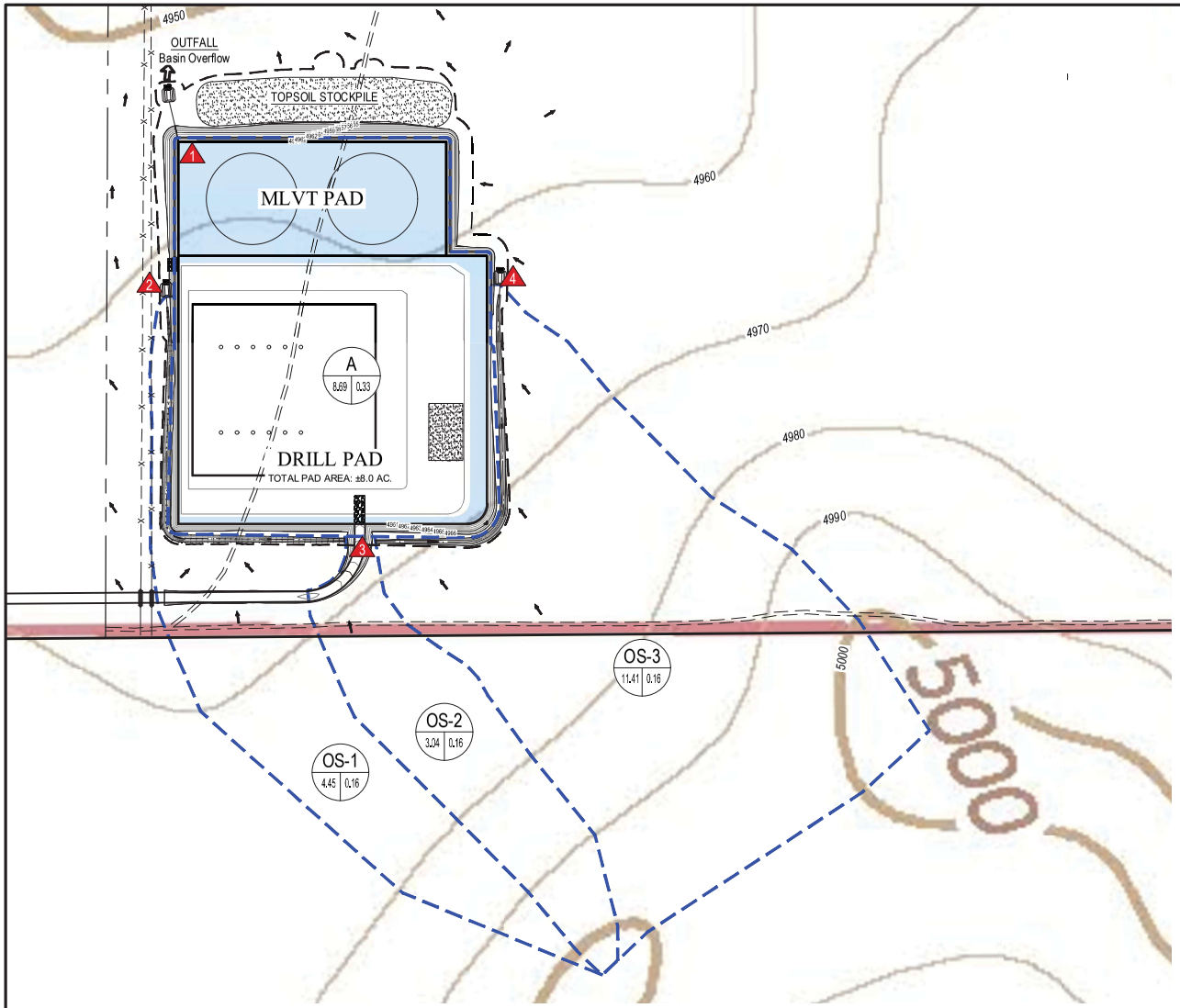
UELS, LLC
Corporate Office * 85 South 200 East
Vernal, UT 84078 * (435) 789-1017

MORNING GUN EXPLORATION LLC

CASTOR 7-59 10 PAD
SW 1/4 SE 1/4, SECTION 10, T7N, R59W, 6th P.M.
WELD COUNTY, COLORADO

SURVEYED BY	J.F., G.W.	12-12-18	SCALE
DRAWN BY	J.L.G.	12-17-18	1 : 24,000
ACCESS ROAD MAP			TOPO B

APPENDIX B – DRAINAGE PLANS



LEGEND:

- DIRECTION OF FLOW ARROW
- OUTFLOW
- DRAINAGE BASIN BOUNDARY

N

SYMBOL LEGEND

- 0 — DESIGN POINT
- A-0 — DRAINAGE BASIN DESIGNATION
- AC. / C — 5-YR WEIGHTED RUNOFF COEFFICIENT
- DRAINAGE BASIN AREA (ACRES)

SUMMARY RUNOFF TABLE

BASIN	DESIGN POINT	BASIN AREA (Ac)	RUNOFF 5-YR (cfs)	PEAK 100-YR (cfs)
A	1	8.69	5.1	15.4
OS-1	2	4.45	1.6	10.7
OS-2	3	3.04	1.3	8.6
OS-3	4	11.41	4.5	29.9

MORNING GUN EXPLORATION

CASTOR 7-59 10
SECTION 10, T7N, R59W, 6TH PM
WELD COUNTY, CO

DRAWN BY: C.J.C.	DATE DRAWN: 12-08-2021
SCALE: 1" = 200'	REVISED:

OFF-SITE DRAINAGE PLAN DRILL & PROD PHASE — **D-1**

UINTAH ENGINEERING & LAND SURVEYING

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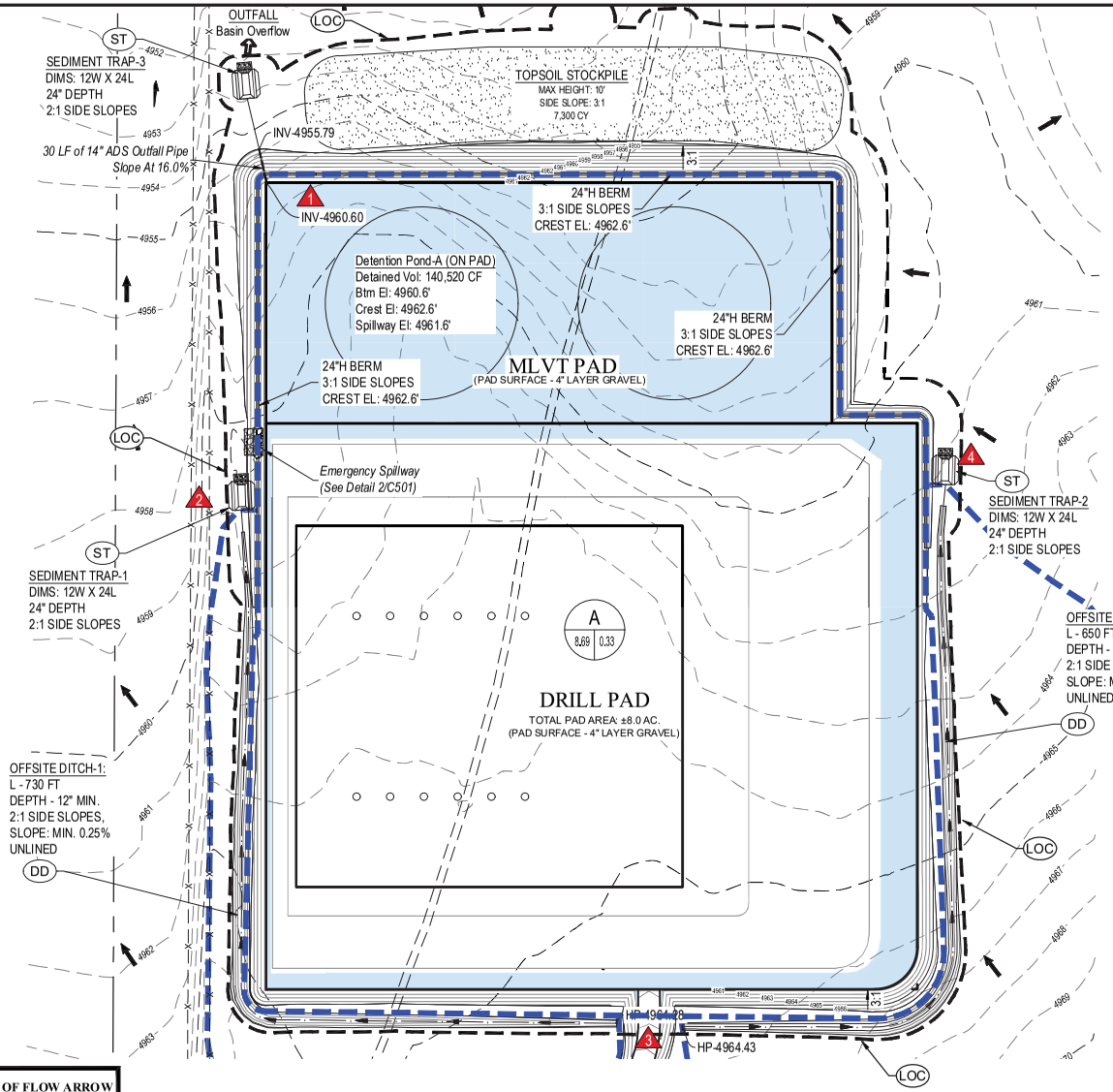
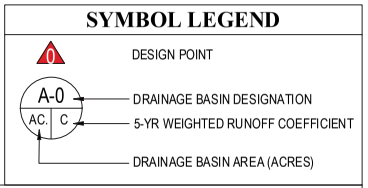
Vernal, UT 84078 * (435) 789-1017

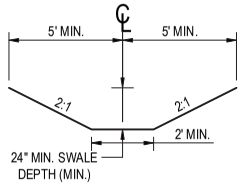


SYMBOL LEGEND



SUMMARY RUNOFF TABLE

BASIN	DESIGN POINT	BASIN AREA (Ac)	RUNOFF 5-YR (cfs)	PEAK 100-YR (cfs)
A	1	8.69	5.1	15.4
OS-1	2	4.45	1.6	10.7
OS-2	3	3.04	1.3	8.6
OS-3	4	11.41	4.5	29.9



TYPICAL OFF-SITE DIVERSION DITCH

LEGEND:

- DIRECTION OF FLOW ARROW
- OUTFLOW
- DRAINAGE BASIN BOUNDARY

N

MORNING GUN EXPLORATION

CASTOR 7-59 10
SECTION 10, T7N, R59W, 6TH PM
WELD COUNTY, CO

DRAWN BY: C.J.C.	DATE DRAWN: 12-08-2021
SCALE: 1" = 100'	REVISED:

ON-SITE DRAINAGE PLAN DRILL PHASE — **D-2**

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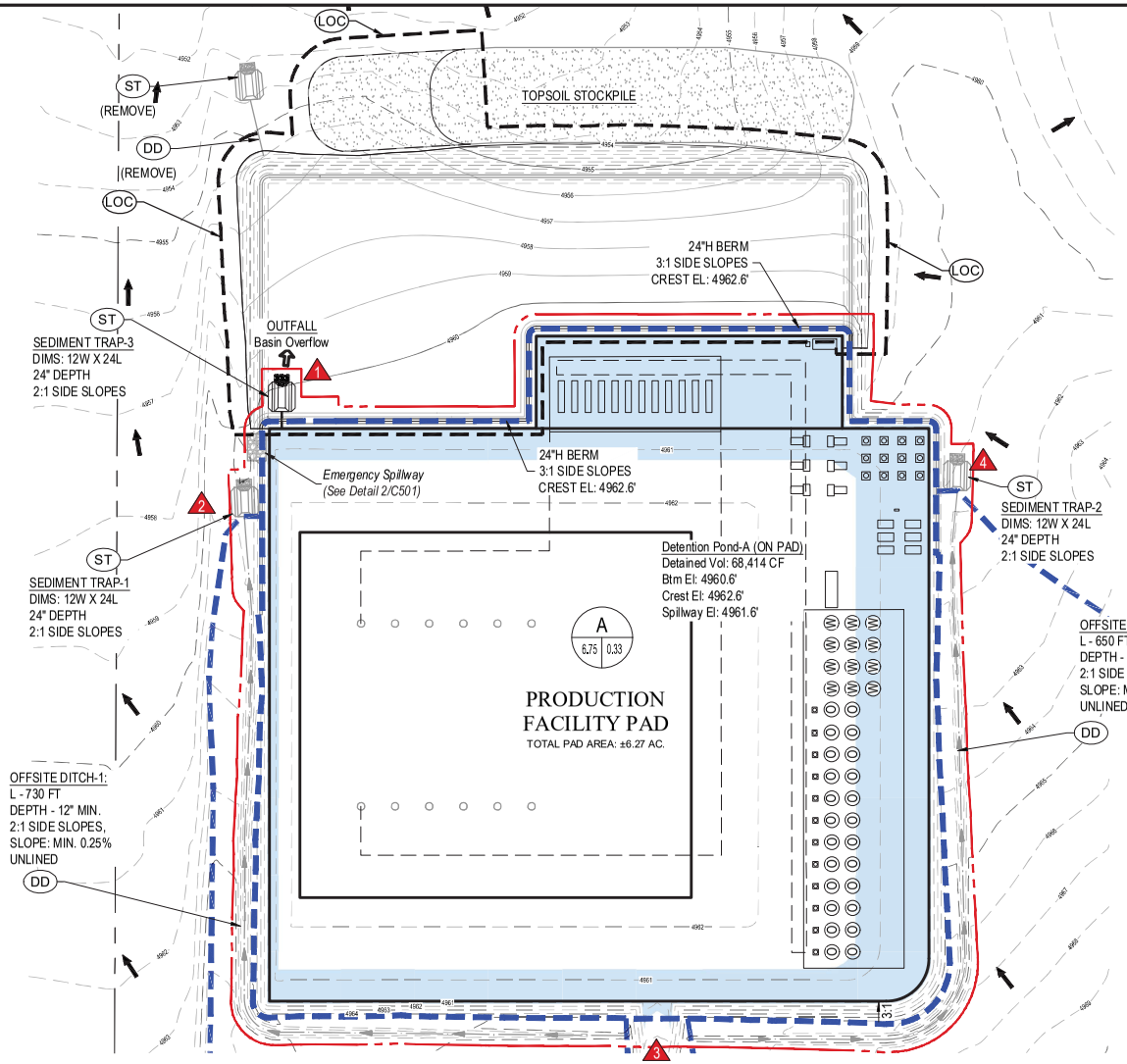

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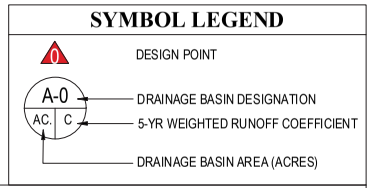
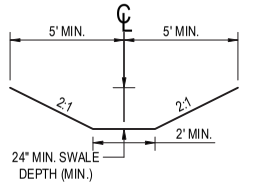


SUMMARY RUNOFF TABLE

BASIN	DESIGN POINT	BASIN AREA (Ac)	RUNOFF 5-YR (cfs)	PEAK 100-YR (cfs)
A	1	6.75	3.3	10.7
OS-1	2	4.45	1.6	10.7
OS-2	3	3.04	1.3	8.6
OS-3	4	11.41	4.5	29.9



TYPICAL OFF-SITE DIVERSION DITCH

LEGEND:

- DIRECTION OF FLOW ARROW
- OUTFLOW
- DRAINAGE BASIN BOUNDARY

N

MORNING GUN EXPLORATION

CASTOR 7-59 10
SECTION 10, T7N, R59W, 6TH PM
WELD COUNTY, CO

DRAWN BY: C.J.C.	DATE DRAWN: 12-08-2021
SCALE: 1" = 100'	REVISED:

ON-SITE DRAINAGE PLAN PRODUCTION PHASE | **D-3**

UINTAH ENGINEERING & LAND SURVEYING

UELS, LLC
Corporate Office * 85 South 200 East
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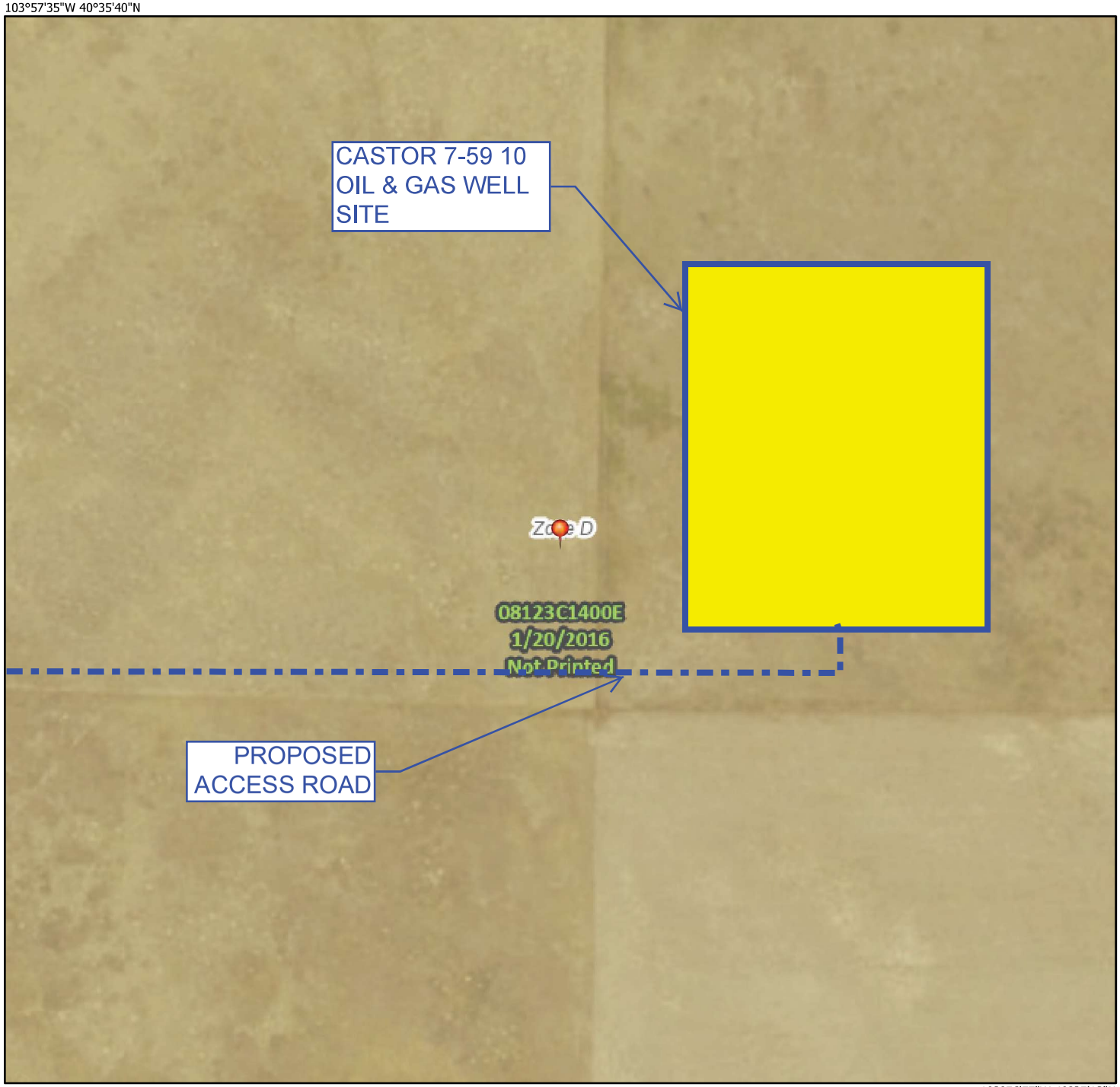
APPENDIX C – FLOOD PLAIN MAP - FIRM MAP PANEL

National Flood Hazard Layer FIRMette

FEMA

103°57'35"W 40°35'40"N



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

1:6,000

103°56'57"W 40°35'12"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 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.

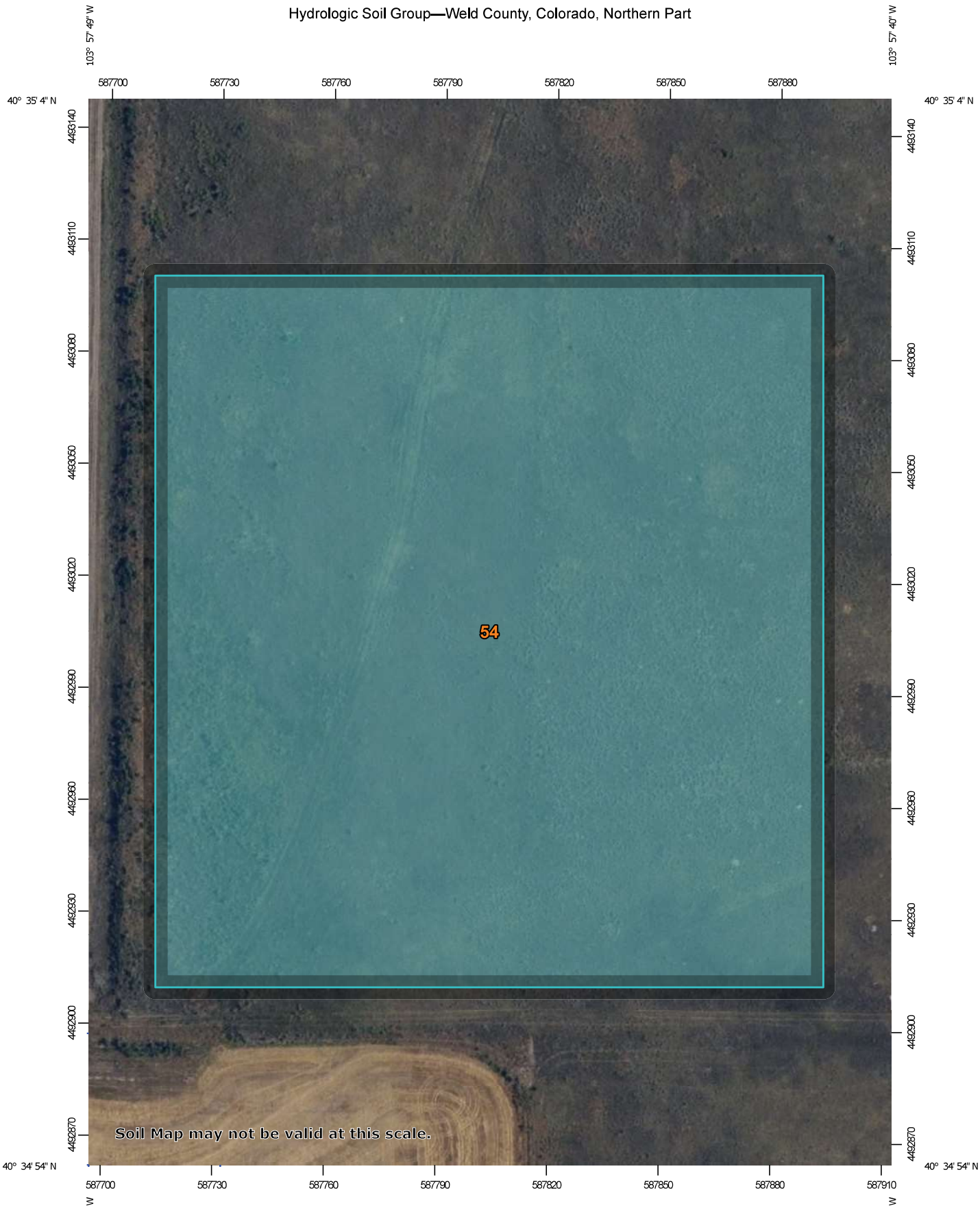
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/10/2021 at 7:31 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.

APPENDIX D – HYDROLOGIC SOIL GROUP

Hydrologic Soil Group—Weld County, Colorado, Northern Part



Map Scale: 1:1,390 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Weld County, Colorado, Northern Part
Survey Area Data: Version 16, Aug 31, 2021

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

Date(s) aerial images were photographed: Jul 19, 2018—Aug 10, 2018

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
54	Platner loam, 0 to 3 percent slopes	C	8.5	100.0%
Totals for Area of Interest			**8.5**	**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

APPENDIX E – NOAA ATLAS 14 – PRECIPITATION VALUES

NOAA Atlas 14, Volume 8, Version 2
Location name: New Raymer, Colorado, USA*
Latitude: 40.5836°, Longitude: -103.9626°
Elevation: 4963.89 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	3.20 (2.57-4.03)	3.86 (3.10-4.88)	5.08 (4.04-6.42)	6.19 (4.90-7.86)	7.88 (6.07-10.6)	9.31 (6.96-12.6)	10.9 (7.80-15.1)	12.5 (8.58-17.9)	14.9 (9.78-21.9)	16.9 (10.7-24.9)
10-min	2.35 (1.88-2.95)	2.83 (2.27-3.57)	3.71 (2.96-4.70)	4.53 (3.59-5.75)	5.77 (4.45-7.73)	6.82 (5.09-9.23)	7.95 (5.71-11.0)	9.18 (6.29-13.1)	10.9 (7.16-16.0)	12.4 (7.82-18.3)
15-min	1.91 (1.53-2.40)	2.30 (1.84-2.90)	3.02 (2.41-3.82)	3.68 (2.92-4.68)	4.69 (3.62-6.29)	5.54 (4.14-7.51)	6.46 (4.64-8.97)	7.46 (5.11-10.7)	8.89 (5.82-13.0)	10.1 (6.36-14.9)
30-min	1.34 (1.07-1.69)	1.61 (1.29-2.03)	2.10 (1.68-2.66)	2.55 (2.02-3.24)	3.24 (2.50-4.35)	3.83 (2.86-5.18)	4.46 (3.20-6.19)	5.14 (3.52-7.34)	6.13 (4.01-8.99)	6.92 (4.38-10.2)
60-min	0.813 (0.652-1.02)	0.996 (0.798-1.26)	1.32 (1.06-1.67)	1.62 (1.28-2.06)	2.07 (1.59-2.77)	2.44 (1.82-3.30)	2.84 (2.04-3.94)	3.28 (2.24-4.67)	3.89 (2.55-5.70)	4.39 (2.78-6.48)
2-hr	0.478 (0.386-0.596)	0.594 (0.479-0.742)	0.798 (0.642-1.00)	0.982 (0.784-1.24)	1.26 (0.974-1.66)	1.49 (1.12-1.99)	1.73 (1.25-2.37)	1.99 (1.37-2.80)	2.36 (1.56-3.42)	2.65 (1.70-3.88)
3-hr	0.336 (0.273-0.417)	0.424 (0.343-0.526)	0.576 (0.465-0.718)	0.712 (0.571-0.891)	0.913 (0.711-1.20)	1.08 (0.816-1.43)	1.25 (0.913-1.71)	1.44 (1.00-2.02)	1.71 (1.14-2.46)	1.92 (1.24-2.78)
6-hr	0.189 (0.155-0.232)	0.239 (0.196-0.295)	0.326 (0.265-0.402)	0.402 (0.325-0.498)	0.512 (0.401-0.663)	0.601 (0.458-0.788)	0.695 (0.510-0.934)	0.794 (0.556-1.10)	0.931 (0.625-1.32)	1.04 (0.678-1.49)
12-hr	0.112 (0.092-0.136)	0.136 (0.112-0.166)	0.178 (0.146-0.217)	0.214 (0.175-0.263)	0.269 (0.212-0.345)	0.313 (0.241-0.406)	0.359 (0.266-0.478)	0.409 (0.290-0.559)	0.478 (0.325-0.671)	0.533 (0.351-0.757)
24-hr	0.067 (0.056-0.081)	0.078 (0.065-0.094)	0.098 (0.081-0.119)	0.116 (0.096-0.141)	0.143 (0.115-0.182)	0.166 (0.129-0.213)	0.190 (0.142-0.250)	0.216 (0.155-0.292)	0.252 (0.174-0.351)	0.281 (0.188-0.395)
2-day	0.038 (0.032-0.046)	0.044 (0.037-0.053)	0.055 (0.046-0.066)	0.065 (0.054-0.078)	0.079 (0.063-0.099)	0.090 (0.071-0.114)	0.102 (0.077-0.133)	0.115 (0.083-0.153)	0.133 (0.092-0.182)	0.147 (0.099-0.204)
3-day	0.028 (0.023-0.033)	0.032 (0.027-0.038)	0.039 (0.033-0.047)	0.046 (0.038-0.055)	0.055 (0.045-0.068)	0.063 (0.049-0.079)	0.071 (0.054-0.091)	0.079 (0.058-0.105)	0.091 (0.064-0.124)	0.101 (0.068-0.139)
4-day	0.022 (0.019-0.026)	0.025 (0.021-0.030)	0.031 (0.026-0.037)	0.036 (0.030-0.043)	0.043 (0.035-0.053)	0.049 (0.039-0.061)	0.055 (0.042-0.070)	0.061 (0.045-0.081)	0.070 (0.049-0.095)	0.077 (0.053-0.106)
7-day	0.014 (0.012-0.017)	0.017 (0.014-0.019)	0.020 (0.017-0.024)	0.023 (0.019-0.027)	0.027 (0.022-0.033)	0.031 (0.024-0.038)	0.034 (0.026-0.043)	0.037 (0.028-0.049)	0.042 (0.030-0.056)	0.046 (0.032-0.062)
10-day	0.011 (0.010-0.013)	0.013 (0.011-0.015)	0.016 (0.013-0.018)	0.018 (0.015-0.021)	0.021 (0.017-0.025)	0.023 (0.019-0.029)	0.026 (0.020-0.032)	0.028 (0.021-0.036)	0.031 (0.022-0.041)	0.034 (0.023-0.045)
20-day	0.007 (0.006-0.009)	0.008 (0.007-0.010)	0.010 (0.009-0.012)	0.011 (0.010-0.013)	0.013 (0.011-0.016)	0.014 (0.012-0.017)	0.016 (0.012-0.019)	0.017 (0.013-0.022)	0.019 (0.013-0.024)	0.020 (0.014-0.026)
30-day	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.008-0.012)	0.011 (0.009-0.013)	0.012 (0.010-0.015)	0.013 (0.010-0.016)	0.014 (0.010-0.018)	0.015 (0.011-0.020)
45-day	0.005 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.010)	0.009 (0.007-0.011)	0.010 (0.008-0.012)	0.010 (0.008-0.013)	0.011 (0.008-0.014)	0.012 (0.008-0.015)
60-day	0.004 (0.004-0.005)	0.005 (0.004-0.005)	0.006 (0.005-0.006)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.006-0.009)	0.008 (0.007-0.010)	0.009 (0.007-0.011)	0.009 (0.007-0.012)	0.010 (0.007-0.013)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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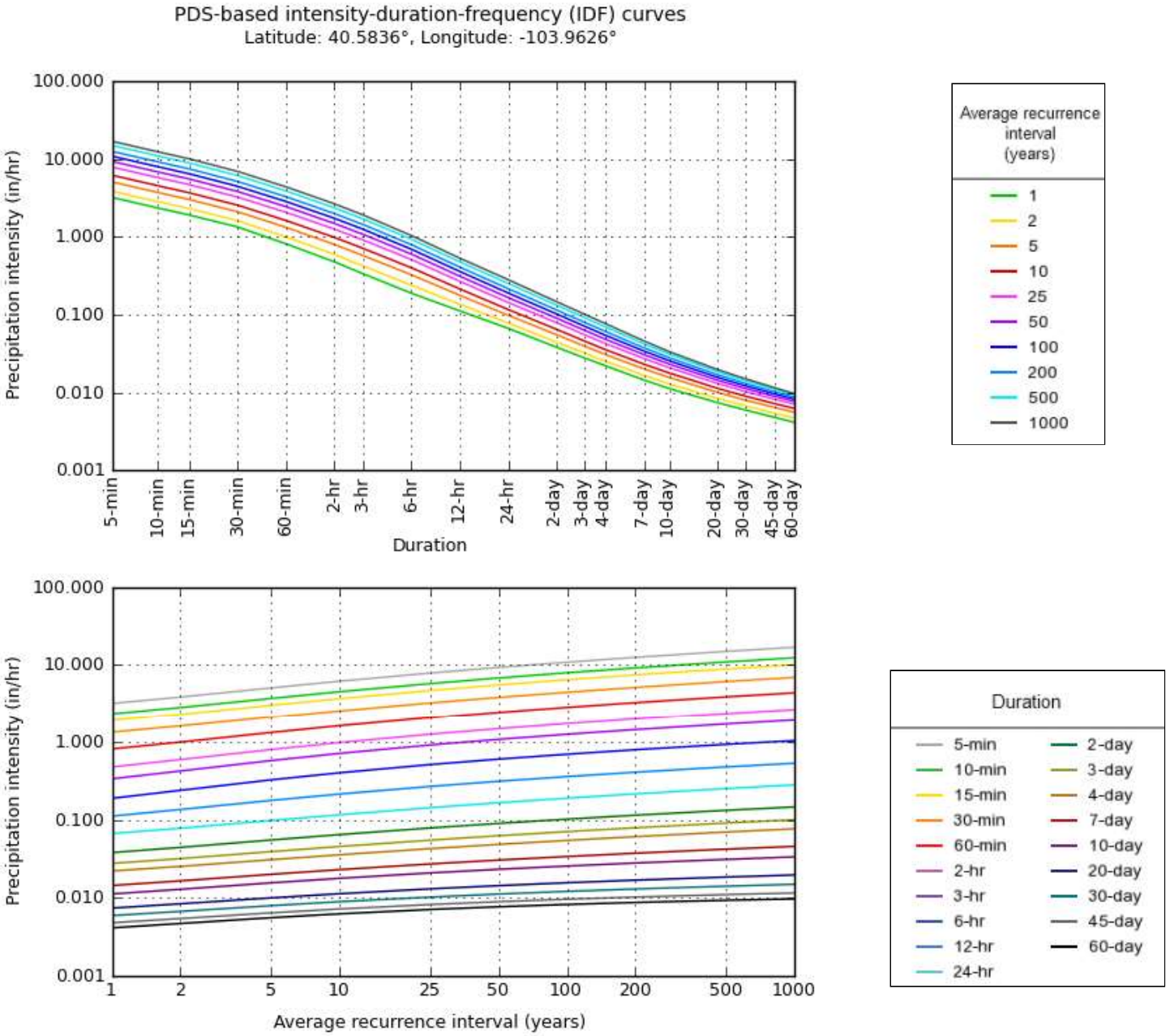
PF graphical



NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Thu Dec 2 23:29:31 2021

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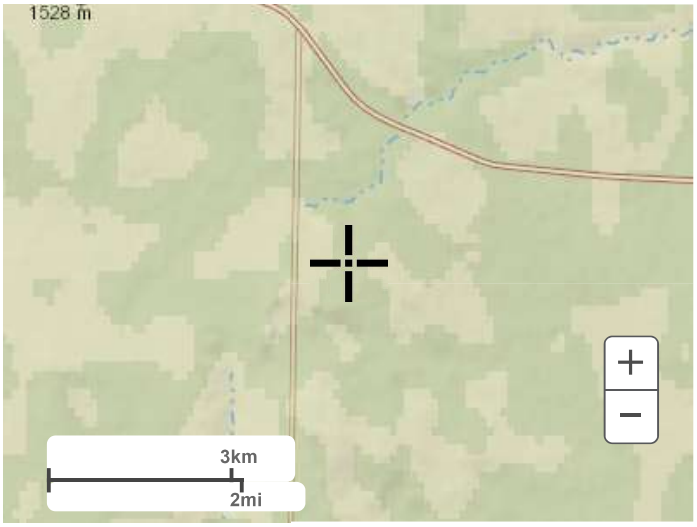
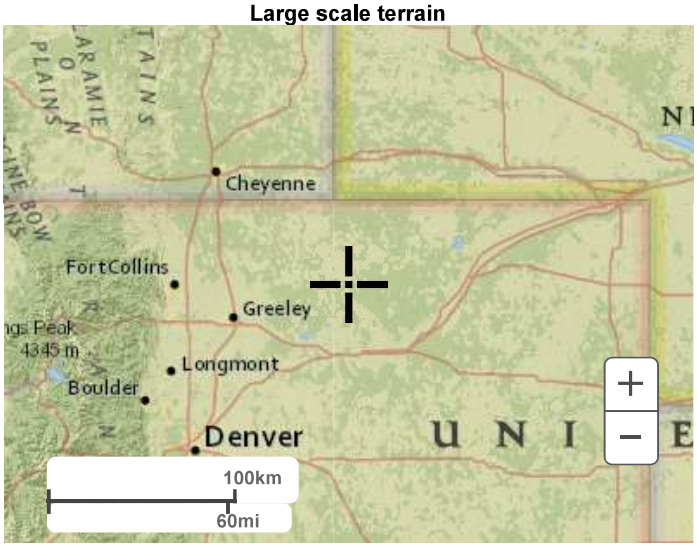
Maps & aerials

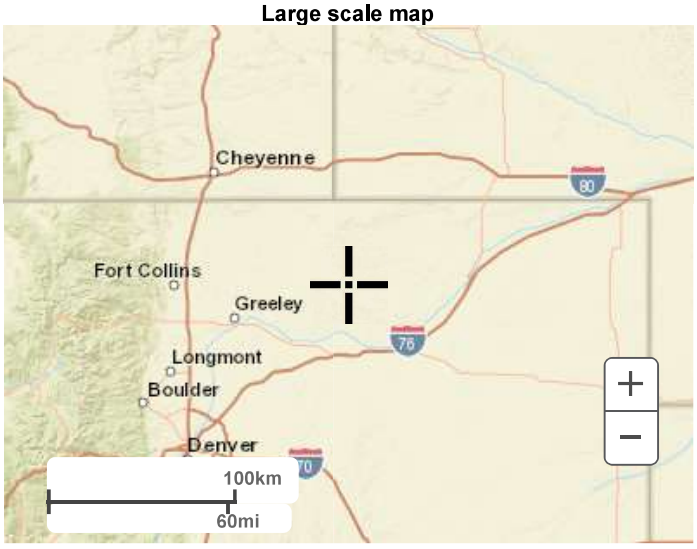
Small scale terrain



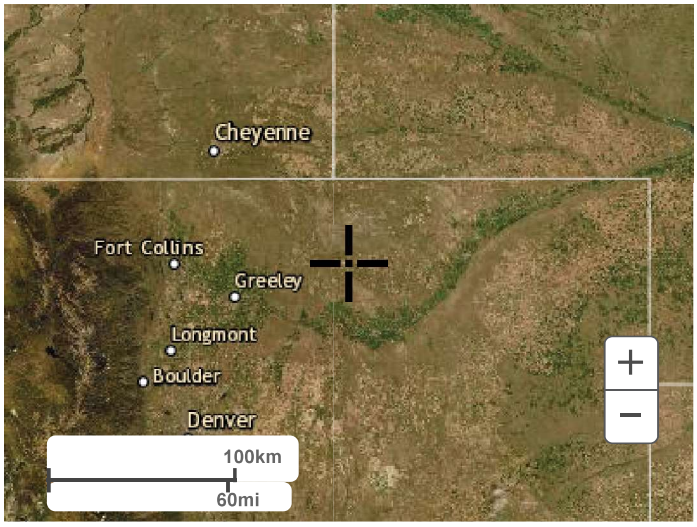
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX F – RUNOFF CALCULATIONS

1. Drainage Basin Runoff Calculations
2. Conveyance Hydraulic Calculations

WEIGHTED IMPERVIOUS SURFACE CALCULATIONS

Weld County Engineering & Construction Criteria Table 5-3 Recommended Percentage Imperviousness Values

UDFCD Vol. 1 - Table 6-3 Recommended Percentage Imperviousness Values

	Undeveloped Areas			Streets			Developed Areas			MISC.					
	Historic Flow Analysis	Greenbelts, Agricultural	Off-site flow analysis (Land Use Not Defined)	Paved	Gravel	Recycled Asphalts	Concrete Driveways	Sidewalks	Roofs	Single-Family Res. 0.75-2.5 Acres	Parks	Pond Area	Berms/ Cut/Fill Slopes/ Landscaping		
% Impervious	2%	2%	45%	100%	40%	75%	90%	90%	90%	20%	10%	100%	2%		
Basin	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Total Area (Ac)	Percent Imperv.
														0.00	0.00%
OS-1	4.45													4.45	2.00%
OS-2	3.04													3.04	2.00%
OS-3	11.41													11.41	2.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														Total: 18.90	

WEIGHTED RUNOFF COEFFICIENT VERSUS WATERSHED IMPERVIOUSNESS

METHOD AS DETAILED IN URBAN STORM DRAINAGE CRITERIA MANUAL VOL. 1 (COLORADO)

$C_A = K_A + (1.31i^3 - 1.44i^2 + 1.135i - 0.12)$ for C_A > or = 0, otherwise $C_A = 0$ (RO-6)

$C_B = (C_A + C_{CD})/2$

$C_{CD} = K_{CD} + (0.858i^3 - 0.786i^2 + 0.774i + 0.04)$ (RO-7)

i = % imperviousness/100 expressed as a decimal

K_A = Correction factor for Type A soils

K_{CD} = Correction factor for Type C and Type D soils

Correction Factors, K_A & K_{CD}

	Storm Return Period			
Soil Type	2-Year	5-Year	10-Yr	100-Year
A	0.00	$-0.08i + 0.09$	$-0.14i + 0.17$	$-0.25i + 0.32$
C or D	0.00	$-0.10i + 0.11$	$-0.18i + 0.21$	$-0.39i + 0.46$

Basin ID	% Imperv.	i	Soil Type	Correction Factors, K_A & K_{CD}			Runoff Coefficients, C				Basin Area (Ac)	Total Area (Ac)	Weighted Runoff Coefficients, C				Soil Type %
				5-Year	10-Year	100-Year	2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year	
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
OS-1	2.00%	0.02	A	0.09	0.17	0.32	0.00	0.00	0.07	0.22	0.00	4.45	0.06	0.16	0.26	0.51	
			B	-	-	-	0.03	0.08	0.17	0.36	0.00						
			C or D	0.11	0.21	0.45	0.06	0.16	0.26	0.51	4.45						100%
OS-2	2.00%	0.02	A	0.09	0.17	0.32	0.00	0.00	0.07	0.22	0.00	3.04	0.06	0.16	0.26	0.51	
			B	-	-	-	0.03	0.08	0.17	0.36	0.00						
			C or D	0.11	0.21	0.45	0.06	0.16	0.26	0.51	3.04						100%
OS-3	2.00%	0.02	A	0.09	0.17	0.32	0.00	0.00	0.07	0.22	0.00	11.41	0.06	0.16	0.26	0.51	
			B	-	-	-	0.03	0.08	0.17	0.36	0.00						
			C or D	0.11	0.21	0.45	0.06	0.16	0.26	0.51	11.41						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.05	0.05	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.05	0.10	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%

STANDARD FORM SF-2
TIME OF CONCENTRATION
METHOD AS DETAILED IN URBAN STORM DRAINAGE CRITERIA MANUAL VOL. 1 (COLORADO)

NRCS Conveyance Factors, K

Heavy Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Tillage/Field	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

Is the basin Urban or Non-Urban? Non-Urban

Design Point	Sub-Basin Data			Non-Urban - Eqn 6-3 Initial/Overland Time T(i)			Non-Urban - Eqn 6-4 Travel Time T(t)					Non-Urban	Urbanized Basin T(c)		Final T(c) (min)	Check Flow Length (Overland)
	Drainage Basin	Area (Ac)	C(5)	Length (ft)	Slope (%)	T(i) min	Length (ft)	Slope (%)	Coeff. (K)	Velocity (fps)	T(t) (min)	Comp. T(c)	Total Length	Eqn 6-5 T(c)		
1		0.00	-	500	1.0		0	1.00	10.00				500			OK
2	OS-1	4.45	0.16	500	2.5	28.1	1085	2.5	10.00	1.57	11.5	39.6	1585	26.9	26.9	OK
3	OS-2	3.04	0.16	500	4.4	23.2	405	4.4	7.00	1.47	4.6	27.7	905	20.3	20.3	OK
4	OS-3	11.41	0.16	500	3.2	25.8	730	3.2	10.00	1.78	6.8	32.7	1230	23.2	23.2	OK
5		0.00	-	500	1.0		100	1.0	10.00				600		10.0	OK
6		0.00	-	500	1.0		100	1.0	10.00				600		10.0	OK
7		0.00	-	500	1.0		100	1.0	10.00				600		10.0	OK
8		0.00	-	500	1.0		100	1.0	10.00				600		10.0	OK
9		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
10		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
11		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
12		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
13		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
14		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
15		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK

STANDARD FORM SF-3
5-YR RUNOFF - RATIONAL METHOD
METHOD AS DETAILED IN URBAN STORM DRAINAGE CRITERIA MANUAL VOL. 1 (COLORADO)

5-Yr Rainfall Depth-Duration-Frequency (1-hr) = *1.32* *in/hr*

Design Storm: *5 Year*

BASIN INFORMATION				DIRECT RUNOFF				TOTAL RUNOFF				
Design Point	Drainage Basin	Area (Ac)	Runoff Coeff.	T(c) (min)	C x A	I (in/hr)	Q (cfs)	T(c) (min)	Sum C x A	I (in/hr)	Q (cfs)	REMARKS
1		0.00	-									
2	OS-1	4.45	0.16	26.9	0.73	2.20	1.6					
3	OS-2	3.04	0.16	20.3	0.50	2.58	1.3					
4	OS-3	11.41	0.16	23.2	1.86	2.40	4.5					
5		0.00	-									
6		0.00	-									
7		0.00	-									
8		0.00	-									
9		0.00	-									
10		0.00	-									
11		0.00	-									
12		0.00	-									
13		0.00	-									
14		0.00	-									
15		0.00	-									

STANDARD FORM SF-3
100-YR RUNOFF - RATIONAL METHOD
METHOD AS DETAILED IN URBAN STORM DRAINAGE CRITERIA MANUAL VOL. 1 (COLORADO)

100-Yr Rainfall Depth-Duration-Frequency (1-hr) = *2.84* *in/hr*

Design Storm: *100 Year*

BASIN INFORMATION				DIRECT RUNOFF				TOTAL RUNOFF				
Design Point	Drainage Basin	Area (Ac)	Runoff Coeff.	T(c) (min)	C x A	I (in/hr)	Q (cfs)	T(c) (min)	Sum C x A	I (in/hr)	Q (cfs)	REMARKS
1		0.00	-									
2	OS-1	4.45	0.51	26.9	2.26	4.74	10.7					
3	OS-2	3.04	0.51	20.3	1.54	5.55	8.6					
4	OS-3	11.41	0.51	23.2	5.79	5.16	29.9					
5		0.00	-									
6		0.00	-									
7		0.00	-									
8		0.00	-									
9		0.00	-									
10		0.00	-									
11		0.00	-									
12		0.00	-									
13		0.00	-									
14		0.00	-									
15		0.00	-									

Worksheet for Off-Site Ditch-1 (5-Yr)_2ft FB

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.25000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	1.60	ft³/s

Results

Normal Depth	0.37	ft
Flow Area	1.01	ft²
Wetted Perimeter	3.65	ft
Hydraulic Radius	0.28	ft
Top Width	3.48	ft
Critical Depth	0.25	ft
Critical Slope	0.01037	ft/ft
Velocity	1.58	ft/s
Velocity Head	0.04	ft
Specific Energy	0.41	ft
Froude Number	0.52	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.37	ft
Critical Depth	0.25	ft
Channel Slope	0.25000	%

Worksheet for Off-Site Ditch-1 (5-Yr)_2ft FB

GVF Output Data

Critical Slope	0.01037	ft/ft

Worksheet for Off-Site Ditch-1 (100-Yr)_2ft FB

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.25000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	10.70	ft³/s

Results

Normal Depth	1.00	ft
Flow Area	3.98	ft²
Wetted Perimeter	6.46	ft
Hydraulic Radius	0.62	ft
Top Width	5.98	ft
Critical Depth	0.75	ft
Critical Slope	0.00792	ft/ft
Velocity	2.69	ft/s
Velocity Head	0.11	ft
Specific Energy	1.11	ft
Froude Number	0.58	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.75	ft
Channel Slope	0.25000	%

Worksheet for Off-Site Ditch-1 (100-Yr)_2ft FB

GVF Output Data

Critical Slope	0.00792	ft/ft

Worksheet for Off-Site Ditch-2 (5-Yr)_2ft FB

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.25000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	4.50	ft³/s

Results

Normal Depth	0.64	ft
Flow Area	2.11	ft²
Wetted Perimeter	4.88	ft
Hydraulic Radius	0.43	ft
Top Width	4.57	ft
Critical Depth	0.46	ft
Critical Slope	0.00890	ft/ft
Velocity	2.13	ft/s
Velocity Head	0.07	ft
Specific Energy	0.71	ft
Froude Number	0.55	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.64	ft
Critical Depth	0.46	ft
Channel Slope	0.25000	%

Worksheet for Off-Site Ditch-2 (5-Yr)_2ft FB

GVF Output Data

Critical Slope	0.00890	ft/ft

Worksheet for Off-Site Ditch-2 (100-Yr)_2ft FB

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.25000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	29.90	ft³/s

Results

Normal Depth	1.62	ft
Flow Area	8.51	ft²
Wetted Perimeter	9.26	ft
Hydraulic Radius	0.92	ft
Top Width	8.49	ft
Critical Depth	1.28	ft
Critical Slope	0.00694	ft/ft
Velocity	3.51	ft/s
Velocity Head	0.19	ft
Specific Energy	1.81	ft
Froude Number	0.62	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.62	ft
Critical Depth	1.28	ft
Channel Slope	0.25000	%

Worksheet for Off-Site Ditch-2 (100-Yr)_2ft FB

GVF Output Data

Critical Slope	0.00694	ft/ft

APPENDIX G – DETENTION POND CALCULATIONS

1. Drill Phase
2. Production Phase

DETENTION VOLUME BY THE MODIFIED FAA METHOD

Project: CASTOR 7-59 10

Basin ID: DRILL PHASE

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)

(NOTE: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

Determination of MINOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	56.80	percent
Catchment Drainage Area	A =	8.690	acres
Predevelopment NRCS Soil Group	Type =	C	A, B, C, or D
Return Period for Detention Control	T =	10	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	59	minutes
Allowable Unit Release Rate	q =	0.64	cfs/acre
One-hour Precipitation	P_1 =	1.62	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.49	
Inflow Peak Runoff	Qp-in =	6.96	cfs
Allowable Peak Outflow Rate	Qp-out =	**5.60**	cfs
Mod. FAA Minor Storage Volume =		9,375	**cubic feet**
Mod. FAA Minor Storage Volume =		**0.215**	**acre-ft**

9 <- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
0	0.00	0.000	0.00	0.00	0.000	0.000
9	4.52	0.239	1.00	5.60	0.069	0.169
18	3.33	0.352	1.00	5.60	0.139	0.213
27	2.67	0.423	1.00	5.60	0.208	0.215
36	2.25	0.475	1.00	5.60	0.278	0.198
45	1.96	0.516	1.00	5.60	0.347	0.169
54	1.73	0.549	1.00	5.60	0.416	0.133
63	1.56	0.578	0.97	5.42	0.470	0.108
72	1.43	0.603	0.91	5.09	0.505	0.098
81	1.31	0.624	0.86	4.84	0.540	0.085
90	1.22	0.644	0.83	4.63	0.574	0.070
99	1.14	0.662	0.80	4.47	0.609	0.053
108	1.07	0.678	0.77	4.33	0.644	0.035
117	1.01	0.693	0.75	4.21	0.678	0.015
126	0.96	0.707	0.73	4.11	0.713	-0.006
135	0.91	0.721	0.72	4.02	0.748	-0.027
144	0.87	0.733	0.70	3.94	0.782	-0.050
153	0.83	0.745	0.69	3.88	0.817	-0.073
162	0.80	0.756	0.68	3.82	0.852	-0.096
171	0.76	0.766	0.67	3.76	0.886	-0.120
180	0.74	0.776	0.66	3.72	0.921	-0.145
189	0.71	0.786	0.66	3.67	0.956	-0.170
198	0.68	0.795	0.65	3.63	0.991	-0.196
207	0.66	0.804	0.64	3.60	1.025	-0.221
216	0.64	0.812	0.64	3.56	1.060	-0.248
225	0.62	0.820	0.63	3.53	1.095	-0.274
234	0.60	0.828	0.63	3.50	1.129	-0.301
243	0.59	0.836	0.62	3.48	1.164	-0.328
252	0.57	0.843	0.62	3.45	1.199	-0.355
261	0.56	0.850	0.61	3.43	1.233	-0.383
270	0.54	0.857	0.61	3.41	1.268	-0.411
279	0.53	0.864	0.61	3.39	1.303	-0.439
288	0.52	0.871	0.60	3.37	1.337	-0.467
297	0.50	0.877	0.60	3.35	1.372	-0.495
306	0.49	0.883	0.60	3.34	1.407	-0.524
315	0.48	0.889	0.59	3.32	1.441	-0.552
324	0.47	0.895	0.59	3.31	1.476	-0.581
333	0.46	0.901	0.59	3.29	1.511	-0.610
342	0.45	0.907	0.59	3.28	1.546	-0.639
351	0.44	0.912	0.58	3.27	1.580	-0.668
360	0.43	0.918	0.58	3.26	1.615	-0.697
369	0.43	0.923	0.58	3.25	1.650	-0.727
378	0.42	0.928	0.58	3.23	1.684	-0.756
387	0.41	0.933	0.58	3.22	1.719	-0.786
396	0.40	0.938	0.57	3.22	1.754	-0.816
405	0.40	0.943	0.57	3.21	1.788	-0.845
414	0.39	0.948	0.57	3.20	1.823	-0.875
423	0.38	0.952	0.57	3.19	1.858	-0.905
432	0.38	0.957	0.57	3.18	1.892	-0.935
441	0.37	0.961	0.57	3.17	1.927	-0.966
450	0.37	0.966	0.57	3.17	1.962	-0.996
459	0.36	0.970	0.56	3.16	1.996	-1.026
468	0.36	0.975	0.56	3.15	2.031	-1.057
477	0.35	0.979	0.56	3.14	2.066	-1.087
486	0.34	0.983	0.56	3.14	2.101	-1.118
495	0.34	0.987	0.56	3.13	2.135	-1.148
504	0.34	0.991	0.56	3.13	2.170	-1.179
513	0.33	0.995	0.56	3.12	2.205	-1.210
522	0.33	0.999	0.56	3.11	2.239	-1.240
531	0.32	1.003	0.56	3.11	2.274	-1.271
540	0.32	1.007	0.55	3.10	2.309	-1.302

Mod. FAA Minor Storage Volume (cubic ft.) = 9,375

Mod. FAA Minor Storage Volume (acre-ft.) = 0.2152

Determination of MAJOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	56.80	percent
Catchment Drainage Area	A =	8.690	acres
Predevelopment NRCS Soil Group	Type =	C	A, B, C, or D
Return Period for Detention Control	T =	100	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	59	minutes
Allowable Unit Release Rate	q =	0.64	cfs/acre
One-hour Precipitation	P_1 =	2.84	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.62	
Inflow Peak Runoff	Qp-in =	15.44	cfs
Allowable Peak Outflow Rate	Qp-out =	**5.60**	cfs
Mod. FAA Major Storage Volume =		37,491	**cubic feet**
Mod. FAA Major Storage Volume =		**0.861**	**acre-ft**

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
0	0.00	0.000	0.00	0.00	0.000	0.000
9	7.93	0.530	1.00	5.60	0.069	0.460
18	5.84	0.780	1.00	5.60	0.139	0.641
27	4.69	0.939	1.00	5.60	0.208	0.731
36	3.95	1.054	1.00	5.60	0.278	0.777
45	3.43	1.145	1.00	5.60	0.347	0.798
54	3.04	1.219	1.00	5.60	0.416	0.803
63	2.74	1.282	0.97	5.42	0.470	0.812
72	2.50	1.337	0.91	5.09	0.505	0.832
81	2.30	1.385	0.86	4.84	0.540	0.845
90	2.14	1.429	0.83	4.63	0.574	0.854
99	2.00	1.468	0.80	4.47	0.609	0.859
108	1.88	1.504	0.77	4.33	0.644	0.861
117	1.77	1.538	0.75	4.21	0.678	0.860
126	1.68	1.569	0.73	4.11	0.713	0.856
135	1.60	1.598	0.72	4.02	0.748	0.851
144	1.52	1.626	0.70	3.94	0.782	0.843
153	1.45	1.652	0.69	3.88	0.817	0.835
162	1.39	1.676	0.68	3.82	0.852	0.824
171	1.34	1.700	0.67	3.76	0.886	0.813
180	1.29	1.722	0.66	3.72	0.921	0.801
189	1.24	1.743	0.66	3.67	0.956	0.787
198	1.20	1.763	0.65	3.63	0.991	0.773
207	1.16	1.783	0.64	3.60	1.025	0.758
216	1.12	1.802	0.64	3.56	1.060	0.742
225	1.09	1.820	0.63	3.53	1.095	0.725
234	1.06	1.837	0.63	3.50	1.129	0.708
243	1.03	1.854	0.62	3.48	1.164	0.690
252	1.00	1.871	0.62	3.45	1.199	0.672
261	0.97	1.887	0.61	3.43	1.233	0.653
270	0.95	1.902	0.61	3.41	1.268	0.634
279	0.93	1.917	0.61	3.39	1.303	0.614
288	0.90	1.931	0.60	3.37	1.337	0.594
297	0.88	1.946	0.60	3.35	1.372	0.573
306	0.86	1.959	0.60	3.34	1.407	0.553
315	0.84	1.973	0.59	3.32	1.441	0.531
324	0.83	1.986	0.59	3.31	1.476	0.510
333	0.81	1.999	0.59	3.29	1.511	0.488
342	0.79	2.011	0.59	3.28	1.546	0.466
351	0.78	2.023	0.58	3.27	1.580	0.443
360	0.76	2.035	0.58	3.26	1.615	0.420
369	0.75	2.047	0.58	3.25	1.650	0.397
378	0.73	2.058	0.58	3.23	1.684	0.374
387	0.72	2.070	0.58	3.22	1.719	0.351
396	0.71	2.081	0.57	3.22	1.754	0.327
405	0.70	2.091	0.57	3.21	1.788	0.303
414	0.68	2.102	0.57	3.20	1.823	0.279
423	0.67	2.112	0.57	3.19	1.858	0.255
432	0.66	2.123	0.57	3.18	1.892	0.230
441	0.65	2.133	0.57	3.17	1.927	0.206
450	0.64	2.143	0.57	3.17	1.962	0.181
459	0.63	2.152	0.56	3.16	1.996	0.156
468	0.62	2.162	0.56	3.15	2.031	0.131
477	0.61	2.171	0.56	3.14	2.066	0.105
486	0.60	2.180	0.56	3.14	2.101	0.080
495	0.60	2.190	0.56	3.13	2.135	0.054
504	0.59	2.198	0.56	3.13	2.170	0.029
513	0.58	2.207	0.56	3.12	2.205	0.003
522	0.57	2.216	0.56	3.11	2.239	-0.023
531	0.56	2.225	0.56	3.11	2.274	-0.049
540	0.56	2.233	0.55	3.10	2.309	-0.076

Mod. FAA Major Storage Volume (cubic ft.) = 37,491

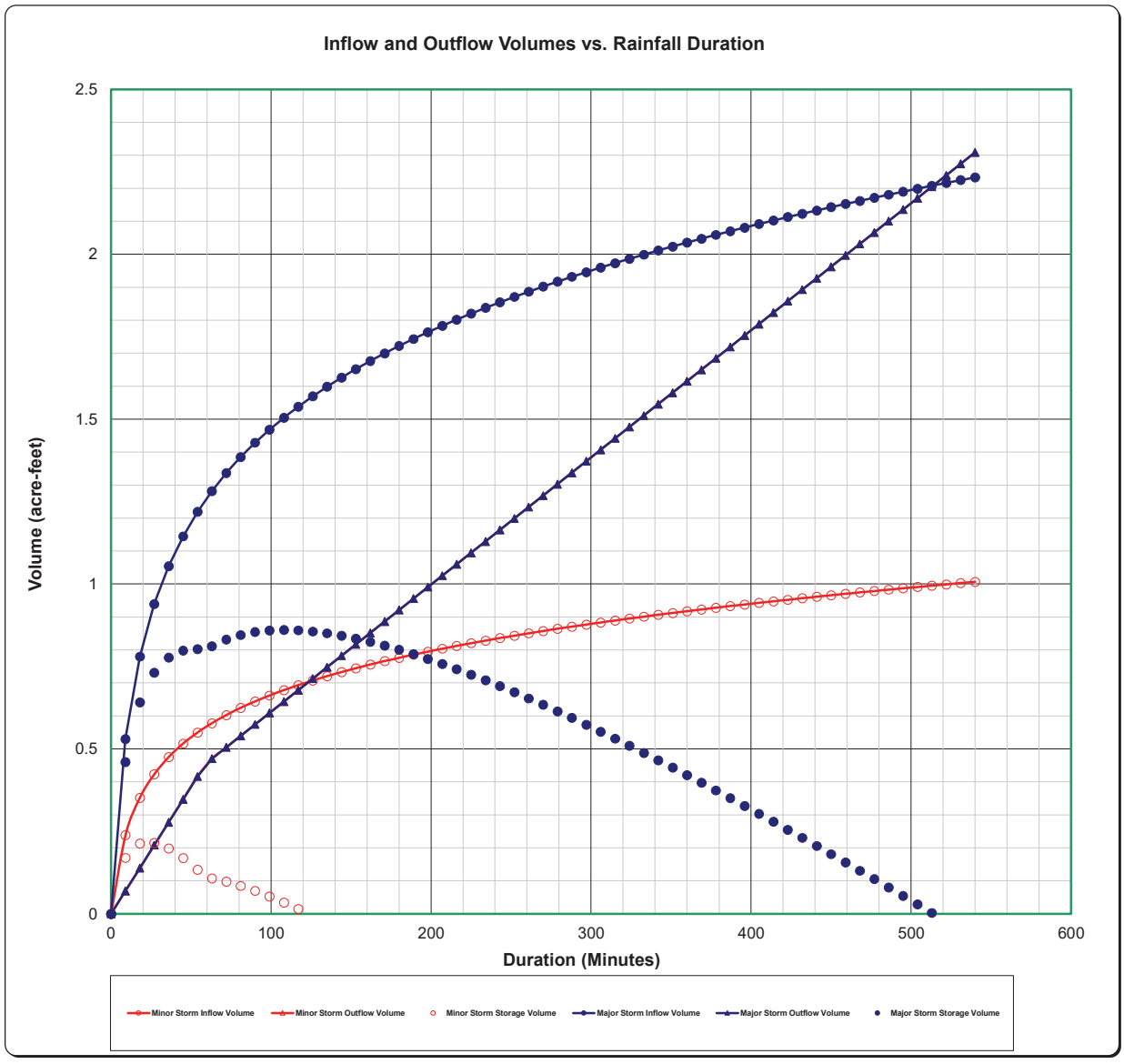
Mod. FAA Major Storage Volume (acre-ft.) = 0.8607

UDFCD DETENTION BASIN VOLUME ESTIMATING WORKBOOK Version 2.35, Released January 2015

DETENTION VOLUME BY THE MODIFIED FAA METHOD

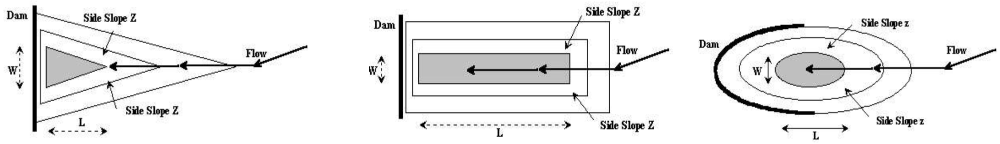
Project: CASTOR 7-59 10

Basin ID: DRILL PHASE



STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: **CASTOR 7-59 10**
Basin ID: **DRILL PHASE DETENTION POND**



Design Information (Input):

Width of Basin Bottom, W =	85.00	ft
Length of Basin Bottom, L =	170.00	ft
Dam Side-slope (H:V), Z_d =	4.00	ft/ft

Check Basin Shape

Right Triangle		OR…
Isosceles Triangle		OR…
Rectangle	X	OR…
Circle / Ellipse		OR…
Irregular		(Use Overide values in cells G32:G52)

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':	0.22	0.86	acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':			acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Water Surface Elevation ft (input)	Side Slope (H:V) ft/ft Below El. (input)	Basin Width at Stage ft (output)	Basin Length at Stage ft (output)	Surface Area at Stage ft² (output)	Surface Area at Stage ft² User Overide	Volume Below Stage ft³ (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
	4960.60		85.00	170.00	14,450.0	0		0.000	0.000	
	4960.70		85.00	170.40	14,484.0	105,467	5,273	2.421	0.121	
	4960.80		85.00	170.80	14,518.0	115,914	16,342	2.661	0.375	WQCV
	4960.90		85.00	171.20	14,552.0	126,165	28,446	2.896	0.653	
	4961.00		85.00	171.60	14,586.0	136,222	41,566	3.127	0.954	100-YR WSEL
	4961.10		85.00	172.00	14,620.0	146,086	55,681	3.354	1.278	
	4961.20		85.00	172.40	14,654.0	155,756	70,773	3.576	1.625	
	4961.30		85.00	172.80	14,688.0	165,234	86,823	3.793	1.993	
	4961.40		85.00	173.20	14,722.0	174,518	103,810	4.006	2.383	
	4961.50		85.00	173.60	14,756.0	183,610	121,717	4.215	2.794	
SPILLWAY	4961.60		85.00	174.00	14,790.0	192,508	140,523	4.419	3.226	
	4961.70		85.00	174.40	14,824.0	201,213	160,209	4.619	3.678	
	4961.80		85.00	174.80	14,858.0	209,725	180,756	4.815	4.150	
	4961.90		85.00	175.20	14,892.0	218,043	202,144	5.006	4.641	
	4962.00		85.00	175.60	14,926.0	226,170	224,355	5.192	5.150	
	4962.10		85.00	176.00	14,960.0	234,104	247,368	5.374	5.679	
	4962.20		85.00	176.40	14,994.0	241,846	271,166	5.552	6.225	
	4962.30		85.00	176.80	15,028.0	249,396	295,728	5.725	6.789	
	4962.40		85.00	177.20	15,062.0	256,753	321,035	5.894	7.370	
	4962.50		85.00	177.60	15,096.0	263,917	347,069	6.059	7.968	
CREST	4962.60		85.00	178.00	15,130.0	267,796	373,655	6.148	8.578	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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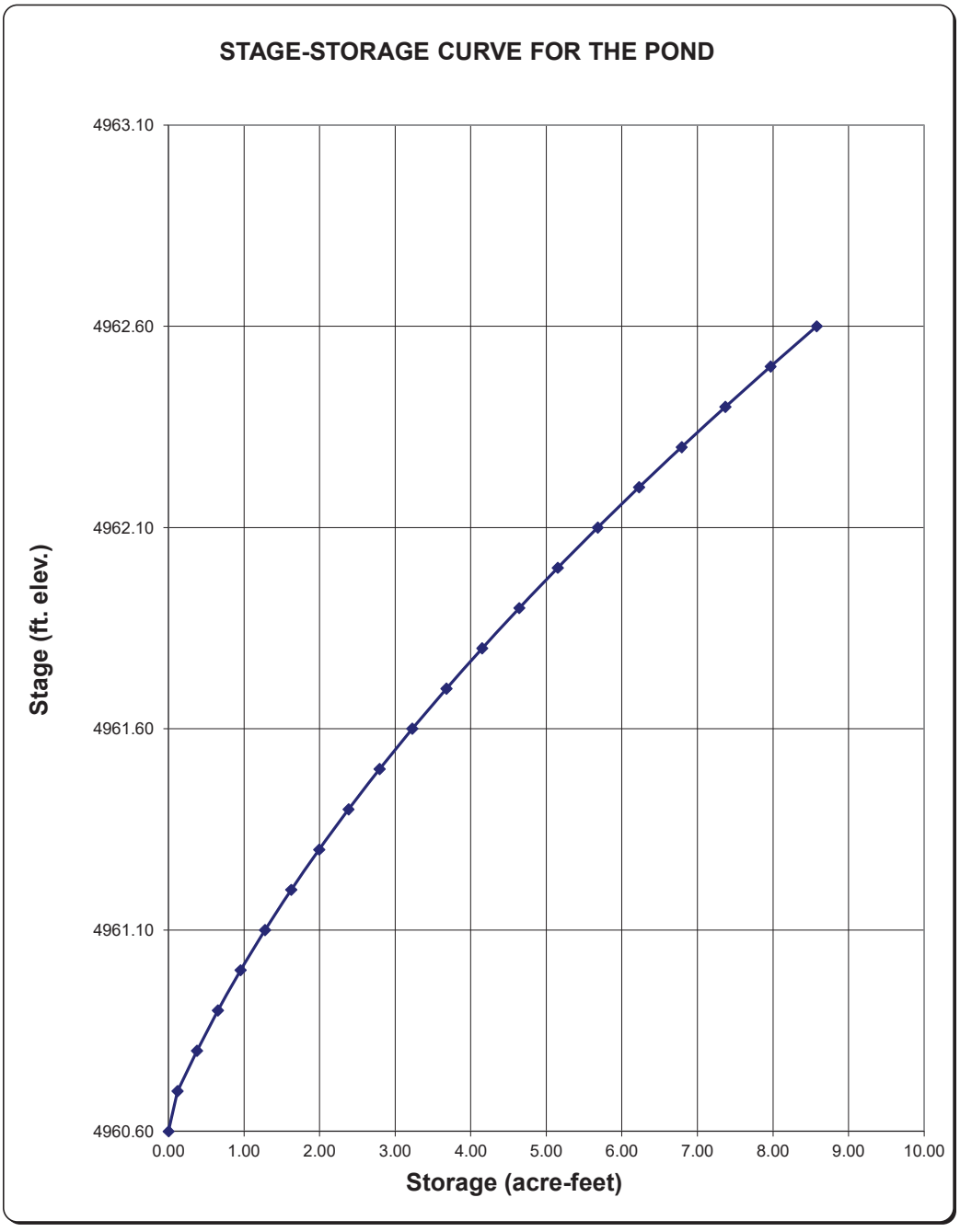
							#N/A		#N/A	

STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: _____

Basin ID: _____



STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: **Castor 7-59 10**
Basin ID: **Drill Phase - Detention**

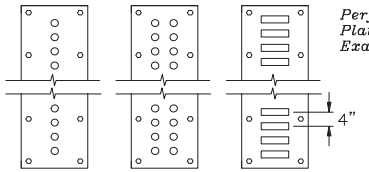
WQCV Design Volume (Input):

Catchment Imperviousness, I_a = 57.0 percent
Catchment Area, A = 8.69 acres
Depth at WQCV outlet above lowest perforation, H = 1 feet
Vertical distance between rows, h = 3.00 inches
Number of rows, NL = 4.00
Orifice discharge coefficient, C_o = 0.68
Slope of Basin Trickle Channel, S = 0.004 ft / ft
Time to Drain the Pond = 72 hours

Diameter of holes, D = 0.678 inches
Number of holes per row, N = 1
OR
Height of slot, H = inches
Width of slot, W = inches

Watershed Design Information (Input):

Percent Soil Type A = %
Percent Soil Type B = %
Percent Soil Type C/D = 100 %



Outlet Design Information (Output):

Water Quality Capture Volume, WQCV = 0.327 watershed inches
Water Quality Capture Volume (WQCV) = 0.236 acre-feet
Design Volume (WQCV / 12 * Area * 1.2) Vol = 0.284 acre-feet
Outlet area per row, Ao = 0.38 square inches
Total opening area at each row based on user-input above, Ao = 0.36 square inches
Total opening area at each row based on user-input above, Ao = 0.003 square feet

3

	Central Elevations of Rows of Holes in feet																								**Σ Flow**
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	Row 23	Row 23	
	4960.60	4960.85	4961.10	4961.35																					
	Collection Capacity for Each Row of Holes in cfs																								
4960.60	0.0000	0.0000	0.0000	0.0000																					**0.00**
4960.70	0.0043	0.0000	0.0000	0.0000																					**0.00**
4960.80	0.0061	0.0000	0.0000	0.0000																					**0.01**
4960.90	0.0075	0.0031	0.0000	0.0000																					**0.01**
4961.00	0.0086	0.0053	0.0000	0.0000																					**0.01**
4961.10	0.0097	0.0068	0.0000	0.0000																					**0.02**
4961.20	0.0106	0.0081	0.0043	0.0000																					**0.02**
4961.30	0.0114	0.0092	0.0061	0.0000																					**0.03**
4961.40	0.0122	0.0101	0.0075	0.0031																					**0.03**
4961.50	0.0130	0.0110	0.0086	0.0053																					**0.04**
4961.60	0.0137	0.0118	0.0097	0.0068																					**0.04**
4961.70	0.0143	0.0126	0.0106	0.0081																					**0.05**
4961.80	0.0150	0.0133	0.0114	0.0092																					**0.05**
4961.90	0.0156	0.0140	0.0122	0.0101																					**0.05**
4962.00	0.0162	0.0147	0.0130	0.0110																					**0.05**
4962.10	0.0167	0.0153	0.0137	0.0118																					**0.06**
4962.20	0.0173	0.0159	0.0143	0.0126																					**0.06**
4962.30	0.0178	0.0165	0.0150	0.0133																					**0.06**
4962.40	0.0183	0.0170	0.0156	0.0140																					**0.06**
4962.50	0.0189	0.0176	0.0162	0.0147																					**0.07**
4962.60	0.0193	0.0181	0.0167	0.0153																					**0.07**
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
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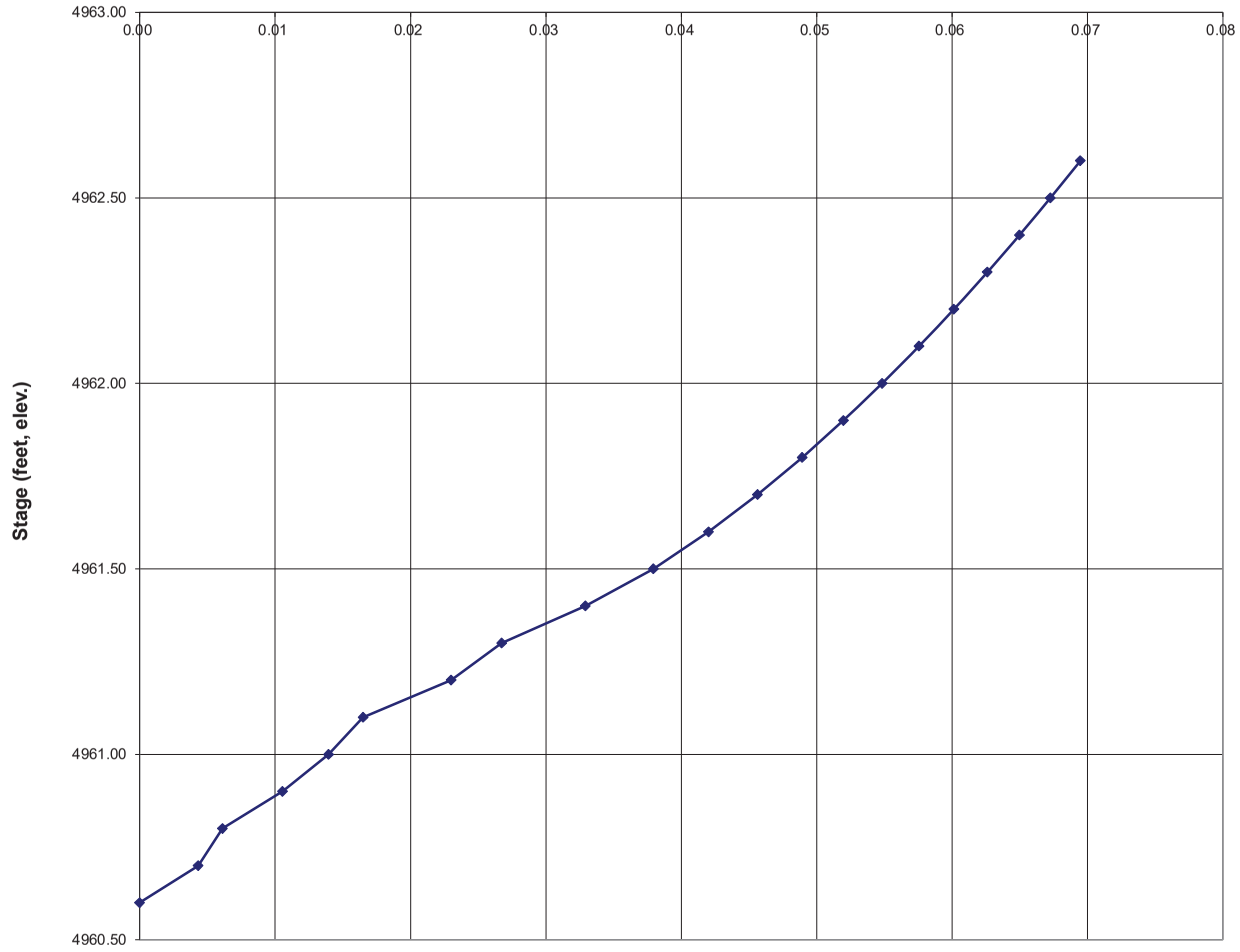
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
	Override Area Row 1	Override Area Row 2	Override Area Row 3	Override Area Row 4	Override Area Row 5	Override Area Row 6	Override Area Row 7	Override Area Row 8	Override Area Row 9	Override Area Row 10	Override Area Row 11	Override Area Row 12	Override Area Row 13	Override Area Row 14	Override Area Row 15	Override Area Row 16	Override Area Row 17	Override Area Row 18	Override Area Row 19	Override Area Row 20	Override Area Row 21	Override Area Row 22	Override Area Row 23	Override Area Row 24	

STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Worksheet Protected

Project: Castor 7-59 10

Basin ID: Drill Phase - Detention

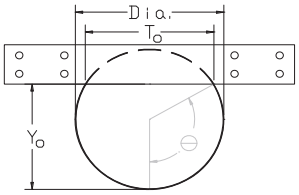


RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICAL ORIFICES

Project: _____

Basin ID: _____

X



		#1 Vertical Orifice	#2 Vertical Orifice	
Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)				
Water Surface Elevation at Design Depth	Elev: WS =	4,962.60		feet
Pipe/Vertical Orifice Entrance Invert Elevation	Elev: Invert =	4,960.60		feet
Required Peak Flow through Orifice at Design Depth	Q =	5.60		cfs
Pipe/Vertical Orifice Diameter (inches)	Dia =	14.0		inches
Orifice Coefficient	C_o =	0.55		
Full-flow Capacity (Calculated)				
Full-flow area	Af =	1.07		sq ft
Half Central Angle in Radians	Theta =	3.14		rad
Full-flow capacity	Qf =	5.6		cfs
	Percent of Design Flow =	100%		
Calculation of Orifice Flow Condition				
Half Central Angle (0<Theta<3.1416)	Theta =	2.79		rad
Flow area	A_o =	1.06		sq ft
Top width of Orifice (inches)	T_o =	4.86		inches
Height from Invert of Orifice to Bottom of Plate (feet)	Y_o =	1.13		feet
Elevation of Bottom of Plate	Elev Plate Bottom Edge =	4,961.73		feet
Resultant Peak Flow Through Orifice at Design Depth	Q_o =	5.6		cfs
Width of Equivalent Rectangular Vertical Orifice	**Equivalent Width =**	**0.94**		**feet**

STAGE-DISCHARGE SIZING OF THE SPILLWAY

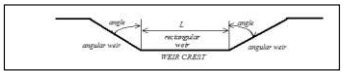
STAGE-DISCHARGE SIZING OF THE SPILLWAY

Project: ______________________

Basin ID: ______________________

Project: ______________________

Basin ID: ______________________



Design Information (input):

Bottom Length of Weir	L =	22.00	feet
Angle of Side Slope Weir	Angle =	75.96	degrees
Elev. for Weir Crest	EL. Crest =	4,961.50	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)	
4960.60	0.00	0.00	0.00	0.00	
4960.70	0.00	0.00	0.00	0.00	
4960.80	0.00	0.00	0.00	0.00	
4960.90	0.00	0.00	0.00	0.00	
4961.00	0.00	0.00	0.00	0.00	
4961.10	0.00	0.00	0.00	0.00	
4961.20	0.00	0.00	0.00	0.00	
4961.30	0.00	0.00	0.00	0.00	
4961.40	0.00	0.00	0.00	0.00	
4961.50	0.00	0.00	0.00	0.00	SPILLWAY
4961.60	2.09	0.04	2.13	2.13	
4961.70	5.90	0.21	6.12	6.12	
4961.80	10.84	0.59	11.44	11.44	
4961.90	16.70	1.21	17.91	17.91	
4962.00	23.33	2.12	25.46	25.46	100-YR FLOW =24.04 CFS
4962.10	30.67	3.35	34.02	34.02	(BASIN A+OS-2)
4962.20	38.65	4.92	43.57	43.57	
4962.30	47.23	6.87	54.09	54.09	
4962.40	56.35	9.22	65.57	65.57	
4962.50	66.00	12.00	78.00	78.00	
4962.60	76.14	15.22	91.37	91.37	
#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	
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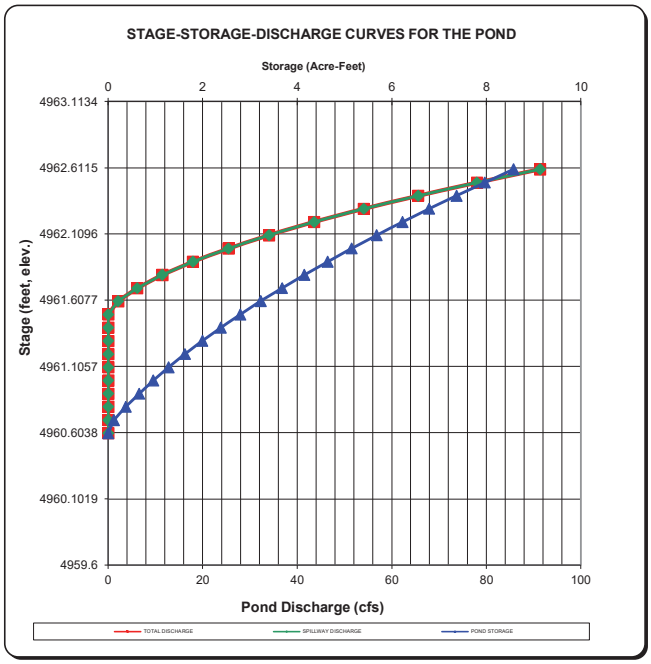

STAGE-STORAGE-DISCHARGE CURVES FOR THE POND

DETENTION VOLUME BY THE MODIFIED FAA METHOD

Project: CASTOR 7-59 10

Basin ID: PROD PHASE

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)

(NOTE: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

Determination of MINOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	53.60	percent
Catchment Drainage Area	A =	6.750	acres
Predevelopment NRCS Soil Group	Type =	C	A, B, C, or D
Return Period for Detention Control	T =	10	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	68	minutes
Allowable Unit Release Rate	q =	0.83	cfs/acre
One-hour Precipitation	P_1 =	1.62	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.47	
Inflow Peak Runoff	Qp-in =	4.71	cfs
Allowable Peak Outflow Rate	Qp-out =	**5.60**	cfs
Mod. FAA Minor Storage Volume =		5,362	**cubic feet**
Mod. FAA Minor Storage Volume =		**0.123**	**acre-ft**

6 <- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
0	0.00	0.000	0.00	0.00	0.000	0.000
6	5.18	0.136	1.00	5.60	0.046	0.090
12	4.03	0.211	1.00	5.60	0.093	0.119
18	3.33	0.262	1.00	5.60	0.139	0.123
24	2.86	0.300	1.00	5.60	0.185	0.115
30	2.51	0.330	1.00	5.60	0.232	0.098
36	2.25	0.354	1.00	5.60	0.278	0.076
42	2.04	0.375	1.00	5.60	0.324	0.051
48	1.88	0.393	1.00	5.60	0.370	0.023
54	1.73	0.409	1.00	5.60	0.417	-0.007
60	1.62	0.424	1.00	5.60	0.463	-0.039
66	1.51	0.437	1.00	5.60	0.509	-0.072
72	1.43	0.449	0.97	5.45	0.540	-0.091
78	1.35	0.460	0.94	5.24	0.563	-0.103
84	1.28	0.470	0.90	5.07	0.586	-0.116
90	1.22	0.480	0.88	4.92	0.610	-0.130
96	1.17	0.489	0.85	4.79	0.633	-0.144
102	1.12	0.497	0.83	4.67	0.656	-0.159
108	1.07	0.505	0.81	4.57	0.679	-0.174
114	1.03	0.513	0.80	4.47	0.702	-0.189
120	0.99	0.520	0.78	4.39	0.725	-0.205
126	0.96	0.527	0.77	4.31	0.749	-0.222
132	0.93	0.534	0.76	4.24	0.772	-0.238
138	0.90	0.540	0.75	4.18	0.795	-0.255
144	0.87	0.546	0.74	4.12	0.818	-0.272
150	0.84	0.552	0.73	4.07	0.841	-0.289
156	0.82	0.558	0.72	4.02	0.864	-0.307
162	0.80	0.563	0.71	3.98	0.887	-0.324
168	0.77	0.568	0.70	3.94	0.911	-0.342
174	0.75	0.573	0.70	3.90	0.934	-0.360
180	0.74	0.578	0.69	3.86	0.957	-0.379
186	0.72	0.583	0.68	3.83	0.980	-0.397
192	0.70	0.588	0.68	3.79	1.003	-0.415
198	0.68	0.592	0.67	3.76	1.026	-0.434
204	0.67	0.597	0.67	3.74	1.050	-0.453
210	0.65	0.601	0.66	3.71	1.073	-0.472
216	0.64	0.605	0.66	3.68	1.096	-0.491
222	0.63	0.609	0.65	3.66	1.119	-0.510
228	0.62	0.613	0.65	3.64	1.142	-0.529
234	0.60	0.617	0.65	3.62	1.165	-0.548
240	0.59	0.621	0.64	3.59	1.188	-0.567
246	0.58	0.625	0.64	3.58	1.212	-0.587
252	0.57	0.628	0.63	3.56	1.235	-0.606
258	0.56	0.632	0.63	3.54	1.258	-0.626
264	0.55	0.635	0.63	3.52	1.281	-0.646
270	0.54	0.639	0.63	3.51	1.304	-0.665
276	0.53	0.642	0.62	3.49	1.327	-0.685
282	0.52	0.645	0.62	3.48	1.350	-0.705
288	0.52	0.649	0.62	3.46	1.374	-0.725
294	0.51	0.652	0.62	3.45	1.397	-0.745
300	0.50	0.655	0.61	3.44	1.420	-0.765
306	0.49	0.658	0.61	3.42	1.443	-0.785
312	0.48	0.661	0.61	3.41	1.466	-0.805
318	0.48	0.664	0.61	3.40	1.489	-0.825
324	0.47	0.667	0.60	3.39	1.513	-0.846
330	0.46	0.670	0.60	3.38	1.536	-0.866
336	0.46	0.673	0.60	3.37	1.559	-0.886
342	0.45	0.676	0.60	3.36	1.582	-0.906
348	0.45	0.678	0.60	3.35	1.605	-0.927
354	0.44	0.681	0.60	3.34	1.628	-0.947
360	0.43	0.684	0.59	3.33	1.651	-0.968

Mod. FAA Minor Storage Volume (cubic ft.) = 5,362

Mod. FAA Minor Storage Volume (acre-ft.) = 0.1231

Determination of MAJOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	53.60	percent
Catchment Drainage Area	A =	6.750	acres
Predevelopment NRCS Soil Group	Type =	C	A, B, C, or D
Return Period for Detention Control	T =	100	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	68	minutes
Allowable Unit Release Rate	q =	0.83	cfs/acre
One-hour Precipitation	P_1 =	2.84	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.61	
Inflow Peak Runoff	Qp-in =	10.71	cfs
Allowable Peak Outflow Rate	Qp-out =	**5.60**	cfs
Mod. FAA Major Storage Volume =		23,058	**cubic feet**
Mod. FAA Major Storage Volume =		**0.529**	**acre-ft**

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
0	0.00	0.000	0.00	0.00	0.000	0.000
6	9.08	0.309	1.00	5.60	0.046	0.263
12	7.06	0.481	1.00	5.60	0.093	0.388
18	5.84	0.596	1.00	5.60	0.139	0.457
24	5.01	0.682	1.00	5.60	0.185	0.497
30	4.41	0.750	1.00	5.60	0.232	0.518
36	3.95	0.806	1.00	5.60	0.278	0.528
42	3.58	0.853	1.00	5.60	0.324	0.529
48	3.29	0.895	1.00	5.60	0.370	0.524
54	3.04	0.931	1.00	5.60	0.417	0.515
60	2.83	0.964	1.00	5.60	0.463	0.501
66	2.66	0.994	1.00	5.60	0.509	0.485
72	2.50	1.021	0.97	5.45	0.540	0.481
78	2.37	1.047	0.94	5.24	0.563	0.483
84	2.25	1.070	0.90	5.07	0.586	0.483
90	2.14	1.092	0.88	4.92	0.610	0.482
96	2.04	1.112	0.85	4.79	0.633	0.479
102	1.96	1.131	0.83	4.67	0.656	0.475
108	1.88	1.150	0.81	4.57	0.679	0.471
114	1.80	1.167	0.80	4.47	0.702	0.465
120	1.74	1.183	0.78	4.39	0.725	0.458
126	1.68	1.199	0.77	4.31	0.749	0.451
132	1.62	1.214	0.76	4.24	0.772	0.442
138	1.57	1.229	0.75	4.18	0.795	0.434
144	1.52	1.242	0.74	4.12	0.818	0.424
150	1.48	1.256	0.73	4.07	0.841	0.415
156	1.43	1.269	0.72	4.02	0.864	0.404
162	1.39	1.281	0.71	3.98	0.887	0.394
168	1.36	1.293	0.70	3.94	0.911	0.382
174	1.32	1.305	0.70	3.90	0.934	0.371
180	1.29	1.316	0.69	3.86	0.957	0.359
186	1.26	1.327	0.68	3.83	0.980	0.347
192	1.23	1.337	0.68	3.79	1.003	0.334
198	1.20	1.348	0.67	3.76	1.026	0.321
204	1.17	1.358	0.67	3.74	1.050	0.308
210	1.15	1.367	0.66	3.71	1.073	0.295
216	1.12	1.377	0.66	3.68	1.096	0.281
222	1.10	1.386	0.65	3.66	1.119	0.267
228	1.08	1.395	0.65	3.64	1.142	0.253
234	1.06	1.404	0.65	3.62	1.165	0.239
240	1.04	1.413	0.64	3.59	1.188	0.224
246	1.02	1.421	0.64	3.58	1.212	0.210
252	1.00	1.430	0.63	3.56	1.235	0.195
258	0.98	1.438	0.63	3.54	1.258	0.180
264	0.97	1.446	0.63	3.52	1.281	0.165
270	0.95	1.454	0.63	3.51	1.304	0.149
276	0.93	1.461	0.62	3.49	1.327	0.134
282	0.92	1.469	0.62	3.48	1.350	0.118
288	0.90	1.476	0.62	3.46	1.374	0.102
294	0.89	1.483	0.62	3.45	1.397	0.087
300	0.88	1.490	0.61	3.44	1.420	0.070
306	0.86	1.497	0.61	3.42	1.443	0.054
312	0.85	1.504	0.61	3.41	1.466	0.038
318	0.84	1.511	0.61	3.40	1.489	0.022
324	0.83	1.518	0.60	3.39	1.513	0.005
330	0.81	1.524	0.60	3.38	1.536	-0.011
336	0.80	1.531	0.60	3.37	1.559	-0.028
342	0.79	1.537	0.60	3.36	1.582	-0.045
348	0.78	1.543	0.60	3.35	1.605	-0.062
354	0.77	1.549	0.60	3.34	1.628	-0.079
360	0.76	1.555	0.59	3.33	1.651	-0.096

Mod. FAA Major Storage Volume (cubic ft.) = 23,058

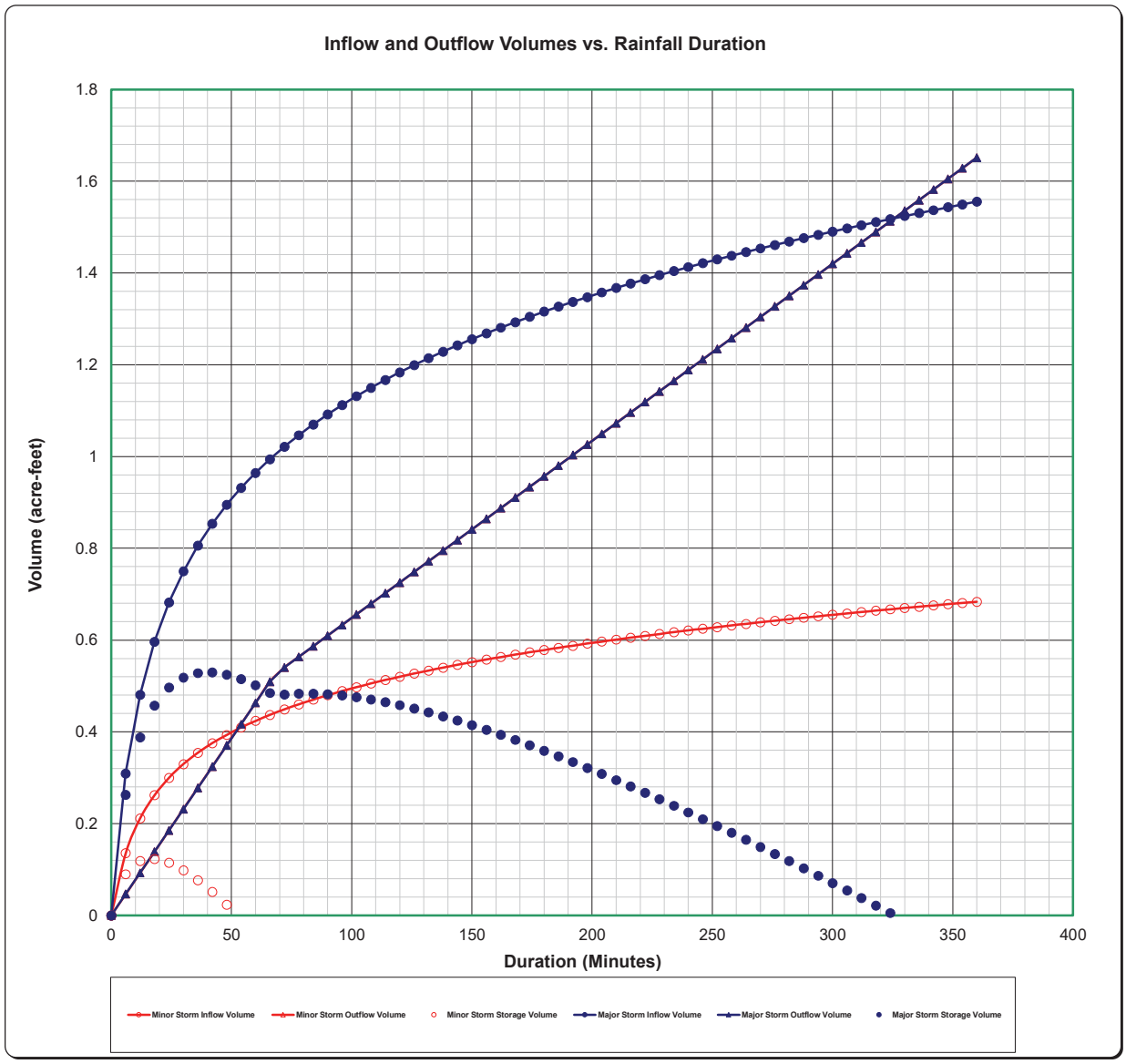
Mod. FAA Major Storage Volume (acre-ft.) = 0.5293

UDFCD DETENTION BASIN VOLUME ESTIMATING WORKBOOK Version 2.35, Released January 2015

DETENTION VOLUME BY THE MODIFIED FAA METHOD

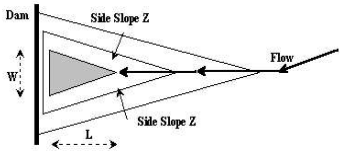
Project: CASTOR 7-59 10

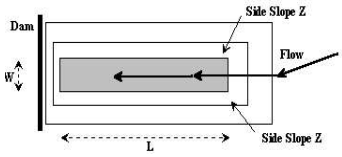
Basin ID: PROD PHASE

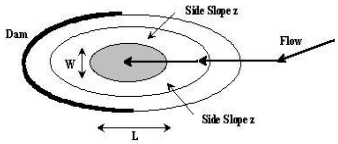


STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: CASTOR 7-59 10
Basin ID: PROD PHASE DETENTION POND







Design Information (Input):

Width of Basin Bottom, W = 85.00 ft
Length of Basin Bottom, L = 170.00 ft
Dam Side-slope (H:V), Z_d = 4.00 ft/ft

Check Basin Shape

Right Triangle		OR…
Isosceles Triangle		OR…
Rectangle	X	OR…
Circle / Ellipse		OR…
Irregular		(Use Overide values in cells G32:G52)

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':	0.12	0.53	acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':			acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Water Surface Elevation ft (input)	Side Slope (H:V) ft/ft Below El.	Basin Width at Stage ft (output)	Basin Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
	4960.60	(input)	85.00	170.00	14,450.0	0		0.000	0.000	
	4960.70		85.00	170.40	14,484.0	29,914	1,496	0.687	0.034	
	4960.80		85.00	170.80	14,518.0	40,239	5,003	0.924	0.115	
	4960.90		85.00	171.20	14,552.0	50,393	9,535	1.157	0.219	WQCV
	4961.00		85.00	171.60	14,586.0	60,382	15,074	1.386	0.346	
	4961.10		85.00	172.00	14,620.0	70,185	21,602	1.611	0.496	
	4961.20		85.00	172.40	14,654.0	79,794	29,101	1.832	0.668	100-YR WSEL
	4961.30		85.00	172.80	14,688.0	89,208	37,551	2.048	0.862	
	4961.40		85.00	173.20	14,722.0	98,427	46,933	2.260	1.077	
	4961.50		85.00	173.60	14,756.0	107,455	57,227	2.467	1.314	
SPILLWAY	4961.60		85.00	174.00	14,790.0	116,288	68,414	2.670	1.571	
	4961.70		85.00	174.40	14,824.0	124,927	80,475	2.868	1.847	
	4961.80		85.00	174.80	14,858.0	133,372	93,390	3.062	2.144	
	4961.90		85.00	175.20	14,892.0	141,625	107,140	3.251	2.460	
	4962.00		85.00	175.60	14,926.0	149,683	121,705	3.436	2.794	
	4962.10		85.00	176.00	14,960.0	157,549	137,067	3.617	3.147	
	4962.20		85.00	176.40	14,994.0	165,221	153,205	3.793	3.517	
	4962.30		85.00	176.80	15,028.0	172,699	170,101	3.965	3.905	
	4962.40		85.00	177.20	15,062.0	179,985	187,735	4.132	4.310	
	4962.50		85.00	177.60	15,096.0	187,076	206,088	4.295	4.731	
CREST	4962.60		85.00	178.00	15,130.0	287,206	229,803	6.593	5.276	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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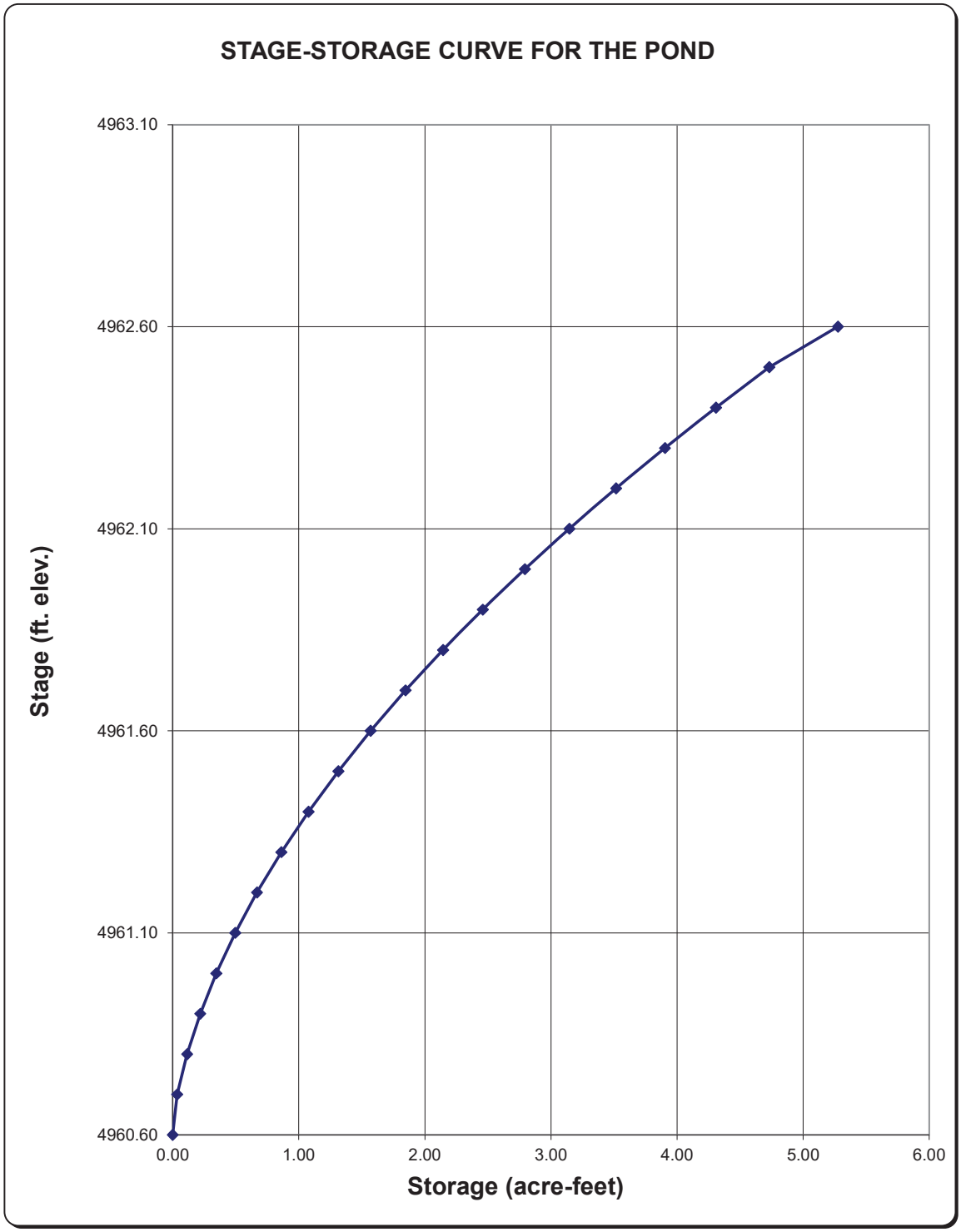
							#N/A		#N/A	

STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: _____

Basin ID: _____



STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: Castor 7-59 10
Basin ID: PROD Phase - Detention

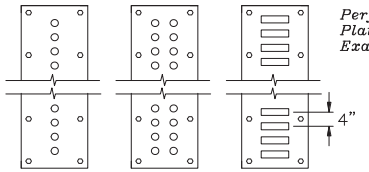
WQCV Design Volume (Input):

Catchment Imperviousness, I_a = 54.0 percent
Catchment Area, A = 6.75 acres
Depth at WQCV outlet above lowest perforation, H = 1 feet
Vertical distance between rows, h = 3.00 inches
Number of rows, NL = 4.00
Orifice discharge coefficient, C_o = 0.68
Slope of Basin Trickle Channel, S = 0.004 ft / ft
Time to Drain the Pond = 72 hours

Diameter of holes, D = 0.640 inches
Number of holes per row, N = 1
OR
Height of slot, H = inches
Width of slot, W = inches

Watershed Design Information (Input):

Percent Soil Type A = %
Percent Soil Type B = %
Percent Soil Type C/D = 100 %



Outlet Design Information (Output):

Water Quality Capture Volume, WQCV = 0.315 watershed inches
Water Quality Capture Volume (WQCV) = 0.177 acre-feet
Design Volume (WQCV / 12 * Area * 1.2) Vol = 0.213 acre-feet
Outlet area per row, Ao = 0.29 square inches
Total opening area at each row based on user-input above, Ao = 0.32 square inches
Total opening area at each row based on user-input above, Ao = 0.002 square feet

3

	Central Elevations of Rows of Holes in feet																								
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	Row 23	Row 23	Σ Flow
	4960.60	4960.85	4961.10	4961.35																					
	Collection Capacity for Each Row of Holes in cfs																								
4960.60	0.0000	0.0000	0.0000	0.0000																					**0.00**
4960.70	0.0039	0.0000	0.0000	0.0000																					**0.00**
4960.80	0.0055	0.0000	0.0000	0.0000																					**0.01**
4960.90	0.0067	0.0027	0.0000	0.0000																					**0.01**
4961.00	0.0077	0.0047	0.0000	0.0000																					**0.01**
4961.10	0.0086	0.0061	0.0000	0.0000																					**0.01**
4961.20	0.0094	0.0072	0.0039	0.0000																					**0.02**
4961.30	0.0102	0.0082	0.0055	0.0000																					**0.02**
4961.40	0.0109	0.0090	0.0067	0.0027																					**0.03**
4961.50	0.0116	0.0098	0.0077	0.0047																					**0.03**
4961.60	0.0122	0.0106	0.0086	0.0061																					**0.04**
4961.70	0.0128	0.0112	0.0094	0.0072																					**0.04**
4961.80	0.0134	0.0119	0.0102	0.0082																					**0.04**
4961.90	0.0139	0.0125	0.0109	0.0090																					**0.05**
4962.00	0.0144	0.0131	0.0116	0.0098																					**0.05**
4962.10	0.0149	0.0136	0.0122	0.0106																					**0.05**
4962.20	0.0154	0.0142	0.0128	0.0112																					**0.05**
4962.30	0.0159	0.0147	0.0134	0.0119																					**0.06**
4962.40	0.0164	0.0152	0.0139	0.0125																					**0.06**
4962.50	0.0168	0.0157	0.0144	0.0131																					**0.06**
4962.60	0.0173	0.0161	0.0149	0.0136																					**0.06**
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
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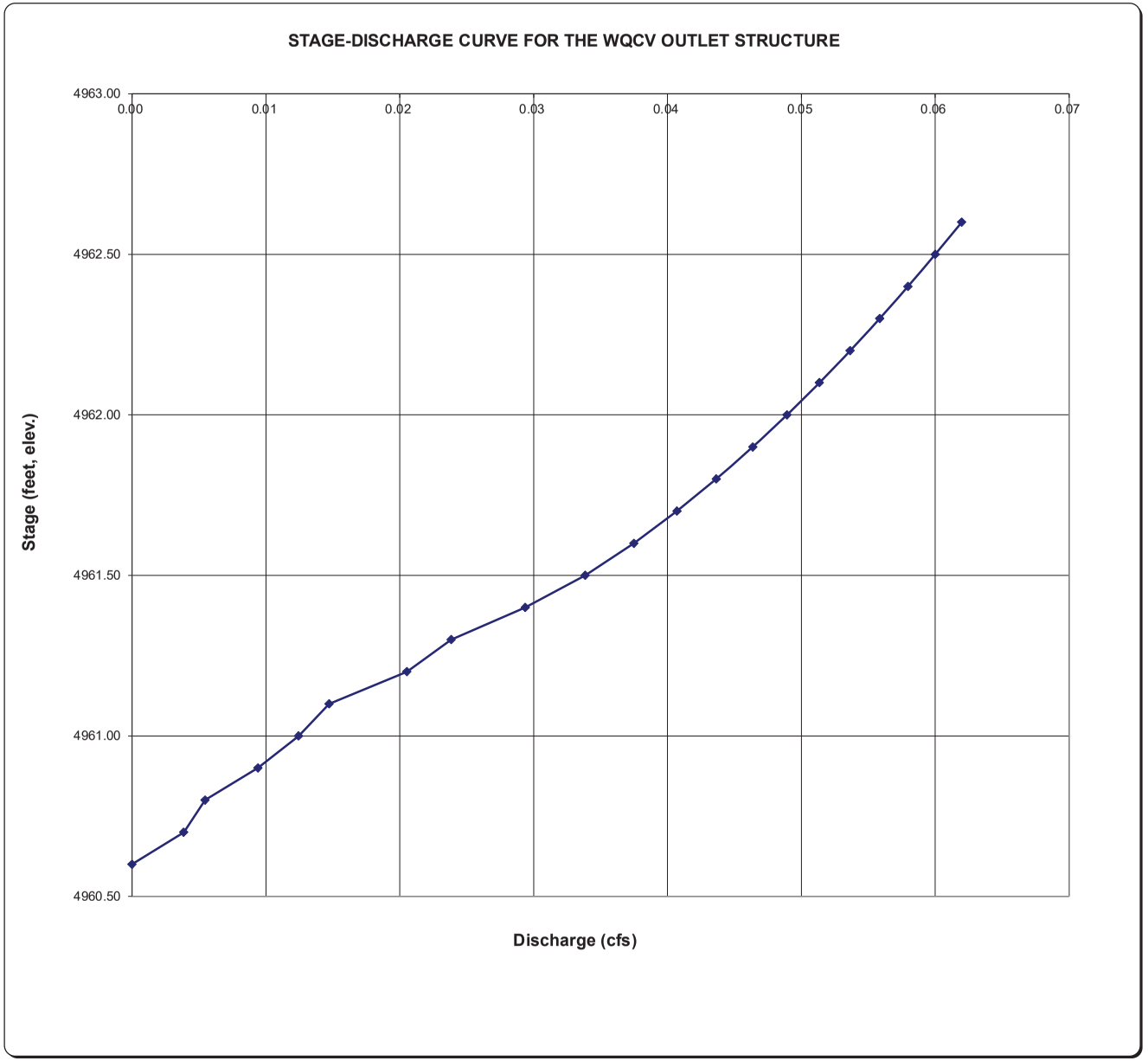
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A	#N/A																					**#N/A**
	Override Area Row 1	Override Area Row 2	Override Area Row 3	Override Area Row 4	Override Area Row 5	Override Area Row 6	Override Area Row 7	Override Area Row 8	Override Area Row 9	Override Area Row 10	Override Area Row 11	Override Area Row 12	Override Area Row 13	Override Area Row 14	Override Area Row 15	Override Area Row 16	Override Area Row 17	Override Area Row 18	Override Area Row 19	Override Area Row 20	Override Area Row 21	Override Area Row 22	Override Area Row 23	Override Area Row 24	

STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Worksheet Protected

Project: Castor 7-59 10

Basin ID: PROD Phase - Detention

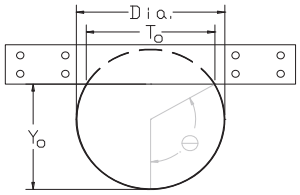


RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICAL ORIFICES

Project: CASTOR 7-59 10

Basin ID: PROD PAD - DETENTION

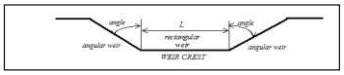
X



		#1 Vertical Orifice	#2 Vertical Orifice	
Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)				
Water Surface Elevation at Design Depth	Elev: WS =	4,962.60		feet
Pipe/Vertical Orifice Entrance Invert Elevation	Elev: Invert =	4,960.60		feet
Required Peak Flow through Orifice at Design Depth	Q =	5.60		cfs
Pipe/Vertical Orifice Diameter (inches)	Dia =	14.0		inches
Orifice Coefficient	C_o =	0.55		
Full-flow Capacity (Calculated)				
Full-flow area	Af =	1.07		sq ft
Half Central Angle in Radians	Theta =	3.14		rad
Full-flow capacity	Qf =	5.6		cfs
	Percent of Design Flow =	100%		
Calculation of Orifice Flow Condition				
Half Central Angle (0<Theta<3.1416)	Theta =	2.79		rad
Flow area	A_o =	1.06		sq ft
Top width of Orifice (inches)	T_o =	4.86		inches
Height from Invert of Orifice to Bottom of Plate (feet)	Y_o =	1.13		feet
Elevation of Bottom of Plate	Elev Plate Bottom Edge =	4,961.73		feet
Resultant Peak Flow Through Orifice at Design Depth	Q_o =	5.6		cfs
Width of Equivalent Rectangular Vertical Orifice	**Equivalent Width =**	**0.94**		**feet**

STAGE-DISCHARGE SIZING OF THE SPILLWAY

Project: CASTOR 7-59 10
Basin ID: PROD PAD - DETENTION



Design Information (input):

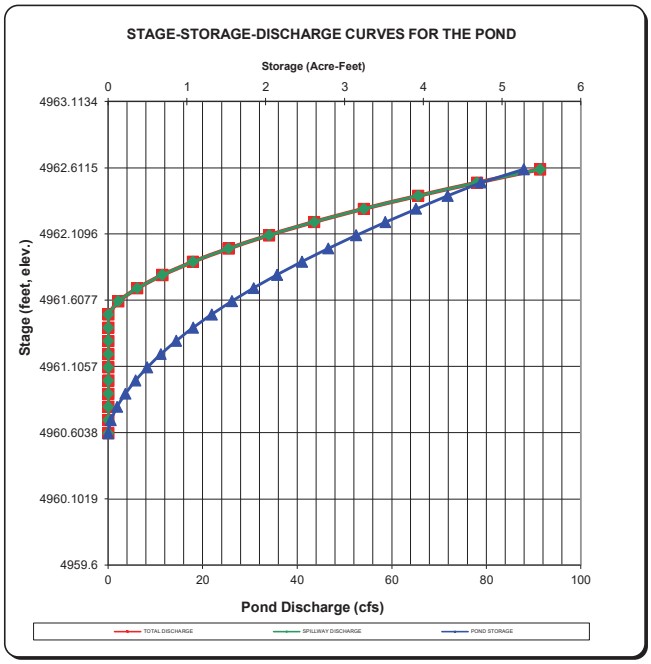
Bottom Length of Weir	L =	22.00	feet
Angle of Side Slope Weir	Angle =	75.96	degrees
Elev. for Weir Crest	EL. Crest =	4,961.50	feet
Coef. for Rectangular Weir	C_w =	3.00	
Coef. for Trapezoidal Weir	C_t =	3.00	

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)	
4960.60	0.00	0.00	0.00	0.00	
4960.70	0.00	0.00	0.00	0.00	
4960.80	0.00	0.00	0.00	0.00	
4960.90	0.00	0.00	0.00	0.00	
4961.00	0.00	0.00	0.00	0.00	
4961.10	0.00	0.00	0.00	0.00	
4961.20	0.00	0.00	0.00	0.00	
4961.30	0.00	0.00	0.00	0.00	
4961.40	0.00	0.00	0.00	0.00	
4961.50	0.00	0.00	0.00	0.00	SPILLWAY
4961.60	2.09	0.04	2.13	2.13	
4961.70	5.90	0.21	6.12	6.12	
4961.80	10.84	0.59	11.44	11.44	
4961.90	16.70	1.21	17.91	17.91	
4962.00	23.33	2.12	25.46	25.46	100-YR FLOW =19.31 CFS
4962.10	30.67	3.35	34.02	34.02	(BASIN A+OS-2)
4962.20	38.65	4.92	43.57	43.57	
4962.30	47.23	6.87	54.09	54.09	
4962.40	56.35	9.22	65.57	65.57	
4962.50	66.00	12.00	78.00	78.00	
4962.60	76.14	15.22	91.37	91.37	
#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	
#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	
#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	
#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	
#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	
#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	
#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	
#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: CASTOR 7-59 10
Basin ID: PROD PAD - DETENTION


STAGE-STORAGE-DISCHARGE CURVES FOR THE POND

WEIGHTED IMPERVIOUS SURFACE CALCULATIONS

Weld County Engineering & Construction Criteria Table 5-3 Recommended Percentage Imperviousness Values

UDFCD Vol. 1 - Table 6-3 Recommended Percentage Imperviousness Values

	Undeveloped Areas			Streets			Developed Areas			MISC.					
	Historic Flow Analysis	Greenbelts, Agricultural	Off-site flow analysis (Land Use Not Defined)	Paved	Gravel	Recycled Asphalts	Concrete Driveways	Sidewalks	Roofs	Single-Family Res. 0.75-2.5 Acres	Parks	Pond Area	Berms/ Cut/Fill Slopes/ Landscaping		
% Impervious	2%	2%	45%	100%	40%	75%	90%	90%	90%	20%	10%	100%	2%		
Basin	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Total Area (Ac)	Percent Imperv.
A-Drill Pad					5.11							2.88	0.71	8.69	56.81%
A-Prod Pad					4.44							1.83	0.48	6.75	53.59%
A-Historic	8.69													8.69	2.00%
A-Historic Prod Ph	6.75													6.75	2.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														0.00	0.00%
														Total: 30.89	

WEIGHTED RUNOFF COEFFICIENT VERSUS WATERSHED IMPERVIOUSNESS

METHOD AS DETAILED IN URBAN STORM DRAINAGE CRITERIA MANUAL VOL. 1 (COLORADO)

$C_A = K_A + (1.31i^3 - 1.44i^2 + 1.135i - 0.12)$ for $C_A >$ or $= 0$, otherwise $C_A = 0$ (RO-6)

$C_B = (C_A + C_{CD})/2$

$C_{CD} = K_{CD} + (0.858i^3 - 0.786i^2 + 0.774i + 0.04)$ (RO-7)

i = % imperviousness/100 expressed as a decimal

K_A = Correction factor for Type A soils

K_{CD} = Correction factor for Type C and Type D soils

Correction Factors, K_A & K_{CD}

Soil Type	Storm Return Period			
	2-Year	5-Year	10-Yr	100-Year
A	0.00	$-0.08i + 0.09$	$-0.14i + 0.17$	$-0.25i + 0.32$
C or D	0.00	$-0.10i + 0.11$	$-0.18i + 0.21$	$-0.39i + 0.46$

Basin ID	% Imperv.	i	Soil Type	Correction Factors, K_A & K_{CD}			Runoff Coefficients, C				Basin Area (Ac)	Total Area (Ac)	Weighted Runoff Coefficients, C				Soil Type %
				5-Year	10-Year	100-Year	2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year	
A-Drill Pad	56.81%	0.57	A	0.04	0.09	0.18	0.30	0.34	0.39	0.48	0.00	8.69	0.38	0.44	0.49	0.62	
			B	-	-	-	0.34	0.39	0.44	0.55	0.00						
			C or D	0.05	0.11	0.24	0.38	0.44	0.49	0.62	8.69						100%
A-Prod Pad	53.59%	0.54	A	0.05	0.09	0.19	0.28	0.32	0.37	0.46	0.00	6.75	0.36	0.42	0.47	0.61	
			B	-	-	-	0.32	0.37	0.42	0.54	0.00						
			C or D	0.06	0.11	0.25	0.36	0.42	0.47	0.61	6.75						100%
A-Historic	2.00%	0.02	A	0.09	0.17	0.32	0.00	0.00	0.07	0.22	0.00	8.69	0.06	0.16	0.26	0.51	
			B	-	-	-	0.03	0.08	0.17	0.36	0.00						
			C or D	0.11	0.21	0.45	0.06	0.16	0.26	0.51	8.69						100%
A-Historic Prod Ph	2.00%	0.02	A	0.09	0.17	0.32	0.00	0.00	0.07	0.22	0.00	6.75	0.06	0.16	0.26	0.51	
			B	-	-	-	0.03	0.08	0.17	0.36	0.00						
			C or D	0.11	0.21	0.45	0.06	0.16	0.26	0.51	6.75						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.05	0.05	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.05	0.10	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%
	0.00%	0.00	A	0.09	0.17	0.32	0.00	0.00	0.05	0.20	0.00	0.00	-	-	-	-	
			B	-	-	-	0.02	0.08	0.15	0.35	0.00						
			C or D	0.11	0.21	0.46	0.04	0.15	0.25	0.50	0.00						100%

STANDARD FORM SF-2
TIME OF CONCENTRATION
METHOD AS DETAILED IN URBAN STORM DRAINAGE CRITERIA MANUAL VOL. 1 (COLORADO)

NRCS Conveyance Factors, K

Heavy Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Tillage/Field	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

Is the basin Urban or Non-Urban? Non-Urban

Design Point	Sub-Basin Data			Non-Urban - Eqn 6-3 Initial/Overland Time T(i)			Non-Urban - Eqn 6-4 Travel Time T(t)					Non-Urban	Urbanized Basin T(c)		Final T(c) (min)	Check Flow Length (Overland)
	Drainage Basin	Area (Ac)	C(5)	Length (ft)	Slope (%)	T(i) min	Length (ft)	Slope (%)	Coeff. (K)	Velocity (fps)	T(t) (min)	Comp. T(c)	Total Length	Eqn 6-5 T(c)		
1	A-Drill Pad	8.69	0.44	500	0.3	42.3	500	0.25	10.00	0.50	16.7	59.0	1000	16.0	59.0	OK
2	A-Prod Pad	6.75	0.42	500	0.3	43.5	860	0.3	10.00	0.50	28.7	72.2	1360	21.5	72.2	OK
3	A-Historic	8.69	0.16	500	1.3	35.0	366	1.3	7.00	0.79	7.7	42.7	866	22.0	22.0	OK
4	A-Historic Prod Ph	6.75	0.16	500	1.3	34.7	225	1.3	7.00	0.80	4.7	39.4	725	20.3	20.3	OK
5		0.00	-	500	1.0		100	1.0	10.00				600		10.0	OK
6		0.00	-	500	1.0		100	1.0	10.00				600		10.0	OK
7		0.00	-	500	1.0		100	1.0	10.00				600		10.0	OK
8		0.00	-	500	1.0		100	1.0	10.00				600		10.0	OK
9		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
10		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
11		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
12		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
13		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
14		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK
15		0.00	-	300	1.0		100	1.0	10.00				400		10.0	OK

STANDARD FORM SF-3
10-YR RUNOFF - RATIONAL METHOD

METHOD AS DETAILED IN URBAN STORM DRAINAGE CRITERIA MANUAL VOL. 1 (COLORADO)

3

10-Yr Rainfall Depth-Duration-Frequency (1-hr) = *1.62* *in/hr*

Design Storm: *10 Year*

BASIN INFORMATION				DIRECT RUNOFF				TOTAL RUNOFF				
Design Point	Drainage Basin	Area (Ac)	Runoff Coeff.	T(c) (min)	C x A	I (in/hr)	Q (cfs)	T(c) (min)	Sum C x A	I (in/hr)	Q (cfs)	REMARKS
1	A-Drill Pad	8.69	0.49	59.0	4.27	1.66	7.1					
2	A-Prod Pad	6.75	0.47	72.2	3.20	1.44	4.6					
3	A-Historic	8.69	0.26	22.0	2.27	3.03	6.9					
4	A-Historic Prod Ph	6.75	0.26	20.3	1.77	3.16	5.6					
5		0.00	-									
6		0.00	-									
7		0.00	-									
8		0.00	-									
9		0.00	-									
10		0.00	-									
11		0.00	-									
12		0.00	-									
13		0.00	-									
14		0.00	-									
15		0.00	-									

STANDARD FORM SF-3
100-YR RUNOFF - RATIONAL METHOD
METHOD AS DETAILED IN URBAN STORM DRAINAGE CRITERIA MANUAL VOL. 1 (COLORADO)

100-Yr Rainfall Depth-Duration-Frequency (1-hr) = *2.84* *in/hr*

Design Storm: *100 Year*

BASIN INFORMATION				DIRECT RUNOFF				TOTAL RUNOFF				
Design Point	Drainage Basin	Area (Ac)	Runoff Coeff.	T(c) (min)	C x A	I (in/hr)	Q (cfs)	T(c) (min)	Sum C x A	I (in/hr)	Q (cfs)	REMARKS
1	A-Drill Pad	8.69	0.62	59.0	5.41	2.90	15.7					
2	A-Prod Pad	6.75	0.61	72.2	4.13	2.53	10.4					
3	A-Historic	8.69	0.51	22.0	4.41	5.31	23.4					
4	A-Historic Prod Ph	6.75	0.51	20.3	3.42	5.54	19.0					
5		0.00	-									
6		0.00	-									
7		0.00	-									
8		0.00	-									
9		0.00	-									
10		0.00	-									
11		0.00	-									
12		0.00	-									
13		0.00	-									
14		0.00	-									
15		0.00	-									

APPENDIX H – CONSTRUCTION PLANS

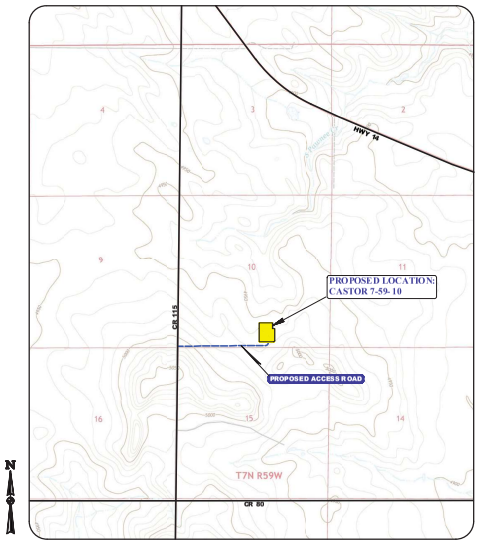
CONSTRUCTION PLANS FOR

MORNING GUN EXPLORATION

CASTOR 7-59- 10

LOCATED IN THE SW 1/4 OF THE SE 1/4 OF SECTION 10,
TOWNSHIP 7 NORTH, RANGE 59 WEST OF THE 6th P.M.
COUNTY OF WELD, STATE OF COLORADO

VICINITY MAP



TAKEN FROM 7.5 MIN TOPOGRAPHIC MAP PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY, BUCKINGHAM COLO., 2016
SCALE: 1" = 2,000'

VICINITY MAP LEGEND

- SITE BOUNDARY
- ACCESS ROAD
- PROPOSED SITE

Standard General Notes for Construction Plans

1. The contractor shall be responsible for contacting the Utility Notification Center of Colorado (Call before you dig), 811. Call two business days prior (not including the day of the call) to digging, grading or excavating for the marking of underground member utilities.
2. Prior to commencement of any construction, the contractor shall contact all utilities to coordinate schedules.
3. The contractor shall be responsible for all traffic control during construction:
   a. All signs, striping and traffic control device shall conform to, and placement shall be performed in accordance with, the *Manual on Uniform Traffic Control Devices (MUTCD)*, latest edition and *CDOT M&S Standards*, latest edition.
   b. The contractor shall be responsible for maintenance and cleaning of traffic control devices.
   c. The contractor shall maintain existing pavement markings during construction operations, in conformance with construction documents.
   d. Removal of existing pavement markings shall be accomplished by a method that does not materially damage the surface or texture of the pavement or existing surfacing. The pavement markings shall be removed to the extent that they are not visible under day or night conditions.
4. The contractor shall restore any disturbed areas to equal or better condition than existed before construction. Drainage ditches or watercourses that are disturbed by construction shall be restored to the grades and cross-sections that existed before construction, unless otherwise shown on the construction documents.
5. The contractor shall carefully preserve benchmarks, property corners, reference points, stakes and other survey reference monuments or markers. In case of willful or careless destruction, the contractor shall be responsible for restorations. Resetting of markers shall be performed under the direction of a Colorado licensed Professional Land Surveyor.
6. The contractor shall immediately remove any construction debris and mud tracked onto existing roadways. The contractor shall repair any excavation or pavement failures caused by the construction.
7. All damaged existing curb, gutter, and sidewalk shall be repaired prior to acceptance of completed improvements.
8. The type, size, location and number of all known underground utilities are approximate when shown on these construction drawings. It shall be the responsibility of the contractor to verify the existence and location of all underground utilities along the route of the work prior to commencing any new construction. The contractor shall be responsible of any unknown underground utilities.
9. The Owner/Developer shall be responsible for providing all required lot staking and construction staking. The Contractor shall coordinate through the Owner's designated representative to assure that the surveyor is given adequate notice and instruction in order to complete the survey requirements for the various phases of work. The Contractor shall be responsible for the cost of re-surveying required due to the Contractor's, or subcontractor's, activities. The Contractor shall be responsible for the costs associated with rescheduling the surveyor to accommodate the Contractor's requests for unscheduled staking.
10. The Contractor shall provide and implement a "Traffic Control Plan" related to all construction activities for this project.
11. The Contractor shall perform all work according to all Town, County, State and Federal safety and health regulations. In particular, the trenching and open excavation operations shall comply with all current O.S.H.A. regulatory requirements.
12. All construction activities must comply with the State of Colorado permitting process for "Stormwater Discharges Associated with Construction Activity." For information contact the Colorado Department of Health, Water Quality Control Division, WQCD-PE-B2, 4300 Cherry Creek Drive South, Denver, Colorado, 80246. Attention: Permits and Enforcement Section. Phone (303) 692-3500.
13. When discharging groundwater, all dewatering methods shall be in conformance with all laws and regulations of the State - including a Colorado Discharge Permit System for Construction Dewatering Wastewater Discharge. The contractor shall take all necessary and proper precautions to protect adjacent properties from any and all damage that may occur from stormwater runoff and /or deposition of debris resulting from any and all work.
14. The contractor shall have a registered land surveyor tie out and reset any property corners or section corners planned to be disturbed by construction of this project, and shall have a registered land surveyor reestablish any property corners or section corners inadvertently disturbed during construction of this project.

CONTACT INFORMATION

OPERATOR
MORNING GUN EXPLORATION
1601 Arapahoe Street
Daniels and Fisher Tower, Box 1
Denver, CO 80202
O: 303.847.1110

CIVIL ENGINEER / SURVEYOR
Uintah Engineering & Land Surveying, LLC
Headquarters
85 South 200 East
Vernal, Utah 84078
(435) 789-1017

Colorado Branch
3313 35th Ave. #B
Evans, CO 80620
(970) 506-1544

SHEET INDEX

INDEX NO.	SHEET NO.	DESCRIPTION
COVER AND GENERAL NOTES		
1	C001	COVER SHEET
SITE PLANS		
2	C101	DRILL PHASE SITE GRADING PLAN
3	C102	PRODUCTION PHASE SITE GRADING PLAN
4	C501	CONSTRUCTION DETAILS

CALL UTILITY NOTIFICATION CENTER OF COLORADO
811
Know what's below. Call before you dig.
CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

UINTAH ENGINEERING & LAND SURVEYING
CIVIL ENGINEERING AND LAND SURVEYING SERVICES
333 35th Ave., Ste. B, Evans, CO 80620
O: 970-506-1544
HQ: 435-789-1017
www.uintahgroup.com
- SINCE 1964 -

MORNING GUN EXPLORATION
CASTOR 7-59- 10
CONSTRUCTION PLANS
SEC. 10, T7N, R59W, 6TH P.M.
WELD, COLORADO

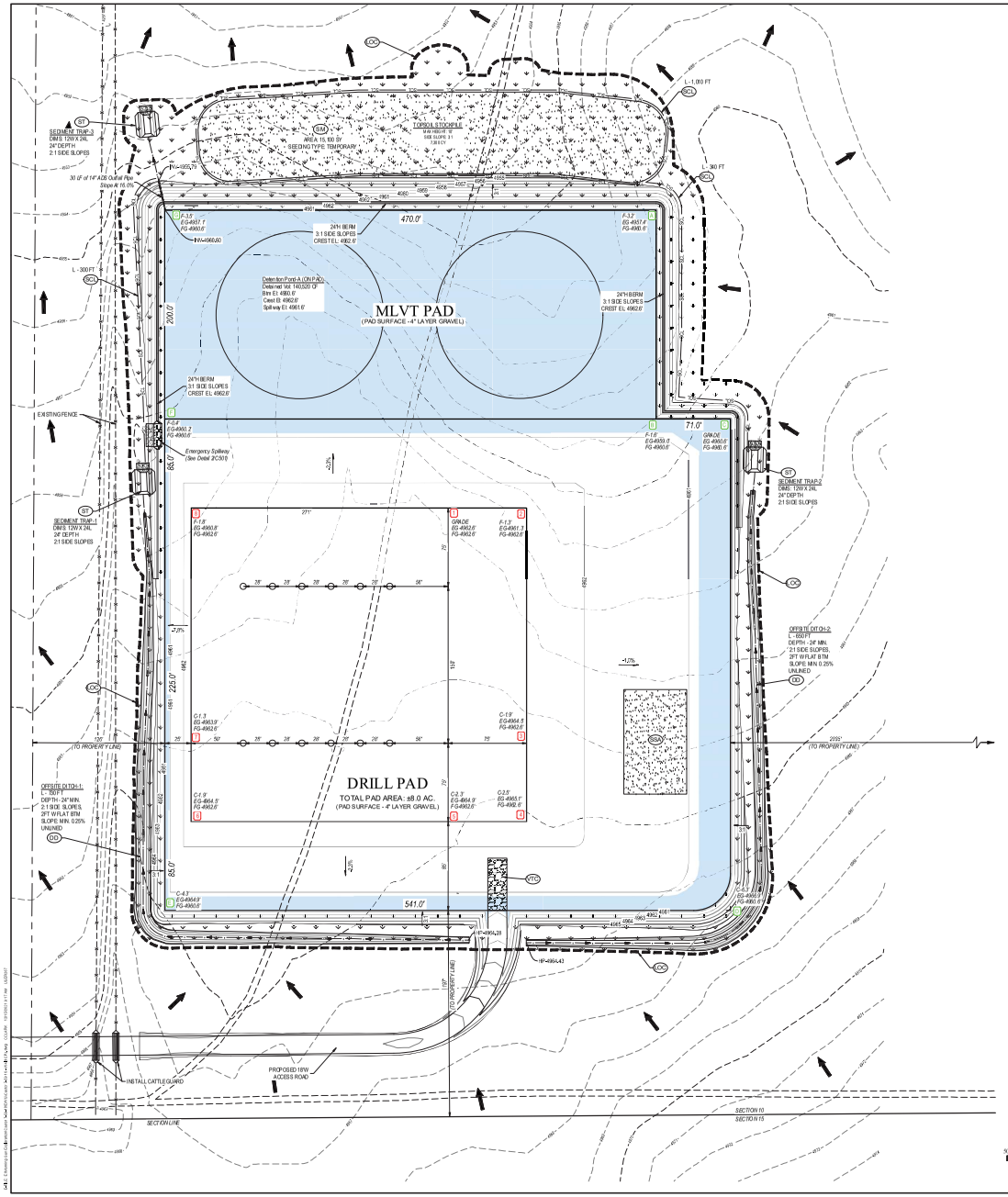
NO.	DATE	BY	REVISIONS
1	12/13/2021	CJC	PERMITTING REVISIONS

RESPONSIBLE ENGINEER:
COLORADO LICENSED
CHRISTOPHER J. CRUZ
40000
PROFESSIONAL ENGINEER
12/13/2021

COVER

SCALE: NO SCALE
DRAWN BY: C.J.C.
DATE DRAWN: 12-08-2021
UELS FILENO: M - 2 - 0 4 6
PROJ NO: MORI0-21-0001
FILE: - - - -

SHEET
C001



LEGEND:

- EXISTING MAJOR CONTOUR (5')
- EXISTING MINOR CONTOUR (1')
- PROPOSED MAJOR CONTOUR (5')
- PROPOSED MINOR CONTOUR (1')
- EXISTING OVERHEAD POWER
- BARBED WIRE FENCE (FIELD FENCE)
- LIMITS OF DISTURBANCE
- PROPOSED PAD EDGE
- PROPOSED EDGE OF ROAD
- EXISTING EDGE OF ROAD
- EXISTING PAD EDGE
- EDGE OF RIGHT OF WAY

NOTES:

1. THE SIZE, TYPE AND LOCATION OF ALL KNOWN UNDERGROUND UTILITIES ARE APPROXIMATE WHEN SHOWN ON THESE DRAWINGS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE OF ALL UNDERGROUND UTILITIES IN THE AREA OF THE WORK, BEFORE COMMENCING NEW CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING DEMOLITION, REMOVAL, REPLACEMENT, AND DISPOSAL OF ALL FACILITIES AND MATERIAL.
3. ALL SYMBOLS ARE ONLY GRAPHICALLY REPRESENTED AND ARE NOT TO SCALE.
4. CONTACT THE PROJECT SURVEYOR FOR ANY INQUIRIES RELATED TO THE EXISTING SITE SURVEY.
5. PROPOSED GRADING PLAN IS BASED ON EXISTING SITE CONTOURS.
6. THE PROPERTY OWNER SHALL CONTROL NOXIOUS WEEDS ON THE SITE.
7. THE HISTORICAL FLOW PATTERNS AND RUNOFF AMOUNTS ON THE SITE WILL BE MAINTAINED.
8. REFER TO DETAIL SHEETS FOR EROSION CONTROL BMP DETAILS.

BMP LEGEND:

- DD DIVERSION DITCH
- RRB REINFORCED ROCK BERM
- RRC RRB FOR CULVERT PROTECTION
- ST SEDIMENT TRAP
- SCL SEDIMENT CONTROL LOG
- ST SEDIMENT TRAP
- SM SEEDING AND MULCHING
- SF SILT FENCE
- SSA STABILIZED STAGING AREA
- VTC VEHICLE TRACKING CONTROL
- CC LIMITS OF CONSTRUCTION
- LIMITS OF PERMANENT DISTURBANCE
- AREA OUTSIDE OF LIMITS OF CONSTRUCTION, LOC
- 100-YEAR WATER SURFACE ELEVATION

GRADING DETAILS:

APPROXIMATE EARTHWORK QUANTITIES	
(6") TOPSOIL STRIPPING (EST. ONLY)	7,300 Cu. Yds.
REMAINING LOCATION	11,930 Cu. Yds.
TOTAL CUT	**19,230 Cu. Yds.**
FILL	**18,300 Cu. Yds.**
EXCESS MATERIAL	850 Cu. Yds.
TOPSOIL	~7,300 Cu. Yds.>
SURFACING (GRAVEL (IMPORTED)	6,400 Cu. Yds.
EARTHWORK BALANCE	**0 Cu. Yds.**

****ESTIMATE ONLY****

APPROXIMATE SURFACE DISTURBANCE AREAS		
	DISTANCE	ACRES
FACILITY DISTURBANCE	NA	±11.119
ACCESS ROAD DISTURBANCE	NA	0.---
TOTAL SURFACE USE AREA		±11.119

NOTES:

- Fill quantity includes 10% for compaction.
- Pad Cut/Fill slopes are 3H:1V
- Topsoil quantity is an estimate of 6" deep acros s the pad grading area. Actual site conditions may vary. Field adjust grades as necessary to balance earthwork.

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MORNING GUN EXPLORATION
CASTOR 7-59-10
CONSTRUCTION PLANS
SEC. 10, T7N, R59W, 6TH P.M.
WELD, COLORADO

NO.	BY	REVISIONS	DATE
1	CJC	REVISED PER COMMENTS	12-13-21

RESPONSIBLE ENGINEER:

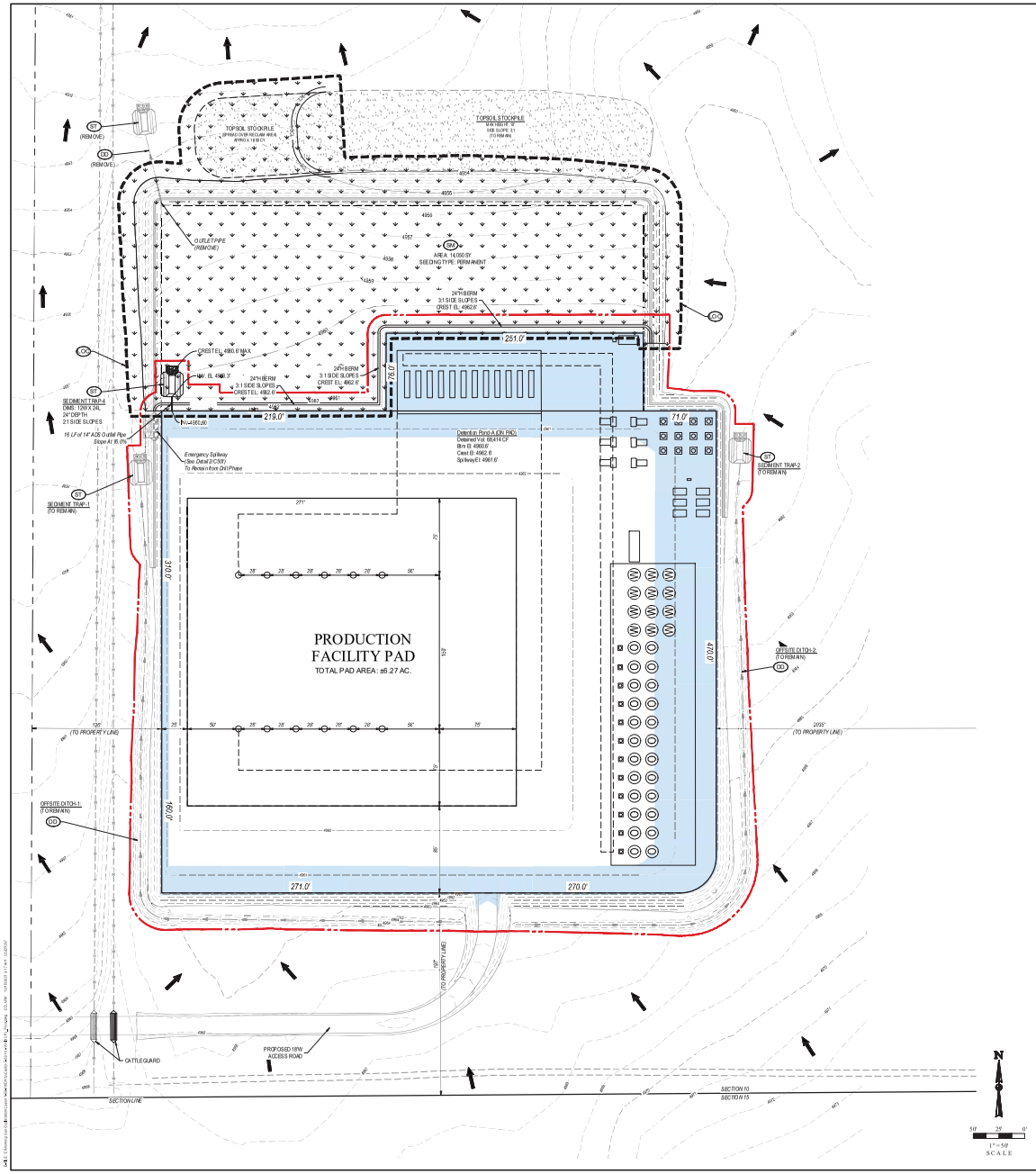
COLORADO LICENSED
CHRISTOPHER J. CARR
40000
PROFESSIONAL ENGINEER

12-13-2021

DRILL PHASE SITE GRADING PLAN

SCALE:	NO SCALE
DRAWN BY:	C.J.C.
DATE DRAWN:	12-08-2021
UELS FILE NO:	M-7-59-10
PROJ NO:	MORG-21-0001
FILE:	- - - -

SHEET
C101



NOTES:

1. THE SIZE, TYPE AND LOCATION OF ALL KNOWN UNDERGROUND UTILITIES ARE APPROXIMATE WHEN SHOWN ON THE DESIGN MAPS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE OF ALL UNDERGROUND UTILITIES IN THE AREA OF THE WORK BEFORE COMMENCING NEW CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES.
2. CONTRACTORS WILL BE RESPONSIBLE FOR COORDINATING DEMOLITION, REMOVAL, REPLACEMENT, AND DISPOSAL OF ALL FACILITIES AND MATERIAL.
3. ALL SYMBOLS ARE ONLY GRAPHICALLY REPRESENTED AND ARE NOT TO SCALE.
4. CONTACT THE PROJECT SURVEYOR FOR ANY INQUIRIES RELATED TO THE EXISTING SITE SURVEY.
5. PROPOSED GRADING PLAN IS BASED ON EXISTING SITE CONTOURS.
6. THE PROPERTY OWNER SHALL CONTROL NOXIOUS WEEDS ON THE SITE.
7. THE HISTORICAL FLOW PATTERNS AND RUNOFF AMOUNTS ON THE SITE WILL BE MAINTAINED.
8. REFER TO DETAIL SHEETS FOR EROSION CONTROL BMP DETAILS.

LEGEND:

- EXISTING MAJOR CONTOUR (5)
- EXISTING MINOR CONTOUR (1')
- PROPOSED MAJOR CONTOUR (5')
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- EXISTING OVERHEAD POWER
- BARBED WIRE FENCE (FIELD FENCE)
- PERMANENT LIMITS OF DISTURBANCE
- LIMITS OF CONSTRUCTION
- PROPOSED PAD EDGE
- PROPOSED EDGE OF ROAD
- EXISTING EDGE OF ROAD
- EXISTING PAD EDGE

GRADING DETAILS:

APPROXIMATE EARTHWORK QUANTITIES	
TOTAL CUT	4,010 Cu. Yds.
FILL	4,010 Cu. Yds.
MATERIAL BALANCE	0 Cu. Yds.
TOPSOIL (4" LAYER OVER RECLAIM)	1,800 Cu. Yds.

****ESTIMATE ONLY****

SCHEDULE OF AREAS	
	ACRES
WELL SITE AREA (RECLAIMED)	±3.350
WELL SITE AREA (PERMANENT DISTURBANCE/UNRECLAIMED)	±7.709
AREA OF LIMITS OF CONSTRUCTION FOR RECLAMATION WORK	±2.900

NOTES:
- Fill quantity includes 10% for compaction.
- Quantities assume a 4" layer of topsoil is spread over entire reclaimed area that will be re-seeded.
- Contractor may adjust reclaimed topography to achieve material balance, ensuring the grade approximates follow the natural grade of the pre-development ground contours.

BMP LEGEND:

- DD DIVERSION DITCH
- RRB REINFORCED ROCK BERM
- RRB RRB FOR CUL VERT PROTECTION
- ST SEDIMENT TRAP
- SCL SEDIMENT CONTROL LOG
- ST SEDIMENT TRAP
- SM SEEDING AND MULCHING
- SF SILT FENCE
- SSA STABILIZED STAGING AREA
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MORNING GUN EXPLORATION
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WELD, COLORADO

NO.	DATE	DESCRIPTION	BY
1	12/13/21	REVISED PER COMMENTS	CJC

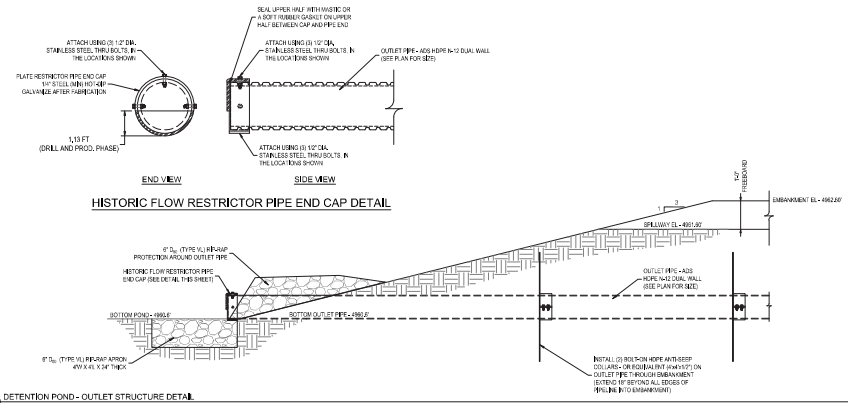
RESPONSIBLE ENGINEER:

COLORADO LICENSED
CHRISTOPHER J. CRUZ
37213
12/13/2021
PROFESSIONAL ENGINEER

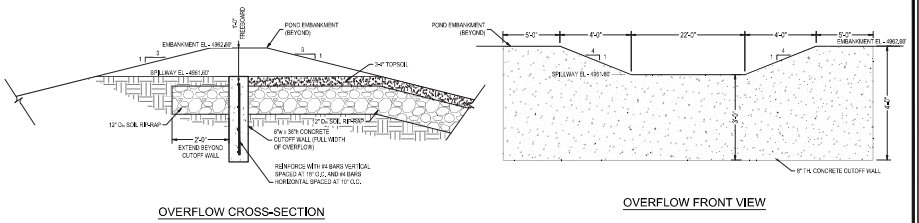
PRODUCTION PHASE
SITE GRADING PLAN

SCALE: NO SCALE
DRAWN BY: C.J.C.
DATE DRAWN: 12-13-2021
UELS FILE NO: M - 2 0 4 6
PROJ NO: MORI0-21-0001
FILE: - -

SHEET
C102



1 DETENTION POND - OUTLET STRUCTURE DETAIL
NO SCALE



2 OVERFLOW SPILLWAY DETAIL - DETENTION POND
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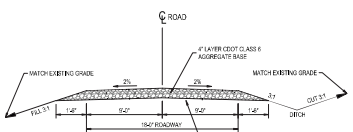
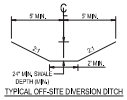


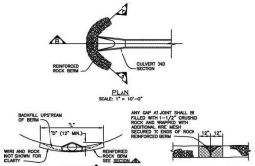
COMPACTION SPECIFICATIONS:
1. COMPACT SUBGRADE AND SURFACING TO 95% OF MAXIMUM DRY DENSITY, ACCORDING TO MATERIAL PROCTOR.
2. MOISTURE CONDITION TO WITHIN ±2% OF THE OPTIMUM MOISTURE CONTENT, AS DETERMINED BY THE MATERIAL PROCTOR.

3 TYPICAL ROADWAY CROSS-SECTION
NO SCALE



TYPICAL OFF-SITE DIVERSION DITCH

4 TYPICAL DIVERSION DITCH
NO SCALE



INSTALLATION NOTES
1. SEE PLAN VIEW FOR:
– LOCATIONS OF CULVERT INLET FILTERS.
– LENGTH, "L", AND DEPTH, "D".
2. CRUSHED ROCK SHALL BE FRACTURED FACE ALL SIDES) AND SHALL COMPLY WITH GRADATION SHOWN ON SHEET 1 (1-1/2" WASH) RECYCLED CONCRETE MATERIAL THIS GRADATION MAY BE USED.
3. WIRE MESH SHALL BE FABRICATED OF 19 GAUGE WIRE TWISTED INTO A MESH WITH A MAXIMUM OPENING OF 1.0 INCH (COMMONLY KNOWN "CHICKEN WIRE").
4. WIRE MESH SHALL BE SECURED USING "SAG BASE" OR WIRE TIES AT 6-INCH CENTERS ALONG ALL JOINTS AND AT 2-INCH CENTERS ON ENDS OF BERM.
5. THE ENDS OF THE REINFORCED ROCK BERM SHALL BE 12" HIGHER THAN THE CENTER OF THE BERM.
MAINTENANCE NOTES
1. THE DESC MANAGER SHALL INSPECT CULVERT INLET FILTER WEEKLY, DURING AND AFTER ANY STORM EVENT AND MAKE REPAIRS OR CLEAN OUT AS NECESSARY.
2. SEDIMENT ACCUMULATED UPSTREAM OF CULVERT INLET FILTER SHALL BE REMOVED WHEN THE SEDIMENT DEPTH UPSTREAM OF FILTER IS 1 FOOT HEIGHT OF THE REINFORCED ROCK BERM.
3. PERS FOR CULVERT PROTECTION ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS APPROVED BY THE COUNTY.
4. WHEN CULVERT INLET FILTERS ARE REMOVED, MAY DISTURBED AREA SHALL BE DRILL SEEDED AND CRIMP MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE COUNTY.

6 REINFORCE ROCK BERM FOR CULVERTS
SCALE: NO SCALE

SEEDING AND MULCHING INSTALLATION NOTES
1. SEE PLAN VIEW FOR:
– AREA OF SEEDING AND MULCHING.
– TYPE OF SEED MIX (PERMANENT, TEMPORARY, OR LOW–GROWTH).
2. ALL WEEDS PERMITTED SHALL BE FREE FROM SUCH NOXIOUS SEEDS AS RUSSIAN OR CANADA THISTLE, FIELD BINDWEED, PERENNIAL SORGHUM, JOHNSON GRASS, PURP WEED AND LEAFY SPURGE.
3. THE SEEDER SHALL FURNISH TO THE CONTRACTOR A SIGNED STATEMENT CERTIFYING THAT THE SEED FURNISHED IS FROM A LOT THAT HAS BEEN TESTED BY A RECOGNIZED LABORATORY, SEED WHICH HAS BECOME WET, MOLDY, OR OTHERWISE DAMAGED IN TRANSIT OR IN STORAGE WILL NOT BE ACCEPTED. (FARMERS' SEED TICKETS SHALL BE PROVIDED TO ARAPAHOE COUNTY UPON REQUEST)
4. DRILL SEEDING MIX SHALL CONFORM TO THE TABLE ON THE RIGHT, UNLESS OTHERWISE APPROVED BY THE COUNTY.
5. IF THE SEED AVAILABLE ON THE MARKET DOES NOT MEET THE MINIMUM PURITY AND GERMINATION PERCENTAGES SPECIFIED, THE SUBCONTRACTOR MUST COMPENSATE FOR A LESSER PERCENTAGE OF PURITY OR GERMINATION BY FURNISHING SUFFICIENT ADDITIONAL SEED TO MEET THE REQUIREMENTS OF THE SPECIFICATIONS. SUCH ADDITIONAL SEED SHALL BE SUPPLIED TO CONTRACTOR AND FURNISHED TO THE ARAPAHOE COUNTY DESC INSPECTOR.
6. THE FORMULA USED FOR DETERMINING THE QUANTITY OF PURE LIVE SEED (PLS) SHALL BE: (POUNDS OF SEED X PURITY X GERMINATION) = POUNDS OF PURE LIVE SEED (PLS).
7. PERMANENT SEED MIX SHALL BE USED UNLESS OTHERWISE APPROVED BY THE COUNTY.
8. ALL AREAS TO BE SEEDED AND MULCHED SHALL HAVE ANIMAL DROPPINGS OR OTHER OBJECTIONABLE MATERIAL REMOVED BEFORE SEEDING. ALL AREAS DISTURBED DURING ROUGH AND FINISH CONSTRUCTION AND/OR FINAL, BE LOOSENED TO A DEPTH OF 6" RAKED PRIOR TO SPREADING TOPSOIL.
9. SOIL IS TO BE TEMPORARILY LOOSENED (TILLED) TO A DEPTH OF 4" (AT LEAST 6 INCHES DEEPER THAN COMPACTED AREAS) WHERE CONSTRUCTION EQUIPMENT HAS COMPACTED THE SOIL. AREAS NOT SUBJECT TO EQUIPMENT COMPACTION SHALL BE RAKED OR OTHERWISE LOOSENED TO A DEPTH OF 4 INCHES WHERE SOIL CLASS GREATER THAN 2 INCHES. SEEDING SHALL NOT BE DIRECTED THAT VARIETY BEEN THOROUGHLY LOOSENED SHALL BE REJECTED.
10. SEED IS TO BE APPLIED USING A MECHANICAL DRILL TO A DEPTH OF 1/4 INCH. ROW SPACING SHALL BE NO MORE THAN 7 INCHES. BROADCAST SEED FOR AN AREA SHALL DOUBLE THE RATE OF DRILL SEED. SEED SHALL BE APPLIED AT A RATE OF 25 POUNDS PER 1,000 SQUARE FEET TO INCHES IN DEPTH. BROADCAST SEED SHALL BE APPLIED AND UNIFORMLY INCORPORATED TO A DEPTH OF AT LEAST 2 INCHES. MULCH SHALL BE APPLIED AT A RATE OF 4000 LB. PER ACRE.
11. IF THE EQUIPMENT DESCRIBED/REFERS TO THE CONTRACT THAT IT IS NOT POSSIBLE TO DRILL SEED IN THE AREA, THE SEED SHALL BE BROADCAST AT TWO TIMES THE DRILLED RATE, THEN LIGHTLY HARROWED TO PROVIDE A SEED DEPTH OF APPROXIMATELY 1/4 INCH, THEN ROLLED TO COMPACT, THEN MULCHED AS SPECIFIED ABOVE.
12. WHEN SEEDING AND MULCHING IS USED TO STABILIZED DISTURBED AREAS, ALL DISTURBED AREAS WHICH ARE TO REMAIN UNDISTURBED FOR ALL SEEDING WITHIN FOR A PERIOD OF 14 DAYS OR MORE SHALL BE SEEDED AND MULCHED WITHIN 14 DAYS OF THE COMPLETION OF THE GRADING ACTIVITIES. THIS MAY REQUIRED MULTIPLE MOBILIZATIONS FOR SEEDING AND MULCHING.
13. MULCH SHALL BE APPLIED WITHIN 24–HOURS OF SEEDING.
14. TACKIFIER SHOULD BE UTILIZED TO HELP WITH STRAW EMPLACEMENT.

SEEDING AND MULCHING MAINTENANCE NOTES
1. SEEDED AND MULCHED AREAS SHALL BE INSPECTED FOR REQUIRED COVERAGE MONTHLY FOR A PERIOD OF TWO YEARS FOLLOWING SEEDING. AREAS FAILING TO MEET THE REQUIRED COVERAGE SHALL BE RESEEDED AND MULCHED AS SOON AS POSSIBLE AFTER DISCOVERY. SUMMER SEEDING SHOULD FOR ANY AREAS FAILING TO MEET THE REQUIRED COVERAGE.
2. REQUIRED COVERAGE FOR STANDARD, OPEN SPACE AND LOW GROWTH SEED MIXES SHALL BE DEFINED AS FOLLOWS:
1. THREE (3) PLANTS PER SQUARE FOOT WITH A MINIMUM HEIGHT OF 3 INCHES. FIVE (5) PLANTS PER SQUARE FOOT SHALL BE OF THE VARIETY AND SPECIES FOUND IN THE ARAPAHOE COUNTY–APPROVED MIX.
2. NO BARE AREAS LARGER THAN 1 SQUARE FEET (TWO–FEET BY TWO–FEET OR EQUIVALENT).
3. FREE OF ERODED AREAS.
4. FREE FROM INFESTATION OF NOXIOUS WEEDS IN ACCORDANCE WITH APPENDIX V OF THE DESC CRITERIA MANUAL.
3. REQUIRED COVERAGE FOR TURF GRASS AREAS SHALL BE DEFINED AS FOLLOWS:
1. AT LEAST 80% VEGETATIVE COVER OF GRASS SPECIES PLANTED.
2. NO BARE AREAS LARGER THAN 1 SQUARE FEET (TWO–FEET BY TWO–FEET OR EQUIVALENT).
3. FREE OF ERODED AREAS.
4. FREE FROM INFESTATION OF NOXIOUS WEEDS IN ACCORDANCE WITH APPENDIX V OF THE DESC CRITERIA MANUAL.
4. WILL AND GULLY EROSION SHALL BE FILLED WITH TOPSOIL PRIOR TO RESEEDING. THE RESEEDING METHOD SHALL BE APPROVED BY THE COUNTY.

ARAPAHOE COUNTY PERMANENT DRILL SEEDING MIX

SPECIES	VARIETY	NOTES	R.M.MIX	POUNDS OF PLS PER ACRE
BIG BLUESTEM	KAW	PMWS	10	5.1
YELLOW INDIANGRASS	CHEYENNE	PMWS	10	1
SWITCHGRASS	BLACKWELL	PMWS	10	3.4
SIDEOATS GRAMA	VAUGHN	PMWS	10	3.9
WESTERN WHEATGRASS	ARRIBA	PNCS	10	1.8
BLUE GRAMA	HACHITA	PMWS	10	3.3
THICKSPIKE WHEATGRASS	CRITANA	PNCS	10	1
PRAIRIE SANDREED	GOSHEN	PMWS	10	3.7
GREEN NEEDLEGRASS	LODORM	PNCB	10	1
SLENDER WHEATGRASS	PRYOR	PNCS	5	3.6
STREAMBANK WHEATGRASS	SODAR	PNCS	5	3.6
			TOTAL	0.2

ARAPAHOE COUNTY TEMPORARY DRILL SEEDING MIX

SPECIES	VARIETY	NOTES	R.M.MIX	POUNDS OF PLS PER ACRE
SMOOTH BROMEGRASS	LINCOLN	PICS	30	3.9
INTERMEDIATE WHEATGRASS	GHMC	PICS	30	4.5
PUBESCENT WHEATGRASS	LUNA	PICS	30	4.2
ANNUAL RYEGRASS	N/A	ACB	10	3.8
			TOTAL	13.4

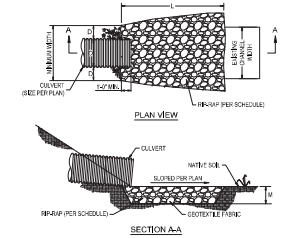
ARAPAHOE COUNTY LOW–GROWTH DRILL SEEDING MIX

SPECIES	VARIETY	NOTES	R.M.MIX	POUNDS OF PLS PER ACRE
BUFFALOGRASS	TEXOKA	PMWS	20	3.2
BLUE GRAMA	HACHITA	PMWS	20	3.6
WESTERN WHEATGRASS	ARRIBA	PNCS	20	3.2
SIDEOATS GRAMA	VAUGHN	PMWS	20	1.8
THICKSPIKE WHEATGRASS	CRITANA	PNCS	10	1
STREAMBANK WHEATGRASS	SODAR	PNCS	10	1.2
			TOTAL	13.9

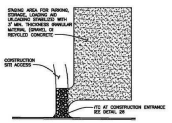
NOTES
N=NATIONAL
A=ARIZONA
B=BANTAM
S=SATIVE
M=MEDIUM
L=LOW GROWTH
D=DOC SEASON
S=SOD FORMER
B=BUNCHGRASS

SM SEEDING AND MULCHING 18

7 SEEDING AND MULCHING DETAILS
SCALE: NO SCALE



8 CULVERT OUTLET PROTECTION - RIP-RAP DETAIL
NO SCALE



STABILIZED STAGING AREA INSTALLATION NOTES
1. SEE PLAN VIEW FOR GENERAL DURATION OF STAGING AREA. CONTRACTOR MAY MODIFY LOCATION AND SIZE OF STABILIZED STAGING AREA WITH COUNTY APPROVAL.
2. STABILIZED STAGING AREA SHALL BE LARGE ENOUGH TO FULLY CONTAIN PARKING, STORAGE, AND UNLOADING AND LOADING OF EQUIPMENT.
3. IF RECOMMENDED BY THE COUNTY, BY LAYDOWN YARDS SHALL BE CONSTRUCTED WITHIN THE STAGING AREA.
4. STAGING AREA SHALL BE STABILIZED PRIOR TO ANY OTHER EXCAVATIONS ON THE SITE.
5. THE STABILIZED STAGING AREA SHALL CONSIST OF A MINIMUM OF 3" OF GRANULAR MATERIAL (GRAVEL OR RECYCLED CONCRETE).

STABILIZED STAGING AREA MAINTENANCE NOTES
1. THE DESC MANAGER SHALL INSPECT THE STABILIZED STAGING AREA WEEKLY, DURING AND AFTER ANY STORM EVENT AND MAKE REPAIRS OR CLEAN OUT UPSTREAM SEDIMENT AS NECESSARY.
2. DESC MANAGER SHALL PROVIDE ADDITIONAL THICKNESS OF GRANULAR MATERIAL, CLEAN, OR OTHER EXCAVATION OR UNDERLYING SEDIMENT BECOMES CLOGGED.
3. STABILIZED STAGING AREA SHALL BE ENLARGED, IF NECESSARY TO CONTAIN PARKING, STORAGE, AND UNLOADING AND LOADING OPERATIONS.
4. ANY ACCUMULATED DIRT OR MUD SHALL BE REMOVED FROM THE SURFACE OF THE STABILIZED STAGING AREA.
5. THE STABILIZED STAGING AREA SHALL BE REMOVED AT THE END OF CONSTRUCTION. THE GRANULAR MATERIAL SHALL BE REMOVED THEN (IF APPROVED BY THE COUNTY) USED ON SITE, AND THE AREA SHALL BE FINAL GRADED AND 3RAP MULCHED OR OTHERWISE STABILIZED.

SSA

9 STABILIZED STAGING AREA
SCALE: NO SCALE

ROCK AND RIPRAP GRADATIONS

TABLE 1: RIPRAP GRADATIONS

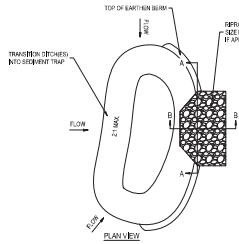
D50 MEDIAN STONE SIZE (INCHES)	% BY MATERIAL SMALLER THAN (TYPICAL RANGE)	TYPICAL STONE DIAMETER (INCHES)	TYPICAL STONE WEIGHT (POUNDS)
6 (VL)	100 – 100 85 – 100 50 – 85 10 – 30	9 8 6 3	25 18 6 0.5
9 (L)	100 – 100 85 – 100 50 – 85 10 – 30	13 12 9 4	80 55 18 1.5
18 (M)	100 – 100 85 – 100 50 – 85 10 – 30	25 23 18 8	600 400 150 12
30 (H)	100 85 – 100 50 – 85 10 – 30	42 39 30 14	1800 1300 500 40
24 (VH)	100 85 – 100 50 – 85 10 – 30	33 31 24 11	1000 750 300 20

TABLE 2: RIPRAP BEDDING

MARK SIZE	ASES PERCENT PASSING SIEVE SIZE
	CLASS A
6" 1 1/2" NO. 4 NO. 200	100 30 – 90 0 – 30 0 – 3

MATCHES SPECIFICATIONS FOR CDOT CLASS C BEDDING MATERIAL. ALL SIDES OF STONE SHALL HAVE SHARP EDGES FRACTURED FACE. ALL SIDES.

10 RIP-RAP GRADATION AND BEDDING
SCALE: NO SCALE



11 TYPICAL SEDIMENT TRAP DETAIL
SCALE: NO SCALE

UINTAH
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- SINCE 1964 -

MORNING GUN EXPLORATION
CASTOR 77-59- 10
CONSTRUCTION PLANS
SEC. 10, T7N, R59W, 6TH P.M.
WELD, COLORADO

NO.	DESCRIPTION	BY	DATE
1	INITIAL SUBMITTAL	CJC	12-13-21

RESPONSIBLE ENGINEER:
COLORADO LICENSED 40594 PROFESSIONAL ENGINEER
12-13-2021

CONSTRUCTION DETAILS

SCALE: NO SCALE
DRAWN BY: C.J.C.
DATE DRAWN: 12-08-2021
UELS FILENO: M - 2 0 4 6
PROJ NO: MORI-21-0001
FILE: - - - -

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C501