FINAL DRAINAGE REPORT

TRAILERS DIRECT EXPRESS
18955 BEACON LITE ROAD
MONUMENT, CO 80132
EL PASO COUNTY

TRAILERS DIRECT EXPRESS

CRAIG OWEN

2900 S TELEPHONE ROAD

MOORE, OK 73160

Western Engineering Consultants inc LLC
127 South Denver Avenue
Fort Lupton, CO 80621

Original: March 28, 2022
Revised: June 20, 2022
Revised: August 5, 2022

FINAL DRAINAGE STUDY
FOR
TRAILERS DIRECT EXPRESS
W ½ of the W ½ of SECTION 11, T 11 S, R 67 W of the 6th P.M.
TOWN OF MONUMENT, EL PASO COUNTY, COLORADO

Prepared For:
Trailers Direct Express
Craig Owen
2900 S Telephone Road
Moore, OK 73160
405-701-9927

Prepared By:

WESTERN ENGINEERING CONSULTANTS, INC. LLC
127 South Denver Avenue
Fort Lupton CO 80621
(720) 685-9951
Contact: Chadwin F. Cox, P.E.

Original: March 28, 2022
Revised: June 20, 2022
Revised: August 5, 2022

WECI Project No. 0415.001.00

Town of Monument

CERTIFICATIONS

I hereby certify that this report and plan for the Final Drainage design of the Trailers Direct Express site, located at 18955 Beacon Lite Road, Monument, Colorado was prepared by me or under my direct supervision in accordance with the provisions of the Town of Monument Code and Mile High Flood District Design and Technical Criteria for the owners thereof. I understand that the Town of Monument does not and will not assume liability for drainage facilities designed by others.

_____
Chadwin F. Cox, P.E.
Registered Professional Engineer
State of Colorado No. 33802

Trailers Direct Express hereby certifies that the drainage facilities for this property located in Monument, Colorado shall be constructed according to the drainage report. I understand that the Town of Monument does not and will not assume liability for the drainage facilities designed and/or certified by my engineer, and that the Town of Monument reviews drainage plans pursuant to Colorado revised Statutes Title 30, Article 28, but cannot, on behalf of Trailers Direct Express guarantee that final drainage design review will absolve Trailers Direct Express and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat, Final Development Plan, and/or Subdivision Development Plan does not imply approval of my engineer's drainage design.

_____ _____
Property Owner Signature Property Owner Signature

TABLE OF CONTENTS

INTRODUCTION 1

I. GENERAL LOCATION AND DESCRIPTION 1

A. Site Location 1
B. Surrounding Developments 3
C. Property Description 4
D. Type of Development 4

II. DRAINAGE BASINS AND SUB-BASINS 4

A. Major Drainage Basins 4
1. Historic 4
2. Existing 5
3. Offsite Basins 6
B. Developed Drainage Basins 7
4. Basin W (0.50 acres) 7
5. Basin E (2.79 acres) 8
6. Basin POND (0.23 acres) 8
7. Basin OFF BLR (0.19 acres) 8
8. Basin OFF W (1.51 acres) 9
9. Basin I-25 (0.21 acres) 9

III. DESIGN CRITERIA 9

A. Regulations 9
B. Drainage Studies & Site Constraints 10
C. Hydrology 10
D. Hydraulics 11
E. Water Quality Enhancement 11
F. Groundwater 11

IV. STORMWATER MANAGEMENT FACILITY DESIGN 12

A. Stormwater Conveyance Facilities 12
B. Stormwater Storage Facilities 12
C. Water Quality BMP's 13
D. Groundwater 14
E. Additional Permitting 14
F. Storm System Maintenance 14

V. CONCLUSIONS 15

A. Compliance with Standards 15
B. Variances 15
C. Drainage Concept 15
D. Additional Items 15

VI. REFERENCES 16

APPENDICES

APPENDIX A

Vicinity Map (USGS)
Key Map (Google Earth)
FEMA Flood Insurance Rate Map (FIRM)
Legal Description
Soil Survey Map & Soil Legend
Geotechnical Report

APPENDIX B

MHFD Rational Method Runoff Calculations

APPENDIX C

Detention Pond Design, Channel Capacities, etc.

APPENDIX D

Drainage Plan – (full size – 24 x 36)

INTRODUCTION

This study has been prepared to provide final hydrologic/hydraulic design for storm-drainage facilities required to develop the Trailers Direct Express site. The Trailers Direct Express property is located on the east side of Beacon Lite Road, west of the I-25 off-ramp approximately 300 feet north of the Beacon Lite Road/Wolf Court intersection within the Town of Monument. The overall site is defined as Lot 1 of the ABC Landscaping Warehouse/Outdoor Storage Filing No. 1 prepared by Rampart Surveys, LLC dated July 9, 2020.

The Trailers Direct Express site is proposed on an existing PUD zoned site (to be rezoned as Light Industrial) that has previously been used primarily as a landscape storage yard. The existing 5,427 sf building was previously used as a warehouse.

Trailers Direct Express wishes to develop the 5.02 acre lot as a trailer sales lot and use the existing building as office and warehouse space.

Trailers Direct Express lies directly east of Beacon Lite Road and west of the I-25 off-ramp, with an undeveloped lot to the north and a lot currently being developed to the south.

The entire Trailers Direct Express site and all adjacent and surrounding properties are historically tributary to Crystal Creek which lies approximately 1,000 feet south of the site, which ultimately flows into Monument Lake lying approximately 1 mile southwest of the site.

Based on the initial coordination with the Town, this site is included in the *ABC Landscaping Warehouse/Outdoor Storage Construction Documents* by ABC Landscaping, Inc dated July 9, 2020.

The Trailers Direct Express site does not lie within an existing or planned floodplain. The entire site is within Zone X "Area of Minimal Flood Hazard" and not within the 100 year floodplain per FEMA FIRM 08041C0276G – effective December 7, 2018.

This report is the Final Drainage Report (FDR) for the overall site. All calculations herein are based on full build-out conditions.

I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

The property lies in the West ½ of the West ½ of Section 11, Township 11 South, Range 67 West of the 6th P.M., Town of Monument, El Paso County, Colorado.

The overall property is 5.02 acres +/- consisting of Lot 1 of ABC Landscaping Warehouse/ Outdoor Storage Filing No. 1. This project is located in between Beacon Lite Road and the I-25 off-ramp, approximately 300 feet north of Wolf Court within the Town of Monument.

A vicinity and key map of the site are included in Appendix A of this study as well as below.

The scales below are not accurate since the maps included herein are for exhibit purposes only.

The Google Earth Exhibit above shows the site and adjacent properties and their relationship to I-25, Beacon Lite Road, and other local roads in the Town of Monument.

The USGS Exhibit above details historic topography of the project site, I-25, Beacon Lite Road, local roads, and their proximity to the Town of Monument.

B. Surrounding Developments

CDOT ROW for the I-25 off-ramp lies to the east, Beacon Lite Road to the west, an undeveloped parcel to the north, S & S Storage (RV storage facility) is approximately 1000 feet to the north, and a property owned by Hammers Construction is being developed to the south.

The proposed site is complimentary to adjacent uses and no negative impacts to adjacent properties are anticipated.

C. Property Description

The legal description for the 5.02 acre +/- property is included in Appendix A.

The existing site drains from north to south off-site at roughly 3.3%. The historic slopes appear to be approximately 2.2%, based on the USGS Quad from northeast to southwest.

The existing grades in general match the historic direction per USGS Quad maps.

The approximate grade at the four corners of the property are as follows – 7111.87 NW corner, 7119.98 NE corner, 7121.35 SE corner, and 7098.49 SW corner of the Trailers Direct Express site.

The soil type of the Trailers Direct Express site is entirely NRCS hydrologic group Type B, as taken from the USDA Soil Survey (Appendix A).

D. Type of Development

The proposed project will develop the existing site into a trailer sales lot. An asphalt millings access is existing off Beacon Lite Road that leads into the existing asphalt millings storage lot that surrounds the existing 5,427 sf building, which will be expanded south and west for trailer parking. The existing access will be paved with concrete from the edge of road to the existing gate and with asphalt from the gate to the ADA parking stall. The existing and proposed on-site swales will convey stormwater runoff to the proposed detention pond on the south side of the site.

No off-site improvements are proposed at this time.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

The Trailers Direct Express site is solely located in the Crystal Creek River Basin and all existing and developed drainage is ultimately tributary to Monument Lake. The historic and existing basins are shown on sheet 10 of the construction drawings.

1. Historic

Basin H (5.02 ac) includes the entirety of the existing site. As noted above, the historic grades (2.2%) drained off-site to the southwest towards Crystal Creek (per USGS Monument, CO Quad Map). The entirety of this basin is (100%) NRCS Soil Type B.

All runoff values presented herein have been prepared with the recently updated method of check for time of concentration – the MHFD 2018 equation of: (26-17i) + [L_{travel} / (60*(14i + 9)*(S_o) ^.5)]. *All values provided in this study are as determined by the USDCM 2018 time of concentration check.*

The Historic effective imperviousness value used for Basin H was 2.0%. The minor (5yr) storm runoff is approximately 0.10 cfs and the major storm runoff is approximately 9.27 cfs at Design Point H1.

2. Existing

Basin W (2.64 acres) includes the west half of the existing site that drains into the existing drainage swale on the west side of the site. The existing basin slopes north to south with moderate slopes of approximately 4.5% into an existing riprap channel just outside of the south property line. The entirety of this basin is (100%) NRCS Soil Type B.

All runoff values presented herein have been prepared with the recently updated method of check for time of concentration – the MHFD 2018 equation of: (26-17i) + [L_{travel} / (60*(14i + 9)*(S_o)^.5)]. *All values provided in this study are as determined by the USDCM 2018 time of concentration check.*

The existing effective imperviousness value calculated for Basin W was 19.80% as the west half of the existing building and the asphalt millings access exist in this basin. The minor (5yr) storm runoff is approximately 1.09 cfs, and the major storm runoff is approximately 7.26 cfs at Design Point E2.

Basin E (2.38 acres) includes the east half of the existing site that drains into the existing drainage swale on the east side of the site. The existing basin slopes north to south with moderate slopes of approximately 2.1% into an existing culvert just outside of the south property line. The entirety of this basin is (100%) NRCS Soil Type B.

All runoff values presented herein have been prepared with the recently updated method of check for time of concentration – the MHFD 2018 equation of: (26-17i) + [L_{travel} / (60*(14i + 9)*(S_o)^.5)]. *All values provided in this study are as determined by the USDCM 2018 time of concentration check.*

The existing effective imperviousness value calculated for Basin E was 35.14% as the east half of the existing building and asphalt millings storage lot exist in this basin. The minor (5yr) storm runoff is approximately 1.72 cfs, and the major storm runoff is approximately 7.19 cfs at Design Point E4.

3. Offsite Basins

Basin OFF BLR (0.19 acres) includes the east half of the existing Beacon Lite Road ROW that drains onto this site. The existing basin slopes from northwest to southeast with moderate slopes of approximately 4.4% onto the site. The entirety of this basin is (100%) NRCS Soil Type B.

All runoff values presented herein have been prepared with the recently updated method of check for time of concentration – the MHFD 2018 equation of: (26-17i) + [L_{travel} / (60*(14i + 9)*(S_o)^.5)]. *All values provided in this study are as determined by the USDCM 2018 time of concentration check.*

The existing effective imperviousness value calculated for Basin OFF BLR was 50.91% as the east half of the existing asphalt Beacon Lite Road is in this basin. The minor (5yr) storm runoff is approximately 0.31 cfs, and the major storm runoff is approximately 1.00 cfs.

Basin OFF NW (20.07 acres) includes the area north of the site which flows into the existing swale going through the west half of the lot. The existing basin slopes from north to south with moderate slopes of approximately 2.9% onto the site. The entirety of this basin is (100%) NRCS Soil Type B.

All runoff values presented herein have been prepared with the recently updated method of check for time of concentration – the MHFD 2018 equation of: (26-17i) + [L_{travel} / (60*(14i + 9)*(S_o)^.5)]. *All values provided in this study are as determined by the USDCM 2018 time of concentration check.*

The existing effective imperviousness value calculated for Basin OFF NW was 14.05% as the east half of the existing asphalt Beacon Lite Road, the west half of the I-25 off-ramp, and the southeast corner of the gravel RV storage lot of S & S Storage is in this basin. The minor (5yr) storm runoff is approximately 3.96 cfs, and the major storm runoff is approximately 36.90 cfs at Design Point E1.

Basin OFF NE (1.21 acres) includes the area north of the site which flows into the existing swale running along the east side of the lot. The existing basin slopes from northeast to southwest with moderate slopes of approximately 4.4% onto the site. The entirety of this basin is (100%) NRCS Soil Type B.

All runoff values presented herein have been prepared with the recently updated method of check for time of concentration – the MHFD 2018 equation of: (26-17i) + [L_{travel} / (60*(14i + 9)*(S_o)^.5)]. *All values provided in this study are as determined by the USDCM 2018 time of concentration check.*

The existing effective imperviousness value calculated for Basin OFF NE was 10.12% as the west half of the existing asphalt I-25 off-ramp exists in this basin. The minor (5yr) storm runoff

is approximately 0.23 cfs, and the major storm runoff is approximately 2.85 cfs at Design Point E3.

Basin OFF I-25 (0.21 acres) includes the west half of the existing I-25 off-ramp that drains onto this site. The existing basin slopes from east to west with moderate slopes of approximately 5 to 15% onto the site. The entirety of this basin is (100%) NRCS Soil Type B.

All runoff values presented herein have been prepared with the recently updated method of check for time of concentration – the MHFD 2018 equation of: (26-17i) + [L_{travel} / (60*(14i + 9)*(S_o)^.5)]. *All values provided in this study are as determined by the USDCM 2018 time of concentration check.*

The existing effective imperviousness value calculated for Basin OFF BLR was 29.38% as the west half of the existing asphalt I-25 off-ramp is in this basin. The minor (5yr) storm runoff is approximately 0.20 cfs, and the major storm runoff is approximately 0.98 cfs.

B. Developed Drainage Basins

This study provides the final developed drainage characteristics for the ~ 5.02 acre site.

The property has been mapped as two developed drainage basins. The site has been designed to convey all developed runoff into the proposed detention pond in the southwest corner of the site.

The developed basins are shown on sheet 11 of the construction drawings.

Each minor storm event referred to below is the 5 year event and each major storm event referred to below is the 100 year event. The 10 year event has also been calculated.

Calculations are carried out to the hundredths for consistency purposes only.

4. Basin W (0.50 acres)

Basin W consists of the portion of the developed site that drains into the west drainage swale. This basin contains the northwest quarter of the existing building, the employee parking, and the west quarter of the proposed trailer parking lot.

Runoff from Basin W begins as roof runoff from the existing building and will be collected via downspouts and discharged along the north side of the building. Runoff will then be conveyed overland to the concrete pan north of the employee parking and flow west/south to the proposed swale, which flows south to the proposed detention pond at design point 4.

The developed effective imperviousness value calculated for Basin W is 92.99%. NRCS Soil Type for this basin is entirely (100%) Type B. The minor storm runoff is 1.64 cfs and the major storm runoff is 3.70 cfs.

5. Basin E (2.79 acres)
Basin E consists of the portion of the developed site that drains into the east drainage swale. This basin contains the east three-quarters of the existing building and the east three-quarters of the proposed trailer parking lot.

Runoff from Basin E begins as roof runoff from the existing building and will be collected via downspouts and discharged along the north side of the building. Runoff will then be conveyed overland across the existing/proposed trailer parking lot to the east swale and flow south then east to the proposed detention pond at Design Point 3.

The developed effective imperviousness value calculated for Basin E is 51.36%. NRCS Soil Type for this basin is entirely (100%) Type B. The minor storm runoff is 2.92 cfs and the major storm runoff is 9.33 cfs.

6. Basin POND (0.23 acres)
Basin S consists of the proposed detention pond, which includes two concrete forebays, concrete rundown channels, concrete trickle pans, spillway wall, and outlet structure.

Runoff from Basin POND begins in the east concrete rundown, flows through Forebay E, and across the concrete trickle pan into the outlet structure.

The developed effective imperviousness value calculated for Basin POND is 74.31%. NRCS Soil Type for this basin is entirely (100%) Type B. The minor storm runoff is 0.59 cfs and the major storm runoff is 1.51 cfs.

7. Basin OFF BLR (0.19 acres)
Basin OFF BLR consists of the east half of Beacon Lite Road that flows on-site.

Runoff from Basin OFF BLR begins at the crown of the road and flows from northwest to southeast onto the property.

The developed effective imperviousness value calculated for Basin OFF BLR is 48.65%. NRCS Soil Type for this basin is entirely (100%) Type B. The minor storm runoff is 0.29 cfs and the major storm runoff is 0.97 cfs.

8. Basin OFF W (1.51 acres)
Basin OFF W consists of the west third of the site, which includes the existing access and the existing National Wetland Inventory watercourse. The only improvement in this basin is paving of the access road. The existing watercourse is to be protected during construction and remain as existing.

Runoff from Basin OFF W begins in the northwest corner of the site and flows east to the existing watercourse. Runoff then flows south along the existing watercourse off-site as existing.

The developed effective imperviousness value calculated for Basin OFF W is 9.01%. NRCS Soil Type for this basin is entirely (100%) Type B. The minor storm runoff is 0.26 cfs and the major storm runoff is 3.71 cfs.

9. Basin I-25 (0.21 acres)
Basin I-25 consists of the west half of the I-25 off-ramp that flows on-site into the east swale.

Runoff from Basin I-25 begins at the crown of the road and flows from east to west onto the property.

The developed effective imperviousness value calculated for Basin S is 29.38%. NRCS Soil Type for this basin is entirely (100%) Type B. The minor storm runoff is 0.20 cfs and the major storm runoff is 0.98 cfs.

Off-site basins OFF NW and OFF NE are to remain as existing as shown above.

III. DESIGN CRITERIA

A. Regulations

The calculations provided in this letter report have been prepared in conformance with the "*City of Colorado Springs and El Paso County Drainage Criteria Manual - Volumes I & II*" (Ref 1), revised January 2021 and "*Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual, Volumes I thru III*" (Ref 2), latest release unless otherwise noted.

All design elements outlined in this report, and illustrated in the construction plans, are proposed as final conditions (as directed, assumed, or otherwise prepared) in order to complete the development of this Project.

B. Drainage Studies & Site Constraints

No apparent Final Drainage Study appears to have been prepared as part of this property in the past. This study has been prepared in conformance with the MHFD Urban Storm Drainage Criteria Manual (Reference 2), Volumes I thru III, and consistent with the City of Colorado Springs and El Paso County Drainage Criteria Manual (Reference 1).

The significant constraints identified as part of the design of this project included adjacent Town and CDOT ROW, and off-site areas flowing into the existing on-site ditches.

C. Hydrology

The rainfall intensity information was obtained from the NOAA Atlas 14 using 1 hour rainfall depths as taken from USDCM Manual Vol 1 (Ref 2).

The City of Colorado Springs and El Paso County Drainage Criteria Manual (Ref 1), latest release unless otherwise noted was utilized for confirmation of 100 year and 5 year event storm rainfall data.

Upon review of the aforementioned references, the NOAA Atlas 14 was referenced, and data derived for 1 hour rainfall depths at 2, 5, 10, and 100 year events are as follows:

	WEC Derived from USDCM NOAA Atlas 14
DESIGN STORM	1-hr Event (inches)
2	0.90
5	1.20
10	1.46
100	2.52

The precipitation depth derived from the NOAA Atlas 14 by WEC for the 1-hour design storm was 2.52 inches rainfall depth for the 100-year storm, 1.46 inches rainfall depth for the 10-year storm, and 1.20 inches rainfall depth for the 5 year storm.

The Rational Method for storm-water runoff calculations, using the Equations as described in the MHFD (Reference 2) Criteria Manual Chapter 6 Runoff was used to calculate stormwater flows within this study. The run-off coefficient 'C' values were obtained from the MHFD (Reference 2) Criteria Manual as well based on the predominate NRCS Soil Type.

It appears that only the adjacent property to the south has any sort of on-site water quality or detention facilities. All other adjacent property either have no known drainage facilities or remain undeveloped.

The use of weighted runoff coefficients is to accurately portray the proposed final conditions of the maximum build out (maximum lot coverage) for this project based on the best available

information at this time. Sole use of Table 6-3 is applicable for Master Plan Drainage analysis including projects of this type – however calculation of proposed final conditions using weighted runoff coefficients provides a more thorough and accurate analysis.

The site has been modeled based on the current expected build out conditions.

No additional Pond volume would be required as the Detention Pond design is based on ultimate tributary imperviousness and complete capture of all rainfall within the tributary basin(s).

It is the expectation of this study that any development or improvements to the properties adjacent will require them to provide appropriate stormwater design(s).

This project will not negatively affect the adjacent properties and will provide modern stormwater control that does not currently exist. In short, this project will be an enormous improvement to the area.

D. Hydraulics

The conveyance of on-site stormwater occurs primarily overland across pavements or landscape into grass swales that will ultimately convey runoff to the proposed detention pond.

Please see Appendix C for all related swale and pond capacities.

There are no major drainage ways on this site or immediately adjacent. Currently, existing storm water runoff is directed into the Beacon Lite Road ROW and then to Crystal Creek.

E. Water Quality Enhancement

Water quality will be provided by overland runoff (landscape areas), grass swales, and by the proposed detention pond forebays and grass bottom. Developed runoff will be routed through the proposed swales along the east and west sides of the proposed trailer parking to the proposed detention pond.

Nearly all of the site will receive on-site water quality through either sedimentation or filtration.

In accordance with Monument WQCV design standards, the detention pond has been designed to drain the water quality capture volume within 40 hours.

F. Groundwater

A Project Geotechnical Report has been completed by Geoquest, LLC, dated May 18, 2020 and is included in Appendix A.

Developed runoff is not anticipated to increase groundwater levels but will be infiltrated into the subsurface soils.

Should groundwater levels surface (above the design bottom) at any time for more than 72 hours the Engineer of Record should be contacted and plans to mitigate said groundwater be undertaken (i.e. cleaning of outlet structure and/or raising of Pond bottom above groundwater).

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities

Runoff analysis for stormwater management has been included and presented in this report.

Capacity calculations for the proposed swales and detention pond are included in Appendix C.

B. Stormwater Storage Facilities

Traditional stormwater storage and attenuation (water quality and detention) is currently proposed since this site has a source of formal outfall.

The Detention Pond has been designed with an outlet structure and emergency overflow wall/channel and is located along the south side of the site.

City of Colorado Springs and El Paso County Drainage Criteria Manual (Ref 1) and MHFD Drainage Criteria (Ref 2) were referenced for determining necessary storage volumes.

Four independent volumes were calculated – (1) Required water quality capture volume, (2) Required EURV yr volume, (3) Required 100 yr, volume, and (4) Available volume @ Emergency Overflow.

Detention Pond: (1) 3,702.6 cubic feet, (2) 11,499.8 cubic feet, (3) 20,124.7 cubic feet, and (4) 29196.0 cubic feet.

The current Trailers Direct Express detention pond storage/grading design provides a single 100 yr, 24 hr rainfall volume for the east two-thirds site, Basin OFF NE, and Basin OFF I-25 (imperviousness of 45% - modeled at 50%). The west third of the site will not be routed to the detention pond in order to preserve the NWI watercourse as existing.

An outlet structure has been designed at the southern edge of the pond to control the release from the pond. The two-chamber structure includes a MHFD standard trash rack on the front and top face, a EURV orifice plate with water quality holes mounted on the interior wall, and a 100-yr

restrictor plate at the downstream outlet pipe. An 18" RCP pipe will convey restricted flows from the outlet structure, through the spillway wall, and into the existing watercourse to the west. An emergency spillway wall has also been designed at the western boundary of the pond. Said wall includes a spillway weir that will allow the pond to overflow into the existing watercourse to the west.

The site has been designed to have a total 100 year release rate of 9.27 cfs, matching the historic 100 year release rate. The outlet structure has been designed to release at a rate of 5.56 cfs. The 100 year runoff from Basin OFF W amounts to 3.71 cfs, which cannot be captured in order to preserve the existing watercourse. The resulting 100 year runoff from the outlet structure and Basin OFF W will be 9.27 cfs, matching historic.

The existing drainage channel downstream of the site will see a significant decrease in flow as the runoff from the east two-thirds of the site will be detained and released at a much lower rate.

All calculations are included in Appendix C.

C. Water Quality BMP's

Overland runoff will provide some water quality. The proposed grass swales and EDB (forebays, trickle channel, landscaped bottom, etc.) will treat all routed runoff from the site. Additional BMP's in accordance with current USDCM Volume III criteria (Ref 2) may be added in the future.

In order to protect water quality during the development of this site, a number of erosion and sediment control BMPs are proposed to be installed.

A sediment basin, silt fence downstream of any anticipated runoff, temporary drainage swales, and check dams will be installed prior to any site construction. Vehicle tracking control, a concrete washout area, and a stabilized staging area will also be installed at this time. These BMPs will capture any construction related runoff and will help to minimize the sediment/debris tracked off-site.

Additional BMPs will be added as site construction begins. Sediment Control Logs will be installed along all swales throughout the site to help minimize the sediment/debris tracked off-site.

These BMPs shall be removed as needed with the development of the site (i.e., sediment basin, drainage swales, vehicle tracking, etc.). Once final grades are established, seeding will be performed to stabilize the landscape areas.

D. Groundwater

Typical Lot runoff is expected to moderately infiltrate the seeded grasses most minor events. Under multiple minor events or major events runoff is expected to sheet flow to adjacent grass swales and be routed to the on-site detention pond as designed. Minimal effect to the groundwater is expected.

Typical commercial geotechnical reports recommend the building design to incorporate foundation drains and sump pumps for protection against groundwater.

E. Additional Permitting

The following permitting will be required as part of this development – State CDPS/COR400000 Permit.

F. Storm System Maintenance

This section defines the maintenance responsibilities for Trailers Direct Express:

- Swales – including but not limited to mowing, weed control, cleaning and removing debris, removing accumulated sediment, adding erosion control, and replacement of any damaged or failing improvements. Improvements for swales include minor regrading and vegetation.

- Drainage Basins – including but not limited to mowing, weed control, cleaning and removing debris, removing accumulated sediment, adding erosion control, and replacement of any damaged or failing improvements.

- Detention Ponds – including but not limited to mowing, weed control, cleaning and removing debris, removing accumulated sediment, adding erosion control, and replacement of any damaged or failing improvements. Improvements for the Detention Ponds includes concrete walls, concrete rundown channels, concrete forebays, trickle pans, pond bottom, outlet structure, and emergency overflow wall.

Frequency of inspections and maintenance are as follows:

- Swales, Basins, Storm Infrastructure, and Detention Pond should be inspected monthly or within 24 hours of each measurable precipitation event.

- Any damaged or lost material (riprap, concrete, etc.) should be replaced immediately.

- Mowing should occur monthly or more often depending upon growth.

- Weed control should occur a minimum of two times per spring/summer/fall season.

Cleaning beyond inspections noted above should occur at a minimum of annually.

V. CONCLUSIONS

A. Compliance with Standards

This Drainage Study for the Trailers Direct Express site is located in, and was prepared in conformance with, "*City of Colorado Springs and El Paso County Drainage Criteria Manual - Volumes I & II*" (Ref 1), and the Mile High Flood District Storm Drainage Design and Technical Criteria (Ref 2).

This drainage design and concept quantifies the requirements to manage stormwater runoff.

B. Variances

No formal variance is proposed or requested at this time.

C. Drainage Concept

The intent of this design is to provide the drainage analysis necessary for capture, routing, and detention of the runoff generated by the Trailers Direct Express property.

D. Additional Items

No additional items were considered at this time.

VI. REFERENCES

1. *"City of Colorado Springs and El Paso County Drainage Criteria Manual - Volumes I & II",* Revised January 2021.

2. *Urban Storm Drainage Criteria Manual, Volumes I-III, Denver Regional Council of Governments,* 2016, Revised 2017 & 2018, and all subsequent updates.

APPENDIX A

Vicinity Map (USGS) / Key Map / FEMA Flood Insurance Rate Map (FIRM) / Legal Description / Soil Survey Map and Soil Legend / Geotechnical Report

VICINITY MAP

SCALE 1" = 2,000'

W 1/2, W 1/2, S11, T11S, R67W, 6th P.M.

SHOWN VICINITY MAP TAKEN FROM USGS QUAD MAP - MONUMENT 7.5 MIN

Google Earth Vicinity Map

National Flood Hazard Layer FIRMette

FEMA

104°52'18"W 39°6'37"N

104°51'41"W 39°6'9"N

Feet 1:6,000

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

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 3/21/2022 at 12:42 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.

Property Legal Description

LOT 1, ABC LANDSCAPING WAREHOUSE/OUTDOOR STORAGE FILING NO. 1, COUNTY OF EL PASO, STATE OF COLORADO.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for El Paso County Area, Colorado

Trailers Direct Express & Off-Site Basins

March 17, 2022

Preface

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

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

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

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

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

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

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Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....11
Map Unit Descriptions.....11
El Paso County Area, Colorado.....13
92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes.....13
93—Tomah-Crowfoot complex, 8 to 15 percent slopes.....14
References.....17

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,170 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, 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: Aug 19, 2018—Sep 23, 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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	3.1	11.4%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	24.3	88.6%
Totals for Area of Interest		**27.4**	**100.0%**

Map Unit Descriptions

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

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

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

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

onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b9
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
Bt - 22 to 48 inches: stratified coarse sand to sandy clay loam
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

93—Tomah-Crowfoot complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 36bb
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
Bt - 22 to 48 inches: stratified coarse sand to sandy clay loam
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

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GEOQUEST, LLC
6825 Silver Ponds Heights #101
Colorado Springs, CO 80908
(719) 481-4560

18 May 2020

ABC Landscaping
3870 Mark Dabling Boulevard
Colorado Springs, Colorado 80907

RE: Soil Test Receipt, 0 Beacon Lite Road, Geoquest #20-0409

Dear ABC Landscaping,

Thank you for choosing Geoquest to perform the Soils Report for the property at the above location.

The attached Soils Report provided by Geoquest, LLC, has been prepared in accordance with the standard of practice. This report does not address possible geologic hazards, environmental hazards, or drainage that exist on-site. There are specific requirements for the design and construction of the foundation of a structure at the location noted in the report. Some of these requirements are placed on the homeowner of the property and may be outside of the builders' control. **Accordingly, we are requiring both the builder and the homeowner to sign this letter indicating both parties have accepted a copy of the report, have read and understood the contents, and know they each have specific responsibilities. Failure to follow the recommendations and requirements of the report by any party can result in unsatisfactory performance of the foundation or building components. Builder and Owner understand the risks, as noted in the Soils Report, and accept all risk, including movement of slabs.**

After the excavation has been completed an **Open Hole Observation is required** to be performed by the Soils Engineer. **After the Open Hole Observation is complete, the owner/builder should inform the Foundation Engineer of any changes to the soil conditions or allowable bearing. The Open Hole Observation is an additional cost.**

Geoquest, LLC, will not provide any documentation for site inspections until we have received this letter with the required signatures. If the property is being developed as a speculative investment and no homeowner has been contracted to purchase the property, you can indicate that under the homeowner signature line. Upon the sale of the property the builder understands that both this letter and a copy of the Soils Report shall be provided to the buyer, and a homeowner signed copy returned to Geoquest, LLC.

If you have any questions, feel free to contact us at (719) 481-4560.

Sincerely,

Charles E. Milligan, P.E.
Civil Engineer

Builder Representatives

Homeowner(s)

_____ _____

_____ _____

GEOQUEST, LLC
6825 Silver Ponds Heights #101
Colorado Springs, CO 80908
(719) 481-4560

SOILS REPORT

FOR

ABC LANDSCAPING

JOB #20-0409

0 Beacon Lite Road,
El Paso County,
Colorado

Sincerely,

Charles E. Milligan, P.E.
Civil Engineer

COLORADO REGISTERED
CHARLES E. MILLIGAN
34608
PROFESSIONAL ENGINEER
18 MAY 20

TABLE OF CONTENTS

INTRODUCTION	1
CONCLUSIONS	1
GENERAL	1
FIELD AND LABORATORY INVESTIGATION	1
TOPOGRAPHY	1
WEATHER	1
DESIGN AND CONSTRUCTION CONSIDERATIONS	2
RECOMMENDATION REMARKS	2-3
COLD TEMPERATURE CONSIDERATIONS	3
SURFACE DRAINAGE	3
SUBSURFACE DRAINAGE	3
REINFORCING	4
FOOTING DESIGN	4
CONSTRUCTION DETAILS	4
MINIMUM MATERIALS SPECIFICATIONS	4
OPEN HOLE OBSERVATION	4
FINAL OBSERVATIONS	4
LOGS	5
SITE MAP	6
SIEVE ANALYSIS RESULTS	7
EXTERIOR DRAIN DETAILS	8
LIMITATIONS	9

INTRODUCTION

The owners must be made aware of the contents of this report. If there are any questions or concerns regarding the information in this report, please contact Geoquest, LLC. It is the responsibility of the contractor on this project to make subsequent owners aware of the contents of this report. This is to ensure that the recommendations and requirements of the report, especially regarding the surface drainage, are acknowledged and followed. This report is prepared for **ABC Landscaping, buyer, on 0 Beacon Lite Road, El Paso County, Colorado.** This report is prepared with the understanding that a commercial structure is planned for this site. The site is currently vacant.

CONCLUSIONS

Due to encountering zones of clay, an Over-Excavation Scheme may be required pending the results of the Open Hole Observation. If the Over-Excavation Scheme is necessary, compaction testing will be required and a bearing of 1,500 pounds per square foot will be used. The over-excavated area shall extend to a minimum depth of 4 feet below the bottom of the foundation elevation and 4 feet laterally from the location of the foundation walls. Additional drainage may be required during construction due to the high moisture content. If the bottom of the excavation becomes unstable, the use of 1' to 2' of 4" to 8" ballast rock may be required.

A satisfactory foundation for this structure is a properly designed shallow foundation system consisting of foundation components resting directly on undisturbed materials. Foundation components resting directly on undisturbed materials shall be designed for a loading of not greater than **5,000 pounds per square foot. Any design by any engineer is subject to revision based on the results of the open hole observation.** The compressibility of this material is low. This bearing capacity is calculated with a safety factor of three. The type of foundation configuration used depends on the building loads applied. The depth of foundation elements shall be determined by the foundation engineer but should be at least as deep as the minimum depth required by the governing building authority. **The laboratory testing revealed that the on-site soil is silty sand with underlying clayey sand (U.S.C.S. Classification Symbol SM, SC). The unit weight of equivalent fluid soil pressure of this material is 40 (SM) and 45 (SC) pounds per cubic foot. The owners shall be made aware that movement will occur if surface or subsurface water is allowed to collect around the foundation wall.**

GENERAL

The investigation was made to reveal important characteristics of the soils and of the site influencing the foundation design. Also evaluated during the investigation were subsurface conditions that affect the depth of the foundation and subsequent loading design, such as ground water levels, soil types, and other factors which affect the bearing capacity of the soils. Design loadings are based on soils characteristics and represent the maximum permissible loads for these conditions.

FIELD AND LABORATORY INVESTIGATION

Two exploratory holes were drilled on May 5, 2020, at the locations shown on the enclosed site map. The location of these test holes was determined by ABC Landscaping. The test holes were drilled with a 3-inch diameter auger. At intervals anticipated to be the foundation depths, and as determined by the soils conditions, the drill tools were removed, and samples were taken by the use of a 2-inch split barrel sampler connected to a 140-pound drop-hammer. This hammer is dropped 30 inches to drive the penetration sampler into the soil **(ASTM D-1586).** The depths and descriptions of the materials encountered in each test boring at which the samples were taken are shown on the enclosed log sheets. All samples were classified both in the field and in the laboratory to evaluate the physical and mechanical properties of the materials encountered.

TOPOGRAPHY

The topography of this site is that of an incline sloping down towards the west at 10%.

WEATHER

The weather at the time of the soil examination consisted of clear skies with moderate temperatures.

DESIGN AND CONSTRUCTION CONSIDERATIONS

Slabs-on-grade may move and crack. Vertical slab movement of one to three inches is considered normal for soils of low to moderate expansion potential and for compacted structural fill after removal of expansive soils. In some cases, vertical movement may exceed this range. If movement and associated damage to basement floors and finish cannot be tolerated, a structural floor system should be installed. If compaction is not performed, settlement may occur causing cracking of foundation walls and floors. Soil located beneath concrete walls shall be compacted to at least 95% Modified Proctor density. Soil located beneath concrete slabs shall be compacted to at least 85% Modified Proctor density. Special care is to be taken to re-compact the material above utility lines to a minimum of 85% Modified Proctor density. During construction, conditions that could cause settlement shall be eliminated. Interior non-bearing partition walls shall be constructed such that they do not transmit floor slab movement to the roof or overlying floor. The gap or void (1.5 inch min.) installed in these non-bearing partitions may require re-construction over the life of the structure to re-establish the gap or void to allow for vertical slab movement. Stairwells, doorways and sheeted walls should be designed for this movement. The following are general recommendations of on-grade slabs:

1. Slabs shall be placed on well-compacted, non-expansive materials, and all soft spots shall be thoroughly excavated and replaced with non-expansive fill materials as stated above.

2. Slabs shall be separated from all foundation walls, load bearing members, and utility lines.

3. At intervals not to exceed 12 feet in each direction, provide control joints to reduce problems with shrinkage and curling as recommended by the American Concrete Institute (ACI). Moisten the ground beneath the slab prior to placement of concrete.

4. All concrete placed must be cured properly as recommended by the American Concrete Institute (ACI). Separate load bearing members from slabs, as discussed above. Care must be exercised to prevent excess moisture from entering the soil under the structure, both during and after construction.

5. Due to the exposure of exterior concrete to variations in moisture fluctuations, heaving and cracking of exterior slabs-on-grade should be expected. Placement of at least 3 feet of non-expansive fill beneath the slabs can help to reduce the impact of differential movement and cracking but may not eliminate movement. Exterior concrete shall slope away from the structure a minimum of 2% grade.

6. The clayey sand (SC) has been analyzed for its expansion and/or consolidation potential. Basement slabs, garage slabs, and all concrete floor slabs, however, exert a very low dead-load pressure on the soil. Since this soil contains at least a small amount of swell potential, slabs will crack and heave or settle if excess water is allowed to penetrate the sub-grade. For example, column openings to pads below the placed slab, if exposed to precipitation during construction, will conduct water to the sub-grade, possibly causing it to expand. Also, if the slab is placed with concrete too wet, expansion may occur. We recommend 3,000 psi concrete placed at a maximum slump of 4 inches.

RECOMMENDATION REMARKS

The recommendations provided in this report are based upon the observed soil parameters, anticipated foundation loads, and accepted engineering procedures. The recommendations are intended to minimize differential movement resulting from the heaving of expansive soil or from the settlement induced by the application of loads. **It must be recognized that the foundation will undergo some movement on all soil types.** In addition, concrete floor slabs will move vertically, therefore, adherence to those recommendations which isolate floor slabs from columns, walls, partitions or other structural components is extremely important if damage to the superstructure is to be minimized.

RECOMMENDATION REMARKS (CONTINUED)

Any subsequent owners should be apprised of the soil conditions and advised to maintain good practice in the future with regard to surface and subsurface drainage and partition framing, drywall and finish work above floor slabs.

Geoquest, LLC does not assure that the contractor and/or homeowner will comply with the recommendations provided in this report. Geoquest, LLC provides recommendations and requirements only and does not supervise, direct or control the implementation of the recommendations.

COLD TEMPERATURE CONSIDERATIONS

1. Concrete shall not be placed upon frozen soil.

2. Concrete shall be protected from freezing until it has been allowed to cure for at least 7 days after placement in forms.

3. Snow or other frozen water shall not be allowed in the forms during placement of concrete.

4. Concrete shall be cured in forms for at least 72 hours.

5. Concrete shall be vibrated or rodded in forms to avoid segregation and cold joints.

6. The site shall be kept well drained at all times.

SURFACE DRAINAGE

After construction of foundation walls, the backfill material shall be well compacted to 80% Modified Proctor density, to reduce future settlement. Any areas that settle after construction shall be filled to eliminate ponding of water adjacent to the foundation walls. **The finished grade shall have a positive slope away from the structure with an initial slope of 6 inch in the first 10 feet.** If a 10 feet zone is not possible on the upslope site of the structure, then a well-defined swale should be created a minimum of 5 feet from the foundation and sloped parallel with the wall at a 2% grade to intercept the surface water and carry it around and away from the structure. Homeowners shall maintain the surface grading and drainage installed by the builder to prevent water directed in the wrong direction. All downspouts shall have splash blocks that will remove runoff to outside the foundation area and carried across backfill zones. No irrigation devices shall be placed within 10 feet of the foundation. Shrubs and plants requiring minimal watering shall be established in this area. Irrigated grass shall not be located within 5 feet of the foundation. Sprinklers shall not discharge water within 5 feet of the foundation. Irrigation should be limited to the minimum amount sufficient to maintain vegetation. Application of more water will increase likelihood of floor slab and foundation movement.

All exterior grading and location of downspouts and their performance shall be inspected by Geoquest, LLC. It is the responsibility of the contractor to schedule all inspections.

SUBSURFACE DRAINAGE

Perimeter drains are required around all walls of the living area portion of the structure that are below finished grade including all common wall(s) adjacent to the basement. Crawlspaces are not considered living area. Walkout areas need not be drained unless specified at the time of the Open Hole Observation. The final determination of the necessity for perimeter drains will be made at the time of the Open Hole Observation.

REINFORCING

The concrete foundation walls shall be properly reinforced as per the specific design for this foundation by a **Colorado Registered Professional Engineer. Exact requirements are a function of the design of the structure. Questions concerning the specific design requirements shall be referred to the design engineer.**

FOOTING DESIGN

The design for footings for this structure is determined by applying the dead load and full live load to the foundation walls.

CONSTRUCTION DETAILS

It is necessary with any soils investigation to assume that the materials from the test holes are representative of the materials in the area. On occasion variations in the subsurface materials do occur, therefore, should such variations become apparent during construction, the owner is advised to contact this office for a determination as to whether these variations will affect the design of the structure's foundation. If anomalies are observed during the excavation for the dwelling, this office should be contacted to determine whether the layers will adversely affect the design.

MINIMUM MATERIALS SPECIFICATIONS

1. Minimum materials specifications of the concrete, reinforcing, etc., shall be determined by the Professional Foundation Design Engineer.
2. Compact beneath foundation walls a minimum of 95% Modified Proctor density to prevent settlement.
3. Compact all backfill material located around the perimeter of the foundation to a minimum of 80% Modified Proctor density.
4. Concrete shall be vibrated or rodded in forms to avoid segregation and cold joints.
5. The site shall be kept well drained at all times.

OPEN HOLE OBSERVATION (added cost)

If anyone other than Geoquest, LLC, performs the Open Hole Observation, that person/company assumes liability for the soils, and any possible changes to the foundation design.

The owner, or a representative of the construction company shall contact **Geoquest, LLC.** a minimum of **24 hours** prior to excavating for the foundation. An Open Hole Observation must be performed on each individual structure prior to the placement of concrete, and preferably prior to the placement of forms in the excavated area. **The failure to request or obtain an Open Hole Observation prior to the placement of foundation components may result in this Soils Report being declared null and void.** This is to ensure that soft areas, anomalies, etc., are not present in the foundation region. At the time of the open hole observation the **foundation type recommendations, maximum allowable bearing capacity may be revised** according to soil conditions found at that time. If revisions are made to the Soils Report due to the soil conditions of the excavation, **the Foundation Design Engineer must be notified of all revisions.**

FINAL OBSERVATIONS

The owner, or a representative of the construction company, shall contact Geoquest, LLC at the time final grading and landscaping procedures are completed. This is to ensure that sprinkler systems are not installed adjacent to the structure and that only shrubs or plants that require minimal watering are established in this area. All exterior grading as well as the location of downspouts and their performance shall be inspected by Geoquest, LLC. Any additional landscaping or grading changes performed by subsequent contractors and/or owners shall be inspected and approved. It is the responsible of the contractor and/or owner to schedule all these inspections at the appropriate times.

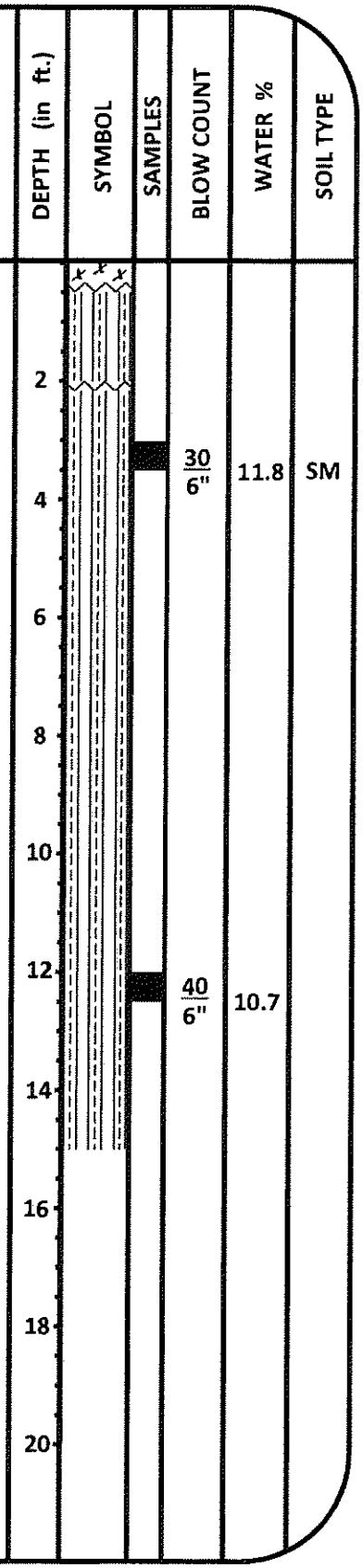
GEOQUEST, INC 481-4560

DRILL LOGS

JOB #: 20-0409

TEST BORING NO.: TH-1

DATE: 5/5/2020



0"-4" Topsoil

4"-2' Sand

Fine-coarse grained
Moderate density
Moderate moisture content
Low clay content
Low plasticity
Light Brown color

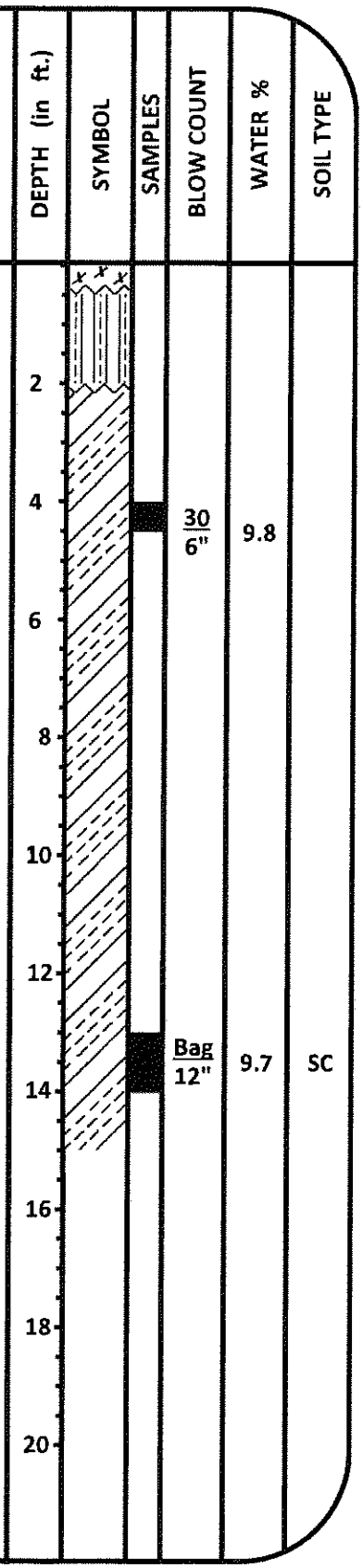
2'- 15' Sanstone (SM)

Fine-coarse grained
High density
Moderate moisture content
Low-moderate clay content
Low plasticity
Greyish Brown color
Zones Of Clay

JOB #: 20-0409

TEST BORING NO.: TH-2

DATE: 5/5/2020



0"-4" Topsoil

4"-2' Sand

Fine-coarse grained
Moderate density
Moderate moisture content
Low clay content
Low plasticity
Light Brown color

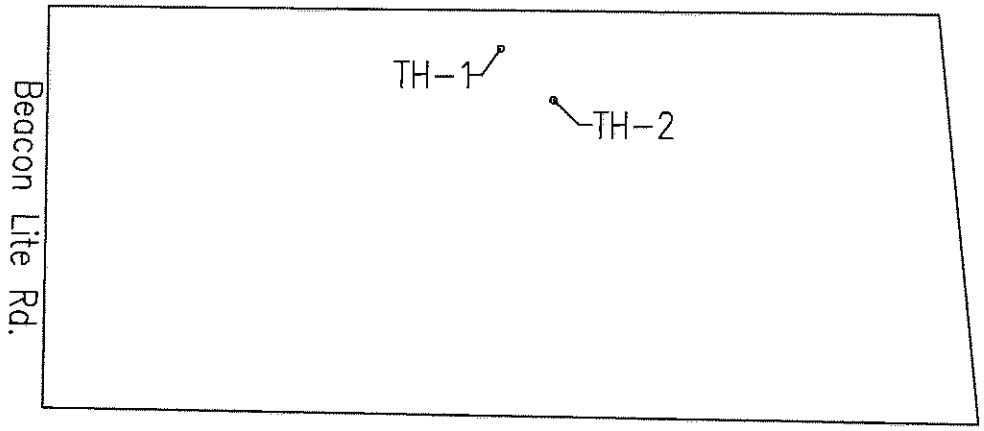
2'- 15' Sanstone (SC)

Fine-coarse grained
High density
Moderate moisture content
Low-moderate clay content
Low plasticity
Greyish Brown color
Zones Of Clay

GEOQUEST LLC

SITE MAP

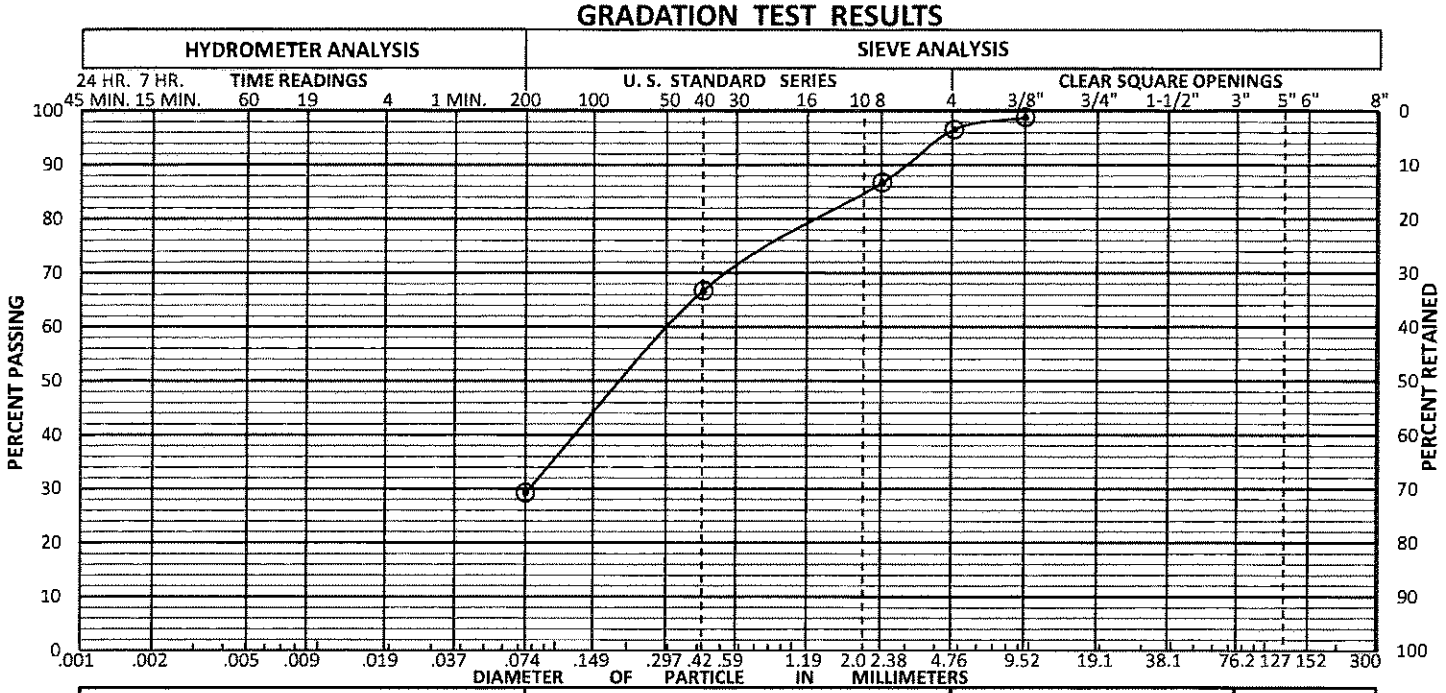
0 Beacon Lite Rd.
El Paso County
Colorado
Job #20-0409



0 50 100 150
GRAPHIC SCALE IN FEET
SCALE: 1" = 150'

GEOQUEST LLC

GRADATION TEST RESULTS



CLASSIFICATION SM

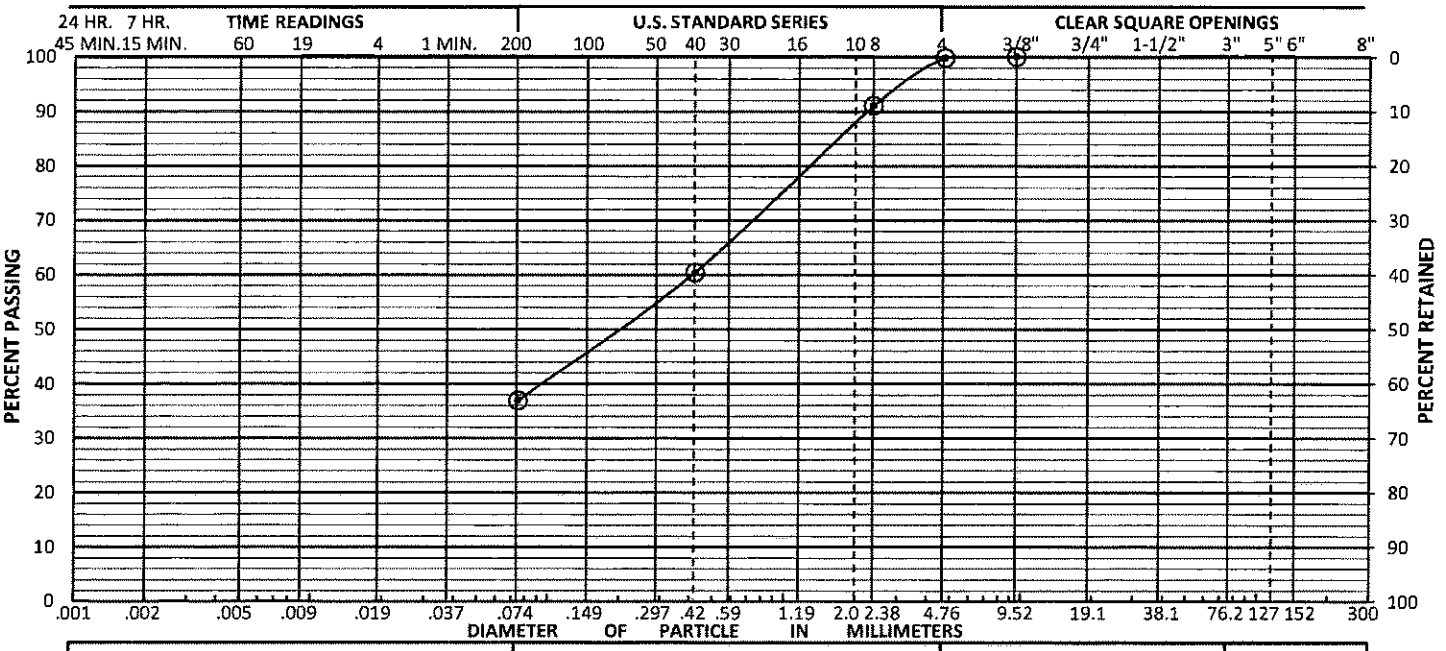
GRAVEL 3.4 %

SAND 67.4 %

FINES 29.2 %

SAMPLE # 1 HOLE # TH-1 DEPTH 3 FEET

NOTES: 11.8 % Moisture Content



CLASSIFICATION SC

GRAVEL 0.2 %

SAND 62.9 %

FINES 36.9 %

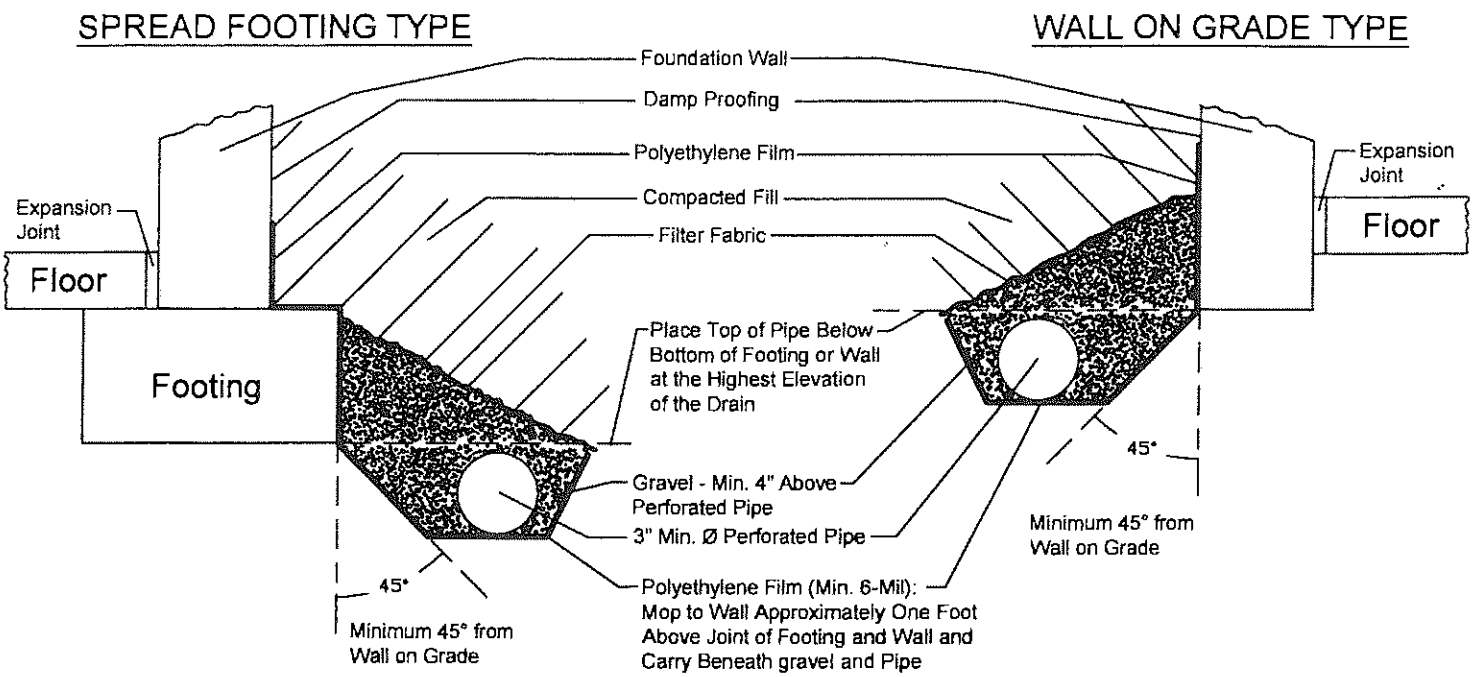
SAMPLE # 1 HOLE # TH-2 DEPTH 13 FEET

NOTES: 9.7 % Moisture Content

Job #: 20-0409 By: MJ 5/5/2020

GEOQUEST, LLC
481-4560

EXTERIOR DRAIN DETAIL



1. Gravel to be Not More Than 1-1/2" and Not Less Than 1/2" Diameter.

2. Perforated Pipe Diameter Varies With Expected Seepage. 3"Ø and 4"Ø are Most Common. ABS and PVC are Most Common Materials for Pipe. We approve the use of an "EZ Flow Drainage System" by Infiltrator. All specifications in this drain detail are still applicable.

3. Pipe to be Laid out in a Minimum Slope of 1" in 10'.

4. Gravity Outfall is Desired if Possible. Portion of Pipe in Area Not Drained Shall be Non-Perforated. Daylight Must be Maintained Clear of Debris in Order to Function Properly.

5. If Gravity Outfall is Not Possible, Provide a Sump With Operational Pump. Pump May Not Connect to Any Sanitary or Storm Sewer.

6. Soil Backfill Should be Compacted to at Least 80% of the Modified Proctor Denisty in the Upper Three Feet of Fill.

7. Filter Fabric to be Mirafi 140s or Approved Equivalent. Roofing Felt and Sheet Plastic are Not Acceptable.

8. Drain Pipe Shall be Laid Below Protected Area, as Shown in The Detail Above.

9. Mop Polyethylene Film to Wall Approximately One Foot Above Joint of Footing and Wall (Do Not Pull Plastic Tight) and Carry Beneath Gravel and Pipe.

10. The Polyethylene Film Shall be Continued to the Edge of the Excavation.

LIMITATIONS

This report is issued based on the understanding that the owner or his representative will bring the information, data, and recommendations contained in this report to the attention of the project engineer and architect, in order that they may be incorporated into the plans for the structure. It is also the owner's responsibility to ensure that all contractors and sub-contractors carry out these recommendations during the construction phase.

This report was prepared in accordance with generally accepted professional geotechnical/engineering methods. However, Geoquest, LLC makes no other warranty, express or implied, as to the findings, data, specifications, or professional advice rendered hereunder.

This report is considered valid as of the present date. The owner acknowledges, however, that changes in the conditions of the property might occur with the passage of time, such as those caused by natural effects or man-made changes, both on this land and on abutting properties. Further, changes in acceptable tolerances or standards might arise as the result of new legislative actions, new engineering advances, or the broadening of geotechnical knowledge. Thus, certain developments beyond our control may invalidate this report, in whole or in part.

This report and its recommendations do not apply to any other site than the one described herein and are predicated on the assumption that the soil conditions do not deviate from those described. In the event that any variations or undesirable conditions should be detected during the construction phase or if the proposed construction varies from that planned as of this report date, the owner shall immediately notify Geoquest, LLC in order that supplemental recommendations can be provided, if so required.

X BBS/15

15 May 2020

ABC Landscaping
3870 Mark Dabling Boulevard
Colorado Springs, Colorado 80907

RE: Soil Test Receipt, 0 Beacon Lite Road, Geoquest #20-0409

Dear ABC Landscaping,

Thank you for choosing Geoquest to perform the Soils Report for the property at the above location.

The attached Soils Report provided by Geoquest, LLC, has been prepared in accordance with the standard of practice. This report does not address possible geologic hazards, environmental hazards, or drainage that exist on-site. There are specific requirements for the design and construction of the foundation of a structure at the location noted in the report. Some of these requirements are placed on the homeowner of the property and may be outside of the builders' control. **Accordingly, we are requiring both the builder and the homeowner to sign this letter indicating both parties have accepted a copy of the report, have read and understood the contents, and know they each have specific responsibilities. Failure to follow the recommendations and requirements of the report by any party can result in unsatisfactory performance of the foundation or building components. Builder and Owner understand the risks, as noted in the Soils Report, and accept all risk, including movement of slabs.**

After the excavation has been completed an **Open Hole Observation is required** to be performed by the Soils Engineer. **After the Open Hole Observation is complete, the owner/builder should inform the Foundation Engineer of any changes to the soil conditions or allowable bearing. The Open Hole Observation is an additional cost.**

Geoquest, LLC, will not provide any documentation for site inspections until we have received this letter with the required signatures. If the property is being developed as a speculative investment and no homeowner has been contracted to purchase the property, you can indicate that under the homeowner signature line. Upon the sale of the property the builder understands that both this letter and a copy of the Soils Report shall be provided to the buyer, and a homeowner signed copy returned to Geoquest, LLC.

If you have any questions, feel free to contact us at (719) 481-4560.

Sincerely,

Charles E. Milligan, P.E.
Civil Engineer

Builder Representatives

Homeowner(s)

_____ _____

_____ _____

APPENDIX B

NOAA Atlas 14 Precipitation Data/
Rational Method Runoff Calculations

NOAA Atlas 14, Volume 8, Version 2
Location name: Monument, Colorado, USA*
Latitude: 39.1067°, Longitude: -104.8667°
Elevation: 7124.73 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)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.244** (0.200-0.297)	**0.312** (0.256-0.379)	**0.426** (0.348-0.518)	**0.523** (0.424-0.638)	**0.659** (0.517-0.830)	**0.768** (0.587-0.974)	**0.878** (0.648-1.14)	**0.993** (0.702-1.31)	**1.15** (0.780-1.55)	**1.27** (0.839-1.73)
10-min	**0.358** (0.293-0.434)	**0.457** (0.375-0.555)	**0.624** (0.509-0.759)	**0.765** (0.621-0.934)	**0.966** (0.757-1.22)	**1.12** (0.859-1.43)	**1.29** (0.949-1.66)	**1.45** (1.03-1.92)	**1.68** (1.14-2.27)	**1.86** (1.23-2.53)
15-min	**0.436** (0.358-0.530)	**0.558** (0.457-0.677)	**0.761** (0.621-0.926)	**0.933** (0.757-1.14)	**1.18** (0.923-1.48)	**1.37** (1.05-1.74)	**1.57** (1.16-2.03)	**1.77** (1.25-2.34)	**2.05** (1.39-2.77)	**2.27** (1.50-3.09)
30-min	**0.575** (0.471-0.698)	**0.736** (0.603-0.894)	**1.00** (0.826-1.22)	**1.23** (1.00-1.51)	**1.56** (1.22-1.96)	**1.81** (1.38-2.30)	**2.07** (1.53-2.68)	**2.34** (1.65-3.09)	**2.70** (1.84-3.64)	**2.99** (1.97-4.07)
60-min	**0.727** (0.596-0.883)	**0.897** (0.735-1.09)	**1.20** (0.975-1.45)	**1.46** (1.18-1.78)	**1.85** (1.46-2.35)	**2.17** (1.67-2.78)	**2.52** (1.86-3.27)	**2.88** (2.04-3.82)	**3.39** (2.31-4.59)	**3.80** (2.51-5.17)
2-hr	**0.878** (0.725-1.06)	**1.06** (0.872-1.27)	**1.38** (1.14-1.67)	**1.69** (1.38-2.04)	**2.15** (1.71-2.72)	**2.54** (1.97-3.23)	**2.96** (2.21-3.84)	**3.42** (2.45-4.52)	**4.08** (2.80-5.50)	**4.61** (3.07-6.24)
3-hr	**0.987** (0.818-1.18)	**1.16** (0.958-1.39)	**1.49** (1.22-1.78)	**1.80** (1.48-2.17)	**2.30** (1.85-2.92)	**2.74** (2.14-3.49)	**3.22** (2.42-4.18)	**3.76** (2.71-4.97)	**4.54** (3.14-6.12)	**5.19** (3.46-6.99)
6-hr	**1.20** (1.00-1.43)	**1.39** (1.16-1.65)	**1.76** (1.46-2.09)	**2.13** (1.75-2.54)	**2.72** (2.21-3.43)	**3.24** (2.55-4.10)	**3.83** (2.90-4.93)	**4.48** (3.25-5.89)	**5.44** (3.79-7.29)	**6.24** (4.19-8.35)
12-hr	**1.46** (1.22-1.71)	**1.72** (1.44-2.02)	**2.20** (1.84-2.60)	**2.66** (2.21-3.15)	**3.37** (2.74-4.19)	**3.99** (3.15-4.98)	**4.65** (3.54-5.92)	**5.39** (3.92-7.00)	**6.44** (4.50-8.55)	**7.31** (4.94-9.72)
24-hr	**1.76** (1.48-2.05)	**2.09** (1.76-2.44)	**2.68** (2.25-3.13)	**3.22** (2.69-3.77)	**4.03** (3.28-4.93)	**4.70** (3.73-5.80)	**5.43** (4.15-6.83)	**6.22** (4.55-8.00)	**7.33** (5.15-9.64)	**8.23** (5.61-10.9)
2-day	**2.09** (1.77-2.41)	**2.44** (2.07-2.82)	**3.08** (2.60-3.56)	**3.65** (3.07-4.24)	**4.51** (3.69-5.47)	**5.23** (4.17-6.39)	**6.00** (4.61-7.48)	**6.83** (5.03-8.70)	**8.00** (5.65-10.4)	**8.94** (6.13-11.7)
3-day	**2.26** (1.92-2.59)	**2.65** (2.26-3.05)	**3.34** (2.83-3.85)	**3.95** (3.33-4.57)	**4.86** (3.99-5.85)	**5.61** (4.49-6.82)	**6.41** (4.94-7.95)	**7.26** (5.36-9.21)	**8.46** (6.00-11.0)	**9.42** (6.48-12.3)
4-day	**2.39** (2.05-2.74)	**2.81** (2.40-3.22)	**3.54** (3.01-4.06)	**4.18** (3.54-4.82)	**5.13** (4.22-6.15)	**5.91** (4.74-7.15)	**6.73** (5.20-8.31)	**7.61** (5.63-9.61)	**8.83** (6.28-11.4)	**9.81** (6.77-12.8)
7-day	**2.79** (2.40-3.17)	**3.23** (2.77-3.67)	**4.00** (3.42-4.56)	**4.68** (3.98-5.36)	**5.70** (4.71-6.77)	**6.53** (5.26-7.84)	**7.42** (5.76-9.10)	**8.36** (6.22-10.5)	**9.68** (6.92-12.5)	**10.7** (7.45-13.9)
10-day	**3.15** (2.72-3.56)	**3.62** (3.11-4.09)	**4.43** (3.80-5.03)	**5.15** (4.40-5.87)	**6.23** (5.17-7.37)	**7.11** (5.75-8.50)	**8.05** (6.28-9.83)	**9.05** (6.76-11.3)	**10.5** (7.50-13.4)	**11.6** (8.06-15.0)
20-day	**4.17** (3.62-4.67)	**4.77** (4.14-5.35)	**5.80** (5.01-6.52)	**6.69** (5.75-7.55)	**7.97** (6.63-9.30)	**8.99** (7.31-10.6)	**10.1** (7.89-12.1)	**11.2** (8.39-13.8)	**12.7** (9.17-16.1)	**13.9** (9.76-17.9)
30-day	**5.00** (4.35-5.57)	**5.73** (4.99-6.39)	**6.95** (6.03-7.77)	**7.98** (6.88-8.96)	**9.41** (7.85-10.9)	**10.5** (8.58-12.3)	**11.7** (9.18-14.0)	**12.9** (9.68-15.8)	**14.4** (10.4-18.2)	**15.7** (11.0-20.0)
45-day	**6.03** (5.28-6.69)	**6.92** (6.05-7.68)	**8.37** (7.29-9.30)	**9.55** (8.27-10.7)	**11.2** (9.31-12.8)	**12.4** (10.1-14.4)	**13.6** (10.7-16.2)	**14.8** (11.2-18.0)	**16.4** (11.9-20.5)	**17.6** (12.4-22.4)
60-day	**6.90** (6.06-7.62)	**7.92** (6.94-8.75)	**9.54** (8.33-10.6)	**10.8** (9.41-12.1)	**12.6** (10.5-14.3)	**13.9** (11.3-16.0)	**15.1** (11.9-17.8)	**16.3** (12.3-19.8)	**17.9** (13.0-22.2)	**19.0** (13.5-24.1)

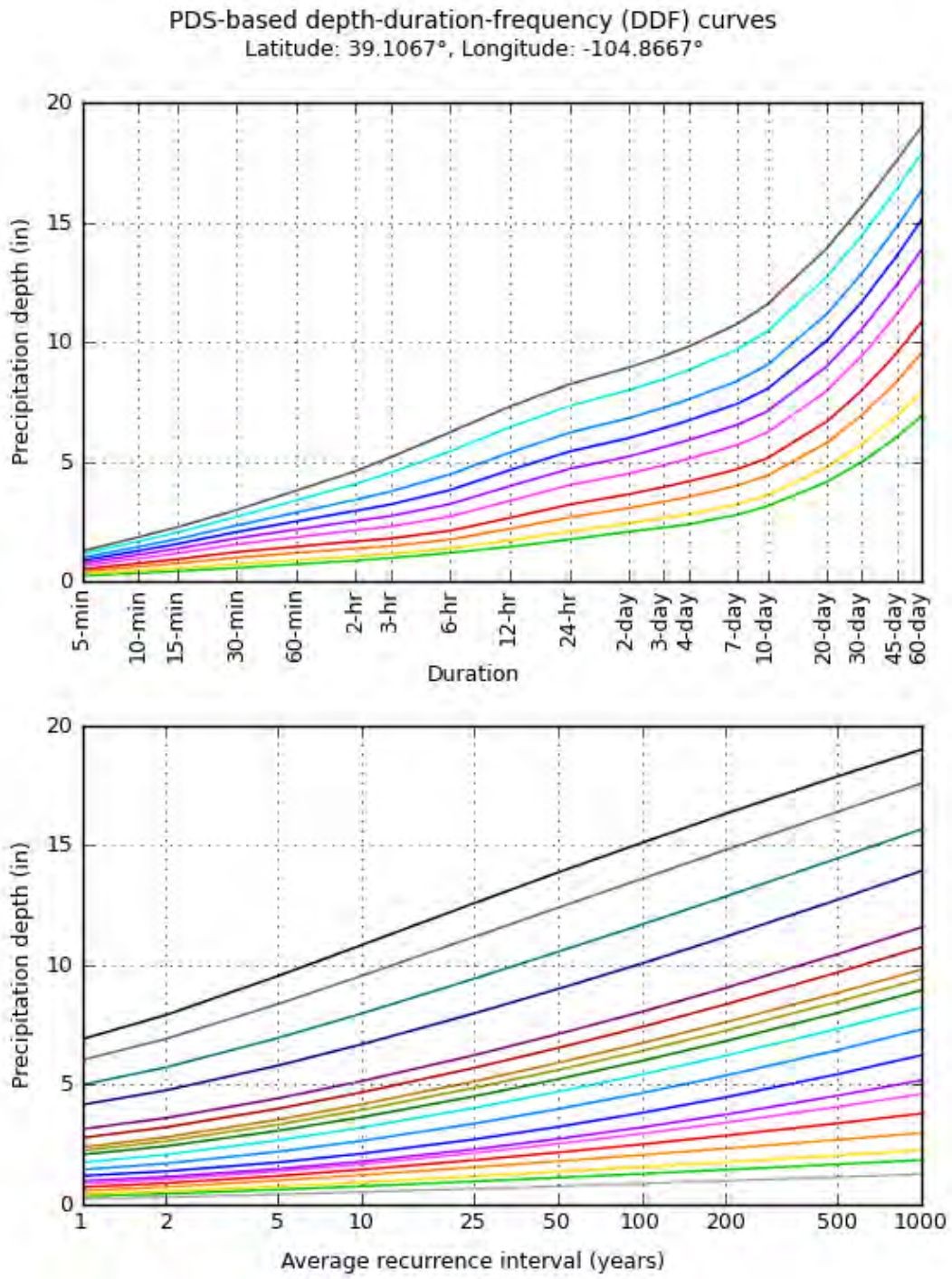
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

PF graphical



NOAA Atlas 14, Volume 8, Version 2

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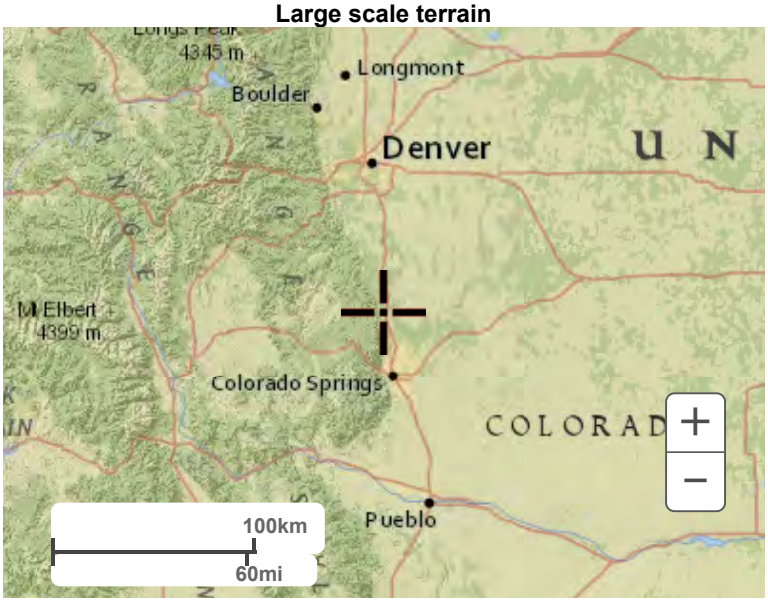
Back to Top

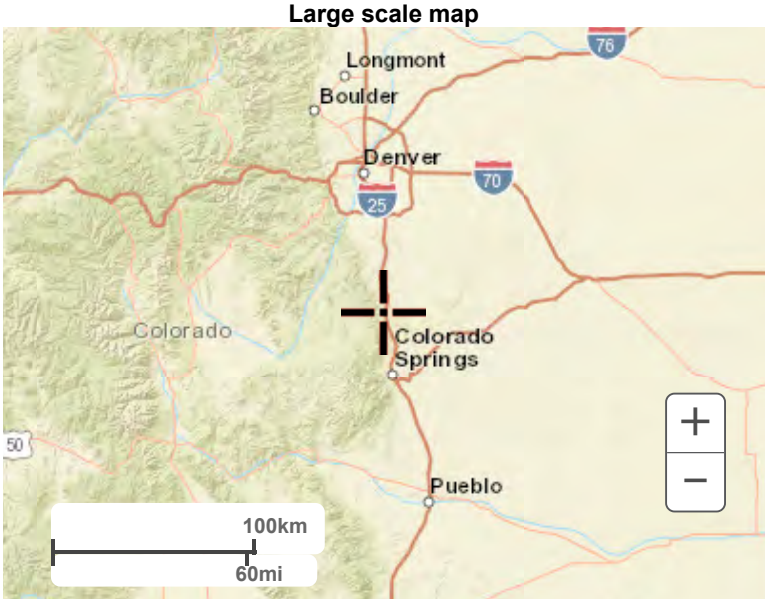
Maps & aerials

Small scale terrain

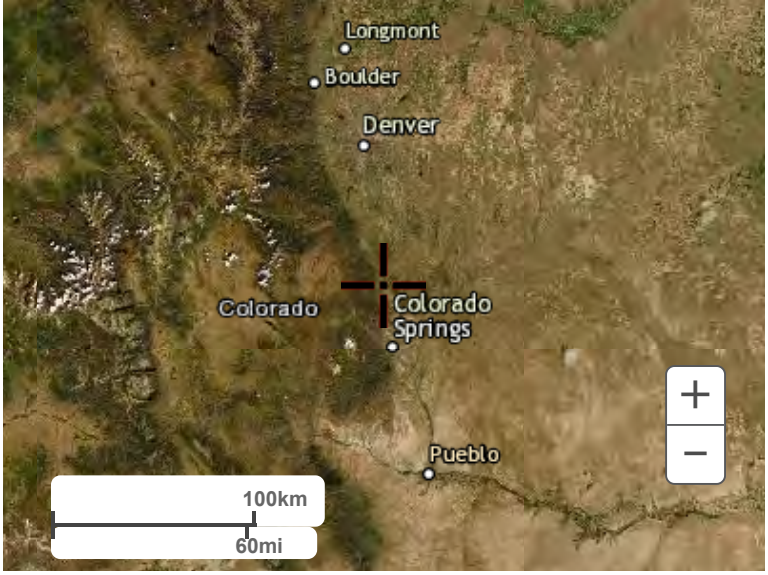
Large scale terrain



Large scale map



Large scale aerial



Back to Top

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

Historic Runoff Table - Trailers Direct Express							
BASIN	Impervious	C-YR	I	A	CIA(YR-historic)	Flow	DESIGN POINT
H							
C_2 (MHFD 2018)	2.00	0.01	1.49	5.02	0.08	cfs	H1
C_5	2.00	0.01	2.00	5.02	0.10	cfs	
C_{10}	2.00	0.07	2.43	5.02	0.85	cfs	
C_{100}	2.00	0.44	4.20	5.02	9.27	cfs	

Trailers Direct Express - Historic Runoff Calcs

3/21/2022

for soils - C_2 C_5 C_{10} C_{100} --> from Table RO-5

**for Ti calculations - only C_5 is used

Ti= (.395*(1.1-C_{yr})*($L^{.5}$)) / ($S)^{.333}$
From MHFD (UDFCD) 2018, Equation 6-3

	2	5	10	100
1-Hour Point Rain	0.897	1.2	1.46	2.52

H — **Historic - 2, 5, 10, 100 yr** — NRCS Type 100% B — **5.024** acres

		Length	Slope	C_{yr} - see frequency left	Ti**	Velocity	Tt	Tc	Use Tc	I	A	$CIA_{5\ existing}$	
2yr				0.01	26.58	1.48	0.52	27.10	27.10	1.49	5.02	0.08	**cfs**
	initial	300	0.022									**$CIA_{10\ existing}$**	
5yr	travel	46	0.022	0.01	26.58	1.48	0.52	27.10	27.10	2.00	5.02	0.10	**cfs**
		346										**$CIA_{10\ existing}$**	
10yr	Overland flow			0.07	26.58	1.48	0.52	27.10	27.10	2.43	5.02	0.85	**cfs**
	300 ft max for urban, 500 ft max for rural												
	Remainder carried as travel											**$CIA_{100\ existing}$**	
100yr		Cv=	10	0.44	26.58	1.48	0.52	27.10	27.10	4.20	5.02	9.27	**cfs**

5.024 acres

H	**Undeveloped**	**Gravel**	**Building**	**Concrete**	**Water/Aphalt**	**EFFECTIVE**
NRCS Type 100% B						
Imperviousness %	2	40.00	90.00	100.00	100.00	**2.00**
C2	0.01	0.29	0.74	0.84	0.84	**0.01**
C5	0.01	0.32	0.76	0.86	0.86	**0.01**
C10	0.07	0.38	0.78	0.86	0.86	**0.07**
C100	0.44	0.61	0.84	0.89	0.89	**0.44**
AREA	5.024	0.00	0.00	0.00	0.00	5.02

2.000 acres

H2	**Undeveloped**	**Gravel**	**Building**	**Concrete**	**Water/Aphalt**	**EFFECTIVE**
NRCS Type 100% B						
Imperviousness %	2	40.00	90.00	100.00	100.00	**2.00**
C2	0.01	0.29	0.74	0.84	0.84	**0.01**
C5	0.01	0.32	0.76	0.86	0.86	**0.01**
C10	0.07	0.38	0.78	0.86	0.86	**0.07**
C100	0.44	0.61	0.84	0.89	0.89	**0.44**
AREA	2.000	0.00	0.00	0.00	0.00	2.00

TABLE RO-2 (taken from MHFD (UDFCD Manual - Vol. I)

Type of Land Surface	Conveyance coefficient,
Heavy Meadow	2.5
Tillage/field	5
Short pasture/Lawns	7
Nearly Bare Ground	10.00
Grassed Waterway	15.00
Paved areas and shallow paved swales	20.00

Existing Runoff Table - Trailers Direct Express							
BASIN	Impervious	C-YR	I	A	CIA(YR-existing)	Flow	DESIGN POINT
W							
C_2 (MHFD 2018)	19.80	0.16	1.87	2.64	0.79	cfs	E4
C_5	19.80	0.16	2.51	2.64	1.09	cfs	
C_{10}	19.80	0.21	3.05	2.64	1.72	cfs	
C_{100}	19.80	0.52	5.27	2.64	7.26	cfs	
E							
C_2 (MHFD 2018)	35.14	0.29	1.82	2.38	1.25	cfs	E2
C_5	35.14	0.30	2.43	2.38	1.72	cfs	
C_{10}	35.14	0.34	2.96	2.38	2.37	cfs	
C_{100}	35.14	0.59	5.10	2.38	7.19	cfs	
OFF BLR							
C_2 (MHFD 2018)	50.91	0.42	2.81	0.19	0.23	cfs	
C_5	50.91	0.43	3.76	0.19	0.31	cfs	
C_{10}	50.91	0.46	4.57	0.19	0.40	cfs	
C_{100}	50.91	0.66	7.89	0.19	1.00	cfs	
OFF NW							
C_2 (MHFD 2018)	14.05	0.11	1.32	20.07	2.81	cfs	E3
C_5	14.05	0.11	1.77	20.07	3.96	cfs	
C_{10}	14.05	0.17	2.15	20.07	7.25	cfs	
C_{100}	14.05	0.49	3.72	20.07	36.90	cfs	
OFF NE							
C_2 (MHFD 2018)	10.12	0.08	1.75	1.21	0.17	cfs	E1
C_5	10.12	0.08	2.34	1.21	0.23	cfs	
C_{10}	10.12	0.14	2.85	1.21	0.47	cfs	
C_{100}	10.12	0.48	4.91	1.21	2.85	cfs	
I-25							
C_2 (MHFD 2018)	29.38	0.24	2.93	0.21	0.15	cfs	
C_5	29.38	0.25	3.92	0.21	0.20	cfs	
C_{10}	29.38	0.29	4.77	0.21	0.29	cfs	
C_{100}	29.38	0.57	8.23	0.21	0.98	cfs	

Trailers Direct Express - Existing Runoff Calcs

3/28/2022

for soils - C2 C_5 C_{10} C_{100} = from Table RO-5

**for Ti calculations - only C_5 is used

Ti= (.395*(1.1-C_{yr})*($L^{.5}$)) / $(S)^{.333}$
From MHFD (UDFCD) 2018, Equation 6-3

	2	5	10	100
1-Hour Point Rainfall	**0.897**	**1.2**	**1.46**	2.52

2018 MHFD >>> Tc Check = (26-17i) + [Ltravel / (60*(14i + 9)(So)^.5)]

W — **Existing - 2, 5, 10, 100 yr** — **2.644** acres — NRCS Type 100% B

		Length	Slope	C_{yr} - see frequency left	Ti**	Velocity	Tt	Tc	check	Use Tc	I	A	$CIA_{5\ existing}$	
2yr				0.16	15.68	2.33	2.09	17.77	24.95	17.77	1.87	2.64	0.79	**cfs**
	initial	238	0.064										**$CIA_{5\ existing}$**	
5yr	travel	292	0.032	0.16	15.68	2.33	2.09	17.77	24.95	17.77	2.51	2.64	1.09	**cfs**
		530												
													$CIA_{10\ existing}$	
10yr	Overland flow			0.21	15.68	2.33	2.09	17.77	24.95	17.77	3.05	2.64	1.72	**cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel												**$CIA_{100\ existing}$**	
100yr	Cv=	13		0.52	15.68	2.33	2.09	17.77	24.95	17.77	5.27	2.64	7.26	**cfs**

E — **Existing - 2, 5, 10, 100 yr** — **2.379** acres — NRCS Type 100% B

		Length	Slope	C_{yr} - see frequency left	Ti**	Velocity	Tt	Tc	check	Use Tc	I	A	$CIA_{5\ existing}$	
2yr				0.29	18.18	2.87	0.73	18.91	20.76	18.91	1.82	2.38	1.25	**cfs**
	initial	300	0.013										**$CIA_{5\ existing}$**	
5yr	travel	126	0.042	0.30	18.18	2.87	0.73	18.91	20.76	18.91	2.43	2.38	1.72	**cfs**
		426												
													$CIA_{10\ existing}$	
10yr	Overland flow			0.34	18.18	2.87	0.73	18.91	20.76	18.91	2.96	2.38	2.37	**cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel												**$CIA_{100\ existing}$**	
100yr	Cv=	14		0.59	18.18	2.87	0.73	18.91	20.76	18.91	5.10	2.38	7.19	**cfs**

OFF BLR — **Existing - 2, 5, 10, 100 yr** — **0.190** acres — NRCS Type 100% B

		Length	Slope	C_{yr} - see frequency left	Ti**	Velocity	Tt	Tc	check	Use Tc	I	A	$CIA_{5\ existing}$	
2yr				0.42	6.61	1.50	0.00	6.61	17.35	6.61	2.81	0.19	0.23	**cfs**
	initial	57	0.044										**$CIA_{5\ existing}$**	
5yr	travel	0	0.010	0.43	6.61	1.50	0.00	6.61	17.35	6.61	3.76	0.19	0.31	**cfs**
		57												
													$CIA_{10\ existing}$	
10yr	Overland flow			0.46	6.61	1.50	0.00	6.61	17.35	6.61	4.57	0.19	0.40	**cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel												**$CIA_{100\ existing}$**	
100yr	Cv=	15		0.66	6.61	1.50	0.00	6.61	17.35	6.61	7.89	0.19	1.00	**cfs**

OFF NW — **Existing - 2, 5, 10, 100 yr** — **20.073** acres — NRCS Type 100% B

		Length	Slope	C_{yr} - see frequency left	Ti**	Velocity	Tt	Tc	check	Use Tc	I	A	$CIA_{5\ existing}$	
2yr				0.11	20.75	1.85	12.53	33.28	36.75	33.28	1.32	20.07	2.81	**cfs**
	initial	300	0.043										**$CIA_{5\ existing}$**	
5yr	travel	1,394	0.026	0.11	20.75	1.85	12.53	33.28	36.75	33.28	1.77	20.07	3.96	**cfs**
		1694												
													$CIA_{10\ existing}$	
10yr	Overland flow			0.17	20.75	1.85	12.53	33.28	36.75	33.28	2.15	20.07	7.25	**cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel												**$CIA_{100\ existing}$**	
100yr	Cv=	11.5		0.49	20.75	1.85	12.53	33.28	36.75	33.28	3.72	20.07	36.90	**cfs**

OFF NE	Existing - 2, 5, 10, 100 yr				1.213 acres								
	NRCS Type 100% B			C_{yr} - see frequency left	Ti**	Velocity	Tt	Tc	check	Use Tc	I	A	$CIA_{5\ existing}$
2yr				0.08	20.05	2.17	0.29	20.34	24.59	20.34	1.75	1.21	0.17 **cfs**
		Length	Slope										$CIA_{5\ existing}$
	initial	300	0.045										
5yr	travel	38	0.039	0.08	20.05	2.17	0.29	20.34	24.59	20.34	2.34	1.21	0.23 **cfs**
		338											$CIA_{10\ existing}$
10yr	Overland flow			0.14	20.05	2.17	0.29	20.34	24.59	20.34	2.85	1.21	0.47 **cfs**
	300 ft max for urban, 500 ft max for rural												
	Remainder carried as travel												$CIA_{100\ existing}$
100yr		Cv=	11	0.48	20.05	2.17	0.29	20.34	24.59	20.34	4.91	1.21	2.85 **cfs**

I-25	Existing - 2, 5, 10, 100 yr				0.211 acres								
	NRCS Type 100% B			C_{yr} - see frequency left	Ti**	Velocity	Tt	Tc	check	Use Tc	I	A	$CIA_{5\ existing}$
2yr				0.24	5.73	1.40	0.00	5.73	21.00	5.73	2.93	0.21	0.15 **cfs**
		Length	Slope										$CIA_{5\ existing}$
	initial	55	0.155										
5yr	travel	0	0.010	0.25	5.73	1.40	0.00	5.73	21.00	5.73	3.92	0.21	0.20 **cfs**
		55											$CIA_{10\ existing}$
10yr	Overland flow			0.29	5.73	1.40	0.00	5.73	21.00	5.73	4.77	0.21	0.29 **cfs**
	300 ft max for urban, 500 ft max for rural												
	Remainder carried as travel												$CIA_{100\ existing}$
100yr		Cv=	14	0.57	5.73	1.40	0.00	5.73	21.00	5.73	8.23	0.21	0.98 **cfs**

2.644 acres

W	Undeveloped	Gravel	Building	Concrete	Water/Asphalt	
NRCS Type 100% B						EFFECTIVE
Imperviousness %	2	40.00	90.00	100.00	100.00	**19.80**
C2	0.01	0.29	0.74	0.84	0.84	**0.16**
C5	0.01	0.32	0.76	0.86	0.86	**0.16**
C10	0.07	0.38	0.78	0.86	0.86	**0.21**
C100	0.44	0.61	0.84	0.89	0.89	**0.52**
AREA	2.157	0.00	0.06	0.01	0.42	2.64

2.379 acres

E	Undeveloped	Gravel	Building	Concrete	Water/Asphalt	
NRCS Type 100% B						EFFECTIVE
Imperviousness %	2	40.00	90.00	100.00	100.00	**35.14**
C2	0.01	0.29	0.74	0.84	0.84	**0.29**
C5	0.01	0.32	0.76	0.86	0.86	**0.30**
C10	0.07	0.38	0.78	0.86	0.86	**0.34**
C100	0.44	0.61	0.84	0.89	0.89	**0.59**
AREA	1.568	0.00	0.06	0.00	0.75	2.38

0.190 acres

OFF BLR	Undeveloped	Gravel	Building	Concrete	Water/Asphalt	
NRCS Type 100% B						EFFECTIVE
Imperviousness %	2	40.00	90.00	100.00	100.00	**50.91**
C2	0.01	0.29	0.74	0.84	0.84	**0.42**
C5	0.01	0.32	0.76	0.86	0.86	**0.43**
C10	0.07	0.38	0.78	0.86	0.86	**0.46**
C100	0.44	0.61	0.84	0.89	0.89	**0.66**
AREA	0.095	0.00	0.00	0.00	0.09	0.19

20.073 acres

OFF NW	Undeveloped	Gravel	Building	Concrete	Water/Asphalt	
NRCS Type 100% B						EFFECTIVE
Imperviousness %	2	40.00	90.00	100.00	100.00	**14.05**
C2	0.01	0.29	0.74	0.84	0.84	**0.11**
C5	0.01	0.32	0.76	0.86	0.86	**0.11**
C10	0.07	0.38	0.78	0.86	0.86	**0.17**
C100	0.44	0.61	0.84	0.89	0.89	**0.49**
AREA	15.790	2.96	0.00	0.06	1.26	20.07

1.213 acres

OFF NE	Undeveloped	Gravel	Building	Concrete	Water/Asphalt	
NRCS Type 100% B						EFFECTIVE
Imperviousness %	2	40.00	90.00	100.00	100.00	**10.12**
C2	0.01	0.29	0.74	0.84	0.84	**0.08**
C5	0.01	0.32	0.76	0.86	0.86	**0.08**
C10	0.07	0.38	0.78	0.86	0.86	**0.14**
C100	0.44	0.61	0.84	0.89	0.89	**0.48**
AREA	1.113	0.00	0.00	0.00	0.10	1.21

0.211 acres

I-25	Undeveloped	Gravel	Building	Concrete	Water/Asphalt	
NRCS Type 100% B						EFFECTIVE
Imperviousness %	2	40.00	90.00	100.00	100.00	**29.38**
C2	0.01	0.29	0.74	0.84	0.84	**0.24**
C5	0.01	0.32	0.76	0.86	0.86	**0.25**
C10	0.07	0.38	0.78	0.86	0.86	**0.29**
C100	0.44	0.61	0.84	0.89	0.89	**0.57**
AREA	0.152	0.00	0.00	0.00	0.06	0.21

TABLE RO-2 (taken from MHFD (UDFCD) Manual - Vol. I)	
Type of Land Surface	Conveyance coefficient, Cv
Heavy Meadow	2.5
Tillage/field	5
Short pasture/Lawns	7
Nearly Bare Ground	10.00
Grassed Waterway	15.00
Paved areas and shallow paved swales	20.00

Developed Runoff Table - Trailers Direct Express							
BASIN	Impervious	C-YR	I	A	CIA(YR-DEVELOPED)	cfs	DESIGN POINT
W							
C_2 (MHFD 2018)	92.99	0.78	3.04	0.50	1.20	cfs	4
C_5	92.99	0.80	4.07	0.50	1.64	cfs	
C_{10}	92.99	0.80	4.95	0.50	2.01	cfs	
C_{100}	92.99	0.86	8.55	0.50	3.70	cfs	
E							
C_2 (MHFD 2018)	51.36	0.43	1.79	2.79	2.13	cfs	3
C_5	51.36	0.44	2.39	2.79	2.92	cfs	
C_{10}	51.36	0.47	2.91	2.79	3.79	cfs	
C_{100}	51.36	0.67	5.02	2.79	9.33	cfs	
POND							
C_2 (MHFD 2018)	74.31	0.62	3.04	0.23	0.43	cfs	5
C_5	74.31	0.64	4.07	0.23	0.59	cfs	
C_{10}	74.31	0.65	4.95	0.23	0.74	cfs	
C_{100}	74.31	0.77	8.55	0.23	1.51	cfs	
OFF W							
C_2 (MHFD 2018)	9.01	0.07	1.86	1.51	0.19	cfs	8
C_5	9.01	0.07	2.48	1.51	0.26	cfs	
C_{10}	9.01	0.13	3.02	1.51	0.58	cfs	
C_{100}	9.01	0.47	5.22	1.51	3.71	cfs	
OFF BLR							7
C_2 (MHFD 2018)	48.65	0.41	2.78	0.19	0.21	cfs	
C_5	48.65	0.41	3.72	0.19	0.29	cfs	
C_{10}	48.65	0.45	4.53	0.19	0.38	cfs	
C_{100}	48.65	0.65	7.82	0.19	0.97	cfs	
OFF NW							
C_2 (MHFD 2018)	14.05	0.11	1.32	20.07	2.81	cfs	6
C_5	14.05	0.11	1.77	20.07	3.96	cfs	
C_{10}	14.05	0.17	2.15	20.07	7.25	cfs	
C_{100}	14.05	0.49	3.72	20.07	36.90	cfs	
OFF NE							
C_2 (MHFD 2018)	10.12	0.08	1.75	1.21	0.17	cfs	1
C_5	10.12	0.08	2.34	1.21	0.23	cfs	
C_{10}	10.12	0.14	2.85	1.21	0.47	cfs	
C_{100}	10.12	0.48	4.91	1.21	2.85	cfs	
I-25							2
C_2 (MHFD 2018)	29.38	0.24	2.93	0.21	0.15	cfs	
C_5	29.38	0.25	3.92	0.21	0.20	cfs	
C_{10}	29.38	0.29	4.77	0.21	0.29	cfs	
C_{100}	29.38	0.57	8.23	0.21	0.98	cfs	

Trailers Direct Express - Developed Runoff Calcs (% Max Bldg-Pavement)

5/12/2022

See below for effective C values as calculated from Table RO-5

**for Ti calculations - only C_5 is used

Ti= (.395*(1.1-C_{yr})*($L^{.5}$)) / $(S)^{.333}$
From MHFD (UDFCD) 2018, Equation 6-3

	2	5	10	100
Point Rainfall	**0.897**	**1.2**	**1.46**	**2.52**

2018 MHFD >>> Tc Check = (26-17i) + [Ltravel / (60*(14i + 9)(So)^.5)]

W — **Developed -2, 5, 10, 100 yr** — **0.50** acres — NRCS Type 100% B

	C_5	Ti	Velocity	Tt	Tc	check	Use Tc	C_{yr} - see above	I	A	CIA_5 developed
2yr	0.80	3.10	3.35	1.49	4.59	11.48	4.59	0.78	3.04	0.50	1.20 **cfs**
5yr	0.80	3.10	3.35	1.49	4.59	11.48	4.59	0.80	4.07	0.50	CIA_5 developed 1.64 **cfs**
10yr	0.80	3.10	3.35	1.49	4.59	11.48	4.59	0.80	4.95	0.50	CIA_{10} developed 2.01 **cfs**
100yr	0.80	3.10	3.35	1.49	4.59	11.48	4.59	0.86	8.55	0.50	CIA_{100} developed 3.70 **cfs**

	Length	Slope
initial	87	0.061
travel	300	0.031
	387	0.038

Overland flow
300 ft max for urban, 500 ft max for rural
Remainder carried as travel
Cv= 19.00

E — **Developed -2, 5, 10, 100 yr** — **2.79** acres — NRCS Type 100% B

	C_5	Ti	Velocity	Tt	Tc	check	Use Tc	C_{yr} - see above	I	A	CIA_5 developed
2yr	0.44	17.96	2.07	2.40	20.36	19.49	19.49	0.43	1.79	2.79	2.13 **cfs**
5yr	0.44	17.96	2.07	2.40	20.36	19.49	19.49	0.44	2.39	2.79	CIA_5 developed 2.92 **cfs**
10yr	0.44	17.96	2.07	2.40	20.36	19.49	19.49	0.47	2.91	2.79	CIA_{10} developed 3.79 **cfs**
100yr	0.44	17.96	2.07	2.40	20.36	19.49	19.49	0.67	5.02	2.79	CIA_{100} developed 9.33 **cfs**

	Length	Slope
initial	300	0.013
travel	298	0.019
	598	0.016

Overland flow
300 ft max for urban, 500 ft max for rural
Remainder carried as travel
Cv= 15.00

POND — **Developed -2, 5, 10, 100 yr** — **0.23** acres — NRCS Type 100% B

	C_5	Ti	Velocity	Tt	Tc	check	Use Tc	C_{yr} - see above	I	A	CIA_5 developed
2yr	0.64	2.21	1.20	0.92	3.12	14.17	3.12	0.62	3.04	0.23	0.43 **cfs**
5yr	0.64	2.21	1.20	0.92	3.12	14.17	3.12	0.64	4.07	0.23	CIA_5 developed 0.59 **cfs**
10yr	0.64	2.21	1.20	0.92	3.12	14.17	3.12	0.65	4.95	0.23	CIA_{10} developed 0.74 **cfs**
100yr	0.64	2.21	1.20	0.92	3.12	14.17	3.12	0.77	8.55	0.23	CIA_{100} developed 1.51 **cfs**

	Length	Slope
initial	37	0.250
travel	66	0.005
	103	0.093

Overland flow
300 ft max for urban, 500 ft max for rural
Remainder carried as travel
Cv= 17.00

OFF W — **Developed -2, 5, 10, 100 yr** — **1.51** acres — NRCS Type 100% B

		Length	Slope	C_5	Ti	Velocity	Tt	Tc	check	Use Tc	C_{yr} - see above	I	A	CIA_5 developed
2yr				0.07	15.89	2.09	2.23	18.12	26.86	18.12	0.07	1.86	1.51	0.19 **cfs**
	initial	170	0.038											CIA_5 developed
5yr	travel	279	0.036	0.07	15.89	2.09	2.23	18.12	26.86	18.12	0.07	2.48	1.51	0.26 **cfs**
		449	0.037											
														CIA_{10} developed
10yr	Overland flow			0.07	15.89	2.09	2.23	18.12	26.86	18.12	0.13	3.02	1.51	0.58 **cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel													
														CIA_{100} developed
100yr	Cv=	11.00		0.07	15.89	2.09	2.23	18.12	26.86	18.12	0.47	5.22	1.51	3.71 **cfs**

OFF BLR — **Developed -2, 5, 10, 100 yr** — **0.19** acres — NRCS Type 100% B

		Length	Slope	C_5	Ti	Velocity	Tt	Tc	check	Use Tc	C_{yr} - see above	I	A	CIA_5 developed
2yr				0.41	6.81	1.70	0.00	6.81	17.73	6.81	0.41	2.78	0.19	0.21 **cfs**
	initial	57	0.044											CIA_5 developed
5yr	travel	0	0.010	0.41	6.81	1.70	0.00	6.81	17.73	6.81	0.41	3.72	0.19	0.29 **cfs**
		57	0.044											
														CIA_{10} developed
10yr	Overland flow			0.41	6.81	1.70	0.00	6.81	17.73	6.81	0.45	4.53	0.19	0.38 **cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel													
														CIA_{100} developed
100yr	Cv=	17.00		0.41	6.81	1.70	0.00	6.81	17.73	6.81	0.65	7.82	0.19	0.97 **cfs**

OFF NW — **Developed -2, 5, 10, 100 yr** — **20.07** acres — NRCS Type 100% B

		Length	Slope	C_5	Ti	Velocity	Tt	Tc	check	Use Tc	C_{yr} - see above	I	A	CIA_5 developed
2yr				0.11	20.75	1.85	12.53	33.28	36.75	33.28	0.11	1.32	20.07	2.81 **cfs**
	initial	300	0.043											CIA_5 developed
5yr	travel	1,394	0.026	0.11	20.75	1.85	12.53	33.28	36.75	33.28	0.11	1.77	20.07	3.96 **cfs**
		1,694	0.029											
														CIA_{10} developed
10yr	Overland flow			0.11	20.75	1.85	12.53	33.28	36.75	33.28	0.17	2.15	20.07	7.25 **cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel													
														CIA_{100} developed
100yr	Cv=	11.50		0.11	20.75	1.85	12.53	33.28	36.75	33.28	0.49	3.72	20.07	36.90 **cfs**

OFF NE — **Developed -2, 5, 10, 100 yr** — **1.21** acres — NRCS Type 100% B

		Length	Slope	C_5	Ti	Velocity	Tt	Tc	check	Use Tc	C_{yr} - see above	I	A	CIA_5 developed
2yr				0.08	20.05	2.17	0.29	20.34	24.59	20.34	0.08	1.75	1.21	0.17 **cfs**
	initial	300	0.045											CIA_5 developed
5yr	travel	38	0.039	0.08	20.05	2.17	0.29	20.34	24.59	20.34	0.08	2.34	1.21	0.23 **cfs**
		338	0.044											
														CIA_{10} developed
10yr	Overland flow			0.08	20.05	2.17	0.29	20.34	24.59	20.34	0.14	2.85	1.21	0.47 **cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel													
														CIA_{100} developed
100yr	Cv=	11.00		0.08	20.05	2.17	0.29	20.34	24.59	20.34	0.48	4.91	1.21	2.85 **cfs**

I-25 **Developed -2, 5, 10, 100 yr** **0.21** acres

NRCS Type 100% B

		Length	Slope	C_5	Ti	Velocity	Tt	Tc	check	Use Tc	C_{yr} - see above	I	A	CIA_5 developed
2yr				0.25	5.73	1.30	0.00	5.73	21.00	5.73	0.24	2.93	0.21	0.15 **cfs**
	initial	55	0.155											CIA_5 developed
5yr	travel	0	0.010	0.25	5.73	1.30	0.00	5.73	21.00	5.73	0.25	3.92	0.21	0.20 **cfs**
		55	0.155											CIA_{10} developed
10yr	Overland flow			0.25	5.73	1.30	0.00	5.73	21.00	5.73	0.29	4.77	0.21	0.29 **cfs**
	300 ft max for urban, 500 ft max for rural													
	Remainder carried as travel													CIA_{100} developed
100yr	Cv=		13.00	0.25	5.73	1.30	0.00	5.73	21.00	5.73	0.57	8.23	0.21	0.98 **cfs**

TOTAL AREA **0.504** acres

W	**Landscaping**	**Gravel**	**Building**	**Concrete**	**Water/ Asphalt**	
NRCS Type 100% B						**EFFECTIVE**
I	2	40.00	90.00	100.00	100.00	**92.99**
C2	0.01	0.29	0.74	0.84	0.84	**0.78**
C5	0.01	0.32	0.76	0.86	0.86	**0.80**
C10	0.07	0.38	0.78	0.86	0.86	**0.80**
C100	0.44	0.61	0.84	0.89	0.89	**0.86**
AREA	0.03	0.00	0.03	0.01	0.43	0.504

TOTAL AREA **2.785** acres

E	**Landscaping**	**Gravel**	**Building**	**Concrete**	**Water/ Asphalt**	
NRCS Type 100% B						**EFFECTIVE**
I	2	40.00	90.00	100.00	100.00	**51.36**
C2	0.01	0.29	0.74	0.84	0.84	**0.43**
C5	0.01	0.32	0.76	0.86	0.86	**0.44**
C10	0.07	0.38	0.78	0.86	0.86	**0.47**
C100	0.44	0.61	0.84	0.89	0.89	**0.67**
AREA	1.37	0.00	0.09	0.00	1.32	2.785

TOTAL AREA **0.229** acres

POND	**Landscaping**	**Gravel**	**Building**	**Concrete**	**Water/ Asphalt**	
NRCS Type 100% B						**EFFECTIVE**
I	2	40.00	90.00	100.00	100.00	**74.31**
C2	0.01	0.29	0.74	0.84	0.84	**0.62**
C5	0.01	0.32	0.76	0.86	0.86	**0.64**
C10	0.07	0.38	0.78	0.86	0.86	**0.65**
C100	0.44	0.61	0.84	0.89	0.89	**0.77**
AREA	0.06	0.00	0.00	0.00	0.17	0.229

TOTAL AREA **1.505** acres

OFF W	**Landscaping**	**Gravel**	**Building**	**Concrete**	**Water/ Asphalt**	
NRCS Type 100% B						**EFFECTIVE**
I	2	40.00	90.00	100.00	100.00	**9.01**
C2	0.01	0.29	0.74	0.84	0.84	**0.07**
C5	0.01	0.32	0.76	0.86	0.86	**0.07**
C10	0.07	0.38	0.78	0.86	0.86	**0.13**
C100	0.44	0.61	0.84	0.89	0.89	**0.47**
AREA	1.40	0.00	0.00	0.05	0.05	1.505

OFF BLR	TOTAL AREA Landscaping	0.190 acres Gravel	Building	Concrete	Water/ Asphalt	
NRCS Type 100% B						EFFECTIVE
I	2	40.00	90.00	100.00	100.00	**48.65**
C2	0.01	0.29	0.74	0.84	0.84	**0.41**
C5	0.01	0.32	0.76	0.86	0.86	**0.41**
C10	0.07	0.38	0.78	0.86	0.86	**0.45**
C100	0.44	0.61	0.84	0.89	0.89	**0.65**
AREA	0.10	0.00	0.00	0.02	0.07	0.190

OFF NW	TOTAL AREA Landscaping	20.073 acres Gravel	Building	Concrete	Water/ Asphalt	
NRCS Type 100% B						EFFECTIVE
I	2	40.00	90.00	100.00	100.00	**14.05**
C2	0.01	0.29	0.74	0.84	0.84	**0.11**
C5	0.01	0.32	0.76	0.86	0.86	**0.11**
C10	0.07	0.38	0.78	0.86	0.86	**0.17**
C100	0.44	0.61	0.84	0.89	0.89	**0.49**
AREA	15.79	2.96	0.00	0.06	1.26	20.073

OFF NE	TOTAL AREA Landscaping	1.213 acres Gravel	Building	Concrete	Water/ Asphalt	
NRCS Type 100% B						EFFECTIVE
I	2	40.00	90.00	100.00	100.00	**10.12**
C2	0.01	0.29	0.74	0.84	0.84	**0.08**
C5	0.01	0.32	0.76	0.86	0.86	**0.08**
C10	0.07	0.38	0.78	0.86	0.86	**0.14**
C100	0.44	0.61	0.84	0.89	0.89	**0.48**
AREA	1.11	0.00	0.00	0.00	0.10	1.213

I-25	TOTAL AREA Landscaping	0.211 acres Gravel	Building	Concrete	Water/ Asphalt	
NRCS Type 100% B						EFFECTIVE
I	2	40.00	90.00	100.00	100.00	**29.38**
C2	0.01	0.29	0.74	0.84	0.84	**0.24**
C5	0.01	0.32	0.76	0.86	0.86	**0.25**
C10	0.07	0.38	0.78	0.86	0.86	**0.29**
C100	0.44	0.61	0.84	0.89	0.89	**0.57**
AREA	0.15	0.00	0.00	0.00	0.06	0.211

TABLE RO-2 (taken from MHFD (UDFCD) Manual - Vol. I)

Type of Land Surface	Conveyance coefficient, Cv
Heavy Meadow	2.5
Tillage/field	5
Short pasture/Lawns	7
Nearly Bare Ground	10.00
Grassed Waterway	15.00
Paved areas and shallow paved swales	20.00

APPENDIX C

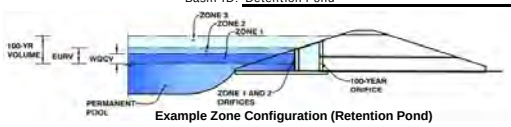
Detention Pond Calcs, Capacity Calcs, etc.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

Project: Trailers Direct Express

Basin ID: Detention Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	4.94	acres
Watershed Length =	600	ft
Watershed Length to Centroid =	300	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	50.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.085	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.264	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.9 in.) =	0.159	acre-feet	0.90	inches
5-yr Runoff Volume (P1 = 1.2 in.) =	0.236	acre-feet	1.20	inches
10-yr Runoff Volume (P1 = 1.46 in.) =	0.322	acre-feet	1.46	inches
25-yr Runoff Volume (P1 = 1.85 in.) =	0.492	acre-feet	1.85	inches
50-yr Runoff Volume (P1 = 2.17 in.) =	0.616	acre-feet	2.17	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.772	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.39 in.) =	1.126	acre-feet	3.39	inches
Approximate 2-yr Detention Volume =	0.151	acre-feet		
Approximate 5-yr Detention Volume =	0.218	acre-feet		
Approximate 10-yr Detention Volume =	0.302	acre-feet		
Approximate 25-yr Detention Volume =	0.366	acre-feet		
Approximate 50-yr Detention Volume =	0.399	acre-feet		
Approximate 100-yr Detention Volume =	0.462	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.085	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.179	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.198	acre-feet
Total Detention Basin Volume =	0.462	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

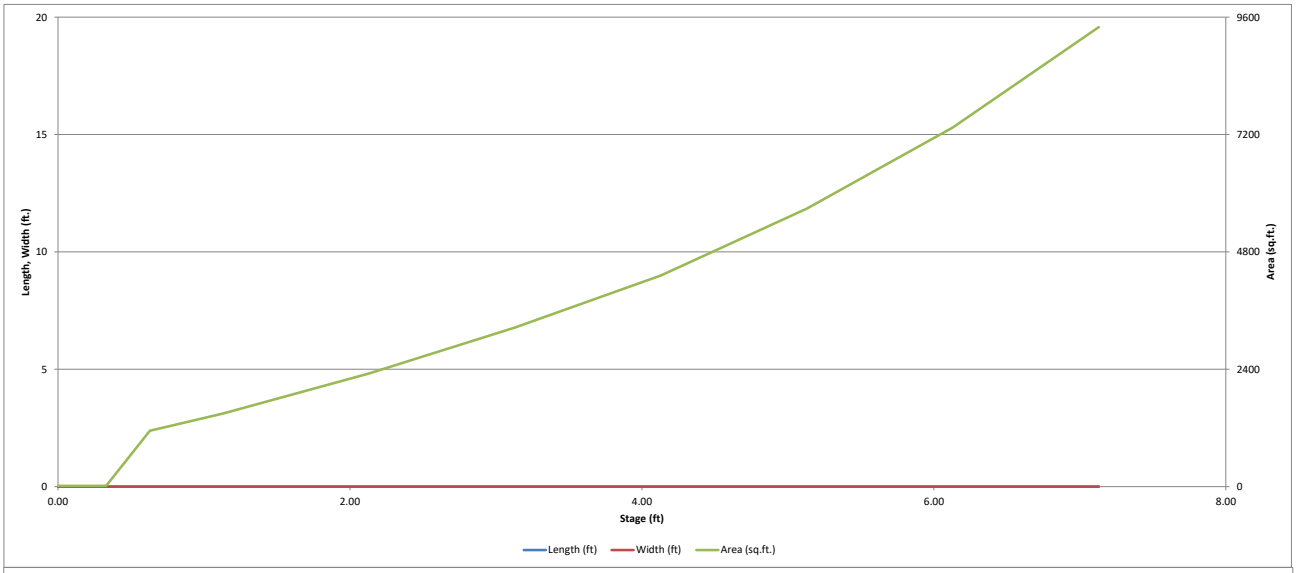
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

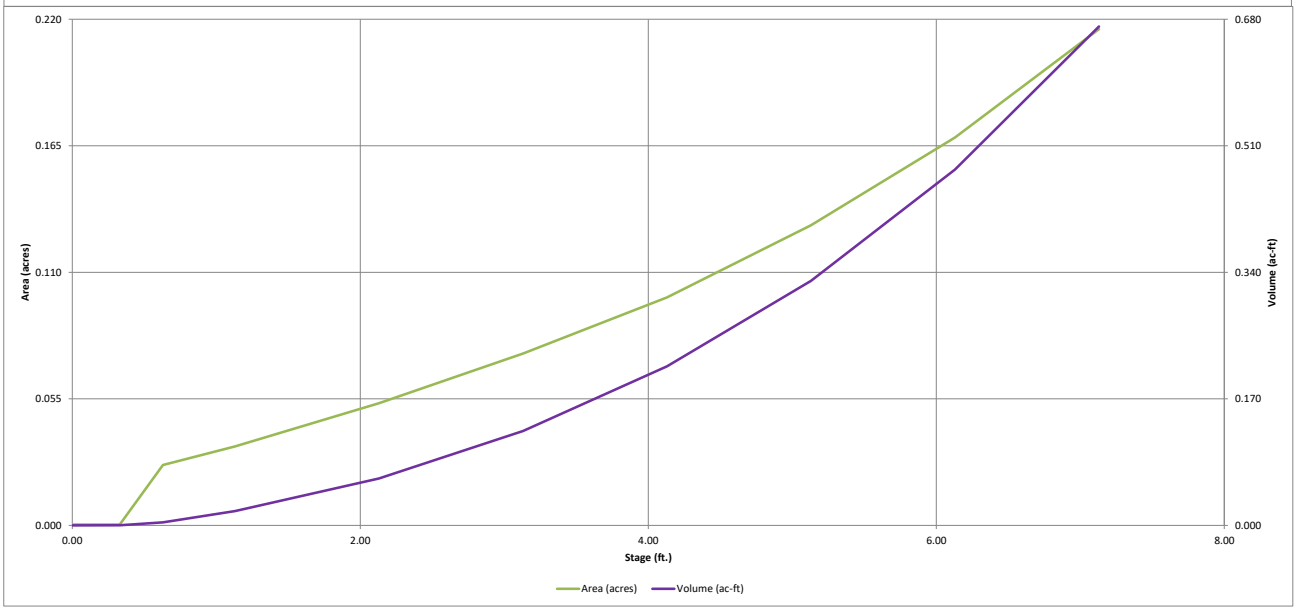
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	16	0.000		
INV = 7,099.20	--	0.33	--	--	--	16	0.000	5	0.000
TOE = 7,099.50	--	0.63	--	--	--	1,143	0.026	179	0.004
7,100.00	--	1.13	--	--	--	1,495	0.034	838	0.019
7101.00	--	2.13	--	--	--	2,314	0.053	2,743	0.063
7102.00	--	3.13	--	--	--	3,255	0.075	5,527	0.127
7103.00	--	4.13	--	--	--	4,316	0.099	9,313	0.214
7104.00	--	5.13	--	--	--	5,683	0.130	14,312	0.329
7105.00	--	6.13	--	--	--	7,344	0.169	20,826	0.478
7106.00	--	7.13	--	--	--	9,396	0.216	29,196	0.670

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)



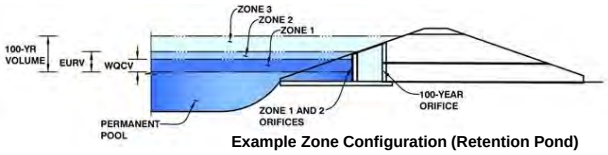


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: Trailers Direct Express

Basin ID: Detention Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.52	0.085	Orifice Plate
Zone 2 (EURV)	4.61	0.179	Rectangular Orifice
Zone 3 (100-year)	6.04	0.198	Weir&Pipe (Restrict)
Total (all zones)		0.462	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.986E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.52	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.43	sq. inches (diameter = 3/4 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00					
Orifice Area (sq. inches)	0.43	0.43	0.43					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.52	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.52	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	4.61	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	1.04	N/A	feet
Vertical Orifice Height =	25.00	N/A	inches				
Vertical Orifice Width =	3.00		inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.61	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.61	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.12	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	23.60	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.48	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	5.74	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.49	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.28	N/A	feet
Restrictor Plate Height Above Pipe Invert =	5.75		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.20	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.04	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.41	feet
Spillway Crest Length =	18.00	feet	Stage at Top of Freeboard =	7.54	feet
Spillway End Slopes =	0.01	H:V	Basin Area at Top of Freeboard =	0.22	acres
Freeboard above Max Water Surface =	1.09	feet	Basin Volume at Top of Freeboard =	0.67	acre-ft

Calculated Parameters for Spillway

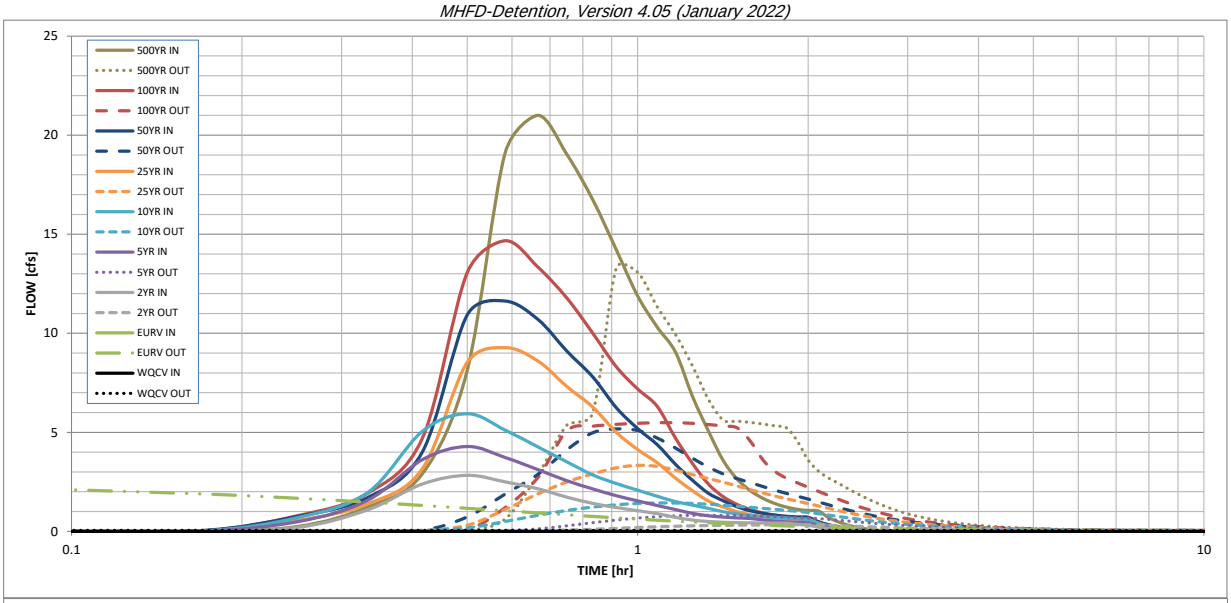
Routed Hydrograph Results

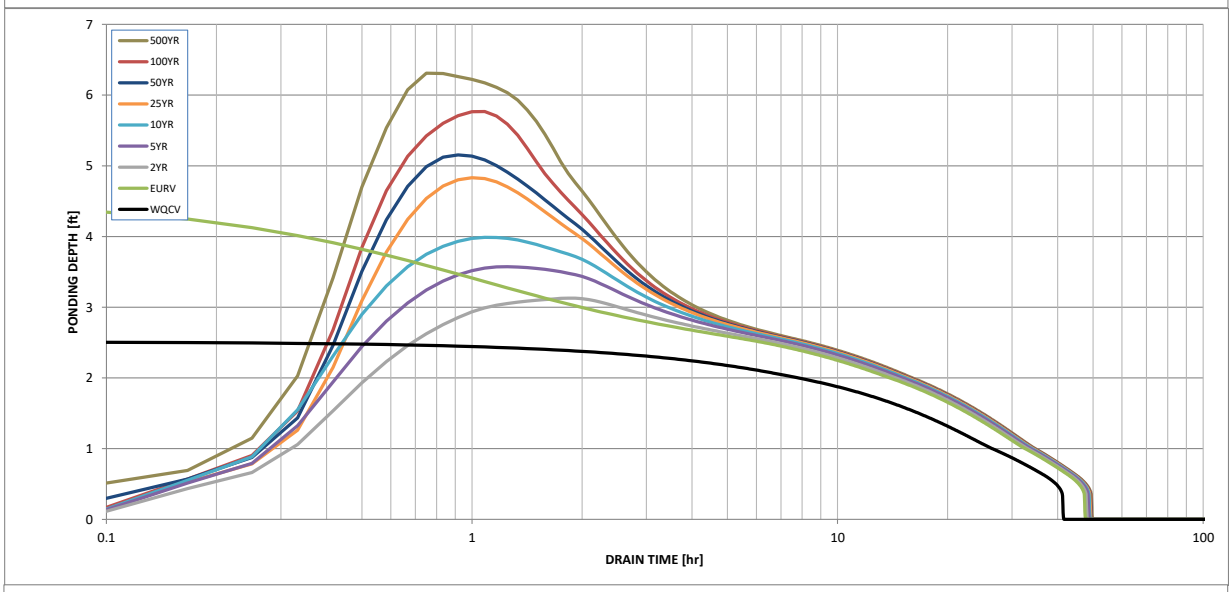
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

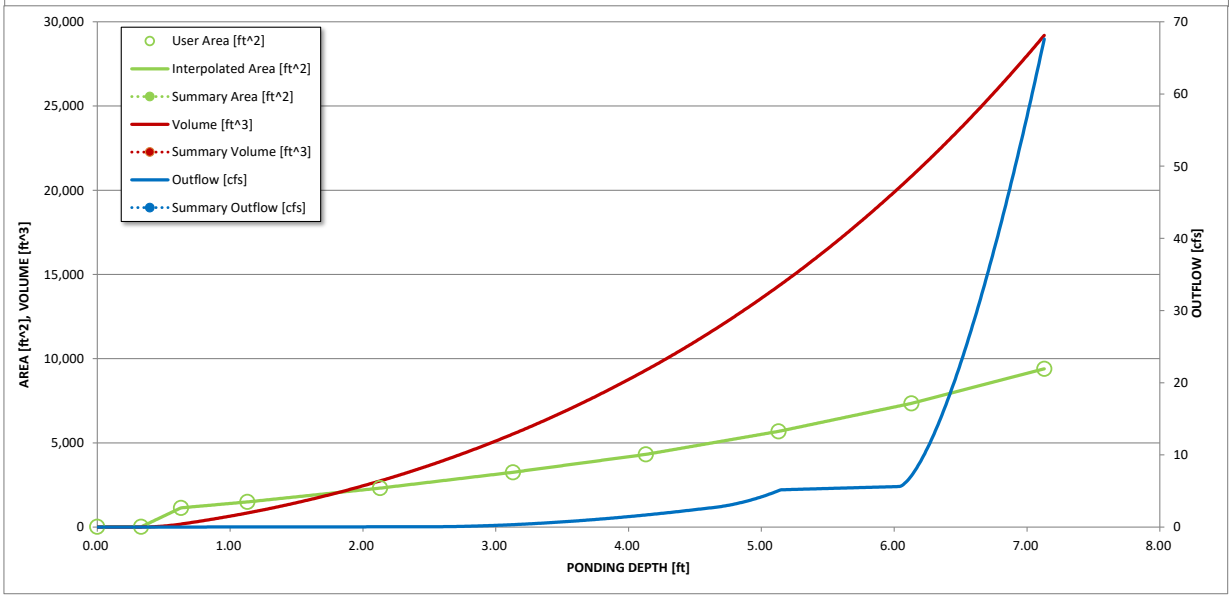
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.90	1.20	1.46	1.85	2.17	2.52	3.39
CUHP Runoff Volume (acre-ft) =	0.085	0.264	0.159	0.236	0.322	0.492	0.616	0.772	1.126
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.159	0.236	0.322	0.492	0.616	0.772	1.126
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.5	1.5	4.1	5.7	7.6	11.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.10	0.30	0.84	1.15	1.54	2.40
Peak Inflow Q (cfs) =	N/A	N/A	2.8	4.3	5.9	9.3	11.6	14.7	21.0
Peak Outflow Q (cfs) =	0.1	2.5	0.3	0.8	1.4	3.3	5.2	5.5	13.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.6	1.0	0.8	0.9	0.7	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.2	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	39	43	41	39	35	32	30	25
Time to Drain 99% of Inflow Volume (hours) =	40	44	46	46	45	44	42	41	38
Maximum Ponding Depth (ft) =	2.52	4.61	3.13	3.57	3.99	4.83	5.15	5.77	6.31
Area at Maximum Ponding Depth (acres) =	0.06	0.11	0.07	0.09	0.10	0.12	0.13	0.15	0.18
Maximum Volume Stored (acre-ft) =	0.085	0.265	0.126	0.162	0.199	0.291	0.331	0.418	0.507

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.24
	0:15:00	0.00	0.00	0.19	0.48	0.68	0.54	0.75	0.78	1.22
	0:20:00	0.00	0.00	1.08	1.57	1.95	1.38	1.71	1.92	2.91
	0:25:00	0.00	0.00	2.39	3.62	5.05	3.16	4.01	4.70	8.12
	0:30:00	0.00	0.00	2.83	4.28	5.94	8.53	10.92	13.06	19.10
	0:35:00	0.00	0.00	2.50	3.73	5.11	9.27	11.63	14.67	21.00
	0:40:00	0.00	0.00	2.15	3.12	4.26	8.60	10.70	13.34	19.02
	0:45:00	0.00	0.00	1.73	2.56	3.51	7.31	9.10	11.77	16.74
	0:50:00	0.00	0.00	1.41	2.14	2.85	6.27	7.79	10.00	14.22
	0:55:00	0.00	0.00	1.20	1.80	2.41	5.00	6.24	8.31	11.88
	1:00:00	0.00	0.00	1.04	1.54	2.08	4.13	5.19	7.19	10.31
	1:05:00	0.00	0.00	0.89	1.30	1.77	3.46	4.37	6.30	9.04
	1:10:00	0.00	0.00	0.71	1.10	1.50	2.69	3.38	4.70	6.81
	1:15:00	0.00	0.00	0.57	0.91	1.33	2.05	2.57	3.42	5.06
	1:20:00	0.00	0.00	0.50	0.79	1.16	1.53	1.92	2.39	3.57
	1:25:00	0.00	0.00	0.46	0.72	0.99	1.23	1.54	1.75	2.63
	1:30:00	0.00	0.00	0.44	0.68	0.88	0.99	1.24	1.35	2.04
	1:35:00	0.00	0.00	0.43	0.65	0.80	0.84	1.03	1.10	1.66
	1:40:00	0.00	0.00	0.42	0.58	0.74	0.74	0.91	0.93	1.40
	1:45:00	0.00	0.00	0.42	0.52	0.70	0.68	0.82	0.81	1.22
	1:50:00	0.00	0.00	0.41	0.48	0.67	0.64	0.76	0.73	1.11
	1:55:00	0.00	0.00	0.35	0.46	0.63	0.62	0.73	0.70	1.05
	2:00:00	0.00	0.00	0.31	0.42	0.57	0.60	0.71	0.69	1.03
	2:05:00	0.00	0.00	0.22	0.30	0.40	0.42	0.49	0.48	0.72
	2:10:00	0.00	0.00	0.15	0.21	0.27	0.29	0.34	0.34	0.50
	2:15:00	0.00	0.00	0.10	0.14	0.19	0.20	0.23	0.23	0.35
	2:20:00	0.00	0.00	0.07	0.09	0.12	0.13	0.16	0.15	0.23
	2:25:00	0.00	0.00	0.04	0.06	0.08	0.09	0.10	0.10	0.15
	2:30:00	0.00	0.00	0.03	0.04	0.05	0.06	0.06	0.06	0.09
	2:35:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.04	0.05
	2:40:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

REQUIRED DETENTION (FULL SPECTRUM EMPIRICAL for COMPARISON)

MHFD 2018 VOL 1 thru 3

IN ACCORDANCE WITH MHFD, THE EFFECTIVE IMPERVIOUSNESS OF THE TOTAL AREA IS USED TO CALCULATE WQCV, EURV, & 100YR VOL IN LIEU OF THE SUMMATION OF EACH BASIN
(CORRECT VALUE INDICATED BY AN ARROW)

WATER QUALITY CALCULATIONS

from Figure EDB-2, 40 hr drain @ I, WQCV= noted below

BASIN	Actual I	Used Herein I	A acres	WQCV (in/watershed)	WQCV DEPTH in (FIG 3-1)	WQCV OTHER (in/watershed)	WQCV acre ft	
W	92.99	93.00	0.50	0.43	0.43	0.43	0.018	
E	51.36	52.00	2.79	0.21	0.43	0.21	0.049	
POND	74.31	75.00	0.23	0.30	0.43	0.30	0.006	
OFF NE	10.12	11.00	1.21	0.07	0.43	0.07	0.007	
I-25	29.38	30.00	0.21	0.15	0.43	0.15	0.003	
TOTAL	**45.61**	**46.25**	**4.94**	1.80	0.43	1.80	0.083	
				0.20	**0.43**	**0.20**	**0.081**	← **WQCV (ZONE 1)**

EXCESS URBAN RUNOFF VOLUME (EURV)

BASIN	Actual I	Used Herein I	A acres	NCS SOIL TYPE %	$EURV_A$ (in/watershed)	$EURV_B$ (in/watershed)	$EURV_C$ (in/watershed)	WEIGHTED AVE. EURV (in/watershed)	EURV** acre ft	
W	92.99	93.00	0.50	100% B	1.53	1.26	1.11	1.11	0.047	
E	51.36	52.00	2.79	100% B	0.73	0.67	0.59	0.59	0.137	
POND	74.31	75.00	0.23	100% B	1.16	1.00	0.88	0.88	0.017	
OFF NE	10.12	11.00	1.21	100% B	0.10	0.13	0.11	0.11	0.011	
I-25	29.38	30.00	0.21	100% B	0.36	0.37	0.33	0.33	0.006	
TOTAL	**45.61**	**46.25**	**4.94**	**100% B**	5.39	4.98	4.39	4.39	0.218	
					0.63	**0.59**	**0.52**	**0.52**	**0.215**	← **EURV**
									0.134	← **ZONE 2**

100YR VOLUME

BASIN	Actual I	Used Herein I	A acres	1hr Rainfall Depth in	NCS SOIL TYPE %	V_{100} (in/watershed)	V_{100} acre ft	
W	92.99	93.00	0.50	2.52	100% B	1.75	0.074	
E	51.36	52.00	2.79	2.52	100% B	1.12	0.261	
POND	74.31	75.00	0.23	2.52	100% B	1.47	0.028	
OFF NE	10.12	11.00	1.21	2.52	100% B	0.47	0.047	
I-25	29.38	30.00	0.21	2.52	100% B	0.79	0.014	
TOTAL	**45.61**	**46.25**	**4.94**	**2.52**	**100% B**	9.96	0.424	
						1.02	**0.420**	← **100YR VOL**
							0.205	← **ZONE 3**

REQUIRED DETENTION VOLUMES USED FOR FOREBAY CALCULATIONS WERE FOUND TO BE SLIGHTLY LOWER THAN THE REQUIRED DETENTION VOLUMES FOUND USING THE "MACRO" APPROACH USED FOR THE MHFD DETENTION POND

FOREBAY CALCS

FOREBAY	BASINS	A acres	WQCV cubic feet	Min Reqd Vol % of WQCV	Min Reqd Vol cubic feet	Max Depth (in)	Forebay Dimensions	Forebay Volume (ft^3)	Release Rate 2% of Dev Q (cfs)
W	W	0.50	783.9	2%	15.7	12	4' * 4'	16	0.07
E	E, OFF NE, I-25	4.21	2,576.9	2%	51.5	12	7' * 8'	56	0.26
TOTAL		**4.71**	**3,360.78**		**67.22**			**72.00**	**0.34**

FOREBAY W MINIMUM WEIR			
Weir Equation: Q = CLH^1.5			
C (per Equation 12-8 - Ranges from 2.6-3.0)		2.60	
2% of 100-year Q (Table EDB-4)		0.07	cfs
H is Forebay Height=		1.00	ft
H=		12.00	inches
Required Min	L=	0.03	ft
Required Min	L=	0.34	inches

FOREBAY E MINIMUM WEIR			
Weir Equation: Q = CLH^1.5			
C (per Equation 12-8 - Ranges from 2.6-3.0)		2.60	
2% of 100-year Q (Table EDB-4)		0.26	cfs
H is Forebay Height=		1.00	ft
H=		12.00	inches
Required Min	L=	0.10	ft
Required Min	L=	1.21	inches

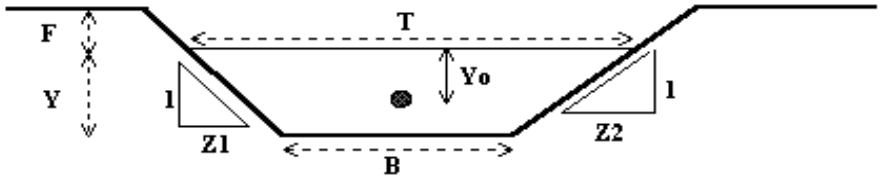
POND EMERGENCY OVERFLOW MINIMUM WEIR			
Weir Equation: Q = CLH^1.5			
Pond TOP		7106.00	
100-year Water Surface		7104.91	
C (per Equation 12-8 - Ranges from 2.6-3.0)		3.00	
Emergency Overflow weir 2X Peak Dev Q=		36.72	cfs
H is flow depth with 0.5 ft of freeboard=		0.59	ft
H=		7.08	inches
Required Min	L=	27.01	ft
Required Min	L=	324.08	inches

POND EMERGENCY OVERFLOW ACTUAL WEIR			
Weir Equation: Q = CLH^1.5			
Pond TOP		7106.00	
100-year Water Surface		7104.91	
C (per Equation 12-8 - Ranges from 2.6-3.0)		3.00	
Emergency Overflow weir 2X Peak Dev Q=		38.07	cfs
H is flow depth with 0.5 ft of freeboard=		0.59	ft
H=		7.08	inches
Provided	L=	28.00	ft
Provided	L=	336.00	inches

Normal Flow Analysis - Trapezoidal Channel

Project: TRAILERS DIRECT EXPRESS

Channel ID: SPILLWAY CHANNEL



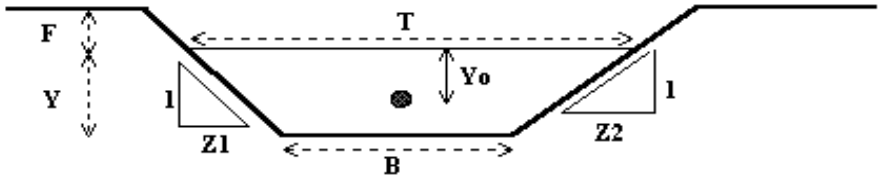
Design Information (Input)			
Channel Invert Slope	So =	0.2500	ft/ft
Manning's n	n =	0.040	
Bottom Width	B =	28.00	ft
Left Side Slope	Z1 =	5.00	ft/ft
Right Side Slope	Z2 =	5.00	ft/ft
Freeboard Height	F =	0.73	ft
Design Water Depth	Y =	**0.21**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**39.17**	cfs
Froude Number	**Fr =**	**2.51**	
Flow Velocity	**V =**	**6.42**	fps
Flow Area	A =	6.10	sq ft
Top Width	T =	30.10	ft
Wetted Perimeter	P =	30.14	ft
Hydraulic Radius	R =	0.20	ft
Hydraulic Depth	D =	0.20	ft
Specific Energy	Es =	0.85	ft
Centroid of Flow Area	Yo =	0.10	ft
Specific Force	Fs =	0.53	kip

Normal Flow Analysis - Trapezoidal Channel

Project: TRAILERS DIRECT EXPRESS

Channel ID: WEST DITCH



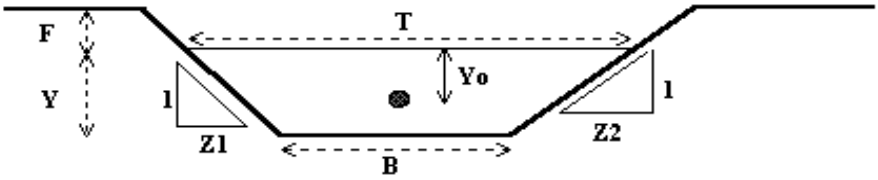
Design Information (Input)			
Channel Invert Slope	So =	0.0100	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Slope	Z2 =	3.00	ft/ft
Freeboard Height	F =	0.24	ft
Design Water Depth	Y =	**0.76**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**3.74**	cfs
Froude Number	**Fr =**	**0.62**	
Flow Velocity	**V =**	**2.16**	fps
Flow Area	A =	1.73	sq ft
Top Width	T =	4.56	ft
Wetted Perimeter	P =	4.81	ft
Hydraulic Radius	R =	0.36	ft
Hydraulic Depth	D =	0.38	ft
Specific Energy	Es =	0.83	ft
Centroid of Flow Area	Yo =	0.25	ft
Specific Force	Fs =	0.04	kip

Normal Flow Analysis - Trapezoidal Channel

Project: TRAILERS DIRECT EXPRESS

Channel ID: EAST DITCH



Design Information (Input)			
Channel Invert Slope	So =	0.0200	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Slope	Z2 =	3.00	ft/ft
Freeboard Height	F =	1.93	ft
Design Water Depth	Y =	**1.07**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**13.16**	cfs
Froude Number	**Fr =**	**0.92**	
Flow Velocity	**V =**	**3.83**	fps
Flow Area	A =	3.43	sq ft
Top Width	T =	6.42	ft
Wetted Perimeter	P =	6.77	ft
Hydraulic Radius	R =	0.51	ft
Hydraulic Depth	D =	0.54	ft
Specific Energy	Es =	1.30	ft
Centroid of Flow Area	Yo =	0.35	ft
Specific Force	Fs =	0.17	kip

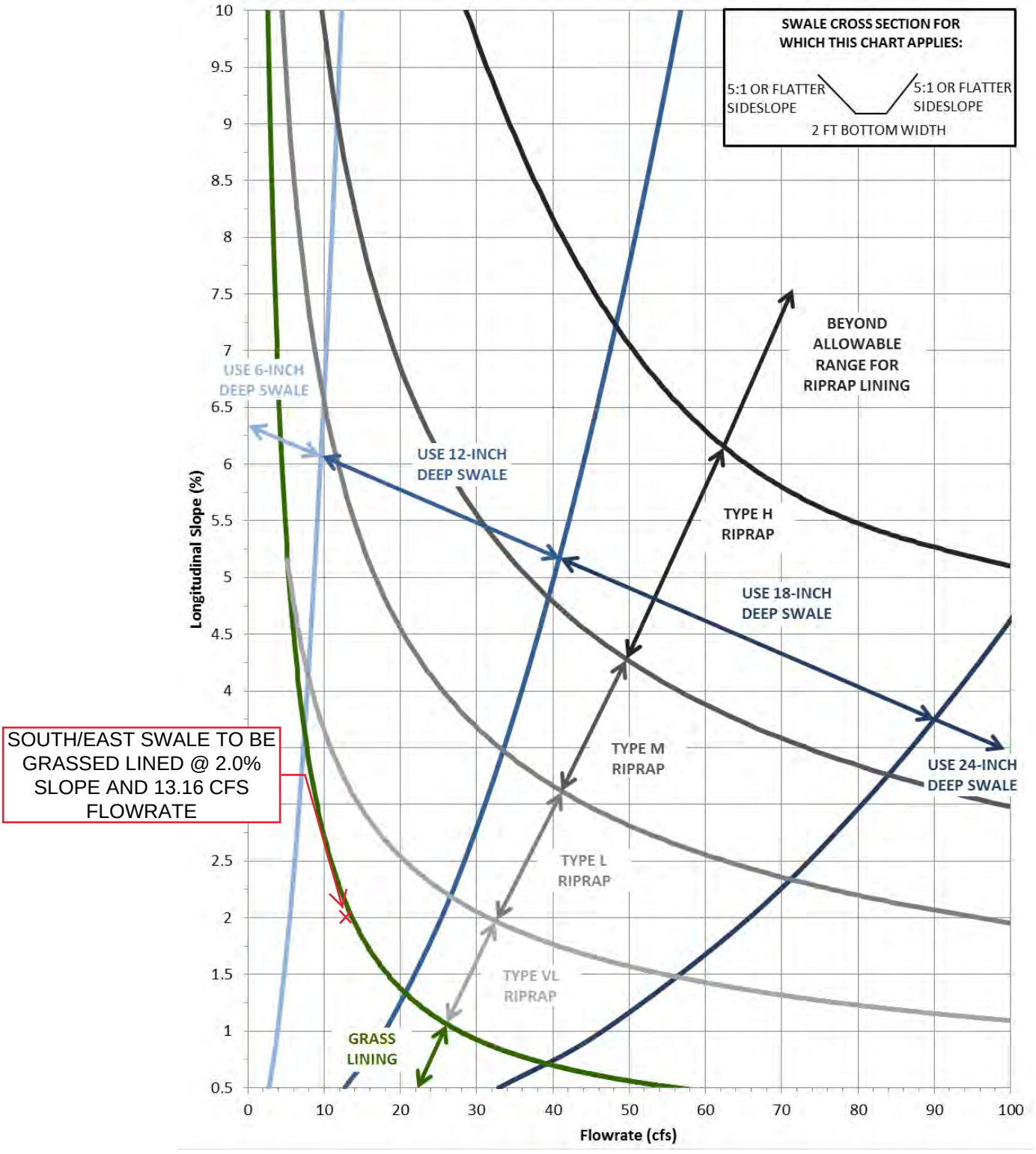


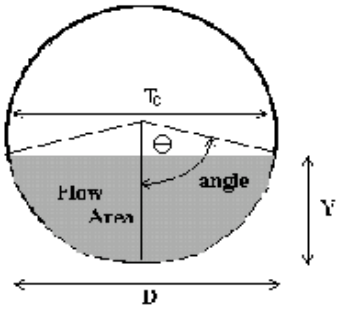
Figure 8-22. Swale stability chart; 2- to 4-foot bottom width and side slopes between 5:1 and 10:1 (Note: Riprap classifications refer to gradation for riprap used in soil riprap or void-filled riprap. See Figure 8-34 for gradations.) (Source: Muller Engineering Company)

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: Trailers Direct Express

Pipe ID: Pond Outlet



Design Information (Input)			
Pipe Invert Slope	So =	0.0060	ft/ft
Pipe Manning's n-value	n =	0.0150	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	5.56	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	7.07	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.91	radians
Flow area	An =	1.25	sq ft
Top width	Tn =	1.41	ft
Wetted perimeter	Pn =	2.87	ft
Flow depth	Yn =	1.00	ft
Flow velocity	Vn =	4.43	fps
Discharge	Qn =	5.56	cfs
Percent of Full Flow	Flow =	78.6%	of full flow
Normal Depth Froude Number	Fr_n =	0.83	subcritical

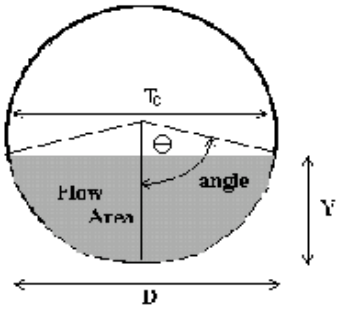
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.78	radians
Critical flow area	Ac =	1.12	sq ft
Critical top width	Tc =	1.47	ft
Critical flow depth	Yc =	0.91	ft
Critical flow velocity	Vc =	4.96	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: Trailers Direct Express

Pipe ID: EX ACCESS CULVERT (36" CMP)



Design Information (Input)			
Pipe Invert Slope	So =	0.0500	ft/ft
Pipe Manning's n-value	n =	0.0200	
Pipe Diameter	D =	36.00	inches
Design discharge	Q =	40.00	cfs

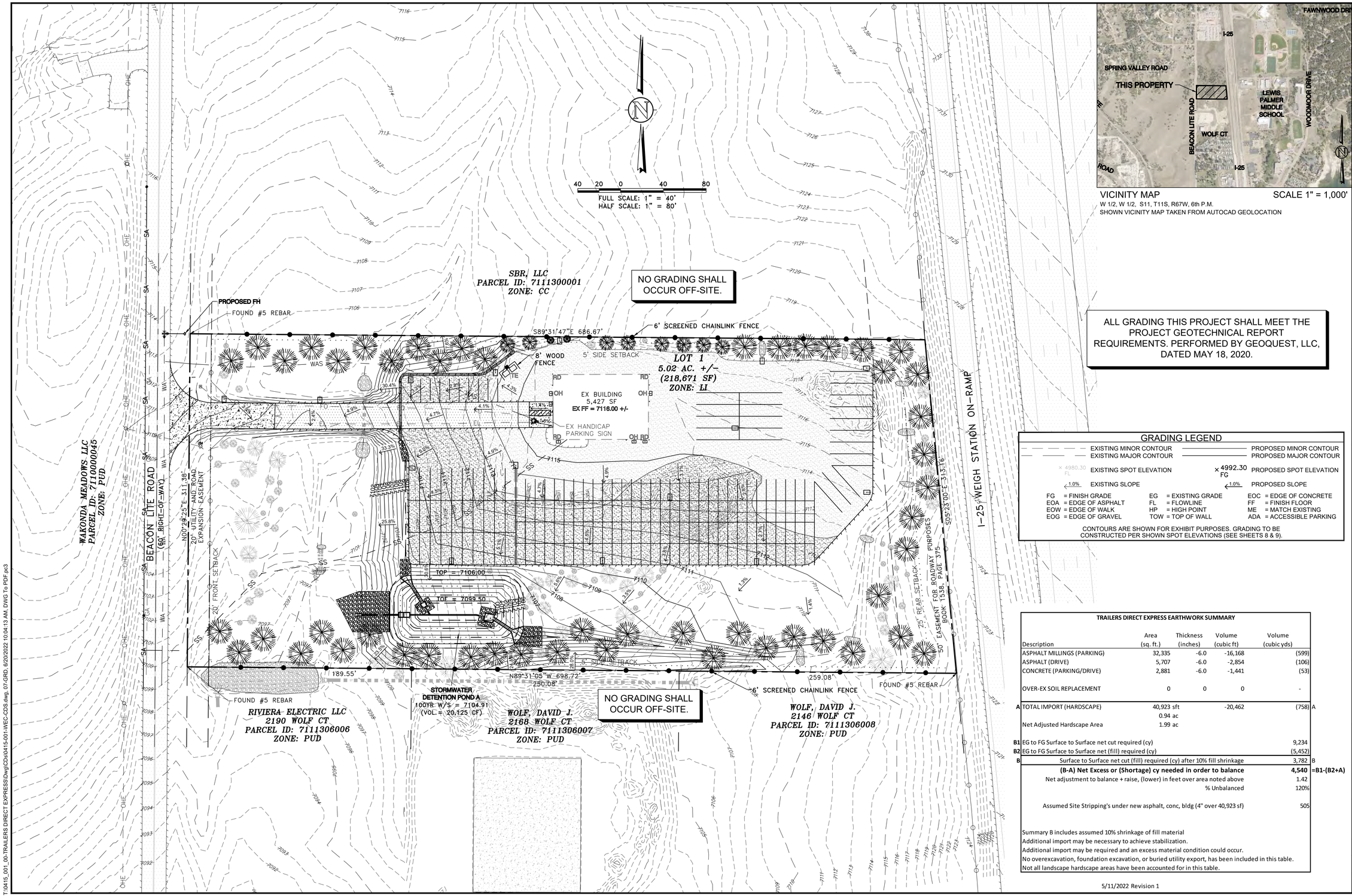
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	7.07	sq ft
Full-flow wetted perimeter	Pf =	9.42	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	97.20	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.46	radians
Flow area	An =	3.06	sq ft
Top width	Tn =	2.98	ft
Wetted perimeter	Pn =	4.39	ft
Flow depth	Yn =	1.34	ft
Flow velocity	Vn =	13.08	fps
Discharge	Qn =	40.00	cfs
Percent of Full Flow	Flow =	41.2%	of full flow
Normal Depth Froude Number	Fr_n =	2.28	supercritical

Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.95	radians
Critical flow area	Ac =	5.17	sq ft
Critical top width	Tc =	2.78	ft
Critical flow depth	Yc =	2.06	ft
Critical flow velocity	Vc =	7.73	fps
Critical Depth Froude Number	Fr_c =	1.00	

APPENDIX D

Grading & Drainage Plans



VICINITY MAP SCALE 1" = 1,000'

W 1/2, W 1/2, S11, T11S, R67W, 6th P.M.
SHOWN VICINITY MAP TAKEN FROM AUTOCAD GEOLOCATION

ALL GRADING THIS PROJECT SHALL MEET THE PROJECT GEOTECHNICAL REPORT REQUIREMENTS. PERFORMED BY GEOQUEST, LLC, DATED MAY 18, 2020.

GRADING LEGEND

EXISTING MINOR CONTOUR	PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR	PROPOSED MAJOR CONTOUR
× 4980.30 FL — EXISTING SPOT ELEVATION	× 4992.30 FG — PROPOSED SPOT ELEVATION
1.0% — EXISTING SLOPE	1.0% — PROPOSED SLOPE

FG = FINISH GRADE	EG = EXISTING GRADE	EOC = EDGE OF CONCRETE
EOA = EDGE OF ASPHALT	FL = FLOWLINE	FF = FINISH FLOOR
EOW = EDGE OF WALK	HP = HIGH POINT	ME = MATCH EXISTING
EOG = EDGE OF GRAVEL	TOW = TOP OF WALL	ADA = ACCESSIBLE PARKING

CONTOURS ARE SHOWN FOR EXHIBIT PURPOSES. GRADING TO BE CONSTRUCTED PER SHOWN SPOT ELEVATIONS (SEE SHEETS 8 & 9).

TRAILERS DIRECT EXPRESS EARTHWORK SUMMARY

	Description	Area (sq. ft.)	Thickness (inches)	Volume (cubic ft)	Volume (cubic yds)	
	ASPHALT MILLINGS (PARKING)	32,335	-6.0	-16,168	(599)	
	ASPHALT (DRIVE)	5,707	-6.0	-2,854	(106)	
	CONCRETE (PARKING/DRIVE)	2,881	-6.0	-1,441	(53)	
	OVER-EX SOIL REPLACEMENT	0	0	0	-	
A	TOTAL IMPORT (HARDSCAPE)	40,923 sft		-20,462	(758)	A
		0.94 ac				
	Net Adjusted Hardscape Area	1.99 ac				
B1	EG to FG Surface to Surface net cut required (cy)				9,234	
B2	EG to FG Surface to Surface net (fill) required (cy)				(5,452)	
B	Surface to Surface net cut (fill) required (cy) after 10% fill shrinkage				3,782	B
	(B-A) Net Excess or (Shortage) cy needed in order to balance				**4,540**	**=B1-(B2+A)**
	Net adjustment to balance + raise, (lower) in feet over area noted above				1.42	
	% Unbalanced				120%	
	Assumed Site Stripping's under new asphalt, conc, bldg (4" over 40,923 sf)				505	

Summary B includes assumed 10% shrinkage of fill material
Additional import may be necessary to achieve stabilization.
Additional import may be required and an excess material condition could occur.
No overexcavation, foundation excavation, or buried utility export, has been included in this table.
Not all landscape hardscape areas have been accounted for in this table.

5/11/2022 Revision 1

Western Engineering Consultants, inc LLC
127 S. DENVER AVE
FT. LUPTON, CO 80621
www.westernec.com
email@westernec.com
(720) 685-9951
FAX (720) 294-1330

No.	REVISION	DATE	BY
0	INITIAL RELEASE	03/28/22	CFC
1	REV PER TOWN COMMENTS 05/02/22	06/20/22	CFC

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SUITE 220
MOORE, OK 73160
CONTACT: CRAIG OWEN
(405) 701-1927
craig.owen@trailersdirectexpress.com

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CHECKED BY: CFC
PROJECT NO. 01-0415.001.00
DOC CON # 0007-GRD
SHEET 7 OF 29

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SBR, LLC
PARCEL ID: 7111300001
ZONE: CC

PROPOSED FH
FOUND #5 REBAR

NO GRADING SHALL OCCUR OFF-SITE.

S89°31'47"E 686.67'

6' SCRE

5' SIDE SETBACK

8' WOOD FENCE

EX BUILDING
5,427 SF
EX FF = 7116.00 +/-

EX HANDICAP PARKING SIGN

ALL GRADING THIS PROJECT SHALL MEET THE PROJECT GEOTECHNICAL REPORT REQUIREMENTS. PERFORMED BY GEOQUEST, LLC, DATED MAY 18, 2020.

BEACON LITE ROAD (60' RIGHT-OF-WAY)

N00°29'25"E 311.38'

20' UTILITY AND ROAD EXPANSION EASEMENT

20' FRONT SETBACK

TOP = 7106.00

TOE = 7099.50

189.55'

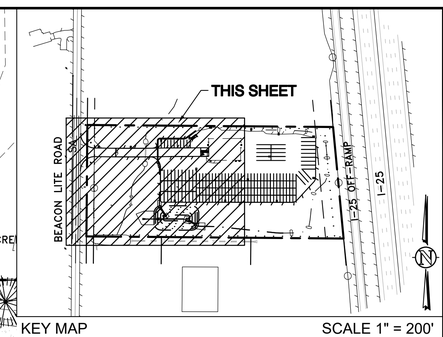
N89°31'05"W 698.72'
250.08'

NO GRADING SHALL OCCUR OFF-SITE.

FOUND #5 REBAR

OUTSIDE SE

KEY MAP



SCALE 1" = 200'

20 10 0 20 40
FULL SCALE: 1" = 20'
HALF SCALE: 1" = 40'

GRADING LEGEND

EXISTING MINOR CONTOUR	PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR	PROPOSED MAJOR CONTOUR
× 4980.30 FL — EXISTING SPOT ELEVATION	× 4992.30 FG — PROPOSED SPOT ELEVATION
1.0% — EXISTING SLOPE	1.0% — PROPOSED SLOPE

FG = FINISH GRADE
EOA = EDGE OF ASPHALT
EOW = EDGE OF WALK
EOG = EDGE OF GRAVEL
EG = EXISTING GRADE
FL = FLOWLINE
HP = HIGH POINT
TOW = TOP OF WALL
EOC = EDGE OF CONCRETE
FF = FINISH FLOOR
ME = MATCH EXISTING
ADA = ACCESSIBLE PARKING

CONTOURS ARE SHOWN FOR EXHIBIT PURPOSES.
GRADING TO BE CONSTRUCTED PER SHOWN SPOT ELEVATIONS.

TRAILERS DIRECT EXPRESS EARTHWORK SUMMARY

	Description	Area (sq. ft.)	Thickness (inches)	Volume (cubic ft)	Volume (cubic yds)	
	ASPHALT MILLINGS (PARKING)	32,335	-6.0	-16,168	(599)	
	ASPHALT (DRIVE)	5,707	-6.0	-2,854	(106)	
	CONCRETE (PARKING/DRIVE)	2,881	-6.0	-1,441	(53)	
	OVER-EX SOIL REPLACEMENT	0	0	0	-	
A	TOTAL IMPORT (HARDSCAPE)	40,923 sft		-20,462	(758)	A
	Net Adjusted Hardscape Area	0.94 ac 1.99 ac				
B1	EG to FG Surface to Surface net cut required (cy)				9,234	
B2	EG to FG Surface to Surface net (fill) required (cy)				(5,452)	
B	Surface to Surface net cut (fill) required (cy) after 10% fill shrinkage				3,782	B
	(B-A) Net Excess or (Shortage) cy needed in order to balance				**4,540**	**=B1-(B2+A)**
	Net adjustment to balance + raise, (lower) in feet over area noted above				1.42	
	% Unbalanced				120%	
	Assumed Site Stripping's under new asphalt, conc, bldg (4" over 40,923 sf)				505	

Summary B includes assumed 10% shrinkage of fill material
Additional import may be necessary to achieve stabilization.
Additional import may be required and an excess material condition could occur.
No overexcavation, foundation excavation, or buried utility export, has been included in this table.
Not all landscape hardscape areas have been accounted for in this table.

5/11/2022 Revision 1

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FT. LUPTON, CO 80621
www.westernec.com
email@westernec.com
(720) 685-9951
FAX (720) 294-1330
Western Engineering Consultants, inc LLC

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CHECKED BY: CFC
PROJECT NO. 01-0415.001.00
DOC CON # 0008-GRD W
SHEET 8 OF 29

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BR, LLC
ID: 7111300001
ONE: CC

NO GRADING SHALL OCCUR OFF-SITE.

7114.15
L

S89°31'47"E 686.67'

6' SCREENED CHAINLINK FENCE

8' WOOD FENCE

5' SIDE SETBACK

7115.00
ME–EOA

LOT 1
5.02 AC. +/–
(218,671 SF)
ZONE: LI

RD

RD

7115.43
EOC

OH

7115.74
EOC

EX BUILDING
5,427 SF
EX FF = 7118.00 +/-

OH

1.4%

4.8%

EX HANDICAP PARKING SIGN

7115.83
RD EOC

OH

RD

7115.00
ME–FG

7115

4.9%

3.7%

7114

4.7%

2.8%

7113

4.5%

2.7%

7112.58
ME–EOA

5.0%

7112

7110.65
EOA

7111

5.0%

7110

7109

3.0%

7108

7107

7106

1.9%

7111

1.4%

7110

7104.12
FL

5' SIDE SETBACK

28.0%

N89°31'05"W 698.72'
250.08'

NO GRADING SHALL OCCUR OFF-SITE.

7108.14
ME–FL

259.08'

6' SCREENED CHAINLINK FENCE

7108

7128

7127

7126

7124

7123

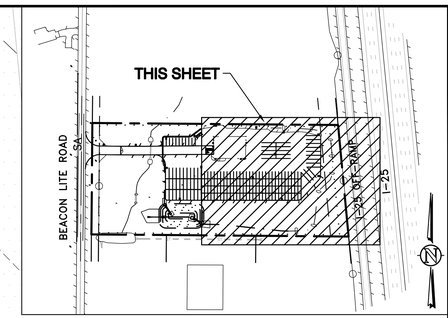
I–25 WEIGH STATION ON–RAMP

S05°23'00"E 313.16'

25' REAR SETBACK

50' EASEMENT FOR ROADWAY PURPOSES
BOOK 1538, PAGE 375

FOUND #5 REBAR



KEY MAP SCALE 1" = 200'

N

20 10 0 20 40
FULL SCALE: 1" = 20'
HALF SCALE: 1" = 40'

ALL GRADING THIS PROJECT SHALL MEET THE PROJECT GEOTECHNICAL REPORT REQUIREMENTS. PERFORMED BY GEOQUEST, LLC, DATED MAY 18, 2020.

GRADING LEGEND

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EXISTING MAJOR CONTOUR	PROPOSED MAJOR CONTOUR
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FF = FINISH FLOOR
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GRADING TO BE CONSTRUCTED PER SHOWN SPOT ELEVATIONS.

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		0.94 ac				
	Net Adjusted Hardscape Area	1.99 ac				
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B2	EG to FG Surface to Surface net (fill) required (cy)				(5,452)	
B	Surface to Surface net cut (fill) required (cy) after 10% fill shrinkage				3,782	B
	(B-A) Net Excess or (Shortage) cy needed in order to balance				**4,540**	**=B1-(B2+A)**
	Net adjustment to balance + raise, (lower) in feet over area noted above				1.42	
	% Unbalanced				120%	
	Assumed Site Stripping's under new asphalt, conc, bldg (4" over 40,923 sf)				505	

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DOC CON # 0009-GRD E
SHEET 9 OF 29

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OFF NW
20.07 .11 .49

OFF NE
1.21 .08 .48

OFF BLR
0.20 .43 .66

H
5.02 .01 .44

W
2.64 .16 .52

E
2.38 .30 .59

I-25
0.21 .25 .57

SBR, LLC
PARCEL ID: 7111300001
ZONE: CC

LOT 1
5.02 AC. +/-
(218,671 SF)
ZONE: PUD

EX BUILDING
5,427 SF

EX HANDICAP PARKING SIGN

FOUND #5 REBAR

S89°31'47"E 686.67'

N89°31'05"W 698.72'

189.55

250.08

259.08

FOUND #5 REBAR

FOUND #5 REBAR

BEACON LITE ROAD
(60' RIGHT-OF-WAY)

WAKONDA MEADOWS LLC
PARCEL ID: 7110000045
ZONE: PUD.

RIVIERA ELECTRIC LLC
2190 WOLF CT
PARCEL ID: 7111306006
ZONE: PUD

WOLF, DAVID J.
2168 WOLF CT
PARCEL ID: 7111306007
ZONE: PUD

WOLF, DAVID J.
2146 WOLF CT
PARCEL ID: 7111306008
ZONE: PUD

20' UTILITY AND ROAD EXPANSION EASEMENT

50' EASEMENT FOR ROADWAY PURPOSES BOOK 1538, PAGE 375

I-25 SOUTHBOUND ON RAMP

I-25

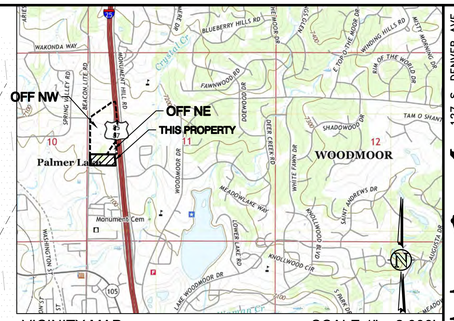
L = 1,394' S = 2.6%
L = 300' S = 4.3%
L = 38' S = 3.9%
L = 300' S = 4.5%
L = 55' S = 15.5%
L = 238' S = 16.4%
L = 292' S = 3.2%
L = 51' S = 2.4%
L = 126' S = 4.2%
L = 300' S = 1.3%
L = 46' S = 2.2%
L = 300' S = 2.2%
S05°23'00"E 343.16'

L - INITIAL LENGTH
S - INTIAL SLOPE
L - TRAVEL LENGTH
S - TRAVEL SLOPE

L_I = LI, S_I = SI
L_T = LT, S_T = ST

* AVERAGE SLOPE INCLUDES ROOF SLOPE OF 8.33%

40 20 0 40 80
FULL SCALE: 1" = 40'
HALF SCALE: 1" = 80'



VICINITY MAP SCALE 1" = 2,000'

W 1/2, W 1/2, S11, T11S, R67W, 6th P.M.
SHOWN VICINITY MAP TAKEN FROM USGS QUAD MAP - MONUMENT 7.5 MIN

EXISTING DRAINAGE LEGEND

E — EXISTING SUB-BASIN DESIGNATION
1.12 .73 .83 — C5, C100
AREA IN ACRES
8 — DESIGN POINT
EXISTING BASIN
EXISTING DRAINAGE PATTERN

HISTORIC DRAINAGE LEGEND

H — HISTORIC SUB-BASIN DESIGNATION
1.12 .73 .83 — C5, C100
AREA IN ACRES
HISTORIC BASIN
HISTORIC DRAINAGE PATTERN

Historic Runoff Table - Trailers Direct Express

BASIN	Impervious	C-YR	I	A	CIA(Y-R-historic)	Flow	DESIGN POINT
H							
C_2 (MHFD 2018)	2.00	0.01	1.49	5.02	0.08	cfs	H1
C_5	2.00	0.01	2.00	5.02	0.10	cfs	
C_{10}	2.00	0.07	2.43	5.02	0.85	cfs	
C_{100}	2.00	0.44	4.20	5.02	9.27	cfs	

Existing Runoff Table - Trailers Direct Express

BASIN	Impervious	C-YR	I	A	CIA(Y-R-existing)	Flow	DESIGN POINT
W							
C_2 (MHFD 2018)	19.80	0.16	1.87	2.64	0.79	cfs	E2
C_5	19.80	0.16	2.51	2.64	1.09	cfs	
C_{10}	19.80	0.21	3.05	2.64	1.72	cfs	
C_{100}	19.80	0.52	5.27	2.64	7.26	cfs	
E							
C_2 (MHFD 2018)	35.14	0.29	1.82	2.38	1.25	cfs	E4
C_5	35.14	0.30	2.43	2.38	1.72	cfs	
C_{10}	35.14	0.34	2.96	2.38	2.37	cfs	
C_{100}	35.14	0.59	5.10	2.38	7.19	cfs	
OFF BLR							
C_2 (MHFD 2018)	50.91	0.42	2.81	0.19	0.23	cfs	
C_5	50.91	0.43	3.76	0.19	0.31	cfs	
C_{10}	50.91	0.46	4.57	0.19	0.40	cfs	
C_{100}	50.91	0.66	7.89	0.19	1.00	cfs	
OFF NW							
C_2 (MHFD 2018)	14.05	0.11	1.32	20.07	2.81	cfs	E1
C_5	14.05	0.11	1.77	20.07	3.96	cfs	
C_{10}	14.05	0.17	2.15	20.07	7.25	cfs	
C_{100}	14.05	0.49	3.72	20.07	36.90	cfs	
OFF NE							
C_2 (MHFD 2018)	10.12	0.08	1.75	1.21	0.17	cfs	E3
C_5	10.12	0.08	2.34	1.21	0.23	cfs	
C_{10}	10.12	0.14	2.85	1.21	0.47	cfs	
C_{100}	10.12	0.48	4.91	1.21	2.85	cfs	
I-25							
C_2 (MHFD 2018)	29.38	0.24	2.93	0.21	0.15	cfs	
C_5	29.38	0.25	3.92	0.21	0.20	cfs	
C_{10}	29.38	0.29	4.77	0.21	0.29	cfs	
C_{100}	29.38	0.57	8.23	0.21	0.98	cfs	

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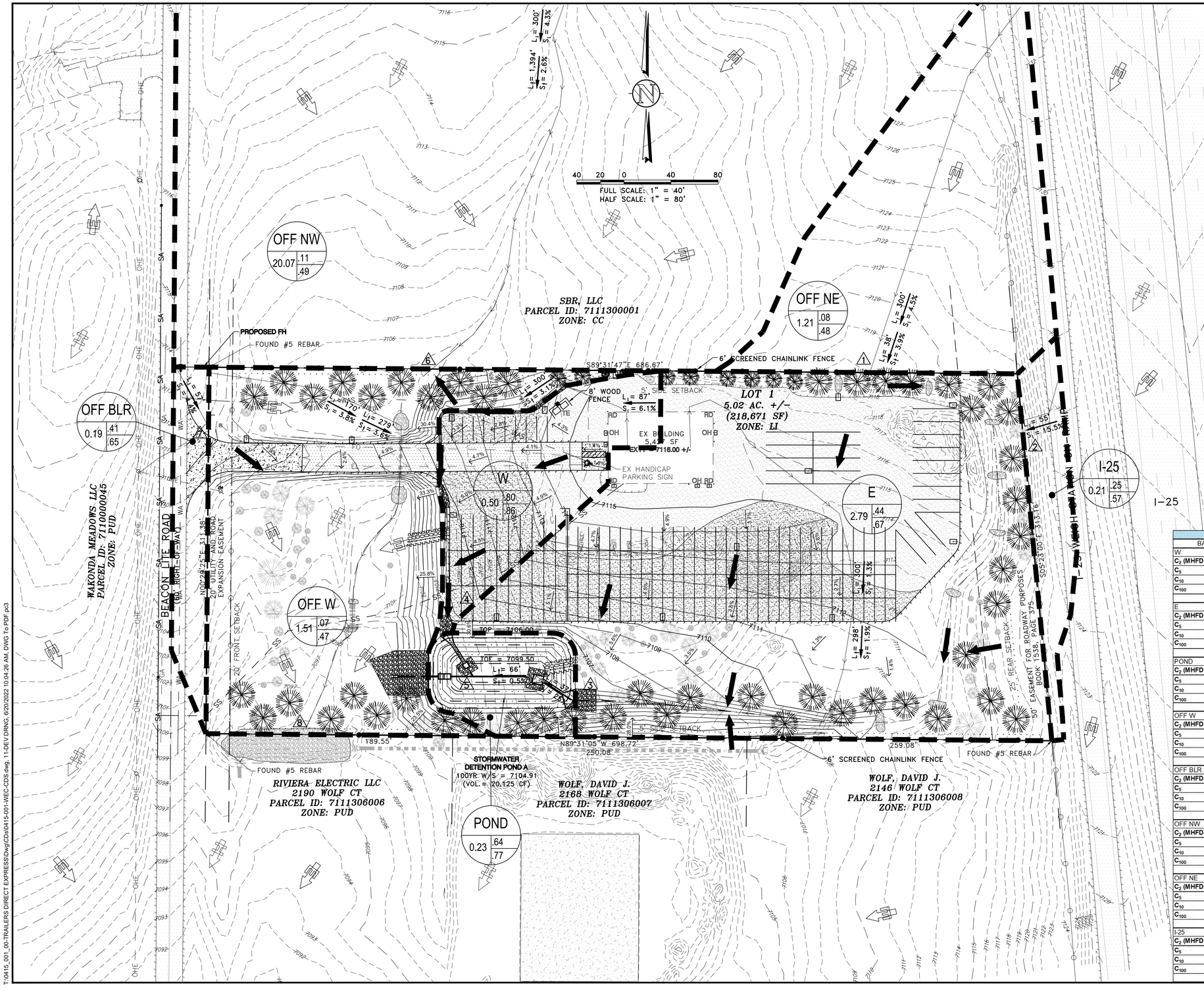

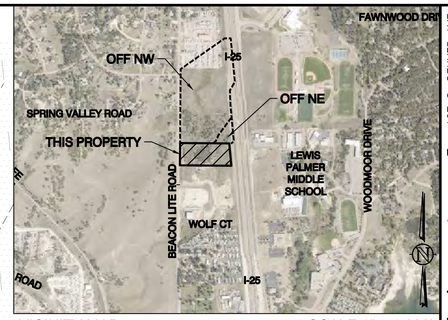

VICINITY MAP SCALE 1" = 1,000'

W 1/2, W 1/2, S11, T11S, R67W, 6th P.M.
SHOWN VICINITY MAP TAKEN FROM AUTOCAD GEOLOCATION

DEVELOPED DRAINAGE LEGEND

B1 — SUB-BASIN DESIGNATION
3.20 | .58 C5 | .88 C100
AREA IN ACRES
DEVELOPED BASIN
PROPOSED DRAINAGE PATTERN
DESIGN POINT
EMERGENCY OVERFLOW

L - INITIAL LENGTH
S - INTIAL SLOPE
L - TRAVEL LENGTH
S - TRAVEL SLOPE
* AVERAGE SLOPE INCLUDES ROOF SLOPE OF 8.33%

$L_I = L_I$, $S_I = S_I$
$L_I = L_t$, $S_I = S_t$

Developed Runoff Table - Trailers Direct Express

BASIN	Impervious	C-YR	I	A	CIA(YR-DEVELOPED)	cfs	DESIGN POINT
W							
C_2 (MHFD 2018)	92.99	0.78	3.04	0.50	1.20	cfs	4
C_5	92.99	0.80	4.07	0.50	1.64	cfs	
C_{10}	92.99	0.80	4.95	0.50	2.01	cfs	
C_{100}	92.99	0.86	8.55	0.50	3.70	cfs	
E							
C_2 (MHFD 2018)	51.36	0.43	1.79	2.79	2.13	cfs	3
C_5	51.36	0.44	2.39	2.79	2.92	cfs	
C_{10}	51.36	0.47	2.91	2.79	3.79	cfs	
C_{100}	51.36	0.67	5.02	2.79	9.33	cfs	
POND							
C_2 (MHFD 2018)	74.31	0.62	3.04	0.23	0.43	cfs	5
C_5	74.31	0.64	4.07	0.23	0.59	cfs	
C_{10}	74.31	0.65	4.95	0.23	0.74	cfs	
C_{100}	74.31	0.77	8.55	0.23	1.51	cfs	
OFF W							
C_2 (MHFD 2018)	9.01	0.07	1.86	1.51	0.19	cfs	8
C_5	9.01	0.07	2.48	1.51	0.26	cfs	
C_{10}	9.01	0.13	3.02	1.51	0.58	cfs	
C_{100}	9.01	0.47	5.22	1.51	3.71	cfs	
OFF BLR							
C_2 (MHFD 2018)	48.65	0.41	2.78	0.19	0.21	cfs	7
C_5	48.65	0.41	3.72	0.19	0.29	cfs	
C_{10}	48.65	0.45	4.53	0.19	0.38	cfs	
C_{100}	48.65	0.65	7.82	0.19	0.97	cfs	
OFF NW							
C_2 (MHFD 2018)	14.05	0.11	1.32	20.07	2.81	cfs	6
C_5	14.05	0.11	1.77	20.07	3.96	cfs	
C_{10}	14.05	0.17	2.15	20.07	7.25	cfs	
C_{100}	14.05	0.49	3.72	20.07	36.90	cfs	
OFF NE							
C_2 (MHFD 2018)	10.12	0.08	1.75	1.21	0.17	cfs	1
C_5	10.12	0.08	2.34	1.21	0.23	cfs	
C_{10}	10.12	0.14	2.85	1.21	0.47	cfs	
C_{100}	10.12	0.48	4.91	1.21	2.85	cfs	
I-25							2
C_2 (MHFD 2018)	29.38	0.24	2.93	0.21	0.15	cfs	
C_5	29.38	0.25	3.92	0.21	0.20	cfs	
C_{10}	29.38	0.29	4.77	0.21	0.29	cfs	
C_{100}	29.38	0.57	8.23	0.21	0.98	cfs	

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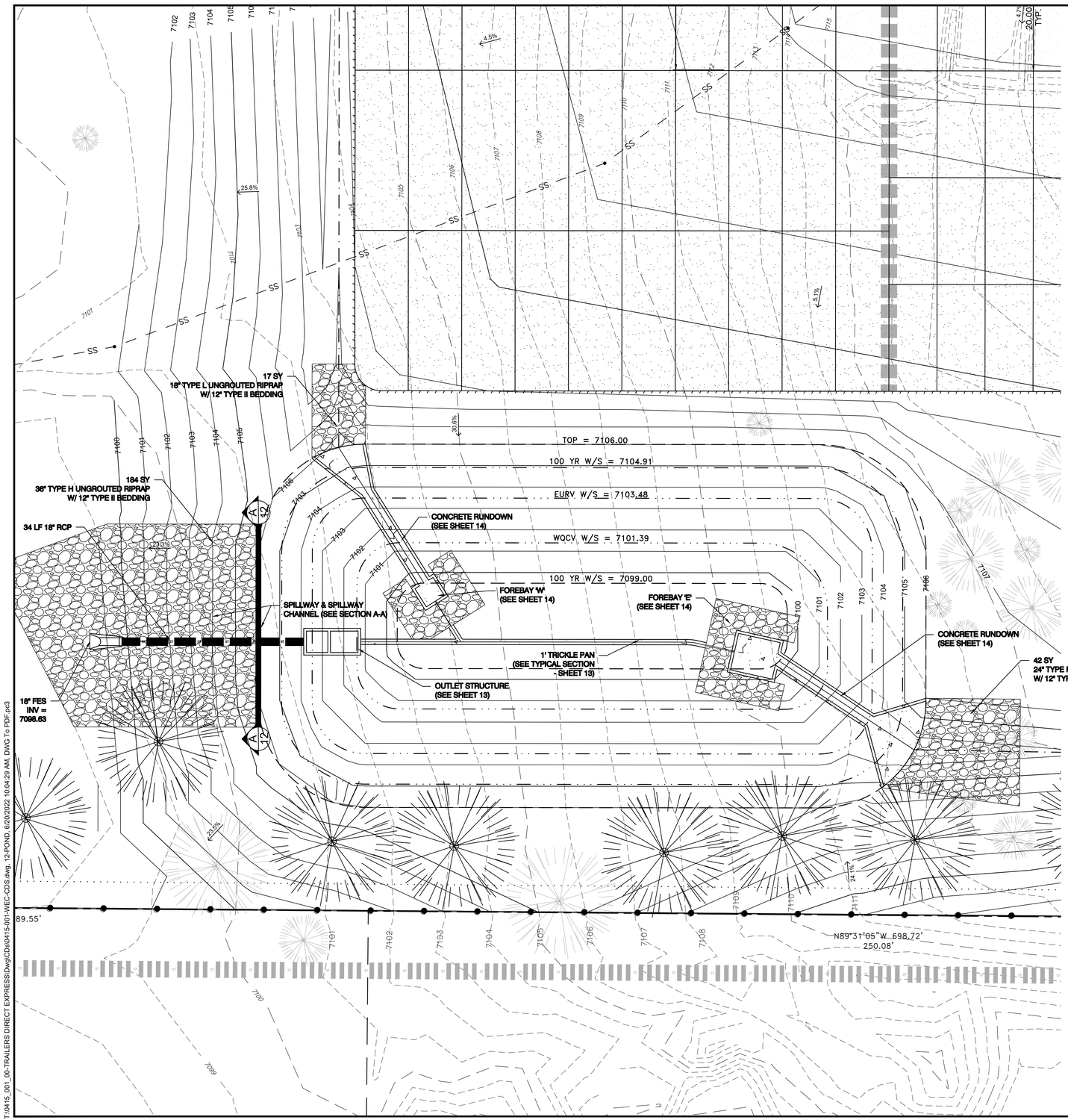
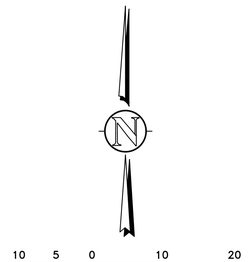
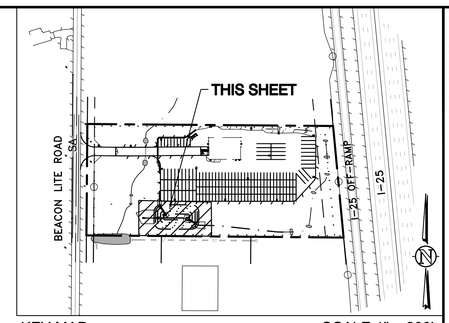
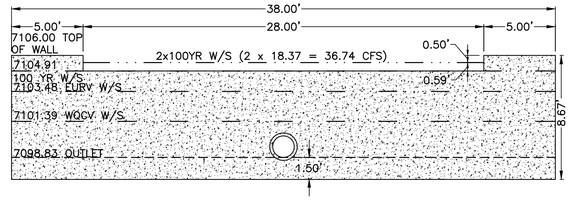






KEY MAP SCALE 1" = 200'

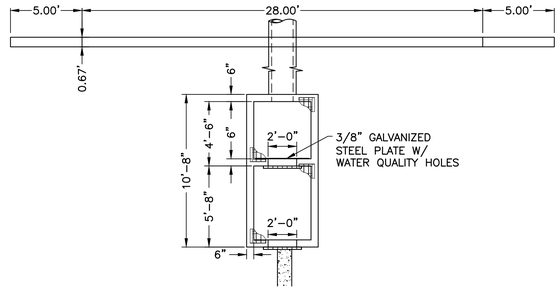
POND WATER SURFACE TABLE			
DESCRIPTION	REQUIRED VOLUME (cft)	PROVIDED VOLUME (cft)	ELEVATION
WQCV	3,702.6	3,702.6	7101.39
EURV	11,499.8	11,499.8	7103.48
100yr	20,124.7	20,124.7	7104.91
TOP OVERFLOW	--	29,196.0	7106.00

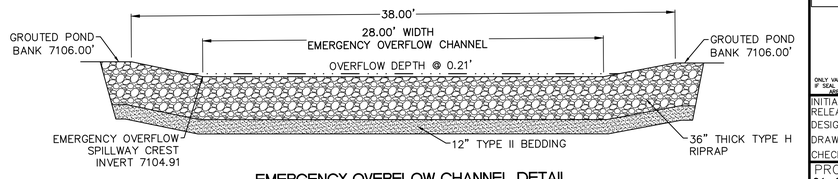


DETENTION POND SPILLWAY WALL WEIR (8" THICK)

PROFILE VIEW - SECTION A-A

SCALE 1" = 5'





EMERGENCY OVERFLOW CHANNEL DETAIL

SCALE 1" = 5' VIEW IS NORTH

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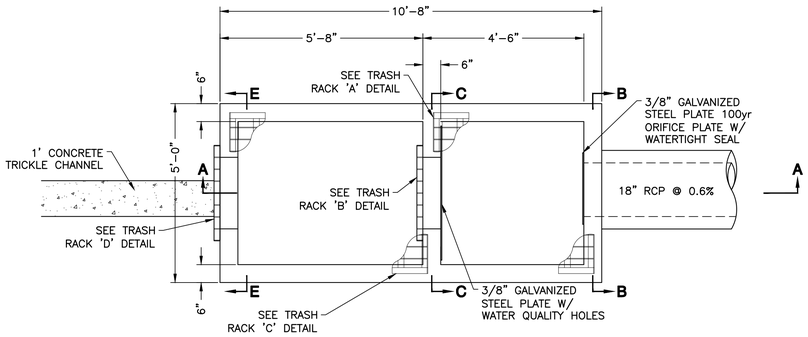
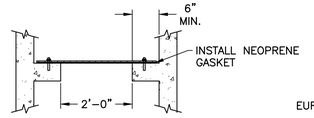
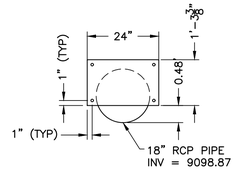
POND WATER SURFACE TABLE			
DESCRIPTION	REQUIRED VOLUME (cft)	PROVIDED VOLUME (cft)	ELEVATION
WQCV	3,702.6	3,702.6	7101.39
EURV	11,499.8	11,499.8	7103.48
100yr	20,124.7	20,124.7	7104.91
TOP OVERFLOW	--	29,196.0	7106.00



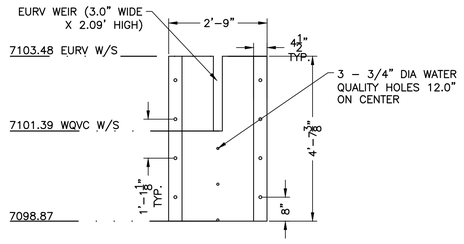
PLAN VIEW
SCALE 1" = 2'



SECTION D-D
SCALE 1" = 2'



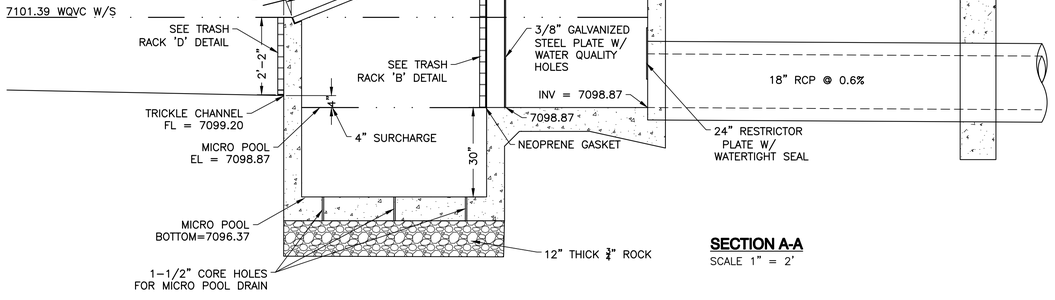
3/8" GALVANIZED STEEL PLATE
100yr ORIFICE PLATE W/ WATERTIGHT SEAL
SCALE 1" = 2'



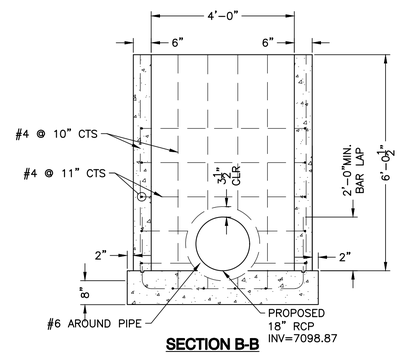
3/8" GALVANIZED STEEL PLATE
W/ WATER QUALITY HOLES
SCALE 1" = 2'

STRUCTURAL NOTES:

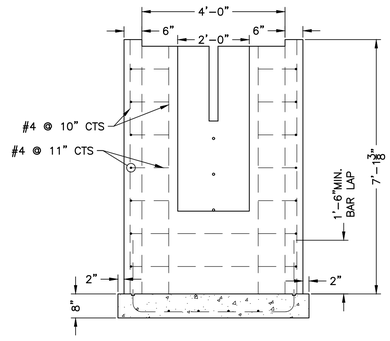
1. ALL CONCRETE SHALL BE C.D.O.T. CLASS B CAST IN PLACE.
2. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFER 3/4".
3. ALL REINFORCING BARS SHALL HAVE A MINIMUM 2" CLEARANCE.
4. ALL REINFORCING BARS SHALL BE EPOXY COATED.
5. ALL STEPS SHALL BE IN ACCORDANCE WITH AASHTO M199.



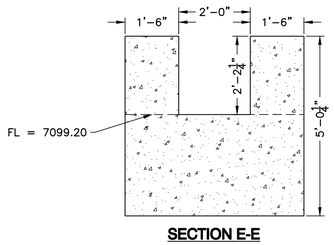
SECTION A-A
SCALE 1" = 2'



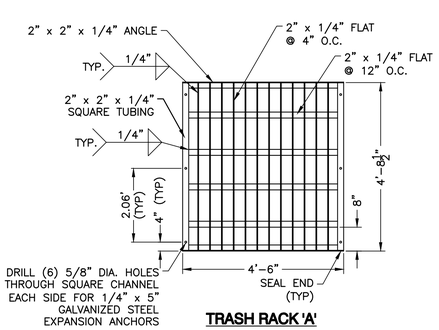
SECTION B-B
SCALE 1" = 2'



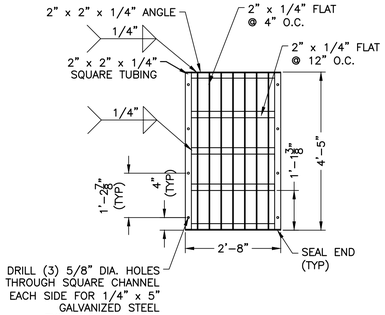
SECTION C-C
SCALE 1" = 2'



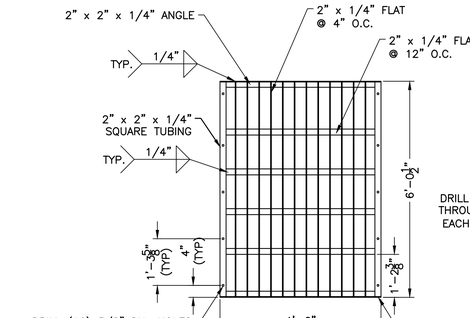
SECTION E-E
SCALE 1" = 2'



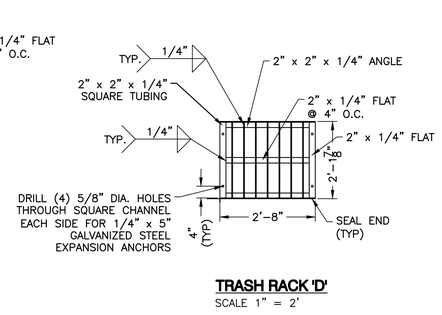
TRASH RACK 'A'
SCALE 1" = 2'



TRASH RACK 'B'
SCALE 1" = 2'



TRASH RACK 'C'
SCALE 1" = 2'



TRASH RACK 'D'
SCALE 1" = 2'

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SHEET 13 OF 29

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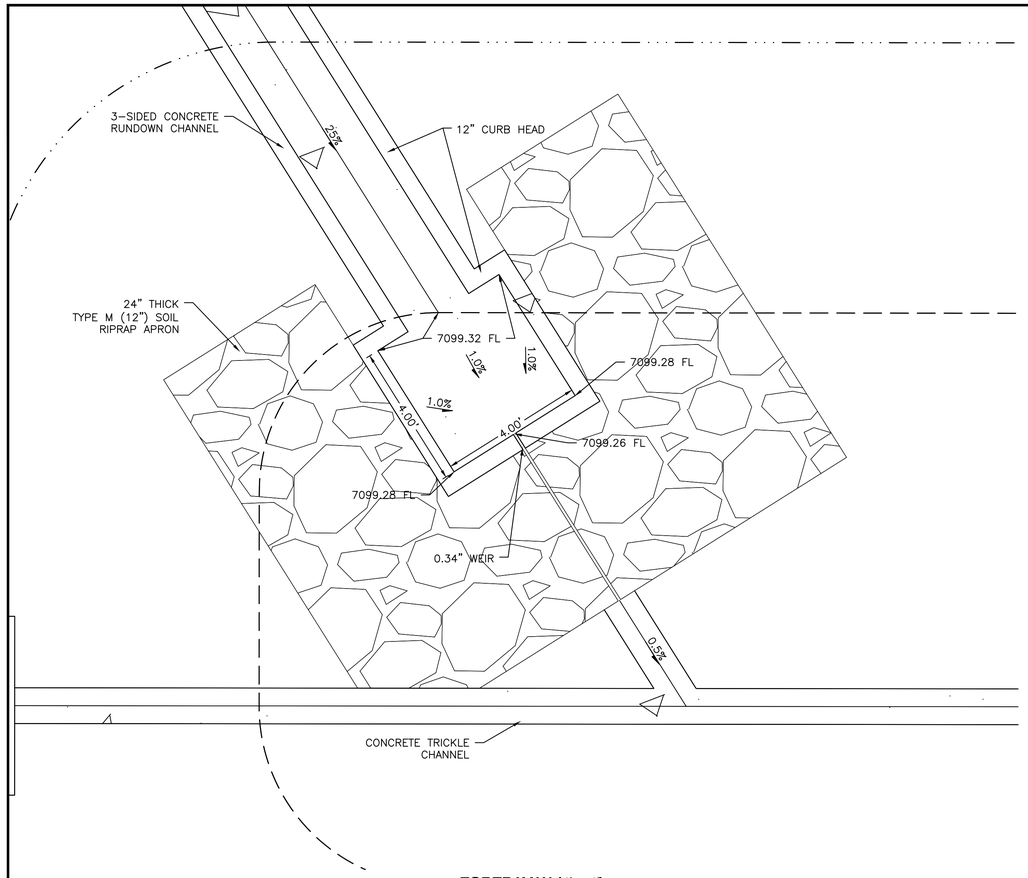
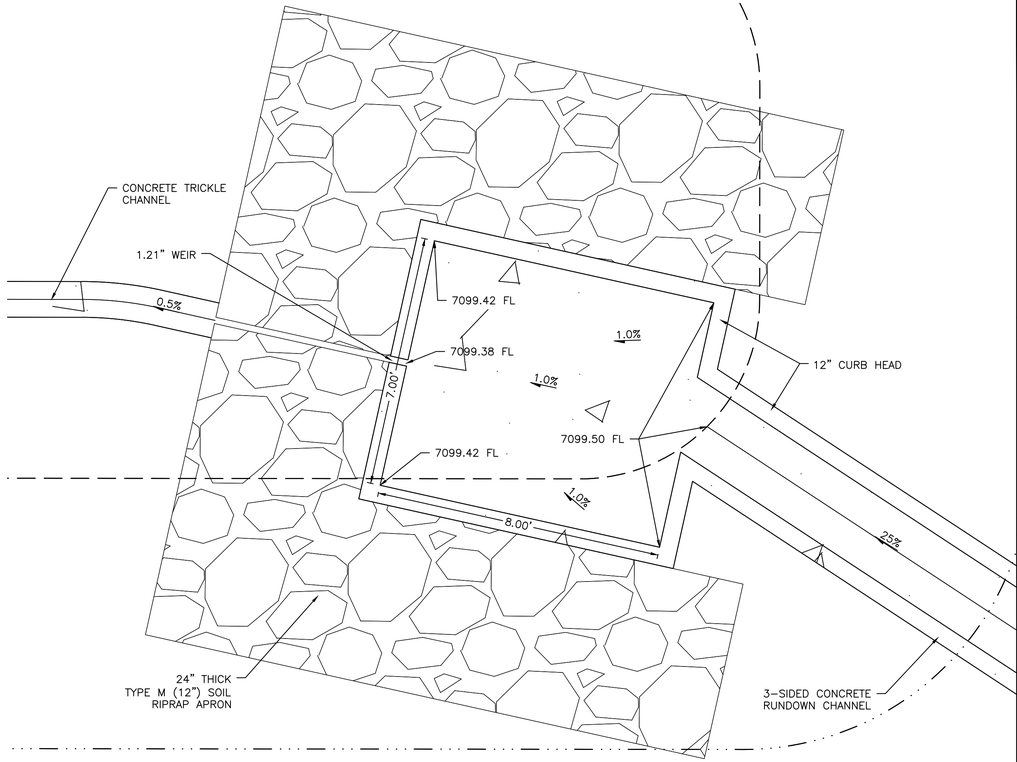


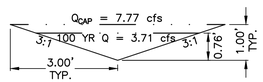
FOREBAY W (4' x 4')

SCALE 1" = 2'



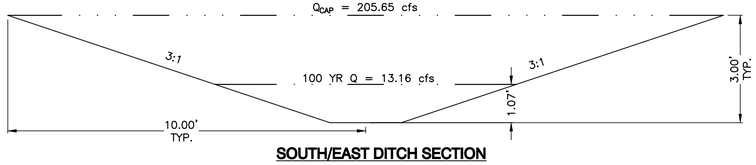
FOREBAY E (8' x 7')

SCALE 1" = 2'



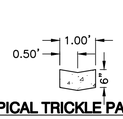
WEST DITCH SECTION

SCALE 1" = 2'



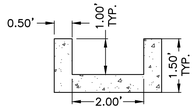
SOUTH/EAST DITCH SECTION

SCALE 1" = 2'



TYPICAL TRICKLE PAN DETAIL

SCALE 1" = 2'



TYPICAL CONCRETE CHANNEL

SCALE 1" = 2'

Classification & Gradation of Ordinary Riprap UDFCD Table MD-7

Riprap Designation	% Smaller Than Given Size by Weight	Intermediate Rock Dimensions (inches)	d50 (inchee)*
Type VL	70–100	12	
	50–70	9	
	35–50	6	6**
	2–10	2	
Type L	70–100	15	
	50–70	12	
	35–50	9	9**
	2–10	3	
Type M	70–100	21	
	50–70	18	
	35–50	12	12**
	2–10	4	
Type H	70–100	30	
	50–70	24	
	35–50	18	18
	2–10	6	

SOIL RIPRAP

70%-75% RIPRAP
25%-30% SOIL

BEDDING GRADATION

UDFCD Table MD-11		
	Percent Weight by Passing Square-Mesh Sieves	
U.S. Standard Sieve Size	Type I CDOT Sect. 703.01	Type II CDOT Sect. 703.09 Class A
3 inches	-----	90-100
1 1/2 inches	-----	-----
3/4 inches	-----	20-90
3/8 inches	100	-----
#4	95-100	0-20
#16	45-80	-----
#50	10-30	-----
#100	2-10	-----
#200	0-2	0-3

RIPRAP BEDDING REQUIREMENTS

UDFCD Table MD-12 (Volume 1)			
	Minimum Bedding Thickness (inches)		
	Fine-Grained Soils*		Coarse-Grained soils**
Riprap Designation	Type I	Type II	Type II
VL (d_{50} =6 in), L (d_{50}=9 in)	4	4	6
M (d_{50} =12 in)	4	4	6
H (d_{50} =18 in)	4	6	8
VH (d_{50} =24 in)	4	6	8

* May substitute one 12-inch layer of type II bedding. The substitution of one layer of type II bedding shall not be permitted at drop structures. The use of a combination of filter fabric and Type II bedding at drop structures is acceptable.

**Fifty percent or more by weight retained on the #40 sieve.

Western Engineering Consultants, inc LLC
127 S. DENVER AVE
FT. LUPTON, CO 80621
www.westernec.com
email@westernec.com
(720) 685-9951
FAX (720) 294-1330

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1	REV PER TOWN COMMENTS	06/20/22	CFC

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CHECKED BY: CFC
PROJECT NO. 01-0415.001.00
DOC CON # 0014-DRNG DTL
SHEET 14 OF 29

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