SWS Engineering, Inc.

Civil Engineering | Land Surveying | Land Planning

5421, 5425, 5429 Franklin Pike

Stormwater Pollution Prevention Plan

Engineer: Mike Schweitzer, PE
SWS Engineering, Inc.

April 18, 2023

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APPENDICES

General Information

This Storm Water Pollution Prevention Plan (SWPPP) is developed in accordance with the Tennessee General NPDES Permit (TNR100000) for Storm Water Discharges Associated with Construction Activities (TNCGP). SWS Engineering, Inc. prepared the SWPPP using sound engineering practices.

Owner/Developer certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

By: ______________________ Date 5-12-23

Owner: Urban Development Group

Contact: Jeremy Walker
(615) 506-7296
jeremy.urbandg@gmail.com

Primary contractor certification:

I certify under penalty of law that I have reviewed this document, any attachments, and the SWPPP referenced above. Based on my inquiry of the construction site owner/developer identified above and/or my inquiry of the person directly responsible for assembling the Notice of Intent, I believe the information submitted is accurate. I am aware that this NOI, if approved, makes the above-described construction activity subject to NPDES permit number TNR100000, and that certain of my activities onsite are thereby regulated. I am aware that there are significant penalties, including the possibility of fine and imprisonment, for knowing violations and failure to comply with these permit requirements.

By: ______________________ ______________________

Date

Contractor: ______________________
Address: ______________________
City, State, Zip: ______________________
Contact Name: ______________________
Contact Phone: ______________________
Email: ______________________

Secondary contractor certification:

I certify under penalty of law that I have reviewed this document, any attachments, and the SWPPP referenced above. Based on my inquiry of the construction site owner/developer identified above and/or my inquiry of the person directly responsible for assembling the Notice of Intent, I believe the information submitted is accurate. I am aware that this NOI, if approved, makes the above-described construction activity subject to NPDES permit number TNR100000, and that certain of my activities onsite are thereby regulated. I am aware that there are significant penalties, including the possibility of fine and imprisonment, for knowing violations or for failure to comply with these permit requirements.

Role/Responsibility:

____

____

____

____

By: ______________________________ Date: ______________________

Name: ____
Address: ____
Phone #: ____
Contact: ____

The permittee shall post a notice near the main entrance of the construction site accessible for the use of all operators, site and TDEC personnel, and to the public with the following information:

1) Name, company name, E-mail address (if available), telephone number and address of the project site owner/operator or a local contact person;
2) A brief description of the project; and
3) The location of the SWPPP. A copy of the SWPPP shall be retained on-site at the location which generates the stormwater discharge. If the site is inactive or does not have an onsite location adequate to store the SWPPP, the location of the SWPPP, along with a contact phone number, shall be posted on-site. If the SWPPP is located offsite, reasonable local access to the plan, during normal working hours, must be provided. The notice must be maintained in a legible condition. If posting this information near a main entrance is infeasible due to safety concerns, or not accessible to the public, the notice shall be posted in a local public building. This permit does not provide the public with any right to trespass on a construction site for any reason, including inspection of a site. This permit does not require that permittees allow members of the public access to a construction site.

The permittee shall also retain the following items/information in an appropriate location on-site:

- A rain gauge

The General Contractor is responsible for installation, maintenance and inspection of all erosion control measures. During the course of construction, the GC may sub-contract the responsibility of this work to other forces. The General Contractor and all Sub-Contractors on the project that have any responsibility to install, inspect, or maintain erosion or sediment control measures shall sign the Contractor's certification and a copy of the NOI (Appendix A), and will submit it to the local Environmental Assistance Center (EAC). All correspondence with the TDEC or EAC shall reference the tracking number assigned by TDEC to the project. The contractor will submit a Notice of Termination (NOT) (Appendix B) after complete installation and successful establishment of the final stabilization activities at the site.

It is the intention and goal of the TNCGP and this SWPPP that any discharge from the property described in this document have no objectionable color contrast to the water body that receives it. The construction activity will be carried out in such a manner as to prevent any discharge that would cause a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of the waters on the property or downstream of the property for fish and aquatic life, livestock watering and wildlife, recreation, irrigation, navigation, or industrial or domestic water supply.

CITATIONS IN PARENTHESIS INDICATE SECTIONS OF THE CURRENT CGP.

1. **SWPPP REQUIREMENTS (3.0)**

1.1. HAS THE SWPPP TEMPLATE BEEN PREPARED BY AN INDIVIDUAL THAT HAS THE FOLLOWING CERTIFICATIONS (3.1.1) YES ☐ NO ☒ (CHECK ALL THAT APPLY BELOW)

1.1.1. ☐ CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL (CPESC); OR

1.1.2. ☐ TDEC LEVEL II

1.2. DOES THE EPSC PLANS INVOLVE STRUCTURAL DESIGN, HYDRAULIC, HYDROLOGIC OR OTHER ENGINEERING CALCULATIONS FOR EPSC STRUCTURAL MEASURES (SEDIMENT BASINS, ETC.)? YES ☐ NO ☒ (3.1.1)

IF YES, HAVE THE EPSC PLANS BEEN PREPARED, STAMPED AND CERTIFIED BY A LICENSED PROFESSIONAL ENGINEER OR LANDSCAPE ARCHITECT?

☐ YES ☐ NO

1.3. DO THE PROJECT STORMWATER OUTFALLS DISCHARGE INTO THE FOLLOWING? (5.4.1)

YES ☐ NO ☐ (CHECK ALL THAT APPLY BELOW)

1.3.1. ☐ IMPAIRED WATERS (303d FOR SILTATION OR HABITAT ALTERATION)

1.3.2. ☐ TENNESSEE KNOWN EXCEPTIONAL WATERS

IF YES, HAVE THE EPSC PLANS BEEN PREPARED BY AN INDIVIDUAL WHO HAS COMPLETED TDEC LEVEL II? ☐ YES ☐ NO ☒ N/A (5.4.1.b); AND

IF YES, HAS THE SWPPP TEMPLATE BEEN PREPARED BY AN INDIVIDUAL WHO HAS COMPLETED TDEC LEVEL II? ☐ YES ☐ NO ☒ N/A (5.4.1.b)

2. **SITE DESCRIPTION** (3.5.1)

2.1. PROJECT LIMITS REFER TO EROSION CONTROL PLAN SHEET C3.00, C3.01, C3.02 (3.5.1.g):

2.2. PROJECT DESCRIPTION: (3.5.1.a)

TITLE: 5421-5429 FRANKLIN PIKE

COUNTY: DAVIDSON

LOCATION: 5421, 5425, 5429 FRANKLIN PIKE, NASHVILLE, TN

2.3. SITE MAP(S): REFER TO APPENDIX B, FIGURE 1– USGS QUADRANGLE MAP (3.5.1.g)

2.4. DESCRIPTION OF EXISTING SITE TOPOGRAPHY (3.5.1.d): THE EXISTING SITE IS COVERED WITH A COMBINATIONS OF TREES AND BRUSH. STEEP SLOPES (>15%) ARE PREVALENT THROUGHOUT SITE WHICH GENERALLY RUN FROM THE SOUTHWEST TO THE NORTHEAST.

2.5. MAJOR SOIL DISTURBING ACTIVITIES (3.5.1.b) (CHECK ALL THAT APPLY)

2.5.1. ☒ CLEARING AND GRUBBING

2.5.2. ☒ EXCAVATION

2.5.3. ☒ CUTTING AND FILLING

2.5.4. ☒ FINAL GRADING AND SHAPING

2.5.5. ☒ UTILITIES

2.5.6. ☐ OTHER (DESCRIBE): ______

2.6. TOTAL PROJECT AREA (3.5.1.c): 6.36 ACRES

2.7. TOTAL AREA TO BE DISTURBED (3.5.1.c): 2.21 ACRES

IF GREATER THAN 50 ACRES, HAS CONSTRUCTION PROJECT PHASING BEEN SPECIFIED IN SECTION 3 BELOW AND IN THE PLANS (3.5.3.1.k)?

☐ YES ☐ NO ☒ N/A

NOTE: BECAUSE THE ENTIRE DISTURBED AREA WILL NOT EXCEED 50 ACRES, ONLY ONE PHASE IS REQUIRED FOR THE PROJECT. HOWEVER, THE PROJECT WILL BE SEQUENCED IN THE TWO STAGES DESCRIBED BELOW. IN THIS WAY, THE TOTAL UNSTABILIZED DISTURBED AREA SHOULD NEVER EXCEED APPROXIMATELY 10 ACRES.

2.8. ARE THERE ANY SEASONAL LIMITATIONS ON WORK? YES ☐ NO ☒

IF YES, DESCRIBE AND LIST THE CORRESPONDING PLAN SHEET: ______

2.9. SOIL PROPERTIES: REFER TO APPENDIX D – USDA CUSTOM SOIL RESOURCE REPORT (3.5.1.e) (4.1.1).

2.10. PROJECT RUNOFF COEFFICIENTS AND AREA PERCENTAGES (3.5.1.f)

RUNOFF COEFFICIENTS FOR EXISTING CONDITIONS

AREA TYPE	AREA (AC)	PERCENTAGE OF WATERSHED (%)	RUNOFF COEFFICIENT
IMPERVIOUS	0.00	0.0	98
PERVIOUS	6.36 (GRASS C)	100.0	79
WEIGHTED CURVE NUMBER OR C-FACTOR =			79

RUNOFF COEFFICIENTS FOR POST-CONSTRUCTION CONDITIONS

AREA TYPE	AREA(AC)	PERCENTAGE OF WATERSHED (%)	RUNOFF COEFFICIENT
IMPERVIOUS	0.71	11.1	98
PERVIOUS	5.65 (GRASS C)	88.9	79
WEIGHTED CURVE NUMBER OR C-FACTOR =			81

** 3 RAIN GARDENS WITH UNDERGROUND STORAGE ARE PROPOSED TO REDUCE THE STORMWATER RUNOFF FROM THE SITE TO BELOW EXISTING CONDITIONS.

3. **ORDER OF CONSTRUCTION ACTIVITIES** (3.5.1.b, 3.5.2.a)

STAGE	DESCRIPTION
1	INSTALL SILT FENCE AND TEMPORARY INLET PROTECTION
	CLEAR, GRUB AND GRADE CONSTRUCTION EXIT
	CLEAR, GRUB, AND GRADE PARKING AREAS AND BUILDING PADS
2	INSTALL STORM DRAINAGE PIPE AND STRUCTURES
	INSTALL FINISH ASPHALT AND CONCRETE PAVING AND BUILDINGS
	REMOVE TEMPORARY EROSION PREVENTION-SEDIMENT CONTROL MEASURES

3.1. PERFORM CLEARING AND GRUBBING (NOT MORE THAN 15 DAYS PRIOR TO GRADING OR EARTH-MOVING. REFER TO THE STABILIZATION PRACTICES BELOW).

3.2. STABILIZE DISTURBED AREAS WITHIN 14 DAYS OF COMPLETING ANY PHASE OF ACTIVITY.

4. **STREAM, OUTFALL, WETLAND, TMDL AND ECOLOGY INFORMATION**

4.1. STREAM INFORMATION

WILL CONSTRUCTION AND/OR EROSION PREVENTION AND SEDIMENT CONTROLS IMPACT ANY STREAMS? YES ☐ NO ☒

4.1.1. STREAM INFORMATION

4.1.1.1. THE STRUCTURAL EPSC MEASURES HAVE BEEN INCLUDED IN THE TOTAL PROJECT IMPACTS. REFER TO THE LIST OF APPLICABLE ENVIRONMENTAL PERMITS. ALL PERMITS WILL BE MAINTAINED ON SITE IN THE "DOCUMENTATION AND PERMITS" BINDER.

4.1.1.2. RECEIVING STREAM: BRENTWOOD BRANCH (3.5.1.j)

4.1.2. ARE BUFFER ZONES REQUIRED? YES ☐ NO ☒ (4.1.2, 5.4.2)

IF YES, THEY HAVE BEEN INCLUDED ON PLAN SHEET(S) ______

IF YES, CHECK THE APPROPRIATE BOX BELOW FOR SIZE OF BUFFER

☐ 60-FEET FOR IMPAIRED AND EXCEPTIONAL WATERS (AVERAGE WIDTH PER SIDE WITH A MINIMUM OF 30-FEET)

☐ 30-FEET FOR ALL OTHER STREAMS (AVERAGE WIDTH PER SIDE WITH A MINIMUM OF 15-FEET)

4.1.3. ARE THERE BUFFER ZONE EXEMPTIONS? YES ☐ NO ☐ N/A ☒ (4.1.2.1)

4.2. OUTFALL INFORMATION:

A SEDIMENT BASIN OR EQUIVALENT MEASURE(S) WILL BE PROVIDED FOR ANY OUTFALL IN A DRAINAGE AREA OF FIVE ACRES OR MORE FOR AN OUTFALL(S) THAT DISCHARGES TO AN IMPAIRED STREAM OR KNOWN EXCEPTIONAL QUALITY WATER (5.4.1.f).

4.2.1. OUTFALL TABLE (3.5.1.d, 5.4.1.f)

OUTFALL INFORMATION

OUTFALL LABEL	SLOPE (%)	DRAINAGE AREA (AC)	SEDIMENT BASIN OR EQUIVALENT MEASURE(S) (YES, NO, OR N/A)	SUB-OUTFALL (e.g., A, B, C)	RECEIVING NATURAL RESOURCE NAME OR LABEL
1	25	3.70	NO	-	BRENTWOOD BRANCH

†NOTE: SUB-OUTFALLS ARE DEFINED AS OUTFALLS THAT DISCHARGE WITHIN THE PROJECT AND DO NOT DIRECTLY DISCHARGE OFF ROW OR INTO WATERS OF THE STATE.

4.2.2. WHERE POSSIBLE, HAS NON-PROJECT RUN-ON BEEN DIVERTED THROUGH THE PROJECT SO THAT THE OFF-SITE RUN-ON WILL NOT FLOW OVER DISTURBED AREAS WITHIN THE ROW, THUS SEPARATING NON-PROJECT RUN-OFF FROM PROJECT RUN-OFF THEREBY REDUCING THE DRAINAGE AREA TO ANY ONE OUTFALL? YES ☒ NO ☐

4.2.3. ARE EQUIVALENT MEASURES BEING SUBSTITUTED FOR A SEDIMENT BASIN(S)?

YES ☐ NO ☒

4.2.4. HAVE ALL OUTFALLS BEEN LABELED ON THE EPSC PLAN SHEETS (3.5.1.g, 5.4.1.f)?

YES ☒ NO ☐

4.2.5. HAVE ALL OUTFALLS BEEN LABELED ON A USGS TOPOGRAPHIC MAP INCLUDED IN THE "DOCUMENTATION AND PERMITS" BINDER (2.6.2)?

YES ☒ NO ☐

4.3. WETLAND INFORMATION

WILL CONSTRUCTION AND/OR EROSION AND SEDIMENT CONTROLS IMPACT ANY WETLANDS? YES ☐ NO ☒

4.4. TOTAL MAXIMUM DAILY LOADS (TMDL) INFORMATION (3.5.10)

4.4.1. IS THIS PROJECT LOCATED IN A WATERSHED THAT MAINTAINS AN EPA APPROVED TMDL FOR SILTATION? YES ☐ NO ☒

4.4.2. IF YES, IS THIS PROJECT LOCATED WITHIN A SUBWATERSHED WITH A WASTE LOAD ALLOCATION (WLA)? YES ☐ NO ☐ N/A ☒

4.4.3. IF YES, DOES THE PROJECT HAVE A DIRECT DISCHARGE TO A 303(d) LISTED STREAM FOR SILTATION OR HABITAT ALTERATION?

YES ☐ NO ☐ N/A ☒

4.4.4. IF YES, HAS A SUMMARY OF THE CONSULTATION (LETTER) BEEN INCLUDED WITH THE SWPPP DOCUMENTATION? YES ☐ NO ☐ N/A ☒

4.5. ECOLOGY INFORMATION (3.5.5.e)

ARE THERE STATE OR FEDERALLY LISTED SPECIES LOCATED WITHIN THE PROJECT AREA? SPECIAL NOTES ARE REQUIRED TO DESCRIBE MEASURES NECESSARY TO PREVENT "TAKING" OF LEGALLY PROTECTED STATE OR FEDERALLY LISTED THREATENED OR ENDANGERED AQUATIC FAUNA AND/OR CRITICAL HABITAT.

YES ☐ NO ☐ NO NOTES REQUIRED ☒

IF YES, LIST ALL PLAN SHEETS WHERE SPECIAL NOTES HAVE BEEN ADDED. ______

5. **EROSION PREVENTION AND SEDIMENT CONTROL (EPSC) MEASURES** (3.5.3) EPSC MEASURES MUST BE DESIGNED, INSTALLED AND MAINTAINED TO CONTROL STORMWATER VOLUME AND VELOCITY WITHIN THE SITE TO MINIMIZE EROSION. (4.1.1)

5.2. EPSC MEASURES MUST CONTROL STORMWATER DISCHARGES, INCLUDING BOTH PEAK FLOWS AND TOTAL STORMWATER VOLUME, TO MINIMIZE EROSION AT OUTLETS, STREAM CHANNELS AND STREAM BANKS. (4.1.1)

5.3. HAVE THE CONTROL MEASURES BEEN DESIGNED ACCORDING TO THE SIZE AND SLOPE OF THE DISTURBED DRAINAGE AREA (3.5.3.3)? YES ☒ NO ☐

SWS ENGINEERING, INC.

5421, 5425, 5429 FRANKLIN PIKE DAVIDSON COUNTY, TENNESSEE			
STORM WATER POLLUTION PREVENTION PLAN			
DRAWN BY: MRB	CHECKED BY: PDA	PROJECT NO.: 22-270T	SHEET NO.: 1
DATE: 02-27-23	DATE: 02-27-23		

5.4. THE CONTROL MEASURES HAVE, AT A MINIMUM, BEEN DESIGNED FOR THE 2-YEAR, 24 HOUR STORM EVENT (3.5.3.3, 5.4.1.a).

5.5. ARE THE LIMITS OF DISTURBANCE CLEARLY MARKED ON THE EPSC PLANS? (3.5.1.n) YES ☒ NO ☐

5.6. HAVE PHASED EPSC PLANS BEEN PREPARED FOR THE PROJECT? (3.5.2)

YES ☒ NO ☐ (IF YES, CHECK ONE BELOW) ☐ PROJECT DISTURBED AREA IS THAN LESS THAN 5 ACRES (MINIMUM OF TWO PHASES OF EPSC PLANS)

5.6.1. ☒ PROJECT DISTURBED AREA IS GREATER THAN 5 ACRES (MINIMUM OF THREE PHASES OF EPSC PLANS)

5.7. IS ADDITIONAL PHYSICAL OR CHEMICAL TREATMENT OF STORMWATER RUNOFF NECESSARY (5.4.1.a)? YES ☐ NO ☒

5.8. HAVE STEEP SLOPES (GREATER THAN 35%) BEEN MINIMALLY DISTURBED AND/OR PROTECTED BY CONVEYING RUNOFF NON-EROSIVELY AROUND OR OVER THE SLOPE? (3.5.3.2) (10 "STEEP SLOPE")

YES ☒ NO ☐

5.9. ALL PHYSICAL AND/OR CHEMICAL TREATMENT WILL BE RESEARCHED, APPLIED IN ACCORDANCE WITH MANUFACTURE'S GUIDELINES AMD FULLY DESCRIBED ON THE EPSC PLANS (3.5.3.1.b).

5.10. ALL EPSC CONTROL MEASURES WILL BE INSTALLED ACCORDING TO REFERENCED STANDARDS.

5.11. EPSC MEASURES WILL NOT BE INSTALLED IN A STREAM WITHOUT FIRST OBTAINING US COE SECTION 404, TDEC ARAP, AND TVA PERMITS.

5.12. DISCHARGES FROM DEWATERING ACTIVITIES ARE PROHIBITED UNLESS MANAGED BY CONTROLS PROVIDING EQUIVALENT LEVEL OF TREATMENT (FILTRATION) (4.14)

5.13. DISCHARGES FROM SEDIMENT BASINS AND IMPOUNDMENTS MUST USE OUTLET STRUCTURES THAT ONLY WITHDRAW WATER FROM NEAR THE SURFACE OF THE BASIN OR IMPOUNDMENT, UNLESS INFEASIBLE. (4.1.7)

5.14. STABILIZATION PRACTICES

PRE-CONSTRUCTION VEGETATIVE COVER WILL NOT BE DESTROYED, REMOVED OR DISTURBED MORE THAN 15 DAYS PRIOR TO GRADING OR EARTH MOVING UNLESS THE AREA WILL BE SEEDED AND/OR MULCHED OR OTHER TEMPORARY COVER IS INSTALLED. (3.5.3.1.h)

5.15. STABILIZATION MEASURES WILL BE INITIATED AS SOON AS POSSIBLE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED. TEMPORARY OR PERMANENT STABILIZATION WILL BE COMPLETED WITHIN 14 DAYS AFTER ACTIVITY HAS TEMPORARILY OR PERMANENTLY CEASED IN THAT AREA. PERMANENT STABILIZATION WILL REPLACE TEMPORARY MEASURES AS SOON AS PRACTICABLE. (3.5.3.2)

5.16. STEEP SLOPES (3.5.3.2)

STEEP SLOPES ARE DEFINED AS A NATURAL OR CREATED SLOPE OF 35% GRADE OR STEEPER REGARDLESS OF HEIGHT. STEEP SLOPES SHALL BE TEMPORARILY STABILIZED NOT LATER THAN 7 DAYS AFTER CONSTRUCTION ACTIVITY ON THE SLOPE HAS TEMPORARILY OR PERMANENTLY CEASED.

6. CONSTRUCTION SUPPORT ACTIVITIES – BORROW AND WASTE AREAS (1.2.2) (3.5.3.1.g)

WASTE MATERIAL (EARTH, ROCK, ASPHALT, CONCRETE, ETC) NOT REQUIRED FOR THE CONSTRUCTION OF THE PROJECT WILL BE DISPOSED OF BY THE CONTRACTOR. THE CONTRACTOR WILL OBTAIN ANY AND ALL NECESSARY PERMITS INCLUDING, BUT NOT LIMITED TO NPDES, AQUATIC RESOURCES ALTERATION PERMIT(S) CORPS OF ENGINEERS SECTION 404 PERMITS, AND TVA SECTION 26A PERMITS TO DISPOSE OF WASTE MATERIALS.

7. MAINTENANCE AND INSPECTION

7.1. INSPECTION PRACTICES (3.5.8)

7.1.1. INSPECTORS MUST HAVE SUCCESSFULLY COMPLETED THE TDEC FUNDAMENTALS OF EROSION AND SEDIMENT CONTROL COURSE (TDEC LEVEL I) AND MAINTAIN THE CERTIFICATION. A COPY OF THE INSPECTOR'S CERTIFICATION SHOULD BE KEPT ON SITE. (3.5.8.1)

7.1.2. INSPECTIONS WILL BE CONDUCTED AT LEAST TWICE EVERY CALENDAR WEEK AND AT LEAST 72 HOURS APART. (3.5.8.2.a)

7.1.3. THE FREQUENCY OF EPSC INSPECTIONS MAY BE REDUCED TO ONCE A MONTH (I.E. EXTREME DROUGHT CONDITIONS, FROZEN GROUND, ETC.) WITH WRITTEN NOTIFICATION TO THE LOCAL ENVIRONMENTAL FIELD OFFICE AND SUBSEQUENT TDEC APPROVAL. WRITTEN NOTIFICATION MUST INCLUDE THE INTENT TO CHANGE FREQUENCY AND JUSTIFICATION. (3.5.8.2.a)

7.1.4. ALL DISTURBED AREAS OF THE SITE THAT HAVE NOT BEEN FINALLY STABILIZED, AREAS USED FOR MATERIAL STORAGE THAT ARE EXPOSED TO PRECIPITATION, STRUCTURAL CONTROL MEASURES, AND LOCATIONS WHERE VEHICLES ENTER OR EXIT THE SITE, AND EACH OUTFALL WILL BE INSPECTED. (3.5.8.2.b)

7.1.5. THE INSPECTOR WILL OVERSEE THE REQUIREMENTS OF OTHER CONSTRUCTION-RELATED WATER QUALITY PERMITS (I.E. TDEC ARAP, US COE AND TVA SECTION 26a PERMITS) FOR CONSTRUCTION ACTIVITIES AROUND WATERS OF THE STATE. (10)

7.1.6. THE SWPPP WILL BE REVISED AS NECESSARY BASED ON THE RESULTS OF THE INSPECTION. REVISION(S) WILL BE RECORDED WITHIN 7 DAYS OF THE INSPECTION. REVISION(S) WILL BE IMPLEMENTED WITHIN 14 DAYS OF THE INSPECTION. (3.8.5.2.e AND 3.8.5.2.f)

7.1.7. THE INSPECTOR SHALL CONDUCT PRE-CONSTRUCTION INSPECTIONS TO VERIFY AREAS THAT ARE NOT TO BE DISTURBED HAVE BEEN MARKED IN THE SWPPP AND IN THE FIELD BEFORE LAND DISTURBANCE ACTIVITIES BEGIN AND INITIAL MEASURES HAVE BEEN INSTALLED. (10 "INSPECTOR") (3.5.1.n)

7.1.8. INSPECTIONS WILL BE DOCUMENTED ON THE CONSTRUCTION STORMWATER INSPECTION CERTIFICATION FORM PROVIDED IN APPENDIX C OF THE CGP AND INCLUDE THE SCOPE OF THE INSPECTION, NAME(S), TITLE AND TN EPSC CERTIFICATION NUMBER OF PERSONNEL MAKING THE INSPECTION, THE DATE(S) OF THE INSPECTION, CURRENT APPROXIMATE DISTURBED ACREAGE AT TIME OF INSPECTION, CHECKLIST (NOC, SWPPP, RAIN GAUGE, SITE CONTACT INFORMATION, ETC.) AND MAJOR OBSERVATIONS RELATING TO THE IMPLEMENTATION OF THE SWPPP. (3.5.8.2.g)

7.1.9. DOCUMENTATION OF INSPECTIONS WILL BE MAINTAINED ON SITE IN THE "DOCUMENTATION AND PERMITS" BINDER.

7.1.10. THESE INSPECTION REQUIREMENTS DO NOT APPLY TO DEFINABLE AREAS OF THE SITE THAT HAVE MET FINAL STABILIZATION REQUIREMENTS AND HAVE BEEN NOTED IN THE SWPPP.

7.1.11. TRAINED CERTIFIED INSPECTORS SHALL COMPLETE INSPECTION DOCUMENTATION TO THE BEST OF THEIR ABILITY. FALSIFYING INSPECTION RECORDS OR OTHER DOCUMENTATION OR FAILURE TO COMPLETE INSPECTION DOCUMENTATION SHALL RESULT IN A VIOLATION OF THIS PERMIT AND ANY OTHER APPLICABLE ACTS OR RULES. (3.8.5.2.h)

7.2. DULY AUTHORIZED REPRESENTATIVE (7.7.3)

THE PROJECT SUPERVISOR/CONTRACTOR MAY DELEGATE AN INDIVIDUAL AND/OR CONSULTANT TO SIGN EPSC INSPECTIONS REPORTS. FOR SATISFYING SIGNATORY REQUIREMENTS FOR EPSC INSPECTION REPORTS, THE PROJECT SUPERVISOR/CONTRACTOR AND NEWLY AUTHORIZED INDIVIDUAL ACCEPTING RESPONSIBILITY MUST SUBMIT WRITTEN AUTHORIZATION TO THE LOCAL TDEC EFO.

7.3. MAINTENANCE PRACTICES (3.5.3.1 AND 3.5.7)

7.3.1. ALL CONTROLS WILL BE MAINTAINED IN GOOD AND EFFECTIVE OPERATING ORDER. NECESSARY REPAIRS OR MAINTENANCE WILL BE ACCOMPLISHED BEFORE THE NEXT STORM EVENT AND IN NO CASE MORE THAN 7 DAYS AFTER THE NEED IS IDENTIFIED. IN A CASE WHERE THE ACTIVITY IS DEEMED IMPRACTICABLE, ANY SUCH CONDITIONS WILL BE DOCUMENTED (3.5.8.2.e).

7.3.2. ALL CONTROLS WILL BE MAINTAINED IN ACCORDANCE WITH STANDARD DRAWINGS AND GOOD ENGINEERING PRACTICES. (3.5.3.1.b)

7.3.3. SEDIMENT WILL BE REMOVED FROM SEDIMENT TRAPS, SILT FENCE, SEDIMENT BASINS, AND OTHER CONTROLS WHEN THE DESIGN CAPACITY HAS BEEN REDUCED BY 50%. (3.5.3.1.e)

7.3.4. CHECK DAMS WILL BE INSPECTED FOR STABILITY. SEDIMENT WILL BE REMOVED WHEN DEPTH REACHES ONE-HALF (½) THE HEIGHT OF THE DAM.

7.3.5. LITTER, CONSTRUCTION DEBRIS, AND CONSTRUCTION CHEMICALS EXPOSED TO STORMWATER WILL BE PICKED UP AND REMOVED FROM STORMWATER EXPOSURE PRIOR TO ANTICIPATED STORM EVENTS OR BEFORE BEING CARRIED OFF OF THE SITE BY WIND, OR OTHERWISE PREVENTED FROM BECOMING A POLLUTANT SOURCE FOR STORMWATER DISCHARGES. AFTER USE, MATERIALS USED FOR EROSION CONTROL WILL BE REMOVED. (3.5.3.1.f)

7.3.6. ALL SEEDED AREAS WILL BE CHECKED FOR BARE SPOTS, EROSION WASHOUTS, AND VIGOROUS GROWTH FREE OF SIGNIFICANT WEED INFESTATIONS.

7.3.7. THE PROJECT SUPERVISOR OR THEIR DESIGNEE AND THE CONTRACTOR'S SITE SUPERINTENDENT ARE RESPONSIBLE FOR INSPECTIONS. MAINTENANCE AND REPAIR ACTIVITIES ARE THE RESPONSIBILITY OF THE CONTRACTOR. THE PROJECT SUPERVISOR OR THEIR DESIGNEE WILL COMPLETE THE INSPECTION REPORTS AND DISTRIBUTE COPIES PER THE CONTRACT.

8. SITE ASSESSMENTS (3.1.2)QUALITY ASSURANCE SITE ASSESSMENTS OF EROSION PREVENTION AND SEDIMENT CONTROLS REQUIRED:

YES ☒ NO ☐

9. STORMWATER MANAGEMENT (3.5.4)STORMWATER MANAGEMENT WILL BE HANDLED BY TEMPORARY CONTROLS OUTLINED IN THIS SWPPP AND ANY PERMANENT CONTROLS NEEDED TO MEET PERMANENT STORMWATER MANAGEMENT NEEDS IN THE POST CONSTRUCTION PERIOD. PERMANENT CONTROLS WILL BE SHOWN ON THE PLANS AND NOTED AS PERMANENT.

9.2. DESCRIBE ANY SPECIFIC POST-CONSTRUCTION MEASURES THAT WILL CONTROL VELOCITY, POLLUTANTS, AND/OR EROSION (3.5.1.f, 3.5.4): BIORETENTION BASIN, DETENTION POND.

9.3. OTHER ITEMS NEEDING CONTROL (3.5.5)

9.3.1. CONSTRUCTION MATERIALS

THE FOLLOWING MATERIALS OR SUBSTANCES ARE EXPECTED TO BE PRESENT ON THE SITE DURING THE CONSTRUCTION PERIOD. (CHECK ALL THAT APPLY).

9.3.1.1. ☒ LUMBER, GUARDRAIL, TRAFFIC CONTROL DEVICES

9.3.1.2. ☒ CONCRETE WASHOUT

9.3.1.3. ☒ MINERAL AGGREGATES, ASPHALT

9.3.1.4. ☒ EARTH

9.3.1.5. ☒ LIQUID TRAFFIC STRIPING MATERIALS, PAINT

9.3.1.6. ☒ ROCK

9.3.1.7. ☐ CURING COMPOUND

9.3.1.8. ☐ EXPLOSIVES

9.3.1.9. ☐ OTHER

THESE MATERIALS WILL BE HANDLED AS NOTED IN THIS SWPPP.

9.3.2. WASTE MATERIALS (3.5.5.b)

WASTE MATERIAL (EARTH, ROCK, ASPHALT, CONCRETE, ETC.) NOT REQUIRED FOR THE CONSTRUCTION OF THE PROJECT WILL BE DISPOSED OF BY THE CONTRACTOR. THE CONTRACTOR WILL OBTAIN ANY AND ALL NECESSARY PERMITS INCLUDING, BUT NOT LIMITED TO NPDES, AQUATIC RESOURCES ALTERATION PERMIT(S) CORPS OF ENGINEERS SECTION 404 PERMITS, AND TVA SECTION 26A PERMITS TO DISPOSE OF WASTE MATERIALS.

9.3.3. HAZARDOUS WASTE (3.5.5.c) (7.9)

ALL HAZARDOUS WASTE MATERIALS WILL BE DISPOSED OF IN A MANNER WHICH IS COMPLIANT WITH LOCAL OR STATE REGULATIONS. SITE PERSONNEL WILL BE INSTRUCTED IN THESE PRACTICES, AND THE INDIVIDUAL DESIGNATED AS THE CONTRACTOR'S ON-SITE REPRESENTATIVE WILL BE RESPONSIBLE FOR SEEING THAT THESE PRACTICES ARE FOLLOWED. THE CONTRACTOR WILL OBTAIN ANY AND ALL NECESSARY PERMITS TO DISPOSE OF HAZARDOUS MATERIAL.

9.3.4. SANITARY WASTE (3.5.5.b)

PORTABLE SANITARY FACILITIES WILL BE PROVIDED ON ALL CONSTRUCTION SITES. SANITARY WASTE WILL BE COLLECTED FROM THE PORTABLE UNITS IN A TIMELY MANNER BY A LICENSED WASTE MANAGEMENT CONTRACTOR OR AS REQUIRED BY ANY LOCAL REGULATIONS. THE CONTRACTOR WILL OBTAIN ANY AND ALL NECESSARY PERMITS TO DISPOSE OF SANITARY WASTE.

9.3.5. OTHER MATERIALS

THE FOLLOWING MATERIALS OR SUBSTANCES ARE EXPECTED TO BE PRESENT ON THE SITE DURING THE CONSTRUCTION PERIOD. (CHECK ALL THAT APPLY).

9.3.5.1. ☐ FERTILIZERS AND LIME

9.3.5.2. ☐ PESTICIDES AND/OR HERBICIDES

9.3.5.3. ☒ DIESEL AND GASOLINE

9.3.5.4. ☒ MACHINERY LUBRICANTS (OIL AND GREASE)

THESE MATERIALS WILL BE HANDLED AS NOTED IN THIS SWPPP.

10. NON-STORMWATER DISCHARGES (3.5.9)

THE FOLLOWING NON-STORMWATER DISCHARGES ARE ANTICIPATED DURING THE COURSE OF THIS PROJECT (CHECK ALL THAT APPLY):

10.1.1. ☐ DEWATERING OF WORK AREAS OF COLLECTED STORMWATER AND GROUND WATER

10.1.2. ☐ WATERS USED TO WASH VEHICLES (OF DUST AND SOIL) WHERE DETERGENTS ARE NOT USED AND DETENTION AND/OR FILTERING IS PROVIDED BEFORE THE WATER LEAVES SITE

10.1.3. ☐ WATER USED TO CONTROL DUST (3.5.3.1.n)

10.1.4. ☐ POTABLE WATER SOURCES INCLUDING WATERLINE FLUSHINGS FROM WHICH CHLORINE HAS BEEN REMOVED TO THE MAXIMUM EXTENT PRACTICABLE

10.1.5. ☐ UNCONTAMINATED GROUNDWATER OR SPRING WATER

10.1.6. ☐ FOUNDATION OR FOOTING DRAINS WHERE FLOWS ARE NOT CONTAMINATED WITH POLLUTANTS

10.1.7. ☐ OTHER:

10.2. ALL ALLOWABLE NON-STORMWATER DISCHARGES WILL BE DIRECTED TO STABLE DISCHARGE STRUCTURES PRIOR TO LEAVING THE SITE. FILTERING OR CHEMICAL TREATMENT MAY BE NECESSARY PRIOR TO DISCHARGE.

10.3. THE DESIGN OF ALL IMPACTED EPSC MEASURES RECEIVING FLOW FROM ALLOWABLE NON-STORMWATER DISCHARGES MUST BE DESIGNED TO HANDLE THE VOLUME OF THE NON-STORMWATER COMPONENT.

10.4. WASH DOWN OR WASTE DISCHARGE OF CONCRETE TRUCKS WILL NOT BE PERMITTED ON-SITE UNLESS PROPER SETTLEMENT AREAS HAVE BEEN PROVIDED IN ACCORDANCE WITH BOTH STATE AND FEDERAL REGULATIONS.

10.5. ARE ANY DISCHARGES ASSOCIATED WITH INDUSTRIAL (NON-CONSTRUCTION STORMWATER) ACTIVITY EXPECTED (3.5.1.h)?

YES ☐ NO ☒

IF YES, SPECIFY THE LOCATION OF THE ACTIVITY AND ITS PERMIT NUMBER.

11. SPILL PREVENTION, MANAGEMENT AND NOTIFICATION (3.5.5.c, 5.1)

11.1. SPILL PREVENTION (3.5.5.c)MATERIAL MANAGEMENT HOUSEKEEPING

ONLY PRODUCTS NEEDED WILL BE STORED ON-SITE BY THE CONTRACTOR. EXCEPT FOR BULK MATERIALS THE CONTRACTOR WILL STORE ALL MATERIALS UNDER COVER AND IN APPROPRIATE CONTAINERS. PRODUCTS MUST BE STORED IN ORIGINAL CONTAINERS AND LABELED. MATERIAL MIXING WILL BE CONDUCTED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. WHEN POSSIBLE, ALL PRODUCTS WILL BE USED COMPLETELY BEFORE PROPERLY DISPOSING OF THE CONTAINER OFF SITE. THE MANUFACTURER'S DIRECTIONS FOR DISPOSAL OF MATERIALS AND CONTAINERS WILL BE FOLLOWED. THE CONTRACTOR'S SITE SUPERINTENDENT WILL INSPECT MATERIALS STORAGE AREAS REGULARLY TO ENSURE PROPER USE AND DISPOSAL. DUST GENERATED WILL BE CONTROLLED IN AN ENVIRONMENTALLY SAFE MANNER. VEGETATION AREAS NOT ESSENTIAL TO THE CONSTRUCTION PROJECT WILL BE PRESERVED AND MAINTAINED AS NOTED ON THE PLANS.

11.1.1.2 HAZARDOUS MATERIALS

PRODUCTS WILL BE KEPT IN ORIGINAL CONTAINERS UNLESS THE CONTAINER IS NOT RESEALABLE. ORIGINAL LABELS AND MATERIAL SAFETY DATA SHEETS WILL BE RETAINED IN A SAFE PLACE TO RELAY IMPORTANT PRODUCT INFORMATION. IF SURPLUS PRODUCT MUST BE DISPOSED OF, MANUFACTURER'S LABEL DIRECTIONS FOR DISPOSAL WILL BE FOLLOWED. MAINTENANCE AND REPAIR OF ALL EQUIPMENT AND VEHICLES INVOLVING OIL CHANGES, HYDRAULIC SYSTEM DRAIN DOWN, DE-GREASING OPERATIONS, FUEL TANK DRAIN DOWN AND REMOVAL, AND OTHER ACTIVITIES WHICH MAY RESULT IN THE ACCIDENTAL

RELEASE OF CONTAMINANTS WILL BE CONDUCTED ON AN IMPERVIOUS SURFACE AND UNDER COVER DURING WET WEATHER TO PREVENT THE RELEASE OF CONTAMINANTS ONTO THE GROUND. WHEEL WASH WATER WILL BE COLLECTED AND ALLOWED TO SETTLE OUT SUSPENDED SOLIDS PRIOR TO DISCHARGE. WHEEL WASH WATER WILL NOT BE DISCHARGED DIRECTLY INTO ANY STORMWATER SYSTEM OR STORMWATER TREATMENT SYSTEM. POTENTIAL PH-MODIFYING MATERIALS SUCH AS: BULK CEMENT, CEMENT KILN DUST, FLY ASH, NEW CONCRETE WASHINGS AND CURING WATERS, CONCRETE PUMPING, AND MIXER WASHOUT WATERS WILL BE COLLECTED ON SITE AND MANAGED TO PREVENT CONTAMINATION OF STORMWATER RUNOFF.

11.1.1.3 PRODUCT SPECIFIC PRACTICES

11.1.1.3.1 PETROLEUM PRODUCTS: ALL ON-SITE VEHICLES WILL BE MONITORED FOR LEAKS AN RECEIVE REGULAR PREVENTIVE MAINTENANCE TO REDUCE THE CHANCE OF LEAKAGE. PETROLEUM PRODUCTS WILL BE STORED IN TIGHTLY SEALED CONTAINERS WHICH ARE CLEARLY LABELED

11.1.1.3.2 FERTILIZERS: FERTILIZERS WILL BE APPLIED ONLY IN THE AMOUNTS SPECIFIED BY THE MANUFACTURER. ONCE APPLIED, FERTILIZERS WILL BE WORKED INTO THE SOIL TO LIMIT THE EXPOSURE TO STORMWATER. FERTILIZERS WILL BE STORED IN AN ENCLOSED AREA UNDER COVER. THE CONTENTS OF PARTIALLY USED FERTILIZER BAGS WILL BE TRANSFERRED TO SEALABLE CONTAINERS TO AVOID SPILLS.

11.1.1.3.3 PAINTS: ALL CONTAINERS WILL BE TIGHTLY SEALED AND STORED WHEN NOT REQUIRED FOR USE. THE EXCESS WILL BE DISPOSED OF ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS AND APPLICABLE STATE AND LOCAL REGULATIONS.

11.1.1.3.4 CONCRETE TRUCKS: CONTRACTORS WILL PROVIDE DESIGNATED TRUCK WASHOUT AREAS ON THE SITE. THESE AREAS MUST BE SELF CONTAINED AND NOT CONNECTED TO ANY STORMWATER OUTLET OF THE SITE. UPON COMPLETION OF CONSTRUCTION WASHOUT AREAS WILL BE PROPERLY STABILIZED.

11.2 SPILL MANAGEMENT

11.2.1 IN ADDITION TO THE PREVIOUS HOUSEKEEPING AND MANAGEMENT PRACTICES, THE FOLLOWING PRACTICES WILL BE FOLLOWED FOR SPILL PREVENTION AND CLEANUP IF NECESSARY.

11.2.2 FOR ALL HAZARDOUS MATERIALS STORED ON SITE, THE MANUFACTURER'S RECOMMENDED METHODS FOR SPILL CLEAN UP WILL BE CLEARLY POSTED. SITE PERSONNEL WILL BE MADE AWARE OF THE PROCEDURES AND THE LOCATIONS OF THE INFORMATION AND CLEANUP SUPPLIES.

11.2.3 APPROPRIATE CLEANUP MATERIALS AND EQUIPMENT WILL BE MAINTAINED BY THE CONTRACTOR IN THE MATERIALS STORAGE AREA ON-SITE AND UNDER COVER. AS APPROPRIATE, EQUIPMENT AND MATERIALS MAY INCLUDE ITEMS SUCH AS BOOMS, DUST PANS, MOPS, RAGS, GLOVES, GOGGLES, KITTY LITTER, SAND, SAWDUST, AND PLASTIC AND METAL TRASH CONTAINERS SPECIFICALLY FOR CLEAN UP PURPOSES.

11.2.4 ALL SPILLS WILL BE CLEANED IMMEDIATELY AFTER DISCOVERY AND THE MATERIALS DISPOSED OF PROPERLY. THE SPILL AREA WILL BE KEPT WELL VENTILATED AND PERSONNEL WILL WEAR APPROPRIATE PROTECTIVE CLOTHING TO PREVENT INJURY FROM CONTACT WITH A HAZARDOUS SUBSTANCE.

11.2.5 THE CONTRACTOR'S SITE SUPERINTENDENT WILL BE THE SPILL PREVENTION AND CLEANUP COORDINATOR. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT THE SITE SUPERINTENDENT HAS HAD APPROPRIATE TRAINING FOR HAZARDOUS MATERIALS HANDLING, SPILL MANAGEMENT, AND CLEANUP.

11.2.6 IF SPILLS REPRESENT AN IMMINENT THREAT OF ESCAPING THE SITE AND ENTERING RECEIVING WATERS, PERSONNEL WILL RESPOND IMMEDIATELY TO CONTAIN THE RELEASE AND NOTIFY THE SUPERINTENDENT AFTER THE SITUATION HAS BEEN STABILIZED.

11.2.7 IF OIL SHEEN IS OBSERVED ON SURFACE WATER (E.G. SETTLING PONDS, DETENTION PONDS, SWALES), ACTION WILL BE TAKEN IMMEDIATELY TO REMOVE THE MATERIAL CAUSING THE SHEEN. THE CONTRACTOR WILL USE APPROPRIATE MATERIALS TO CONTAIN AND ABSORB THE SPILL. THE SOURCE OF THE OIL SHEEN WILL ALSO BE IDENTIFIED AND REMOVED OR REPAIRED AS NECESSARY TO PREVENT FURTHER RELEASES.

11.2.8 IF A SPILL OCCURS THE CONTRACTOR WILL BE RESPONSIBLE FOR COMPLETING THE SPILL REPORTING FORM.

11.2.9 SPILL RESPONSE EQUIPMENT WILL BE INSPECTED AND MAINTAINED BY THE CONTRACTOR AS NECESSARY TO REPLACE ANY MATERIALS USED IN SPILL RESPONSE ACTIVITIES.

11.3 SPILL NOTIFICATION (5.1)

WHERE A RELEASE CONTAINING A HAZARDOUS SUBSTANCE IN AN AMOUNT EQUAL TO OR IN EXCESS OF A REPORTABLE QUANTITY ESTABLISHED UNDER EITHER 40 CFR 117 OR 40 CFR 302 OCCURS DURING A 24 HOUR PERIOD:

11.3.1 A WRITTEN DESCRIPTION OF THE RELEASE, DATE OF RELEASE AND

11.3.2 CIRCUMSTANCES LEADING TO THE RELEASE, WHAT ACTIONS WERE TAKEN TO MITIGATE EFFECTS OF THE RELEASE, AND STEPS TAKEN TO MINIMIZE THE CHANCE OF FUTURE OCCURRENCES WILL BE SUBMITTED TO THE APPROPRIATE TDEC ENVIRONMENTAL FIELD OFFICE WITHIN 14 DAYS OF KNOWLEDGE OF THE RELEASE.

11.3.3 THE SWPPP MUST BE MODIFIED WITHIN 14 DAYS OF KNOWLEDGE OF THE RELEASE PROVIDING A DESCRIPTION OF THE RELEASE, CIRCUMSTANCES LEADING TO THE RELEASE, AND THE DATE OF RELEASE. THE SWPPP WILL BE REVIEWED AND MODIFIED AS NECESSARY TO IDENTIFY MEASURES TO PREVENT THE REOCCURRENCE OF SUCH RELEASES AND TO RESPOND TO SUCH RELEASES.

12. RECORD-KEEPING

12.1. REQUIRED RECORDS

CONTRACTOR OR THEIR DESIGNEE WILL MAINTAIN AT THE SITE THE FOLLOWING RECORDS OF CONSTRUCTION ACTIVITIES (3.5.3.1.m) (6.2.1):

12.1.1. THE DATES WHEN MAJOR GRADING ACTIVITIES OCCUR

12.1.2. THE DATES WHEN CONSTRUCTION ACTIVITIES TEMPORARILY OR PERMANENTLY CEASE ON A PORTION OF THE SITE

12.1.3. THE DATES WHEN STABILIZATION MEASURES ARE INITIATED

12.1.4. RECORDS OF TWICE WEEKLY EPSC INSPECTION REPORTS AND CORRECTIVE MEASURES

12.1.5. RECORDS OF QUALITY ASSURANCE SITE ASSESSMENTS

12.1.6. COPY OF SITE EPSC INSPECTOR'S TDEC LEVEL 1 CERTIFICATIONR

12.1.7. AINFALL MONITORING PLAN (3.5.3.1.o)EQUIPMENT

AT A MINIMUM, THE CONTRACTOR WILL INSTALL A FENCE POST TYPE RAIN GAUGE TO MEASURE RAINFALL. THE STANDARD FENCE POST RAIN GAUGE WILL BE A WEDGE-SHAPED GAUGE THAT MEASURES UP TO 6 INCHES OF RAINFALL. AN ENGLISH SCALE WILL BE PROVIDED ON ONE FACE, WITH A METRIC SCALE ON THE OTHER FACE. GRADUATION WILL BE PERMANENTLY MOLDED IN DURABLE WEATHER-RESISTANT PLASTIC. THE MINIMUM GRADUATION WILL BE 0.01 INCH (OR 0.1MM). AN ALUMINUM BRACKET WITH SCREWS MAY BE USED TO MOUNT THE GAUGE ON A WOODEN SUPPORT.

12.1.3.2. LOCATION

THE RAIN GAUGE WILL BE LOCATED AT THE PROJECT SITE, IN AN OPEN AREA SUCH THAT THE MEASUREMENT WILL NOT BE INFLUENCED BY OUTSIDE FACTORS (I.E. OVERHANGS, GUTTER, TREES, ETC). ALTERNATIVELY, A REFERENCE SITE MAY BE USED. A REFERENCE SITE IS THE DOCUMENTATION FROM THE CLOSEST GAUGE WITHIN PROXIMITY OF THE PROJECT FROM A RECOGNIZED SOURCE SUCH AS THE NOAA NATIONAL WEATHER SERVICE.

12.1.3.3. METHODS

12.1.3.3.1. RAINFALL MONITORING WILL BE INITIATED PRIOR TO CLEARING, GRUBBING, EXCAVATION, GRADING, CUTTING, OR FILLING, EXCEPT AS SUCH MINIMAL CLEARING MAY BE NECESSARY TO INSTALL A RAIN GAUGE IN AN OPEN AREA. THE RAIN GAUGE WILL BE CHECKED FOR OPERATIONAL SOUNDNESS DAILY (DURING NORMAL BUSINESS HOURS) IN WET TIMES AND WEEKLY IN DRY TIMES. GAUGES WILL BE REPAIRED OR REPLACED ON THE SAME DAY IF FOUND TO BE NON-OPERATIONAL OR MISSING.

12.1.3.3.2. EACH RAIN GAUGE WILL BE READ (FOR DETAILED RECORDS OF RAINFALL) AND EMPTIED AFTER EVERY RAINFALL EVENT OCCURRING ON THE PROJECT SITE AT APPROXIMATELY THE SAME TIME OF THE DAY (DURING NORMAL BUSINESS HOURS). DURING PERIODS OF DRY CONDITIONS, IT WILL NOT BE NECESSARY TO READ THE RAIN GAUGE EVERY DAY. IN LIEU OF THIS REQUIREMENT ON WEEKENDS AND ON STATE HOLIDAYS, THE RAIN GAUGES CAN BE EMPTIED THE NEXT BUSINESS DAY AND A REFERENCE SITE USED FOR A RECORD OF DAILY AMOUNT OF PRECIPITATION FOR THOSE DAYS. A REFERENCE SITE IS THE DOCUMENTATION FROM THE CLOSEST GAUGE WITHIN PROXIMITY OF THE PROJECT FROM A RECOGNIZED SOURCE SUCH AS THE NOAA NATIONAL WEATHER SERVICE.

12.1.3.3.3. DETAILED RECORDS WILL BE RECORDED OF RAINFALL EVENTS INCLUDING DATES, AMOUNTS OF RAINFALL, AND THE APPROXIMATE DURATION (OR THE STARTING AND ENDING TIMES).

12.1.3.3.4. IF, IN THE EVENT THAT THE RAINFALL EVENT IS STILL IN PROGRESS AT THE DAILY RECORDING TIME, THE GAUGE WILL BE EMPTIED AND THE RECORD WILL INDICATE THAT THE STORM EVENT WAS STILL IN PROGRESS.

12.1.3.3.5. RAIN GAUGE INFORMATION (DETAILED RECORDS), INCLUDING THE LOCATION OF THE NEAREST OUTFALL, WILL BE RECORDED ON THE EPSC INSPECTION REPORT FORMS AT THE TIME OF MEASUREMENT.

12.2. KEEPING PLANS CURRENT (3.4)

CONTRACTOR OR THEIR DESIGNEE WILL MODIFY AND UPDATE THE SWPPP WHEN ANY OF THE FOLLOWING CONDITIONS APPLY:

12.2.1. WHENEVER THERE IS A CHANGE IN THE SCOPE OF THE PROJECT THAT WOULD BE EXPECTED TO HAVE A SIGNIFICANT EFFECT ON THE DISCHARGE OF POLLUTANTS TO THE WATERS OF THE STATE AND WHICH HAS NOT OTHERWISE BEEN ADDRESSED IN THE SWPPP.

12.2.2. WHENEVER THERE IS A CHANGE IN THE SCOPE OF THE PROJECT THAT WOULD BE EXPECTED TO HAVE A SIGNIFICANT EFFECT ON THE DISCHARGE OF POLLUTANTS TO THE WATERS OF THE STATE AND WHICH HAS NOT OTHERWISE BEEN ADDRESSED IN THE SWPPP.

12.2.3. WHENEVER INSPECTIONS OR INVESTIGATIONS BY SITE OPERATORS, LOCAL, STATE, OR FEDERAL OFFICIALS INDICATE THE SWPPP IS PROVING INEFFECTIVE IN ELIMINATING OR SIGNIFICANTLY MINIMIZING POLLUTANTS FROM CONSTRUCTION ACTIVITY SOURCES, OR IS OTHERWISE NOT ACHIEVING THE GENERAL OBJECTIVES OF CONTROLLING POLLUTANTS IN STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY; WHERE LOCAL, STATE, OR FEDERAL OFFICIALS DETERMINE THAT THE SWPPP IS INEFFECTIVE IN ELIMINATING OR SIGNIFICANTLY MINIMIZING POLLUTANT SOURCES, A COPY OF ANY CORRESPONDENCE TO THAT EFFECT MUST BE RETAINED IN THE SWPPP;

12.2.4. WHEN ANY NEW OPERATOR AND/OR SUB-OPERATOR IS ASSIGNED OR RELIEVED OF THEIR RESPONSIBILITY TO IMPLEMENT A PORTION OF THE SWPPP.

12.2.5. TO PREVENT A NEGATIVE IMPACT TO LEGALLY PROTECTED STATE OR FEDERALLY LISTED OR PROPOSED THREATENED OR ENDANGERED AQUATIC FAUNA.

12.2.6. WHEN THERE IS A CHANGE IN CHEMICAL TREATMENT METHODS INCLUDING: USE OF DIFFERENT TREATMENT CHEMICALS, DIFFERENT DOSAGE OR APPLICATION RATES OR A DIFFERENT AREA OF APPLICATION NOT SPECIFIED ON THE EPSC PLANS; OR

12.2.7. WHEN A TMDL IS DEVELOPED FOR THE RECEIVING WATERS FOR A POLLUTANT OF CONCERN (SILTATION AND/OR HABITAT ALTERATION)

12.3. MAKING PLANS ACCESSIBLE

12.3.1. CONTRACTOR WILL RETAIN A COPY OF THIS SWPPP (INCLUDING A COPY OF THE "DOCUMENTATION AND PERMITS" BINDER AT THE CONSTRUCTION SITE (OR OTHER LOCATION

SWS ENGINEERING, INC.		5421, 5425, 5429 FRANKLIN PIKE DAVIDSON COUNTY, TENNESSEE
		STORM WATER POLLUTION PREVENTION PLAN
DRAWN BY: MRB	CHECKED BY: PDA	PROJECT NO.: 22-270T
DATE: 02-27-23	DATE: 02-27-23	SHEET NO.: 3

ACCESSIBLE TO TDEC AND THE PUBLIC) FROM THE DATE CONSTRUCTION COMMENCES TO THE DATE OF FINAL STABILIZATION. CONTRACTOR WILL HAVE A COPY OF THE SWPPP AVAILABLE AT THE LOCATION WHERE WORK IS OCCURRING ON-SITE FOR THE USE OF OPERATORS AND THOSE IDENTIFIED AS HAVING RESPONSIBILITIES UNDER THE SWPPP WHENEVER THEY ARE ON THE CONSTRUCTION SITE. (6.2)

12.3.2. PRIOR TO THE INITIATION OF LAND DISTURBING ACTIVITIES AND UNTIL THE SITE HAS MET THE FINAL STABILIZATION CRITERIA, CONTRACTOR OR THEIR DESIGNEE WILL POST A NOTICE NEAR THE MAIN ENTRANCE OF THE CONSTRUCTION SITE WITH THE FOLLOWING INFORMATION (3.3.3) (6.2.1):

12.3.2.1. A COPY OF THE NOTICE OF COVERAGE (NOC) WITH THE NPDES PERMIT NUMBER FOR THE PROJECT; WHITE HOUSE COMMUNITY CENTER

12.3.2.2. THE INDIVIDUAL NAME, COMPANY NAME, E-MAIL ADDRESS (IF APPLICABLE) AND TELEPHONE NUMBER OF THE LOCAL PROJECT SITE OWNER AND OPERATOR CONTACT.

12.3.2.3. A BRIEF DESCRIPTION OF THE PROJECT; AND

12.3.2.4. THE LOCATION OF THE SWPPP.

12.3.3. ALL INFORMATION DESCRIBED IN SECTION 10.3.2 MUST BE MAINTAINED IN LEGIBLE CONDITION. IF POSTING THIS INFORMATION NEAR A MAIN ENTRANCE IS INFEASIBLE DUE TO SAFETY CONCERNS, THE NOTICE SHALL BE POSTED IN A LOCAL BUILDING. THE NOTICE MUST BE PLACED IN A PUBLICLY ACCESSIBLE LOCATION WHERE CONSTRUCTION IS ACTIVELY UNDERWAY AND MOVED AS NECESSARY. NOTICE OF TERMINATION (8.0)

12.4.1. WHEN ALL STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES THAT ARE AUTHORIZED BY THE PERMIT ARE ELIMINATED BY FINAL STABILIZATION, CONTRACTOR WILL SUBMIT A NOTICE OF TERMINATION (NOT) THAT IS SIGNED IN ACCORDANCE WITH THE PERMIT TO THE LOCAL ENVIRONMENTAL FIELD OFFICE.

12.4.2. FOR THE PURPOSES OF THE CERTIFICATION REQUIRED BY THE NOT, THE ELIMINATION OF STORMWATER DISCHARGES ASSOCIATED WITH THE CONSTRUCTION ACTIVITY MEANS THE FOLLOWING:

12.4.2.1. ALL EARTH-DISTURBING ACTIVITIES ON THE SITE ARE COMPLETED AND ALL DISTURBED SOILS AT THE PORTION OF THE CONSTRUCTION SITE WHERE THE OPERATOR HAD CONTROL HAVE BEEN FINALLY STABILIZED; AND

12.4.2.2. ALL CONSTRUCTION MATERIALS, WASTE AND WASTE HANDLING DEVICES, AND ALL EQUIPMENT, AND VEHICLES THAT WERE USED DURING CONSTRUCTION HAVE BEEN REMOVED AND PROPERLY DISPOSED; AND

12.4.2.3. ALL STORMWATER CONTROLS THAT WERE INSTALLED AND MAINTAINED DURING CONSTRUCTION, EXCEPT THOSE THAT ARE INTENDED FOR LONG-TERM USE FOLLOWING TERMINATION OF PERMIT COVERAGE, HAVE BEEN REMOVED; AND

12.4.2.4. ALL POTENTIAL POLLUTANTS AND POLLUTANT GENERATING ACTIVITIES ASSOCIATED WITH CONSTRUCTION HAVE BEEN REMOVED; AND

12.4.2.5. THE PERMITTEE HAS IDENTIFIED WHO IS RESPONSIBLE FOR ONGOING MAINTENANCE OF ANY STORMWATER CONTROLS LEFT ON THE SITE FOR LONG-TERM USE FOLLOWING TERMINATION OF PERMIT COVERAGE; AND

12.4.2.6. TEMPORARY EPSC MEASURES HAVE BEEN OR WILL BE REMOVED AT AN APPROPRIATE TIME TO ENSURE FINAL STABILIZATION IS MAINTAINED; AND

12.4.2.7. ALL STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES FROM THE IDENTIFIED SITE THAT ARE AUTHORIZED BY A NPDES GENERAL PERMIT HAVE OTHERWISE BEEN ELIMINATED FROM THE PORTION OF THE CONSTRUCTION SITE WHERE THE OPERATOR HAD CONTROL.

12.5. RETENTION OF RECORDS (6.2)

THE PERMITTEE WILL RETAIN COPIES OF THE SWPPP, ALL REPORTS REQUIRED BY THE PERMIT, AND RECORDS OF ALL DATA USED TO COMPLETE THE NOTICE OF INTENT FOR THE PROJECT FOR A PERIOD OF AT LEAST THREE (3) YEARS FROM THE DATE THE NOT WAS FILED.

13. ENVIRONMENTAL PERMITS (9.0)

LIST ALL ENVIRONMENTAL PERMITS AND EXPIRATION DATES FOR PROJECT

ENVIRONMENTAL PERMITS			
PERMIT	**YES OR NO**	**PERMIT OR TRACKING NO.**	**EXPIRATION DATE***
TDEC ARAP	NO		
CORPS OF ENGINEERS (COE)	NO		
TVA 26A	NO		
TDEC CGP	YES	PENDING	
OTHER:	N/A		

SWS ENGINEERING, INC.		5421, 5425, 5429 FRANKLIN PIKE DAVIDSON COUNTY, TENNESSEE	
		STORM WATER POLLUTION PREVENTION PLAN	
DRAWN BY: MRB	CHECKED BY: PDA	PROJECT NO.: 22-270T	SHEET NO.: 4
DATE: 02-27-23	DATE: 02-27-23		

<u>APPENDIX A</u>

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES (DWR)
William R. Snodgrass Tennessee Tower, 312 Rosa L. Parks Avenue, 11th Floor
Nashville, TN 37243
Toll Free Number: 1-888-891-8332 (TDEC)

NOTICE OF INTENT (NOI) FOR GENERAL NPDES PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES (TNR100000)

Site or Project Name: 5421-5429 Franklin Pike	**NPDES Tracking Number: TNR**
Street Address including city or zip code or Location: 5421-5429 Franklin Pike, Nashville, TN 37220	Construction Start Date: 6/23
	Estimated End Date: 6/24
Site Description: 3 single family homes with shared access drive off of Franklin Pike.	Latitude (dd.dddd): 36.0491
	Longitude (-dd.dddd): -86.7755
County(ies): Davidson — MS4 Jurisdiction (if applicable): Nashville	Acres Disturbed: 2.21
	Total Acres: 5.6

Are there any streams ☐ and/or wetlands ☐ on or adjacent to the construction site?
If wetlands are located on-site and may be impacted, attach wetlands delineation report.
If an Aquatic Resource Alteration Permit has been obtained for this site, what is the permit number? ARAP Number:

Receiving waters: Brentwood Branch

Include the SWPPP with the NOI ☒ SWPPP Included | Include a site location map ☒ Map Included

Name of Site Owner or Developer (Site-Wide Permittee): (correct legal name of person, company, or entity that has operational or design control over construction plans and specifications)
Urban Development Group, LLC

For corporate entities only, provide the Tennessee Secretary of State (SOS) Control Number:

Site Owner or Developer Contact Name: (individual responsible for site) Jeremy Walker	Title or Position: (the party who signs the certification below): OWNER		
Mailing Address: PO Box 90288	City: Nashville	State: TN	Zip: 37209
Phone: ( ) 615-506-7296	E-mail: jeremy.urbandg@gmail.com		

Optional Contact Name:	Title or Position:		
Mailing Address:	City:	State:	Zip:
Phone: ( )	E-mail:		

CN-0940 (Rev. 11-21) RDA 2366

Owner or Developer Certification: (must be signed by president, vice-president or equivalent, or ranking elected official) (Primary Permittee)		
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.		
Owner or Developer Name: (print or type): Jeremy Walker	Signature:	Date: 5-5-23

Contractor(s) Certification: (must be signed by president, vice-president or equivalent, or ranking elected official) (Secondary Permittee)		
I certify under penalty of law that I have reviewed this document, any attachments, and the SWPPP referenced above. Based on my inquiry of the construction site owner/developer identified above and/or my inquiry of the person directly responsible for assembling this NOI and SWPPP, I believe the information submitted is accurate. I am aware that this NOI, if approved, makes the above-described construction activity subject to NPDES permit number TNR100000, and that certain of my activities on-site are thereby regulated. I am aware that there are significant penalties, including the possibility of fine and imprisonment for knowing violations, and for failure to comply with these permit requirements.		
Primary contractor name, address, and SOS control number (if applicable): (print or type) Urban Development Group LLC	Signature:	Date: 5-5-23
Primary contractor name, address, and SOS control number (if applicable): (print or type) 408 Hollydale Dr Nashville TN 37217 SOS#711261	Signature:	Date:
Primary contractor name, address, and SOS control number (if applicable): (print or type)	Signature:	Date:

NOTICE OF INTENT (NOI) FOR GENERAL NPDES PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITES (TNR100000)

Purpose of this form - A completed notice of intent (NOI) must be submitted to obtain coverage under the Tennessee General NPDES Permit for Discharges of Stormwater Associated with Construction Activity (permit). **Requesting coverage under this permit means that an applicant has obtained and examined a copy of this permit, and thereby acknowledges applicant's claim of ability to be in compliance with permit terms and conditions.** This permit is required for stormwater discharge(s) from construction activities including clearing, grading, filling and excavating (including borrow pits) of one or more acres of land. This form should be submitted at least 30 days prior to the commencement of land disturbing activities, or no later than 48 hours prior to when a new operator assumes operational control over site specifications or commences work at the site.

The appropriate permit application fee must accompany the NOI and is based on total acreage to be disturbed by an entire project, including any associated construction support activities (e.g., equipment staging yards, material storage areas, excavated material disposal areas, borrow or waste sites):

(i) Projects equal to or greater than 150 acres	$10,000
(ii) Projects equal to or greater than 50 acres and less than 150 acres	$6,000
(iii) Projects equal to or greater than 20 acres and less than 50 acres	$3,000
(iv) Projects equal to or greater than 5 acres and less than 20 acres	$1,000
(v) Projects equal to or greater than 1 acre and less than 5 acres	$250
(vi) Projects seeking subsequent coverage under an actively covered larger common plan of development or sale	$100

There is no fee for sites less than 1 acre. A separate annual maintenance fee is also required for construction activities that exceed 1 year under general permit coverage. Tennessee Rules, Chapter 0400-40-11-.02(b)(12)).

Who must submit the NOI form? Per Section 2 of the permit, all site operators must submit an NOI form. "Operator" for the purpose of this permit and in the context of stormwater associated with construction activity means any person associated with a construction project who meets either or both of the following two criteria: (1) The person has operational or design control over construction plans and specifications, including the ability to make modifications to those plans and specifications. This person is typically the owner or developer of the project or a portion of the project (e.g. subsequent builder), or the person that is the current landowner of the construction site. This person is considered the primary permittee; or (2) The person has day-to-day operational control of those activities at a project which are necessary to ensure compliance with a SWPPP for the site or other permit conditions. This person is typically a contractor or a commercial builder who is hired by the primary permittee and is considered a secondary permittee.

Owners, developers and all contractors that meet the definition of the operator in subsection 2.2 of the permit shall apply for permit coverage on the same NOI, insofar as possible. After permit coverage has been granted to the primary permittee, any separate or subsequent NOI submittals must include the site's previously assigned permit tracking number and the project name. The site-wide site-specific SWPPP shall be prepared in accordance with the requirements of part 5 of the permit and must be submitted with the NOI unless the NOI being submitted is to only add a contractor (secondary permittee) to an existing coverage. Artificial entities (e.g., corporations or partnerships excluding entities not required to register) must submit the TN Secretary of State, Division of Business Services, control number. The Division reserves the right to deny coverage to artificial entities that are not properly registered and in good standing with the TN Secretary of State.

Notice of Coverage - The division will review the NOI for completeness and accuracy and prepare a notice of coverage (NOC). Stormwater discharge from the construction site is authorized as of the effective date of the NOC.

Complete the form - Type or print clearly, using ink and not markers or pencil. Answer each item or enter "NA," for not applicable, if a particular item does not fit the circumstances or characteristics of your construction site or activity. If you need additional space, attach a separate piece of paper to the NOI form. **The NOI will be considered incomplete without a permit fee, a map, and the SWPPP.**

Describe and locate the project - Use the legal or official name of the construction site. If a construction site lacks street name or route number, give the most accurate geographic information available to describe the location (reference to adjacent highways, roads and structures; e.g. intersection of state highways 70 and 100). Latitude and longitude (expressed in decimal degrees) of the center of the site can be located on USGS quadrangle maps. The maps can be obtained at the USGS World Wide Web site: http://www.usgs.gov/; latitude and longitude information can be found at numerous other web sites. Attach a copy of a portion of a 7.5 minute topographic map, a city map, or a county map showing location of site, with boundaries at least one mile outside the site boundaries. Provide estimated starting date of clearing activities and completion date of the project, and an estimate of the number of acres of the site on which soil will be disturbed, including borrow areas, fill areas, stockpiles and the total acres. For linear projects, give location at each end of the construction area.

Give name of the receiving waters - Trace the route of stormwater runoff from the construction site and determine the name of the river(s), stream(s), creek(s), wetland(s), lake(s) or any other water course(s) into which the stormwater runoff drains. Note that the receiving water course may or may not be located on the construction site. If the first water body receiving construction site runoff is unnamed ("unnamed tributary"), determine the name of the water body that the unnamed tributary enters.

An ARAP may be required - **If your work will disturb or cause alterations of a stream or wetland, you must obtain an appropriate Aquatic Resource Alteration Permit (ARAP).** If you have a question about the ARAP program, contact your local Environmental Field Office (EFO).

Submitting the form and obtaining more information - Note that this form must be signed by the company President, Vice-President, or a ranking elected official in the case of a municipality, for details see subpart 2.5. For more information, contact your local EFO at the toll-free number 1-888-891-8332 (TDEC). Submit the completed NOI form (keep a copy for your records) to the appropriate EFO for the county(ies) where the construction activity is located, addressed to **Attention: Stormwater NOI Processing** or use MyTDEC Forms for electronic submittal.

EFO	Street Address	Zip Code	EFO	Street Address	Zip Code
Memphis	8383 Wolf Lake Drive, Bartlett	38133-4119	Cookeville	1221 South Willow Ave.	38506
Jackson	1625 Hollywood Drive	38305-4316	Chattanooga	1301 Riverfront Parkway, Suite 206	37402-2013
Nashville	711 R S Gass Boulevard	37243	Knoxville	3711 Middlebrook Pike	37921
Columbia	1421 Hampshire Pike	38401	Johnson City	2305 Silverdale Road	37601

APPENDIX B

USGS science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

OAK HILL QUADRANGLE
TENNESSEE
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid:Universal Transverse Mercator, Zone 16S
This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery........NAIP, June 2016 - October 2016
Roads........U.S. Census Bureau, 2016 - 2019
Names........GNIS, 1980 - 2022
Hydrography........National Hydrography Dataset, 2002 - 2018
Contours........National Elevation Dataset, 2019
Boundaries........Multiple sources; see metadata file 2019 - 2021
Wetlands........FWS National Wetlands Inventory 1980 - 1981

3°46' 67 MILS
0°7' 2 MILS
UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000 - m Square ID
EE
Grid Zone Designation 16S

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

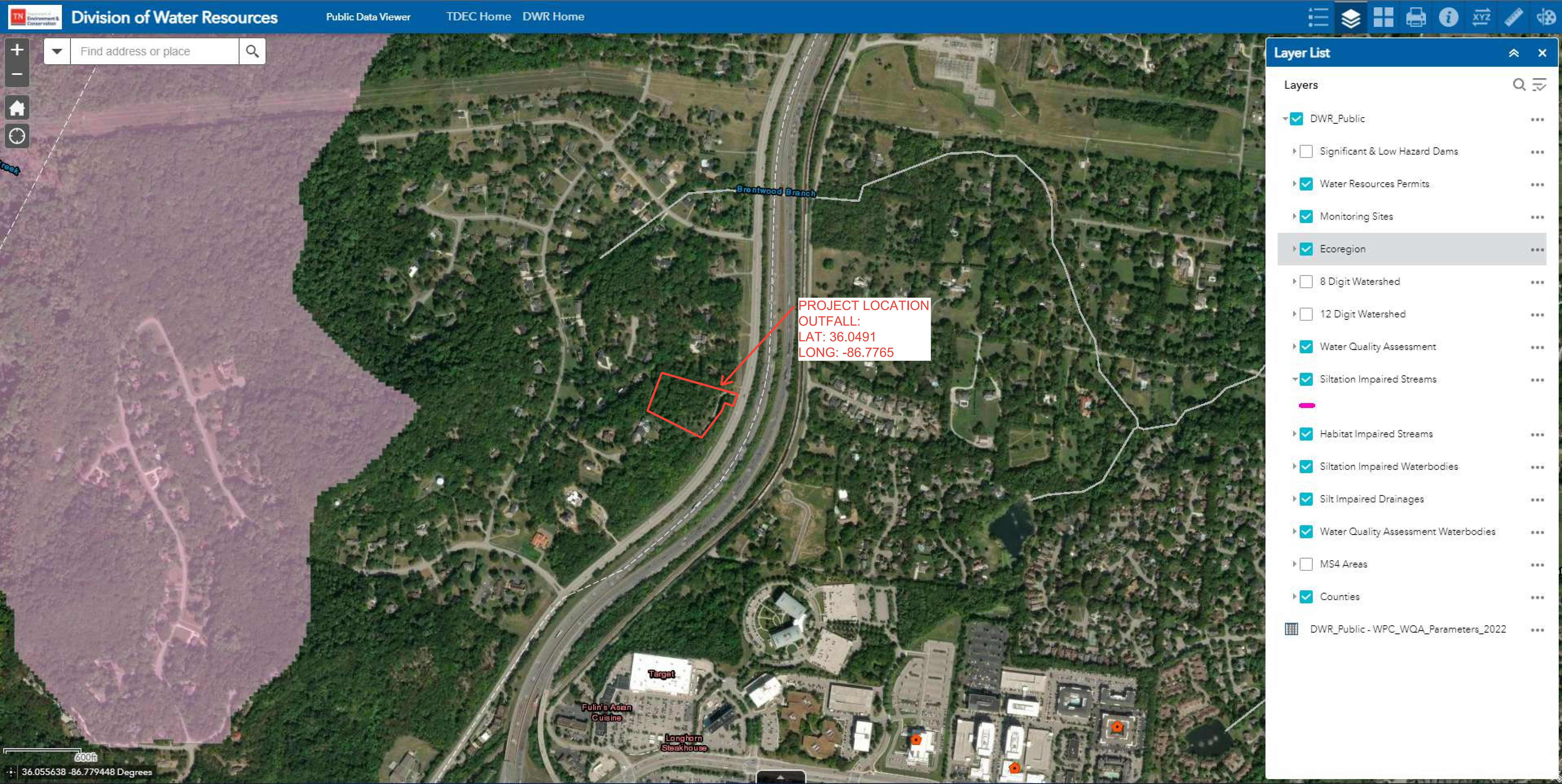
This map was produced to conform with the National Geospatial Program US Topo Product Standard.

QUADRANGLE LOCATION

ADJOINING QUADRANGLES
1 Scottsboro
2 Nashville West
3 Nashville East
4 Bellevue
5 Antioch
6 Leipers Fork
7 Franklin
8 Nolensville

ROAD CLASSIFICATION
Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route

OAK HILL, TN
2022


Division of Water Resources
Public Data Viewer
TDEC Home
DWR Home
Find address or place
Brentwood Branch
PROJECT LOCATION
OUTFALL:
LAT: 36.0491
LONG: -86.7765
Target
Fulin's Asian Cuisine
Longhorn Steakhouse
600ft
36.055638 -86.779448 Degrees
Layer List
Layers
DWR_Public
Significant & Low Hazard Dams
Water Resources Permits
Monitoring Sites
Ecoregion
8 Digit Watershed
12 Digit Watershed
Water Quality Assessment
Siltation Impaired Streams
Habitat Impaired Streams
Siltation Impaired Waterbodies
Silt Impaired Drainages
Water Quality Assessment Waterbodies
MS4 Areas
Counties
DWR_Public - WPC_WQA_Parameters_2022

EROSION CONTROL LEGEND

DESCRIPTION	SYMBOL
SILT FENCE, TCP–13	
STABILIZED CONSTRUCTION ENTRANCE, TCP–03	
CONCRETE WASHOUT	CW
SLOPE MATTING, TCP–09	
SEDIMENT TUBE, TCP–14	
OUTLET PROTECTION, PESC – 07	
CHECK DAM, TCP–12	
TREE PROTECTION	
LIMITS OF DISTURBANCE = 2.21 ACRES	

NOTE:

ALL PERIMETER MEASURES MUST BE IN PLACE BEFORE GRADING.

CONTRACTOR SHALL PROVIDE AN AREA FOR CONCRETE WASH DOWN AND EQUIPMENT FUELING IN ACCORDANCE WITH METRO CP–10 AND CP–13, RESPECTIVELY. CONTRACTOR TO COORDINATE EXACT LOCATION WITH NPDES DEPARTMENT DURING PRECONSTRUCTION MEETING. CONTROL OF OTHER SITE WASTES SUCH AS DISCARDED BUILDING MATERIALS, CHEMICALS, LITTER, AND SANITARY WASTES THAT MAY CAUSE ADVERSE IMPACTS TO WATER QUALITY IS ALSO REQUIRED BY THE GRADING PERMITTEE.

ANY DISTURBED AREA LEFT EXPOSED FOR A PERIOD GREATER THAN 14 DAYS SHALL BE STABILIZED ACCORDING TO TDEC'S SPECIFICATIONS.

PROVIDE EROSION CONTROL MATTING ON ALL SLOPES 3:1 OR GREATER.

SITE CONTAINS 15% OR GREATER SLOPES ACROSS THE PROPERTY.

ALL GRASSED AREAS ON SLOPES 15% OR GREATER WILL REQUIRE SOD.

GEOTECHNICAL ENGINEER SHALL BE ON SITE DURING CONSTRUCTION TO MONITOR CONSTRUCTION. ENGINEER SHALL SUBMIT A GEOTECHNICAL CERTIFICATION LETTER CERTIFYING THE STABILITY OF THE SLOPE AND THE STRUCTURE TO THE CITY OF OAK HILL UPON COMPLETION OF CONSTRUCTION AND PRIOR TO THE ISSUANCE OF A CERTIFICATE OF OCCUPANCY.

MAP NO. 16.01 - PARCEL 07.00

PROJECT BENCHMARK
BENCHMARK DESCRIPTION: HYDRANT TAG BOLT
N: 625410.80 ELEVATION: 725.07
E: 1738950.30 (NAVD88)

30' 15' 0' 30' 60'
SCALE IN FEET
GRAPHIC SCALE 1"=30'

SWS ENGINEERING, INC.
CIVIL ENGINEERING • LAND PLANNING • SURVEYING
504 Autumn Springs Court, Suite A-6
Franklin, TN 37067
951-704-0890
SAN DIEGO - NASHVILLE - PHOENIX

DATE: May 16, 23 9:56am by: preston.ayer
FILE: N:\2022\22-270T\PROD\Construct\GP\LOT 1\22-270T_GP-C3.00 Initial EPSC Plan.dwg

MICHAEL D. SCHWEITZER
REGISTERED ENGINEER
AGRICULTURE
STATE OF TENNESSEE
5/03/23

Tennessee811
Know what's below. Call before you dig.

INITIAL EPSC PLAN

CONSTRUCTION DOCUMENTS
5421, 5425, 5429 FRANKLIN PIKE
NASHVILLE, TENNESSEE 37220

REV.	COMMENTS	DATE

C3.00

JOB NO.: 22-270T

DRAWN BY:	DMO	CHKD BY:	PDA

EROSION CONTROL LEGEND

DESCRIPTION	SYMBOL
SILT FENCE, TCP-13	
STABILIZED CONSTRUCTION ENTRANCE, TCP-03	
CONCRETE WASHOUT	CW
SLOPE MATTING, TCP-09	
SEDIMENT TUBE, TCP-14	
OUTLET PROTECTION, PESC - 07	
CHECK DAM, TCP-12	
TREE PROTECTION	
LIMITS OF DISTURBANCE = 2.21 ACRES	

NOTE:

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MAP NO. 16.01 - PARCEL 07.00

PROJECT BENCHMARK
BENCHMARK DESCRIPTION: HYDRANT TAG BOLT
N: 625410.80 ELEVATION: 725.07
E:1738950.30 (NAVD88)

30' 15' 0' 30' 60'
SCALE IN FEET
GRAPHIC SCALE 1"=30'

SWS ENGINEERING, INC.
CIVIL ENGINEERING • LAND PLANNING • SURVEYING
504 Autumn Springs Court, Suite A-6
Franklin, TN 37067
951-704-0890
SAN DIEGO - NASHVILLE - PHOENIX
DATE: May 16, 23 9:56am by: preston.ayer
FILE: N:\2022\22-270T\PROD\Construct\GP\LOT 1\22-270T_GP-C3.01 Construction EPSC Plan.dwg

MICHAEL D. SCHWEITZER
REGISTERED ENGINEER
AGRICULTURE COMMERCE
NO. 124978
STATE OF TENNESSEE
5/03/23

Tennessee811 Know what's below. Call before you dig.

CONSTRUCTION EPSC PLAN

CONSTRUCTION DOCUMENTS
5421, 5425, 5429 FRANKLIN PIKE
NASHVILLE, TENNESSEE 37220

REV.	COMMENTS	DATE

C3.01

JOB NO.: 22-270T

DRAWN BY:	DMO	CHKD BY:	PDA

EROSION CONTROL LEGEND

DESCRIPTION	SYMBOL
SILT FENCE, TCP-13	
STABILIZED CONSTRUCTION ENTRANCE, TCP-03	
CONCRETE WASHOUT	CW
SLOPE MATTING, TCP-09	
SEDIMENT TUBE, TCP-14	
OUTLET PROTECTION, PESC - 07	
CHECK DAM, TCP-12	
TREE PROTECTION	
LIMITS OF DISTURBANCE = 2.21 ACRES	

NOTE:

ALL PERIMETER MEASURES MUST BE IN PLACE BEFORE GRADING.

CONTRACTOR SHALL PROVIDE AN AREA FOR CONCRETE WASH DOWN AND EQUIPMENT FUELING IN ACCORDANCE WITH METRO CP-10 AND CP-13, RESPECTIVELY. CONTRACTOR TO COORDINATE EXACT LOCATION WITH NPDES DEPARTMENT DURING PRECONSTRUCTION MEETING. CONTROL OF OTHER SITE WASTES SUCH AS DISCARDED BUILDING MATERIALS, CHEMICALS, LITTER, AND SANITARY WASTES THAT MAY CAUSE ADVERSE IMPACTS TO WATER QUALITY IS ALSO REQUIRED BY THE GRADING PERMITTEE.

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SWS ENGINEERING, INC.
CIVIL ENGINEERING • LAND PLANNING • SURVEYING
504 Autumn Springs Court, Suite A-6
Franklin, TN 37067
951-704-0890
SAN DIEGO - NASHVILLE - PHOENIX

DATE: May 16, 23 9:57am by:preston.ayer
FILE:N: \2022\22-270T\PROD\Construct\GP\LOT 1\22-270T_GP-C3.02 Final EPSC Plan.dwg

MICHAEL D. SCHWEITZER
REGISTERED ENGINEER
AGRICULTURE COMMERCE
NO. 124979
STATE OF TENNESSEE
5/03/23

Tennessee811
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FINAL EPSC PLAN

CONSTRUCTION DOCUMENTS
5421, 5425, 5429 FRANKLIN PIKE
NASHVILLE, TENNESSEE 37220

REV. | DATE | COMMENTS

MAP NO. 16.01 - PARCEL 07.00

PROJECT BENCHMARK
BENCHMARK DESCRIPTION: HYDRANT TAG BOLT
N: 625410.80 ELEVATION: 725.07
E: 1738950.30 (NAVD88)

30' 15' 0' 30' 60'
SCALE IN FEET
GRAPHIC SCALE 1"=30'

C3.02

JOB NO.: 22-270T

DRAWN BY:	DMO	CHKD BY:	PDA

ACTIVITY: Silt Fence | TCP – 13

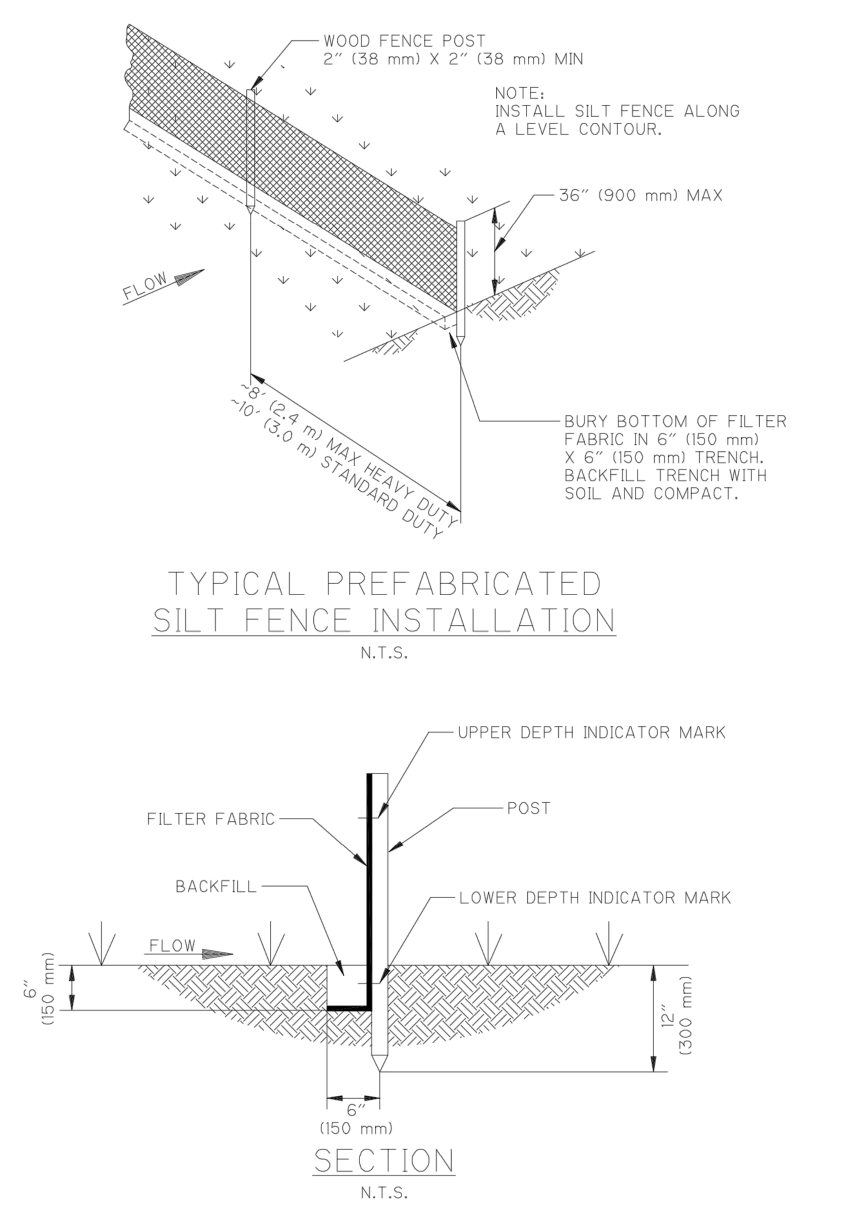


Figure TCP-13-1
Silt Fence Anchoring

DETAIL #1 - SILT FENCE

ACTIVITY: Stabilized Construction Entrance | TCP – 03

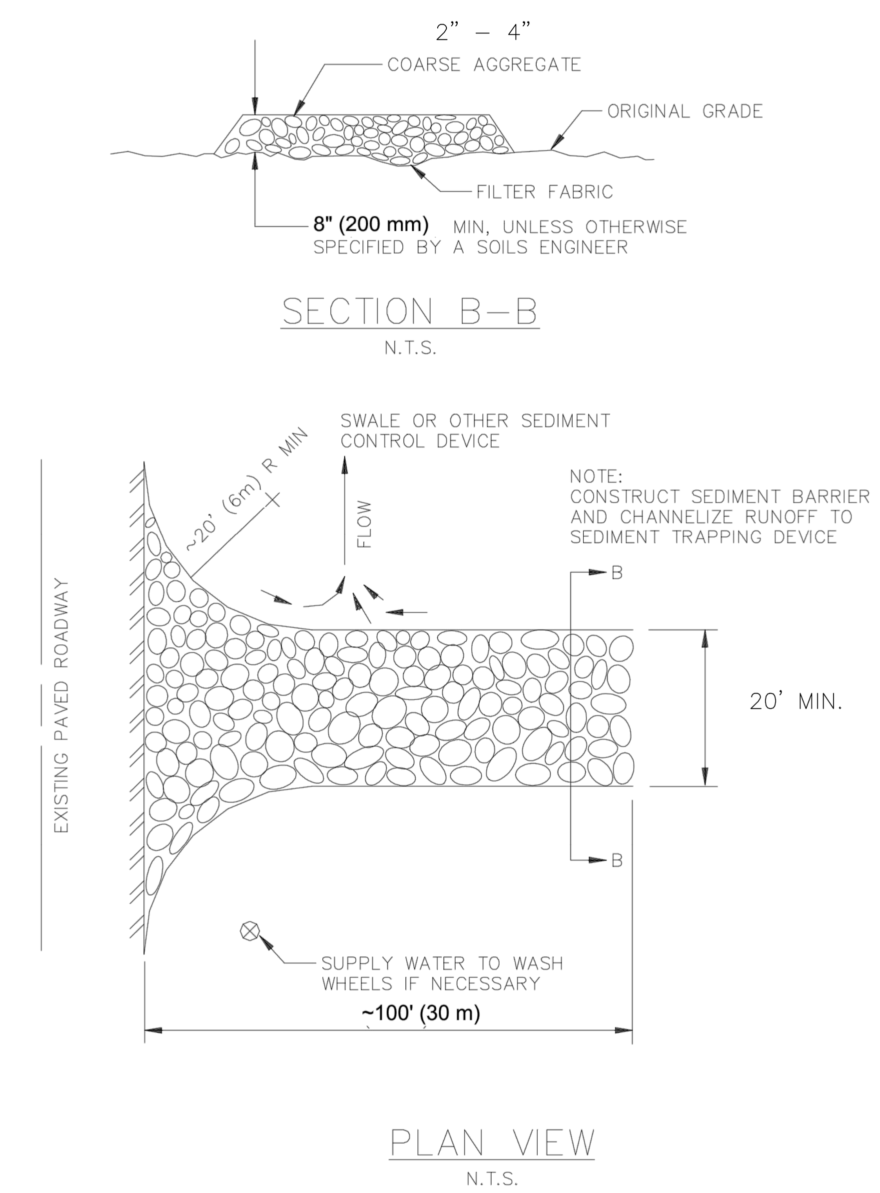


Figure TCP-03-1
Stabilized Construction Entrance

DETAIL #2 - CONSTRUCTION ENTRANCE

ACTIVITY: Weighted Sediment Tube | TCP – 14

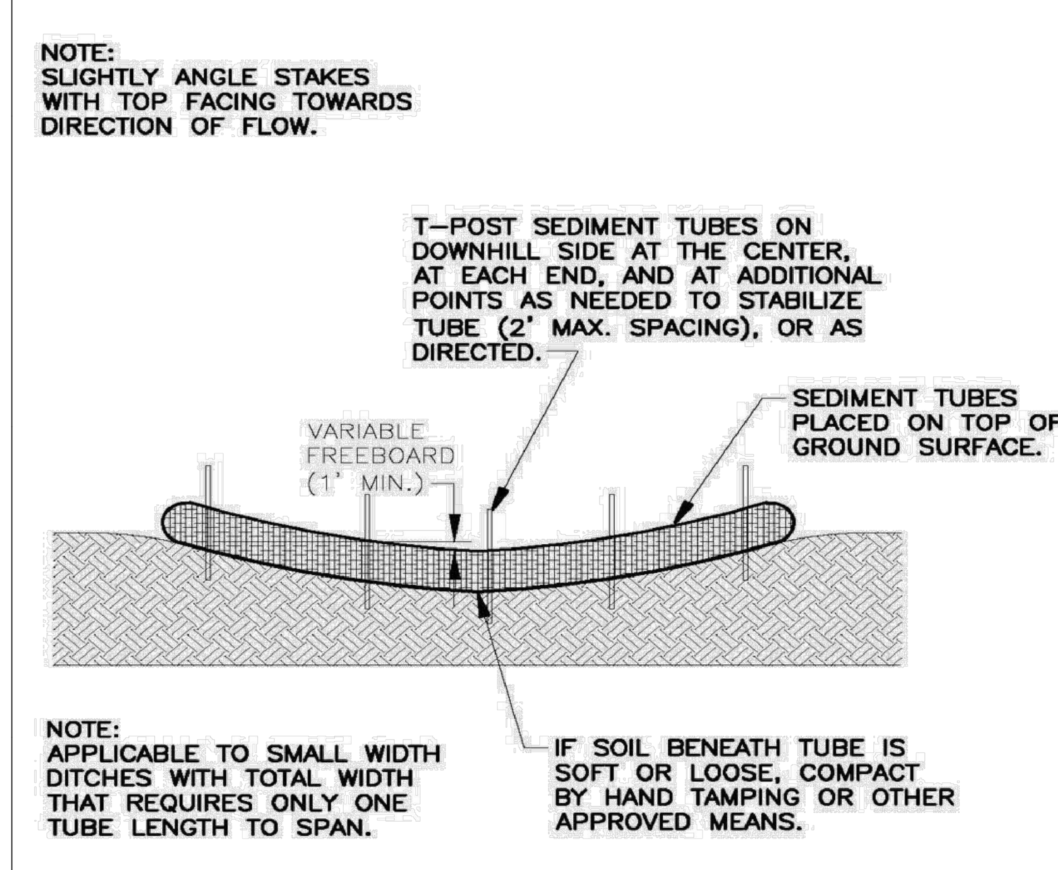


Figure TCP-14-1
Small Ditch Checks for Sediment Tubes

DETAIL #3 - SEDIMENT TUBE

ACTIVITY: Nets and Mats | TCP – 09

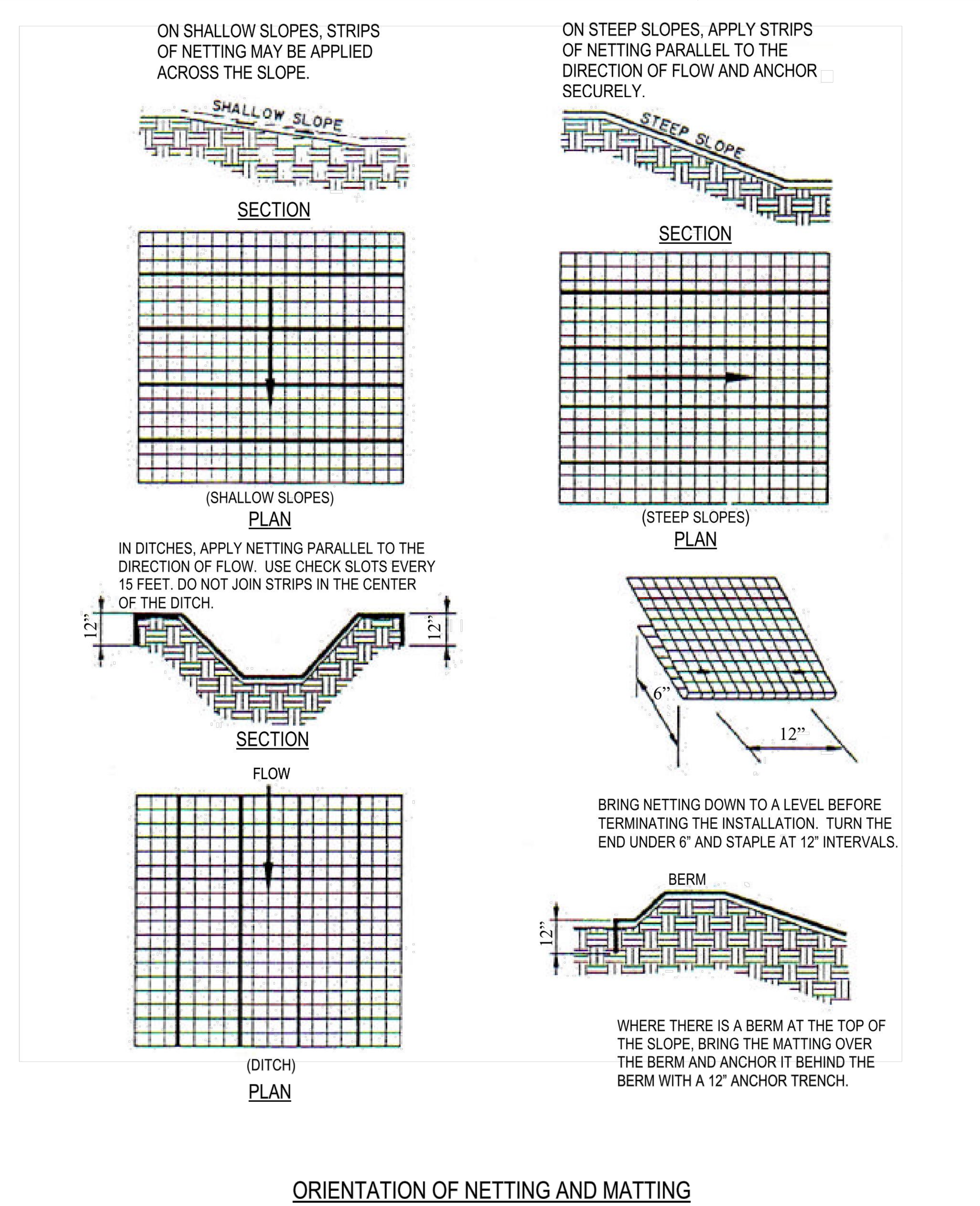
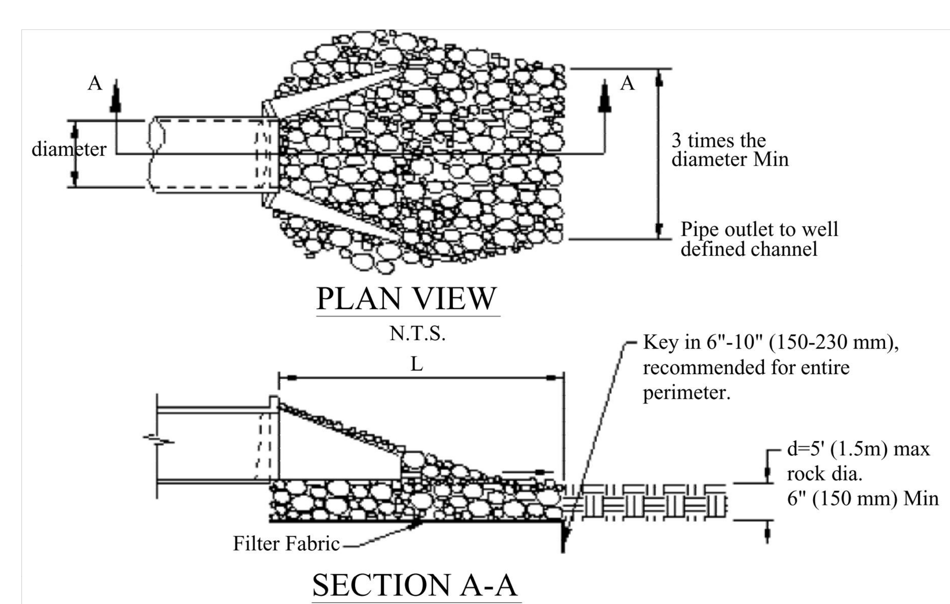


Figure TCP-09-2
Mat Anchoring and Layout

DETAIL #4 - EROSION CONTROL MATTING

ACTIVITY: Outlet Protection | PESC – 07



Adapted from: Virginia Erosion & Sediment Control Handbook, 1992

Pipe Diameter in (mm)	Discharge ft³/s (m³/s)	Apron Length, L ft (m)	Rip-Rap D_{50} Diameter Min in (mm)
12 (300)	4.9 (0.14)	10 (3)	4 (100)
	9.89 (0.28)	13 (4)	6 (150)
18 (450)	9.89 (0.28)	10 (3)	6 (150)
	20.13 (0.57)	16 (5)	8 (200)
	30.01 (0.85)	23 (7)	12 (300)
	39.90 (1.13)	26 (8)	16 (400)
24 (600)	30.01 (0.85)	16 (5)	8 (200)
	39.90 (1.13)	26 (8)	8 (200)
	50.14 (1.42)	26 (8)	12 (300)
	60.03 (1.70)	30 (9)	16 (400)
For larger or higher flows, consult a registered civil engineer			

Source: Adapted from USDA-SCS

Figure PESC-07-1
Outlet Protection Sizing

DETAIL #5 - OUTLET PROTECTION

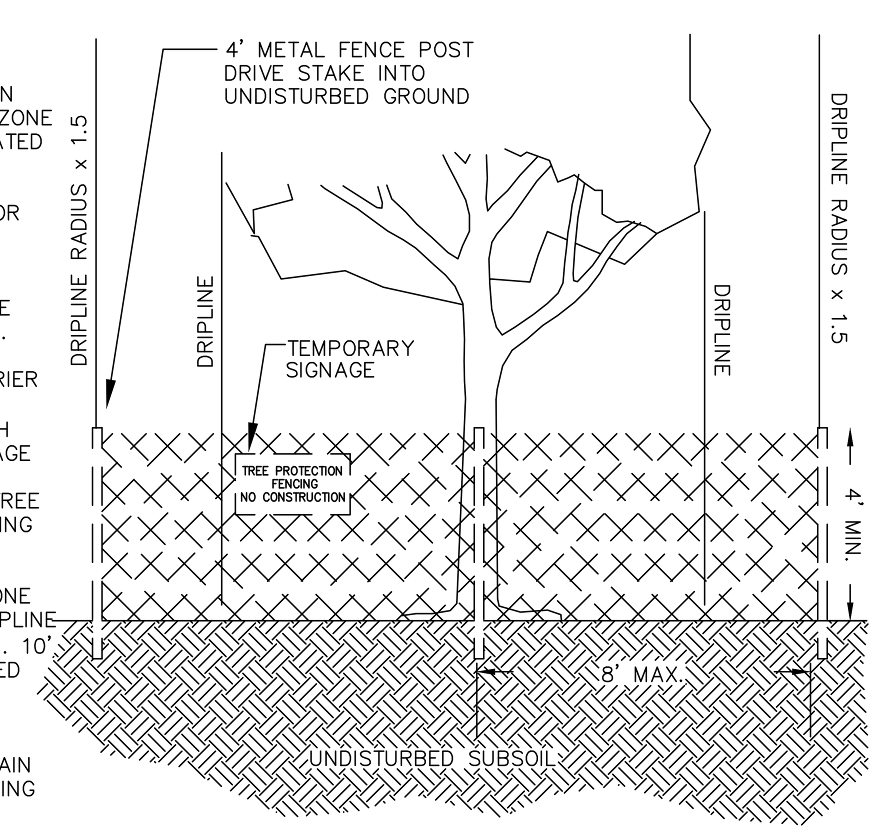
NOTE:

ANY REQUIRED EXCAVATION WITHIN THE PROTECTION ZONE SHALL BE EXCAVATED BY HAND.

NO STOCKPILING OR STORAGE OF MATERIALS IS PERMITTED WITHIN THE LIMITS OF THE PROTECTION AREA.

CONTINUOUS BARRIER OF 4' HIGH CHAIN LINK FENCING WITH TEMPORARY SIGNAGE DELINEATING BOUNDARIES OF TREE PROTECTION FENCING FENCING TO ENCOMPASS THE CRITICAL ROOT ZONE OR 1.5 x THE DRIPLINE OF THE TREE, MIN. 10' SQUARE PROTECTED AREA REQUIRED.

FILLING MAY BE ALLOWED IN CERTAIN AREAS, SEE GRADING PLANS



CONTRACTORS RESPONSIBILITY TO ACQUIRE TREE REMOVAL PERMITS

DETAIL #6 - TREE PROTECTION

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CIVIL ENGINEERING • LAND PLANNING • SURVEYING
504 Autumn Springs Court, Suite A-6
Franklin, TN 37067
615-794-0890
SAN DIEGO • NASHVILLE • PHOENIX

MICHAEL D. SCHWEITZER
STATE OF TENNESSEE
REGISTERED ENGINEER
AGRICULTURE COMMERCE
No. 124979
4/18/23

Tennessee811
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EPSC DETAILS
CONSTRUCTION DOCUMENTS
5421 FRANKLIN PIKE
NASHVILLE, TENNESSEE 37220

REV.	DATE	COMMENTS

C5.20

JOB NO.: 22-270T

DRAWN BY:	DMO	CHKD BY:	PDA

APPENDIX C

7.2 CONSTRUCTION SEQUENCING

Definition A work schedule specific to each project that coordinates the timing of land disturbing activities, installation of erosion prevention and sediment control measures, permanent stormwater management controls and stabilization.

Purpose To minimize the erosion and sedimentation by performing land disturbing activities, installing EPSC measures, installing permanent stormwater controls and stabilization in accordance with a planned schedule. Note that phasing is a site management technique within an overall construction schedule, but should not be mistaken for the construction schedule itself.

Conditions Where Practice Applies All construction sites disturbing one or more acres are required to have a construction schedule in their SWPPP. However, sites that affect less than one acre can benefit from a planned construction schedule as well.

Design Criteria The construction sequence should be designed and written so that it is easily understood and followed by contractors and subcontractors. The sequence should clearly state the order in which erosion prevention and sediment control devices are to be installed, including stating what measures should be in place before other activities are begun. See Table 5.2-1 in Chapter 5 for an example construction sequence.

An example of construction sequencing could be as follows:

- Install Construction entrance, mark sensitive areas, and designate equipment and chemical storage areas.
- Install sediment basins and traps, silt fencing, and other sediment barriers for Phase 1.
- Install runoff controls such as diversion structures, silt fence, wattles, and outlet protection for Phase 1.
- Perform land clearing and grading, installing EPSC components at the earliest possible time during grading activities for Phase 1. Maintain EPSC measures throughout the grading process.
- Stabilize surfaces immediately in areas where work is delayed or completed.
- Mark sensitive areas and install perimeter measures for Phase 2.
- Clear and grub Phase 2.
- Install sediment traps and other internal controls. Maintain controls.
- Install permanent stabilization measures in Phases 1 and 2, such as seeding and mulching, sodding, and riprap at earliest possible time following completion of grading and construction activities.
- Remove temporary controls and stabilize all disturbed areas.

As in the CGP, project sites exceeding 50 acres of disturbance require phasing. In some cases individual construction sequences may be provided for each individual planned phase, while in other cases the designer may find it necessary to provide an overall construction sequence which interconnects the phases and encompasses the project as a whole.

Construction Specifications

The construction sequence is a part of the SWPPP and therefore shall be maintained onsite and be available to all contractors and subcontactors at all times. Efforts to adhere to construction sequence should be a coordinated effort between all parties onsite.

Maintenance and Inspection Points

Follow the construction sequence throughout the entire project development. When changes in construction activities are needed, amend the sequence schedule in advance to maintain management control.

References

North Carolina Erosion and Sediment Control Planning and Design Manual

TDOT Design Division Drainage Manual

7.3 TOPSOILING

Definition The act of scraping topsoil from a construction site and reserving it for use to aid final stabilization.

Purpose To provide a suitable soil medium to support vegetation growth.

Conditions Where Practice Applies Topsoiling should be utilized on all construction sites where topsoil is available at the surface of the soil. Preserving topsoil for use at final stabilization ensures a healthy stand of vegetation. Topsoil storage areas should have EPSC measures applied, such as stockpile perimeter controls and temporary cover. Topsoil should only be placed on slopes less than 2:1 unless additional engineered slope stabilization is applied to prevent slippage.

Planning Considerations Topsoil is the major zone of root development and biological activity. It is generally darker than the subsoils due to enrichment with organic matter, but not all darker soils are topsoils. Questionable soils available for topsoiling should be analyzed by a soils specialist or soil scientist to insure that the soils can in fact support vegetation growth.

Although topsoil may improve growth capabilities for vegetation, there are some disadvantages to topsoiling. Stripping, stockpiling, hauling, and spreading topsoil, or importing topsoil, may not be cost-effective for some projects. In addition, some topsoil contains weed seeds which compete with desirable vegetation species.

In planning for the final grading and vegetation of a site, the designer should compare the options of topsoiling with preparing a seedbed in the available subsoils.

Subgrade elevations and finished grade elevations should be considered when planning for topsoil thickness.

Topsoil stockpiling should be conducted early in the project as large disturbed areas are scheduled. Placement of topsoil should be completed at the end of construction just before permanent vegetation is to be installed.

Design Criteria

Topsoil should be stripped and stockpiled onsite before grading activities are commenced in any new area of the site. Stockpiled topsoil should be stabilized utilizing temporary vegetation practices *(refer to Sections 7.8 and 7.10 for more information).* Include a topsoil stockpile area on the EPSC Plan and in the construction sequence. Stockpile areas should be located where topsoil is less likely to discharge into streams and other sensitive areas if measures failed; where it does not block natural or artificial drainage ways; and where it does not interfere with work on the site.

Construction Specifications

The topsoil stockpile must be protected against erosion. Stabilize the stockpile with a temporary or permanent groundcover. In addition, perimeter measures should be provided around the stockpile area to prevent sediment migration.

Once grading on any portion of the site has reached final grade, topsoil should be spread prior to final stabilization. Topsoil placement should not be specified in areas where slopes are steeper than 2:1.

Good quality topsoil has the following characteristics:

General Characteristics – Topsoil should be friable and loamy, free of debris, objectionable weeds and stones, and contain no toxic substances that may be harmful to plant growth. Topsoil should be handled only when it is dry enough to work without damaging the soil structure.

Texture – Loam, sandy loam, and silt loam are best; sandy clay loam, silty clay loam, clay loam, and loamy sand are fair. Heavy clay and organics such as peat or muck should not be used as topsoil.

Organic Matter Content – Organic materials should be greater than 2% by weight.

Fertility and nutrients – pH range should be 5.5 to 7.0; liming may be specified if pH is less than 5.5. Soil test for nutrients as well, based upon the type of vegetation to be established.

Organic and inorganic soil amendments (see Chapter 7) may be applied to topsoil to achieve the desired characteristics.

The depth of topsoil to be applied should be 5 inches (unsettled).

STRIPPING
Strip topsoil only from areas that will be disturbed by excavation, filling, paving, or compaction by equipment. Stripping depth various and should be site-specific.

STOCKPILING
Topsoil stockpiles should be located to avoid slopes, natural and artificial drainage ways, and construction traffic. Multiple stockpiles near areas to be stripped may be specified on large sites so that re-spreading topsoil is more efficient and economical.

Sediment controls should be specified where necessary around stockpiles to prevent eroded topsoils from leaving the stockpile area. Temporary seeding practices should be performed no more than 15 days after the formation of the stockpile. Permanent groundcovers should be considered where topsoil stockpiles are to be inactive for longer periods of time.

TOPSOIL SPREADING
Topsoil should be spread only when grading activities have been completed and permanent vegetation is to be applied. Grades should be maintained according to the approved plan, and final grades should not be altered by adding topsoil. The subgrade surface should be roughened by disking or scarifying to a minimum depth of 4 inches prior to spreading topsoil to ensure bonding of the topsoil and subsoils. Apply lime or fertilizer to subgrade before roughening.

Topsoil should be uniformly distributed to a minimum depth of 5 inches and compacted. Do not spread topsoil while it is excessively wet or frozen. Uniformly moisten excessively dry soil that is not workable or too dusty. Correct any irregularities in the surface to prevent the formation of depressions or water pockets. After topsoil application, follow procedures for permanent vegetation.

Maintenance and Inspection Points

Topsoiled areas should be inspected for erosion, depressions or ridges, rocks, and other foreign materials prior to beginning permanent vegetation applications. These areas are subject to ongoing inspections and maintenance until final permanent stabilization has been achieved and a Notice of Termination has been submitted.

References

TDOT Design Division Drainage Manual

North Carolina Erosion and Sediment Control Planning and Design Manual

AIA Masterspec 95 Format, section 02920

STABILIZATION PRACTICES

7.8 TEMPORARY VEGETATION

TS STABILIZATION WITH TEMPORARY VEGETATION

Definition The establishment of temporary vegetative cover with fast growing species for seasonal protection on disturbed or denuded areas.

Purpose To temporarily stabilize denuded areas that will not be brought to final grade for a period of more than 14 days.

Temporary seeding controls runoff and erosion until permanent vegetation or other erosion control measures can be established. Seeding with a temporary groundcover provides temporary stabilization until permanent stabilization can be achieved. In addition, it provides residue for soil protection and seedbed preparation, and reduces problems of mud and dust production from bare soil surfaces during construction.

Conditions Where Practice Applies On any cleared, unvegetated, or sparsely vegetated soil surface where vegetative cover is needed for less than 1 year.

For permanent seeding specifications, see Section 7.9.

Planning Considerations Annual plants that sprout and grow rapidly and survive for only one season are suitable for establishing initial or temporary vegetative cover. Temporary seeding preserves the integrity of earthen sediment control structures such as dikes, diversions, and the banks of dams and sediment basins. It can also reduce the amount of maintenance associated with these devices. For example, the frequency of sediment basin cleanouts will be reduced if the watershed areas outside the active construction zone are stabilized.

Proper seedbed preparation, selection of appropriate species, and the use of quality seed are important. Failure to follow established guidelines and recommendations carefully may result in an inadequate or short-lived stand of vegetation that will not control erosion. Temporary seeding provides protection for no more than 1 year, during which time permanent stabilization should be initiated.

Design Criteria

Complete grading before preparing seedbeds, and install all necessary erosion control practices such as dikes, waterways, and basins. Minimize steep slopes because they make seedbed preparation difficult and increase the erosion hazard. If soils become compacted during grading, loosen them to a depth of 6-8 inches using a ripper, harrow, or chisel plow.

Construction Specifications

Grading and Shaping: Excessive water runoff shall be reduced by properly designed and installed erosion control practices such as ditches, dikes, diversions, and sediment basins. No shaping or grading is required if slopes can be stabilized by hand-seeded vegetation or if hydraulic seeding equipment is to be used.

Seedbed Preparation: Good seedbed preparation is essential to successful plant establishment. A good seedbed is well pulverized, loose and uniform. Where hydroseeding methods are used, the surface may be left with a more irregular surface of large clods and stones.

Liming: Apply lime according to soil test recommendations. If the pH (acidity) of the soil is not known, an application of ground agricultural limestone at the rate to 1 to 1½ tons/acre on coarse textured soils and 2-3 tons/acre on fine textured soils is usually sufficient. Apply limestone uniformly and incorporate into the top 4-6 inches of soil. Soils with a pH of 6 or higher do not need to be limed.

Fertilizer: Base application rates on soil tests. When soil tests are not possible, apply a 10-10-10 grade fertilizer at 700-1000lb/acre. Both fertilizer and lime should be incorporated into the top 4-6 inches of soil. If a hydraulic seeder is used, do not mix seed and fertilizer more than 30 minutes before the application.

Surface Roughening: If recent tillage operations have resulted in a loose surface, additional roughening may not be necessary, except to break up large clods. If rainfall caused the surface to become sealed or crusted, loosen it just prior to seeding by disking, raking, harrowing, or other suitable methods. Groove or furrow slopes steeper than 3:1 on the contour before seeding.

Seeding: Select a non-invasive grass or grass-legume mixture suitable to the area and season of the year. See Figures 7.8-1 to 7.8-3 for suggestions of temporary seeding species. Although native plants are preferred, there are currently no available native species that are not cost prohibitive. Non-invasive annual plants are preferred. Seed shall be applied uniformly by hand, cyclone seeder, drill, cultipacker seeder, or hydraulic seeder. Drill or cultipacker seeders should normally place seed ¼ to ½ inches deep. Appropriate depth of planting is 10 times the seed diameter. Soil should be raked lightly to cover seed with soil if seeded by hand.

Mulching: The use of mulch will help ensure establishment under normal conditions, and is essential to seeding success under harsh site conditions. Harsh site conditions include:

- Seeding in fall for winter cover
- Slopes steeper than 3:1
- Excessively hot or dry weather
- Adverse soils (shallow, rocky, or high in clay or sand), and
- Areas receiving concentrated flow.

Irrigation: During times of drought, water shall be applied at a rate not causing runoff and erosion. The soil shall be thoroughly wetted to a depth that will ensure germination of the seed. Subsequent applications should be made as needed. Newly seeded areas require more water than more mature plants.

Species	**Rate (lb/acre)**
Rye	120

Seeding dates

East ....Above 2500 feet: Feb. 15 - May 15
Below 2500 feet: Feb. 1- May 1
Middle .... Jan. 1 - May 1
West .... Dec. 1 - Apr. 15

Soil amendments

Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance

Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage.

Figure 7.8-1 Temporary Seeding Recommendation for Late Winter and Early Spring

Species	**Rate (lb/acre)**
Oats	60
Brown top millet	30

Seeding dates

East .... May 15 - Aug. 15
Middle .... May 1 - Aug. 15
West .... Apr. 15 - Aug. 15

Soil amendments

Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance

Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage.

Figure 7.8-2 Temporary Seeding Recommendation for Summer

Species	**Rate (lb/acre)**
Oats	30
Winter wheat	30

Seeding dates

East .... Aug 15 – Dec 15
Middle .... Aug. 15 – Dec 30
West .... Aug. 15 – Dec 30

Soil amendments

Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance

Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage. If necessary to extend temporary cover beyond June 15, overseed with 50 lb/ac crimson clover in late February or early March.

Figure 7.8-3 Temporary Seeding Recommendations for Fall

Maintenance and Inspection Points

Reseed and mulch areas where seedling emergence is poor or where erosion occurs, as soon as possible. Do not mow.

References

North Carolina Erosion and Sediment Control Planning and Design Manual

STABILIZATION PRACTICES

7.9 PERMANENT VEGETATION

PS STABILIZATION WITH PERMANENT VEGETATION

Definition The planting of native perennial vegetation such as ground covers, shrubs, vines, trees, and/or flowering plants (forbs) on exposed areas for erosion control and final stabilization. Permanent perennial vegetation is required to achieve final stabilization. Native perennial plants are preferred for erosion control because of the following reasons:

- In appropriate habitats, native plants are better adapted to environmental and site conditions, resulting in lower maintenance costs
- Natives are not typically aggressive and do not allow the site to become a source of exotic invasive plants that can spread to other locations and become costly to remove
- Unlike most non-natives, native plants support native insect, bird, and other wildlife for pollinations, food sources, and nesting
- Using native plants provides opportunities to educate and demonstrate various sustainable approaches for the public
- The Tennessee Exotic Pest Plant (TNEPPC) council has ranked non-native plants in Tennessee based on their invasiveness and threats to the natural environment. The following plants that have been used for erosion control ty TDEC and TDOT are listed in TNEPPC's publication **"Invasive Exotic Pest Plants in Tennessee – 2009"**:
  - Korean (and Kobe) lespedeza – "Severe Threat" Category (Kobe is not ranked but has same invasive characteristics as Korean)
  - Tall fescue – "Significant Threat" Category

- Foxtail millet – "Significant Threat" Category
- Crown vetch – "Alert" Category

We are providing native and non-invasive alternative species as the preferred choice for erosion control and soil stabilization for TDEC projects. (Table 7.9-1)

Purpose

To reduce stormwater runoff velocity, maintain sheet flow, protect the soil surface from erosion, promote infiltration of runoff into the soil, and improve aesthetics and provide diversity. Many native grasses have very deep and fibrous roots, a minimum of one foot and up to fifteen feet, and provide long-term erosion control.

Conditions Where Practice Applies

Apply to fine-graded areas on which permanent, long-lived vegetative cover is the most practical or most effective method of stabilizing the soil. Permanent seeding may also be used on rough-graded areas that will not be brought to final grade for a year or more. Areas to be seeded with permanent vegetation must be seeded or planted within 14 days after the construction activity in that portion of the site has permanently ceased.

Planning Considerations

The most common and economical means of stabilizing disturbed soils is by seeding a mixture of grasses and forbs. The advantages of seeding over other means of establishing plants include the smaller initial cost, lower labor input, and greater flexibility of method. The disadvantages of seeding include the potential for erosion during the establishment stage, the need to reseed areas that fail to establish, seasonal limitations on suitable seeding dates, and a need for water and appropriate temperatures during germination and early growth. The probability of successful plant establishment can be maximized through good planning, knowledge of the soil characteristics, selection of suitable plant materials for the site, good seedbed preparation, adequate liming and fertilization, and timely planting and maintenance.

Native grasses can be planted by drilling or seeding. The ground should be prepared by discing or rotovating prior to seeding in the spring or summer. Annual grains such as rye or oats can be planted prior to sowing the grass seed for erosion control. Grass seed can be planted in the dormant season as well.

Permanent perennial vegetation is used to provide a protective cover for exposed areas including cuts, fill, and other denuded areas that will not be regraded. Permanent stabilization should be applied where topsoil was never stripped, or has been returned and incorporated into the soil surface.

- When stripping a site, topsoil should be stockpiled for later use.
- Stockpiled topsoil should be stabilized using temporary vegetation.
- Where a suitable planting medium is not present, topsoil shall be imported and incorporated into the site.
- Block sod provides immediate cover; it is especially effective in controlling erosion adjacent to concrete flumes and other structures. .
- When mixed plantings are done during marginal planting periods, companion crops shall be used.
- No-till planting can be effective when planting is done following a summer or winter annual cover crop.
- Irrigation should be used when the soil is dry or when summer plantings are done.

- Native species are low maintenance plants and are preferred to ensure long-lasting erosion control.
- Wildlife plantings of native species should be included when applicable.

Wildlife Plantings: Commercially available plants beneficial to wildlife species include the following:

- Mast Bearing Trees: Beech, Black Cherry, Blackgum, Chestnut, Oak, Hackberry, Hickory, Honey Locust, Black Locust, and Persimmon.
- Shrubs and Small Trees: Serviceberry, Crabapple, Pawpaw, Spicebush, Hazelnut, Dogwood, Highbush and Lowbush Blueberries, native Holly, Red Cedar, Red Mulberry, Sumac, Wild Plum, Blackhaw and Blackberry. Plant shrubs in patches without tall trees to develop stable shrub communities. All produce fruit used by many kinds of wildlife.

Design Criteria

The state is divided into three planting regions designated I, II and III as shown in the figure below. Native seed mixes are preferred and the recommendations are shown in Table 7-9.1. Note that the rates are based upon Pure Live Seed (PLS).

Figure 7.9-1: TN Planting Regions

Table 7.9-1 Preferred seed mixes using natives or naturalized plants and planting dates.
**non-native but do not spread.*

<table>
<tr><th colspan="2">Zone</th><th>Best</th><th>Marginal</th><th>Preferred Rate/Mix (lb/ac PLS)</th></tr>
<tr><td rowspan="3">Region I</td><td>Poorly drained soils</td><td>Feb 1 – Mar 20
Sept 1 – Sept 30</td><td>Mar 20 – Apr 30
Sept 30 – Oct 31</td><td>15 Browntop millet* (nurse crop)
2 switch grass
4 little bluestem
4 Virginia wild rye
4 purpletop
2 partridge pea
2 black-eyed susan</td></tr>
<tr><td>Well drained soils</td><td>Apr 1 – July 15</td><td></td><td>15 Browntop millet* (nurse crop)
4 little blue stem
4 purpletop
2 sideoats gramma
2 partridge pea
2 black-eyed susan</td></tr>
<tr><td>High maintenance</td><td>Apr 1 – July 15</td><td></td><td>15 Browntop millet* (nurse crop)
2 partridge pea
45 Red fescue*
45 hard fescue*
25 chewing fescue*</td></tr>
<tr><td rowspan="3">Region II</td><td>Low maintenance; Slopes and Poor, shallow soils</td><td>Aug 25 – Sept 15
Feb 15 – May 30</td><td>Sept 15 – Oct 25
Mar 21 – May 30</td><td>15 Browntop millet* (nurse crop)
5 little bluestem
2 switch grass
2 tall dropseed
5 sideoats gramma
2 black-eyed susan
2 partridge pea
1 greyheaded coneflower</td></tr>
<tr><td>Low maintenance; Moderate slopes; soils >6 in. depth</td><td>Aug 25 – Sept 15
Feb 15 – May 30</td><td>Sept 15 – Oct 25
Mar 21 – Apr 15</td><td>15 Browntop millet* (nurse crop)
5 purpletop
5 little bluestem
5 Virginia wild rye
2 black-eyed susan
2 partridge pea
1 greyheaded coneflower</td></tr>
<tr><td>High maintenance</td><td>Aug 30 – Oct 15</td><td>Feb 15 – Apr 15</td><td>15 Browntop millet* (nurse crop)
2 partridge pea
45 Red fescue*
45 hard fescue*
25 chewing fescue*</td></tr>
<tr><td rowspan="2">Region III</td><td>>2500 ft elevation; steep slopes</td><td>Mar 20 – Apr 30</td><td>Aug 15 – Aug 30
Mar 1 – Mar 20
Apr 20 – June 15</td><td rowspan="2">15 Browntop millet* (nurse crop)
5 purpletop
10 little bluestem
10 Indian grass
2 black-eyed susan
0.5 monarda (bergamot)
4 Maryland senna</td></tr>
<tr><td><2500 ft elevation; steep slopes</td><td>Aug 15 – Sept 1
Mar 1 – Apr 1</td><td>Sept 1 – Sept 15
Apr 1 – June 10</td></tr>
</table>

Region III *cont'd*	>2500 ft elev.; Shallow soils	Mar 20 – Apr 20	Aug 15 – Aug 30 Mar 5 – Mar 20 April 20 – June 15	15 Browntop millet* (nurse crop) 4 purpletop 10 little bluestem 10 broomsedge 2 partridge pea 2 black-eyed susan 0.5 monarda (bergamot)
	<2500 ft elev.; Shallow soils	Aug 15 – Sept 1 **Mar 1 – Apr 1**	Sept 1 – Sept 15 Apr 1 – June 10	
	>2500 ft. elev.; Moderate slopes	Mar 20 – Apr 20	Aug 15 – Aug 30 Mar 5 – Mar 20 Apr 20 – June 15	15 Browntop millet* (nurse crop) 4 purpletop 10 little bluestem 10 Indian grass 2 black-eyed susan 0.5 monarda (bergamot) 4 Maryland senna
	<2500 ft. elev.; Moderate slopes	Aug 15 – Sept 1 **Mar 1 – Apr 1**	Sept 1 – Sept 15 Apr 1 – June 10	
	>2500 ft elev.; High maintenance	**Mar 20 – Apr 20**	Aug 15 – Aug 30 Mar 5 – Mar 20 Apr 20 – June 15	15 Browntop millet* (nurse crop) 45 Red fescue* 45 hard fescue* 25 chewing fescue*
	<2500 ft elev.; High maintenance	Aug 15 – Sept 1 **Mar 1 – Apr 1**	Sept 1 – Sept 15 Apr 1 – June 10	

In Table 7.9-1, the bold dates are the preferred dates for seeding. Also, high maintenance areas include lawns and other grassed areas that will be maintained for aesthetics.

Table 7.9-2 Allowable seed mixes and planting dates.

Zone		Best	Marginal	Rate/Mix (lb/ac PLS)
Region I	Poorly drained soils	Feb 1 – Mar 20 Sept 1 – Sept 30	Mar 20 – Apr 30 Sept 30 – Oct 31	80 Pensacola bahiagrass 30 Bermudagrass (hulled) 20 Korean lespedeza** 10 Kobe lespedeza**
	Well drained soils	Apr 1 – July 15		50 Pensacola bahiagrass 15 Bermudagrass (hulled) 30 Korean lespedeza** 15 Foxtail millet**
	High maintenance	Apr 1 – July 15		40 Bermudagrass (hulled)
Region II	Low maintenance; Slopes and Poor, shallow soils	Aug 25 – Sept 15 **Feb 15 – Mar 21**	Sept 15 – Oct 25 Mar 21 – Apr 15	100 Pensacola bahiagrass 40 Bermudagrass (hulled) 20 Korean lespedeza** 10 Kobe lespedeza**
	Low maintenance; Moderate slopes; soils >6 in. depth	Aug 25 – Sept 15 **Feb 15 – Mar 21**	Sept 15 – Oct 25 Mar 21 – Apr 15	80 Pensacola bahiagrass 30 Bermudagrass (hulled) 20 Korean lespedeza** 10 Kobe lespedeza**
	High maintenance	Aug 15 – Oct 15	Feb 15 – Apr 15	200 KY 31 fescue**

Region III	>2500 ft elevation; steep slopes	July 25 - Aug 15 **Mar 20 – Apr 20**	July 15 – July 25 Aug 15 – Aug 30 Mar 1- Mar 20 Apr 20 – May 15	100 KY 31 fescue** 20 Kobe lespedeza** 10 Korean lespedeza** 5 Redtop
	<2500 ft elevation; steep slopes	Aug 15 – Sept 1 **Mar 1 – Apr 1**	July 25 – Aug 15 Sept 1 – Sept 15 Apr 1 – May 10	
	>2500 ft elev.; Shallow soils	July 25 - Aug 15 **Mar 20 – Apr 20**	July 15 – July 25 Aug 15 – Aug 30 Mar 5 – Mar 20 Apr 20 – May 15	40 KY 31 Fescue** 10 Korean lespedeza** 10 Redtop 10 Crown vetch**
	<2500 ft elev.; Shallow soils	Aug 15 – Sept 1 **Mar 1 – Apr 1**	July 25 – Aug 15 Sept 1 – Sept 15 Apr 1 – May 10	
	>2500 ft. elev.; Moderate slopes	July 25- Aug 15 **Mar 20 – Apr 20**	July 15 – July 25 Aug 15 – Aug 30 Mar 5 – Mar 20 Apr 20 – May 15	60 KY 31 fescue** 15 Korean lespedeza** 15 Kobe lespedeza**
	<2500 ft. elev.; Moderate slopes	Aug 15 – Sept 1 **Mar 1 – Apr 1**	July 25 – Aug 15 Sept 1 – Sept 15 Apr 1 – May 10	
	>2500 ft elev.; High maintenance	July 25 - Aug 15 **Mar 20 – Apr 20**	July 15 – July 25 Aug 15 – Aug 30 Mar 5 – Mar 20 Apr 20 – May 15	200 KY 31 fescue**
	<2500 ft elev.; High maintenance	Aug 15 – Sept 1 **Mar 1 – Apr 1**	July 25 – Aug 15 Sept 1 – Sept 15 Apr 1 – May 10	

Roundstone Native Seed, LLC
9764 Raider Hollow Road, Upton, KY 42784

Kind: Switchgrass		Lot No: 11074	
Variety:	Cave-in-Rock	Inert Matter:	1.78
Origin:	KY	Weed Seeds:	0.00
Test Date:	02/12	Crop Seeds:	0.00
Pure Seed:	98.22	Hard Seed:	0.00
Total Germ:	95.32	Germ:	95.32
Pure Live Seed:	93.62	Noxious:	0.00

Figure 7.9-2 Typical Seed

Seeding rates: *Seed rates in Table 7.9-1 are based upon Pure Live Seed (PLS), which is the product of the purity shown on the seed tag multiplied by the germination. The PLS for the seed tag shown in Figure 7.9-2 would be 0.9362 X 0.95 = 0.89 Thus only 89% of the seed are considered live. If the plan calls for a seed rate of 2 lb/acre of switchgrass find the actual seed rate for the conditions shown on the tag. Actual seed rate required is 2 lb/ac / 0.95 PLS = 2.15 lb/acre. In other words, to get an actual rate of 2 lb. per acre it will require 2.15 lb. of seed.*

Temporary seed may be required when seeding outside of the preferred seeding dates. See Section 7.8 for more information on temporary seeding.

Construction Specifications

Grading and Shaping: Grading and shaping may not be required where hydraulic seeding and fertilizing equipment is to be used. Vertical banks shall be sloped to enable plant establishment.

When conventional seeding and fertilizing are to be done, grade and shape the slope, where feasible and practical, so that equipment can be used safely and efficiently during seedbed preparation, seeding, mulching, and maintenance of vegetation.

Concentrations of water that could cause excessive soil erosion should be diverted to a safe outlet. Diversions and other treatment practices must conform to the appropriate standards and specifications.

Plant Selection: Only certified seed shall be used. Refer to Table 7.9-1 for suggested species. Grass type should be selected on the basis of species characteristics; site and soil conditions; planned use and maintenance of the area; time of year of planting, method of planting; and the needs and desires of the land user.

Plant selection may also include annual companion crops. Annual companion crops should be used only when the perennial species are not planted during their optimum planting period. Care should be taken in selecting companion crop species and seeding rates because annual crops will compete with perennial species for water, nutrients, and growing space. A high seeding rate of the companion crop may prevent the establishment of perennial species.

Ryegrass shall not be used in any seeding mixtures containing permanent, perennial species due to its ability to out-compete desired species chosen for permanent perennial cover. However, crimson, clover, oats and winter wheat can be planted any time of the year and are recommended as a cover crop with native perennial species.

Topsoil: Topsoil should be replaced on all areas to be seeded. See Practice 7.3 for more information on the removal, storage and reapplication of topsoil.

Seedbed Preparation: When conventional seeding is to be used, topsoil should be applied to any area where the disturbance results in subsoil at the final grade surface. Figure 7.9-3 provides guidance on the volume of topsoil required to provide specific topsoil depths. Soil pH should be above 5 – preferably between 6.0 and 6.5. Soil on the site should be tested to determine lime and fertilizer rates. Soil should be submitted to a soils specialist or County Agricultural Extension agent for testing and soil amendment recommendations. In the absence of soil test results, the following application rates can be used:

- **Ground agricultural limestone:**
  Light-textured, sandy soils: 1- 1 1/2 tons/acre
  Heavy-textured, clayey soils: 2-3 tons/acre
- **Fertilizer:**
  Grasses: 800-1200 lb/acre of 10-10-10 (or the equivalent)
  Grass-legume mixtures: 800-1200 lb/acre of 5-10-10 (or the equivalent)

Broadcast Seeding:

- Seedbed preparation may not be required where hydraulic seeding equipment is to be used.
- Tillage, at a minimum, shall adequately loosen the soil to a depth of 4 to 6 inches; alleviate compaction; incorporate topsoil, lime, and fertilizer; smooth and firm the soil; allow for the proper placement of seed, sprigs, or plants; and allow for the anchoring of straw or hay mulch if a crimper is to be used.
- Tillage may be done with any suitable equipment.
- Tillage should be done parallel to the contour where feasible.
- On slopes too steep for the safe operation of tillage equipment, the soil surface shall be pitted or trenched across the slope with appropriate hand tools to provide consecutive beds, 6 to 8 inches apart, in which seed may lodge and germinate. Hydraulic seeding may also be used.

Depth (Inches)	Per 1,000 Square Feet	Per Acre
1	3.1	134
2	6.2	268
3	9.3	403
4	12.4	537
5	15.5	672
6	18.6	806

7.9-3 Cubic yards of topsoil required to attain various soil depths

Inoculants: Native legume seeds do not need to be inoculated. All non-native legume seed shall be inoculated with appropriate nitrogen fixing bacteria. The inoculants shall be pure culture prepared specifically for the seed species and used within the dates on the container. A mixing medium recommended by the manufacturer shall be used to bond the inoculants to the seed. For conventional seeding, use twice the amount of inoculants recommended by the manufacturer.

No-Till Seeding: No-till seeding is permissible into annual cover crops when planting is done following maturity of the cover crop or if the temporary cover stand is sparse enough to allow adequate growth of the permanent (perennial) species. No-till seeding shall be done with appropriate no-till seeding equipment. The seed must be uniformly distributed and planted at the proper depth. Native grasses respond very well to drill seeding at a depth of one-fourth inch.

Mulch: Straw mulch is required for all permanent vegetation applications and must be applied immediately after the application of seed. The application rate for mulch is 2 tons per acre with overall uniform soil coverage of 70%. All mulch must be anchored. See Practice 7.6 for more information on straw mulch.

Maintenance and Inspection Points

Any areas that have washed out due to high stormwater flows, areas that have been disturbed by blowing wind, and areas that do not show good germination should be retreated.

Inspect seeded areas for failure and make necessary repairs and reseedings within the same season, if possible.

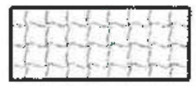
Reseeding: If a stand has inadequate cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed the stand. Consider seeding temporary, annual species if the time of year is not appropriate for permanent seeding.

References

North Carolina Erosion and Sediment Control Planning and Design Manual

STABILIZATION PRACTICES

7.11 ROLLED EROSION CONTROL PRODUCTS



ROLLED EROSION CONTROL PRODUCT

Definition Rolled erosion control products (RECPs) are manufactured sheets of mulch materials (e.g., straw, coir, wood fibers, curled wood, etc.) that are bound into netting composed of either photodegradable synthetic or natural materials. They are usually delivered to a construction site in rolls which are then installed as a protective covering designed to protect soil and hold seed and mulch in place on slopes and in channels so that vegetation can become well established. **This section only addresses RECPs applied to slopes. RECPs as channel linings are covered in Section 7.27 Channels.**

Purpose To reduce soil erosion and assist in the growth, establishment and protection of temporary or permanent vegetation on steep slopes.

Conditions Where Practice Applies RECPs can be applied to steep slopes where erosion hazards are high and conventional seeding is likely to be too slow in providing adequate protective cover. RECPs shall be applied to cut or fill slopes of 2.5:1 or steeper with a height of 10 feet or greater in need of protection during establishment of temporary or permanent ground cover.

Planning Considerations There are many types of erosion control nets and blankets on the market that may be appropriate in certain circumstances. In general, most nets require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.

Good ground contact is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion. It is preferred that loose woven netting made with natural fibers be used.

Most netting used with blankets is photodegradable, meaning they break down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation has established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after the installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a fiber mesh and stitching which may last up to one year.

Design Criteria

Formal design of RECPs applied to slopes is not required. However, for each location erosion control blankets are used, the type of blanket should be indicated in the EPSC Plans.

The use of erosion control blankets on cut or fill slopes may be considered for the following conditions:

- In flat or rolling terrain, on 2H:1V or 3H:1V fill slopes and/or 2H:1V or 3H:1V cut slopes (in soils) that are 20 feet or greater in height;
- In mountainous or hilly terrain, 2H:1V or 3H:1V fill slopes and/or 2H:1V or 3H:1V cut slopes (in soils) that are 30 feet or greater in height;
- On slopes built of highly erodible soils such as sandy/loess soils in West Tennessee;
- On slopes running adjacent to a stream or adjacent to a large ditch or channel that empties directly into high-quality or sediment-impaired waters near the roadway construction;
- At point of stormwater runoff concentration where off-site runoff threatens stability of cut slopes.

On sites with flat slopes or short slope lengths, it may be possible to substitute mulch control netting or open weave textiles for erosion control blanket, based on economic considerations.

In addition to the above criteria, the designer should consider the design life of the erosion control blanket. The designer should ensure that it is possible for the permanent vegetation to become well established before the degradable portions of the blanket have degraded to the point that their resistance to erosion is significantly reduced.

Construction Specifications

Even if properly designed, if not properly installed, erosion control blankets will likely not function as desired. Proper installation is imperative. Even if properly installed, if not properly timed and nourished, vegetation will likely not grow as desired. Proper seed/vegetation selection is also imperative.

Grade the surface of installation areas so that the ground is smooth and soil loose. When seeding prior to installation, follow the steps for seed bed preparation, soil amendments, and seeding. All gullies, rills, and any other disturbed areas must be fine graded prior to installation. Spread seed before blanket installation. (**Important**: Remove all large rocks, dirt clods, stumps, roots, grass clumps, trash, and other obstructions from the soil surface to allow for direct contact between the soil surface and the blanket.) Terminal anchor trenches are required at blanket end. Terminal anchor trenches should be a minimum of 12 inches in depth and 6 inches in width.

Installation for Slopes: Place the blanket 2-3 feet over the top of the slope and into an excavated end trench measuring approximately 12 inches deep by 6 inches wide. Pin the blanket at 1 foot intervals along the bottom of the trench, backfill, and compact. Unroll the blanket down (or along) the slope maintaining direct contact between the soil and the blanket. Overlap adjacent rolls a minimum of 3 inches. Pin the blanket to the ground using staples or pins in a 3 foot center-to-center pattern or as recommended by manufacturer.

Anchoring Devices: 11 gauge, at least 6 inches length by 1 inch width, staples or 12 inch minimum length wooden stakes are recommended for anchoring the blanket to the ground.

Drive staples or pins so that the top of the staple or pin is flush with the ground surface. Anchor each blanket every 3 feet along its center. Longitudinal overlaps must be sufficient to accommodate a row of anchors and uniform along the entire length of overlap and anchored every 3 feet along the overlap length. Roll ends may be spliced by overlapping 1 foot (in the direction of water flow), with the upstream/upslope mat placed on top of the downstream/downslope blanket. This overlap should be anchored at 1 foot spacing across the blanket. When installing multiple width mats heat seamed in the factory, all factory seams and field overlaps should be similarly anchored.

Maintenance and Inspection Points

Good contact with the ground must be maintained, and erosion must not occur beneath the blanket.

Any areas of the blanket that are damaged or not in close contact with the ground shall be repaired and stapled.

If erosion occurs due to poorly controlled drainage, the problem shall be fixed and the eroded area repaired.

Monitor and repair the blanket as necessary until ground cover is established. Inspections should include walking across the slope to check for erosion gullies that can be felt rather than seen.

References

TDOT Design Division Drainage Manual

TDOT Erosion Control Standard Drawing EC-STR-34

North Carolina Erosion and Sediment Control Planning and Design Manual

POLLUTION PREVENTION

7.16 CONCRETE WASHOUT

CONCRETE WASHOUT

Definition

A designated area where concrete wash can harden, can be broken up, and can then be placed in the dumpster or backfilled.

Purpose

To prevent or reduce the discharge of pollutants to stormwater from concrete waste by conducting washout offsite or performing onsite washout in a designated area.

Conditions Where Practice Applies

Concrete washout areas are applicable where:

- Concrete trucks and other concrete-coated equipment are washed onsite.
- Slurries containing portland cement concrete or asphalt concrete are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition.
- Washing of exposed aggregate concrete.
- Building or house construction mortar mixer waste

Planning Considerations

There are two main types of concrete washouts to be considered, prefabricated washout containers and site-built washouts.

PREFABRICATED WASHOUT CONTAINERS

Many private companies offer heavy-duty, prefabricated concrete washout containers that are delivered to the site. Some services provide only the containers while others also provide the maintenance and disposal of the materials. Utilizing full-service concrete washout companies removes much of the burden from the jobsite superintendent and tends to result in a more maintained washout facility. When selecting a company to handle concrete waste, ensure that they are properly disposing of all materials. If the project utilizes a concrete pump truck, the prefabricated container should have an adequate ramp to accommodate the concrete pump truck.

SITE-BUILT WASHOUTS

There are many design options for the site-built washout, but preference should be given to those built below-grade to prevent breaches and reduce the likelihood of runoff. Above-grade structure can also be used if they are sized properly to avoid spillage, constructed properly to prevent leaks, and diligently maintained.

An important factor that dictates the success of concrete washout facilities is whether or not concrete truck drivers and subcontractors are educated on the use of the washout facilities. The site superintendent should educate all appropriate parties on proper use of concrete washout facilities. Signs should be posted indicating the location and designated use of the facilities.

Design Criteria

When using prefabricated washout containers, ensure containers can withstand heavy impacts and are watertight.

Site-built washouts should be constructed by providing a temporary pit or bermed area sized large enough to handle solids, wash slurry, and rainfall to prevent overflow and include a minimum of 4" freeboard. Above-grade washouts should allow adequate at least 4" of freeboard for structural stability of berms or containment walls. The temporary pit containing dry waste concrete may be incorporated into fill areas as needed. The waste concrete may be broken into smaller pieces to allow proper soil compaction. The storage area should be lined with geotextile fabric to allow water to infiltrate, further aiding the dewatering and drying process.

Consideration should be given to locating washout facilities. The designer should included suggested concrete washout areas on all applicable SWPPPs. Each facility should be located conveniently for concrete trucks, preferably near the area where concrete is being poured, and away from heavy volume construction traffic or access areas to prevent disturbance or tracking. Facilities should also be located a minimum of 50 feet away from storm drains, open ditches, and waterbodies. Appropriate gravel or rock should cover paths to concrete washout facilities if the facilities are located in undeveloped areas.

On large sites with extensive concrete work, concrete washouts should be located in multiple areas for ease of use.

Construction Specifications

- The storage pit area should be lined with a permeable geotextile fabric.
- Do not allow runoff from the storage area. Construct a temporary pit or bermed area large enough to contain anticipated slurry amount, solid waste, and direct rainwater.
- Wash out wastes into the temporary pit where the concrete can set, be broken up, and then disposed properly.
- Avoid creating runoff by draining water to a bermed or level area when washing concrete to remove fine particles and expose the aggregate.

Maintenance and Inspection Points

Ensure contractors avoid mixing excess amounts of fresh concrete and perform washout of concrete trucks offsite or in designated areas only. Do not allow concrete trucks to wash into storm drains, open ditches, streets, or streams. Do not allow excess concrete to be dumped onsite, except in designated areas. Do not wash sweepings from exposed aggregate concrete into the street or storm drains.

Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 inches for above grade facilities and 12 inches for below grade facilities. Inspect plastic linings and sidewalls of site-built washouts to ensure they have not been damaged during construction activities. Inspect all surfaces of prefabricated washouts to ensure the container is not leaking.

Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

Inspectors should note whether washout facilities are being used and maintained regularly. If inspector finds that concrete trucks are being washed out in locations other than designated washout areas, the inspector should notify the site superintendent immediately and the site superintendent should correct the issue.

References

California Stormwater BMP Handbook

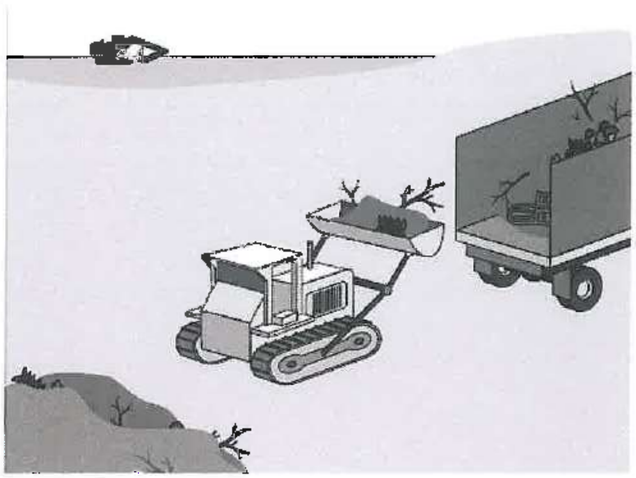
City of Knoxville Best Management Practices Manual

Hamilton County, TN BMP Manual

EPA National Pollutant Discharge Elimination System Concrete Washout

POLLUTION PREVENTION

7.19 TRASH AND DEBRIS MANAGEMENT



TRASH AND DEBRIS MANAGEMENT

Definition The management of waste materials and debris on the construction site.

Purpose To prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, and arranging for regular disposal.

Conditions Where Practice Applies This practice is applicable when the following items may be found on the construction site:

- Waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction.
- Packaging materials including wood, paper, and plastic.
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces and masonry products.
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes.
- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, Styrofoam and other materials used to transport and package construction materials.
- Construction crew sanitary waste management facilities.

Planning Considerations All construction trash and debris must be properly collected and managed for proper offsite disposal. A debris storage area should be included on the SWPPP when the materials noted above will be encountered on the project.

Consider using onsite ground trees and brush as mulch. Identify other recyclable materials, and keep them sorted for easy removal.

Design Criteria

Select designated waste collection areas onsite. These areas should be located well away from sensitive site features such as streams, wetlands, and sinkholes.

Locate containers in an easily accessible area and post signage designating waste disposal areas if needed. Provide enclosed containers or locate containers in covered areas to prevent direct rainwater contact or loss of waste due to wind. If using large containers, ensure they have lids to prevent rain from mixing with the debris and trash.

Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris. Post signage and provide worker education related to items that should not be disposed of in municipal waste and construction debris containers.

Construction Specifications

Do not hose out dumpsters on the construction site. Dumpster cleaning should be taken care of by the solid waste management company providing the containers. Do not allow solid waste management workers to clean their containers on the construction site.

Arrange for regular waste collection before containers overflow.

Stormwater runoff should be prevented from contacting stored waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.

Waste storage areas should be located at least 50 feet from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding or in the stream buffer zone.

Clean up immediately if a container does spill.

Ensure that construction debris and trash are not being used as fill onsite unless approved by the local municipality and TDEC.

Maintenance and Inspection Points

Inspect the site for evidence of trash and construction debris being placed outside of the designated trash and debris collection area. Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas. Contractors should ensure all waste and debris is removed from construction site after construction is completed before leaving.

To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.

Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters before a rain event, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.

Inspect trash and debris collection areas after wind and/or rain events to ensure that they are keeping the trash and debris contained.

References

California Stormwater BMP Handbook

RUNOFF CONTROL AND MANAGEMENT

This section contains measures that are permanent or temporary. They are designed to convey storm water runoff non-erosively. Rip rap is a material incorporated into many of the management practices. The following rip rap classes and stone sizes apply to measures throughout this manual:

Table 7.20-1 TDOT Rip Rap Classification and Sizes

TDOT Classification	D_{50} Stone Size (inches)	Overall Stone Sizes (inches)	Placement Depth
Class A-1	9	2 – 15	18 inches
Class A-3	4	2 – 6	As noted on plans
Class B	15	3 – 27	2.5 feet
Class C	20	5 – 36	3.5 feet

7.20 CHECK DAM

→ → CHECK DAM

Definition A small temporary barrier, grade control structure or dam constructed across a swale, drainage ditch, or area of concentrated flow.

Purpose To minimize the erosion rate by reducing the velocity of stormwater in areas of concentrated flow. While check dams are primarily erosion control devices, they provide limited sediment control by slowing velocities and ponding runoff. Note that wattles and tubes installed as check dams are addressed in Section 7.25.

Conditions Where Practice Applies This practice is applicable for use in ditches and small open channels and **is not to be used in a stream.** Specific applications include:

- Temporary or permanent swales or ditches in need of protection during establishment of grass linings.
- Temporary or permanent swales or ditches that, due to their short length of service or for other reasons, cannot receive a permanent non-erodible lining for an extended period of time.
- Other locations where small localized erosion and sedimentation problems exist in areas of concentrated flow.

Planning Considerations Check dams are an expedient way to reduce gullying in the bottom of channels that will be filled or stabilized at a later date. The dams should only be used while permanent stabilization measures are being put into place.

Check dams installed in grass-lined channels may kill the vegetative lining if submergence after it rains is too long and/or silting is excessive. All stone and riprap must be removed if mowing is planned as part of vegetative maintenance.

The main function of a check dam is to decrease velocity, not to collect sediment, although sediment capture is an added benefit.

Design Criteria

The channel and check dam must be designed to adequately convey the design storm for the associated drainage area.

Spacing: Maximum spacing between dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam. Two or more check dams in series should be used when the drainage area exceeds the limitation for one dam.

Height: The height of the check dam from the bottom of the channel to the bottom of the weir should be a minimum of 1 foot above the ditch bottom.

Weir: The depth of flow on the center of the structure (weir) shall be computed for the peak flow rate generated by the 2-year, 24-hour storm in order to ensure that the top of the structure will not be overtopped. For sites draining to high quality streams or streams listed as impaired by sediment, the depth must be determined for the 5-year, 24-hour peak flow rate. The weir must be at least 9 inches deep.

Side Slopes: The side slopes should be 2:1 or flatter.

Materials: A geotextile should be used as a separator between the graded stone and the soil base and abutments. The geotextile will prevent the migration of soil particles from the subgrade into the graded stone. Geotextiles should be "set" into the subgrade soils. The geotextile should be placed immediately adjacent to the subgrade without any voids and extend three feet beyond the downstream toe of the dam to prevent scour.

Construction Specifications

- Rock check dams should be constructed out of machined riprap, Class A-1 (see Table 7.20-1 for stone size and d_{50}).
- Place stone to the lines and dimensions shown in the plan on a filter fabric foundation.
- Keep the center stone section at least 9 inches below natural ground level where the dam abuts the channel banks.
- Set spacing between dams to assure that the elevation at the top of weir section of the lower dam is the same as the toe elevation of the upper dam.
- Extend geotextile fabric 3 feet down gradient from the toe of the check dam to prevent scour at the toe.
- Protect the channel after the lowest check dam from heavy flow that could cause erosion.
- Ensure that the channel reach above the most upstream dam is stable.
- Ensure that other areas of the channel, such as culvert entrances below the check dams, are not subject to damage or blockage from displaced stones.

Maintenance and Inspection Points

Sediment should be removed before it reaches a depth of one-half the original dam height.

Add rock as needed to maintain design height and cross section.

If the area is to be mowed, check dams must be removed once final stabilization has occurred. After removal, the disturbed area should be seeded and mulched immediately.

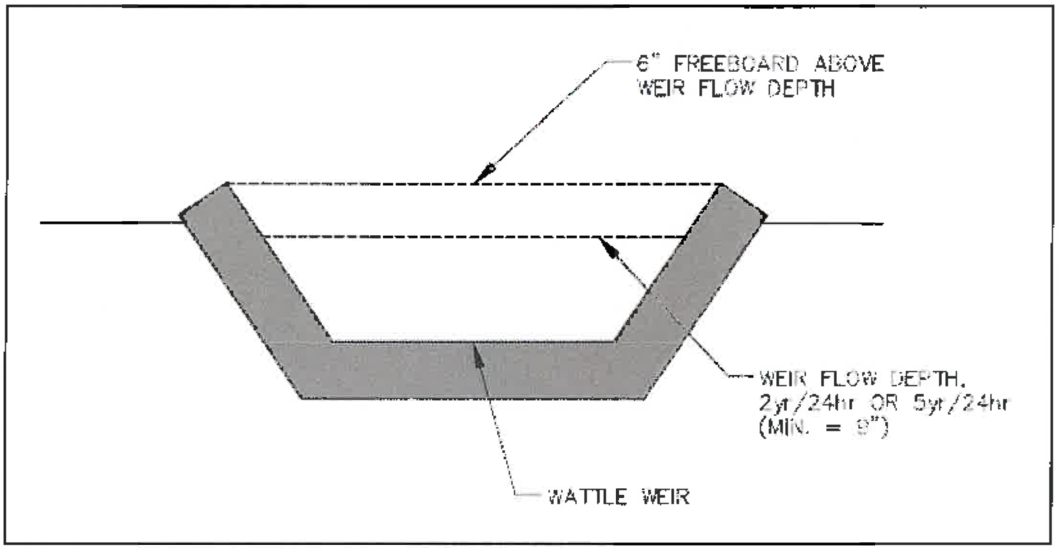


Figure 7.20-1. Wattle Check Dam

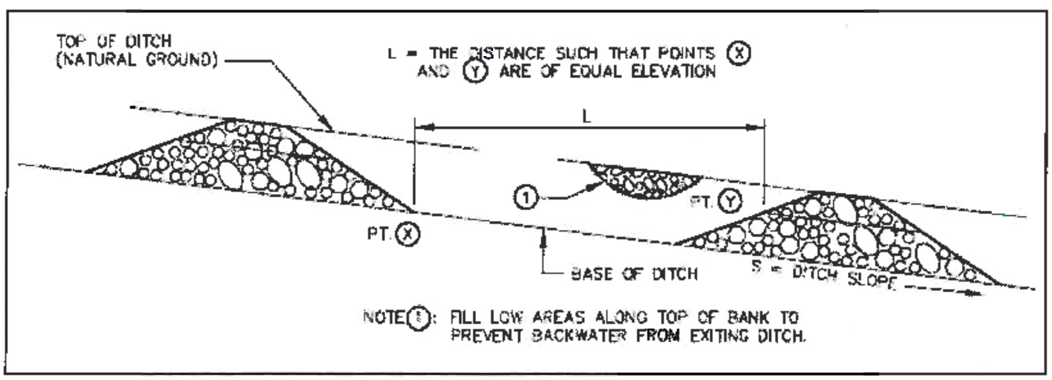


Figure 7.20-2 Spacing between check dams (Source: TDOT)

References

TDOT Design Division Drainage Manual

TDOT Erosion Control Standard Drawing EC-STR-6

North Carolina Erosion and Sediment Control Planning and Design Manual

RUNOFF CONTROL AND MANAGEMENT

7.23 OUTLET PROTECTION

OP

Definition A structure designed to control erosion at the outlet of a channel or conduit.

Purpose To prevent outlet scouring, reduce water velocity, and dissipate the energy from the flow leaving a pipe to prevent erosion in the downstream channel.

Conditions Where Practice Applies This practice applies where the discharge velocity of a pipe, box culvert, diversion, open channel, or other water conveyance structure exceeds the permissible velocity of the receiving water channel or disposal area. Specific applications include:

- Storm drain outlets
- Road culvert outlets
- Paved channel outlets
- Slope drain outlets
- Sediment basin outlets

Planning Considerations The outlets of channels, conduits, and other structures are points of high erosion potential because they frequently carry flow at velocities that exceed the allowable limit for the area downstream. To prevent scour and undermining, an outlet stabilization structure is needed to absorb the impact of the flow and reduce the velocity to non-erosive levels. A riprap-lined apron is the most commonly used practice for this purpose because of its relatively low cost and ease of installation. The riprap apron should be extended downstream until stable conditions are reached even though this may exceed the length calculated for design velocity control. Riprap stilling basins or plunge pools reduce flow velocity rapidly. They should be considered in lieu of aprons where pipe outlets are cantilevered or where high flows would require an excessive apron length. Consider other energy dissipaters such as concrete impact basins or paved outlet structures where conditions warrant.

The installation of a culvert in a stream is subject to the conditions of a U.S. Army Corps of Engineers 404 permit and Tennessee ARAP conditions. These permit conditions may not allow the use of a riprap apron, and may require that the bottom of the culvert be buried below the natural stream bed elevation. A pre-formed scour pool or plunge pool should be considered in these situations.

Design Criteria

Capacity: The structure should be designed to handle the peak storm flow (Q) in cubic feet per second (cfs) from the 25-year, 24-hour frequency storm, or the design discharge of the water conveyance structure, whichever is greater.

Velocity: Compute velocity using Manning's equation with an appropriate *n* value for the selected outlet protection material.

Tailwater Depth: The design depth of the tailwater immediately below the pipe outlet must be determined for the design capacity of the pipe. Manning's Equation may be used to determine the tailwater depth. If the tailwater depth is less than half the diameter of the pipe, it should be classified as a low tailwater condition. If the tailwater depth is greater than half the pipe diameter, then it should be classified as a high tailwater condition. Pipes which outlet onto flat areas with no defined channel may be assumed to have a low tailwater condition.

Apron Length (L_A): The apron length should be determined according to tailwater conditions described in Table 7.23-1.

Apron Width (W_A): See Figure 7.23-1. If the pipe discharges directly into a well-defined channel, the apron should extend across the channel bottom and up the channel banks to an elevation 1 foot above the high tailwater depth or to the top of the bank (whichever is less). If the pipe discharges onto a flat area with no defined channel, the width of the apron should be determined as follows:

- The upstream end of the apron, adjacent to the pipe, should have a width three times the diameter of the outlet pipe
- For a low tailwater condition, the downstream end of the apron should have a width equal to the pipe diameter plus the length of the apron.
- For a high tailwater condition, the downstream end should have a width equal to the pipe diameter plus 0.4 times the length of the apron.

Grade: The apron should be constructed on zero grade. The invert elevation of the downstream end of the apron should be equal to the elevation of the invert of the receiving channel. There should be no turbulence at the end of aprons.

Side Slope: If the pipe discharges into a well defined channel, the side slopes of the channel should not be steeper than 2:1.

Alignment: The apron should be straight throughout its entire length, but if a curve is necessary to align the apron with the receiving stream, locate the curve in the upstream section of the riprap.

Materials: The apron may be lined with riprap, grouted riprap, or concrete. The median sized stone for riprap (d_{50}) should be determined according to tailwater conditions described in Table 7.23-1. Maximum stone size is equal to 1.5 times the d_{50} value. The gradation, quality, and placement of riprap should conform to riprap specifications.

Thickness: Make the minimum thickness of riprap 1.5 times the maximum stone diameter.

Stone Quality: Select stone for riprap from field stone or quarry stone. The stone should be hard, angular, and highly weather resistant. The specific gravity for the individual stones should be at least 2.5.

Separators: A separator must be provided between the riprap and natural ground. Suitable filters are flexible and consist of a well-graded gravel or sand-gravel layer or a synthetic filter fabric manufactured for this express purpose. The design of a gravel filter blanket is based on the ratio of particle size in the overlying filter material to that of the base material in accordance with the criteria below. The designed gravel filter blanket may consist of several layers of increasingly large particles from sand to erosion control stone.

A gravel filter blanket should have the following relationship for a stable design:

$$\frac{d_{15}\text{ filter}}{d_{85}\text{ base}} \leq 5$$

$$5 \leq \frac{d_{15}\text{ filter}}{d_{15}\text{ base}} \leq 40$$

$$\frac{d_{50}\text{ filter}}{d_{50}\text{ base}} \leq 40$$

In these relationships, filter refers to the overlying material, and base refers to the underlying material. These relationships must hold between the filter material and the base material (soil foundation), and between the riprap and the filter. More than one layer of filter material may be needed. Each layer of filter material should be at least 6 inches thick.

A synthetic filter fabric may be used with or in place of gravel filters. The following particle size relationships should exist:

- Filter fabric covering a base with granular particles containing 50% or less (by weight) of fine particles (less than U.S. Standard Sieve no. 200 [0.074mm]):

  a. $\frac{d_{85}\text{ base (mm)}}{\text{EOS* filter fabric (mm)}} > 1$

  b. total open area of filter should not exceed 36%.

- Filter fabric covering other soils:

  a. EOS is no larger than U.S. Standard Sieve no. 70 (0.21mm),

  b. total open area of filter should not exceed 10%.

**EOS - Equivalent opening size compared to a U.S. standard sieve size.*

No filter fabric should have less than 4% open area, or an EOS less than U.S. Standard Sieve No. 100 (0.15mm). The permeability of the fabric must be greater than that of the soil. The fabric may be made of woven or nonwoven monofilament yarns, and should meet the following minimum requirements:

- thickness 20 - 60 mils,
- grab strength 90 - 120 lb, and
- conform to ASTM D-1682 or ASTM D-177.

Filter blankets should always be provided where seepage is significant, or where flow velocity and duration of flow or turbulence may cause the underlying soil particles to move through the riprap.

Energy Dissipators and Stilling Basins: Structural controls, generally made from precast concrete or from pour-in-place concrete, should be used whenever concrete aprons are installed. The design of the energy dissipaters and stilling basins shown in Figure 7.23-2 are discussed in the Federal Highways Administration (FHWA) publication HEC-14, Hydraulic Design of Energy Dissipaters for Culverts and Channels.

Stilling basins are used to convert flows from supercritical to subcritical flow rates by allowing a hydraulic jump to occur. The stilling basin allows a controlled hydraulic jump to occur within the structure over a wide range of flow conditions and depths. A professional engineer must design energy dissipaters and stilling basins using hydraulic computations. A primary concern for both energy dissipaters and stilling basins is whether sediment and trash can accumulate. TDOT standard drawings include a riprap basin energy dissipater, based upon procedures in HEC-14. The United States Bureau of Reclamation (USBR) also has developed many designs of such structures.

Construction Specifications

- Ensure that the subgrade for the geotextile and riprap follows the required lines and grades shown in the plan. Compact any fill required in the subgrade to the density of the surrounding undisturbed material. Low areas in the subgrade on undisturbed soil may also be filled by increasing the riprap thickness.
- Install a geotextile liner to prevent soil movement through the openings in the riprap
- The geotextile must meet design requirements and be properly protected from punching or tearing during installation. Repair any damage by removing the riprap and placing another piece of geotextile over the damaged area. All connecting joints should overlap a minimum of 1 foot. If the damage is extensive replace the entire geotextile liner.
- Riprap may be placed by equipment, but take care to avoid damaging the geotextile.
- The minimum thickness of the riprap should be 1.5 times the maximum stone diameter, but not less than 6 inches.
- The outlet structure must conform to the specified grading limits shown on the plans.

- Construct the apron on zero grade with no turbulence at the end. Make the top of the riprap at the downstream end level with the receiving area or slightly below it.
- Ensure that the apron is properly aligned with the receiving stream and, preferably, straight throughout its length.
- Immediately after construction, stabilize all disturbed areas with vegetation.
- Select stone for riprap from fieldstone or quarry stone. The stone should be hard, angular, and highly weather-resistant. The specific gravity of the individual stones should be at least 2.5.

Maintenance and Inspection Points

Inspect riprap outlet structures after heavy rains to see if any erosion around or below the riprap has taken place, if the stones have been dislodged, or if the separator has been damaged. Immediately make all needed repairs to prevent further damage.

References

TDOT Design Division Drainage Manual

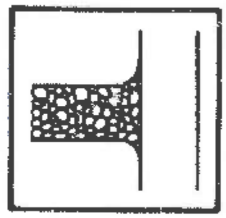
TDOT Standard Drawing EC-STR-21

North Carolina Erosion and Sediment Control Planning and Design Manual

Federal Highways Administration, HEC-14

SEDIMENT CONTROL PRACTICES

7.28 CONSTRUCTION EXIT



GRAVEL CONSTRUCTION EXIT

Definition A stone pad on geotextile fabric or a rumble strip located at any point where traffic will be moving from a construction site onto a public roadway or other paved area.

Purpose To reduce or eliminate the transport of material from the construction area onto a public roadway by providing an area where mud and soil can be removed from the tires of construction vehicles.

Conditions Where Practice Applies This practice is applicable wherever construction traffic leaves a construction site and enters a public right of way.

Planning Considerations Construction exits should be planned and installed at any point that construction traffic exits the project. These stone pads should not be placed in areas with hydric or saturated soils.

Stormwater management must be considered around the construction exit as well.

Avoid steep grades and exits in or near curves in public roads.

Design Criteria Calculations are not required; however, a typical construction exit should conform to the specifications listed below.

- A layer of geotextile fabric is required to stabilize and support the aggregate. The geotextile fabric should extend the full length and width of the construction exit. The fabric should meet the requirements of the standard specifications for geotextiles, AASHTO designated M-288, erosion control.
- The stone pad should be constructed from clean, washed stone with a 2 inch to 4 inch gradation at a minimum thickness of 8 inches. At a minimum, the stone pad should be 50 feet long and 20 feet wide. In addition a turning radius of 20 feet should be provided on each side of the pad where it intersects with the public roadway. See Figures 7.28-1 and -2.
- The area where the pad is to be installed must be undercut at least 3 inches, and then the geotextile fabric should be installed before placing the stone.

- Stormwater management around the construction exit must be taken into consideration. If stormwater runoff flows across the stone pad and onto the public right of way, mud on the pad can be washed into the ROW as well. Diversions or waterbars should be installed at the upgradient end of the pad, directing runoff into sediment traps for treatment prior to discharging runoff into the ROW.

Construction Specifications

- Excavate areas where construction exits are to be constructed to a depth of at least 3 inches and clear the area of all vegetation, roots, and other objectionable material.
- Construction exit areas should be at minimum 50 feet in length by 20 feet in width.
- Install a geotextile underliner across the full width and depth of the construction exit to separate the rock from underlying soil.
- Provide clean, washed stone to a depth of 8 inches. Stone should vary in size from 2 to 4 inches. Rock must be clean rock with no fines. Crusher run and road base are not acceptable materials for a construction exit, as the fines can be tracked out onto the road.

Waterbar Diversion:
On sites where the grade toward the public roadway is greater than 2%, a waterbar diversion 6 to 8 inches in depth with 3:1 side slopes should be constructed at the upper end of the construction exit to prevent stormwater from washing sediment off the construction exit and into the public roadway or storm drain system. See Figure 7.28-1. Other devices, such as berms also may be used to divert stormwater from flowing down the construction exit and onto the pubic ROW.

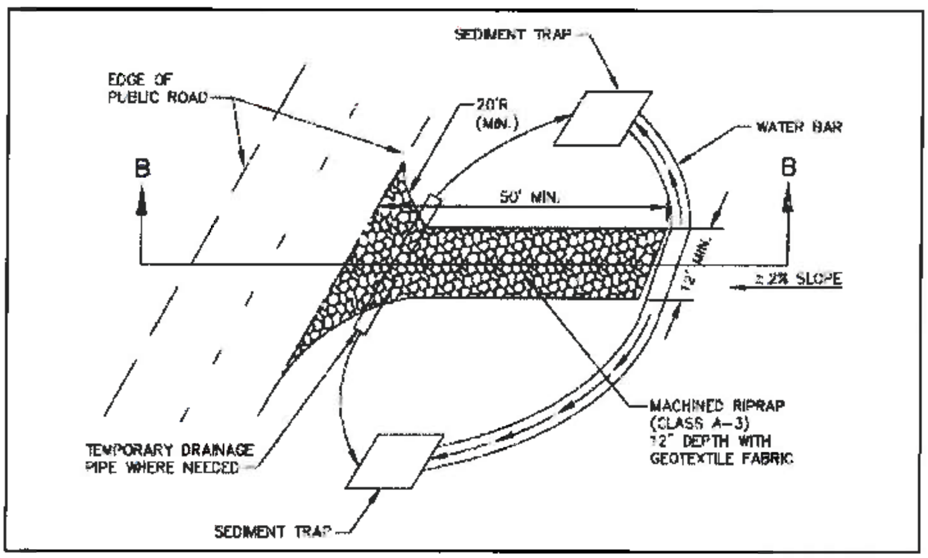


Figure 7.28-1 Construction Exit with Water Bars

Maintenance and Inspection Points

The exit must be maintained in a condition that will prevent tracking or flow of material onto public rights-of-way or into the storm drain system. This may require periodic top dressing with fresh stone or full replacement of stone as conditions demand, and repair and/or cleanout of any related diversions and sediment traps. All materials spilled, dropped, washed, or tracked from vehicles or site onto roadways or into storm drains must be removed by the end of the day.

References

TDOT Design Division Drainage Manual

North Carolina Erosion and Sediment Control Planning and Design Manual

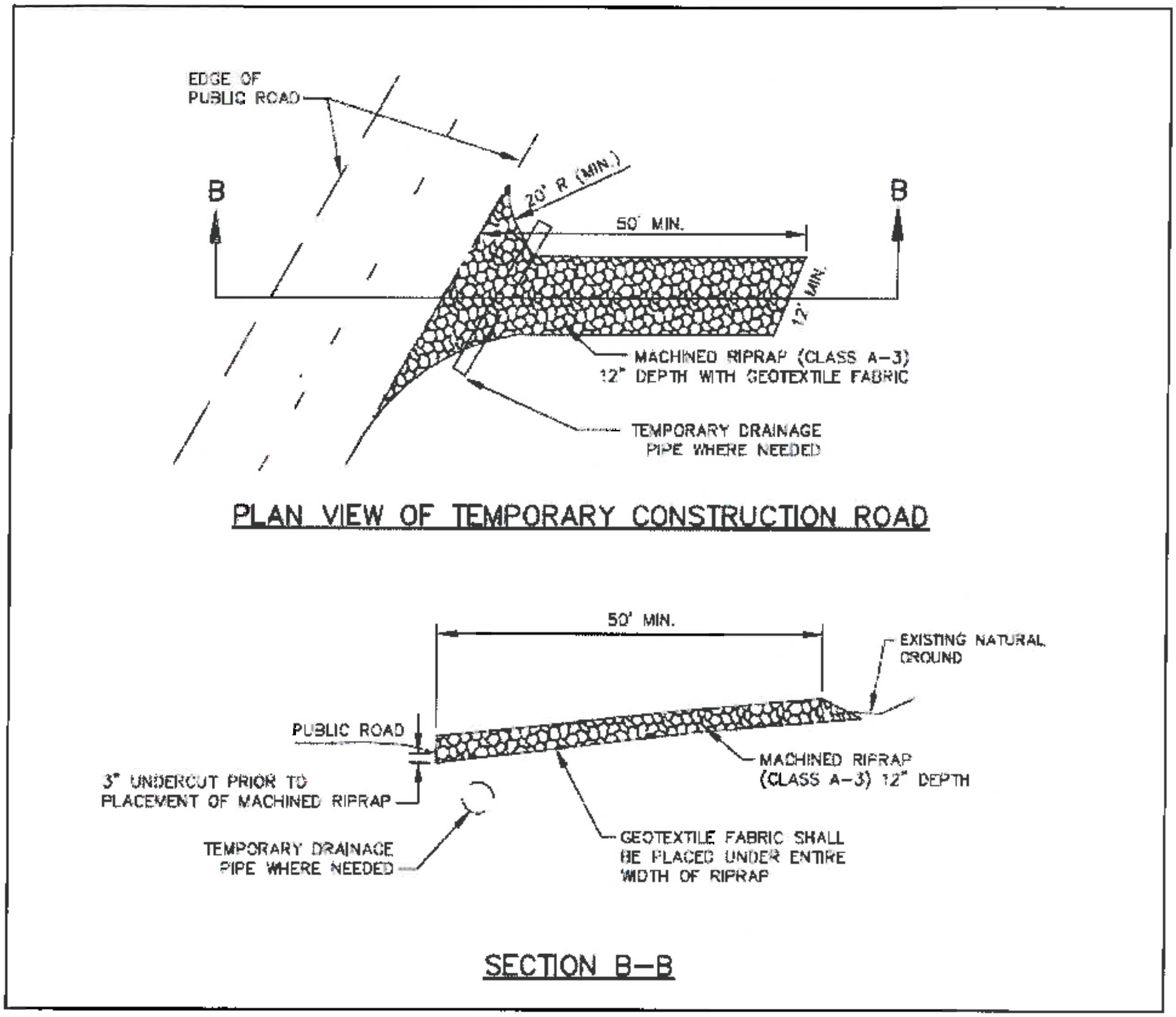


Figure 7.28-2 Construction Exit Detail

SEDIMENT CONTROL PRACTICES

7.34 SILT FENCE

SILT FENCE

Definition A temporary sediment control measure, composed of woven geotextile fabric supported by steel or wood posts, used to intercept sediment transported from areas where runoff occurs as sheet flow.

Purpose To prevent sediment carried by sheet flow from leaving the site and entering natural drainage ways or storm drainage systems by slowing storm water runoff, causing ponding and the deposition of sediment at the structure. Silt fence does not filter sediment.

Conditions Where Practice Applies Silt fence may be used in a variety of locations including:

- at the toe of, or on, an exposed slope
- around the perimeter of an exposed construction site
- along the banks of ditches or swales
- around the perimeter of a soil stockpile
- around buffer areas

Silt fence shall not be installed across streams, ditches, waterways, or other concentrated flow areas.

Planning Considerations Silt fence is a system to retain sediment on the construction site. The fence retains sediment primarily by retarding flow and promoting deposition. In operation, the geotextile silt fence material ponds runoff behind it, as the flow rate through the geotextile is often much lower than the flow rate of the runoff coming to the silt fence. Ponding behind the silt fence is necessary to encourage sediment settling. The designer should anticipate ponding and provide sufficient storage areas and overflow outlets to prevent flows from overtopping the fence. Since silt fence is not designed to withstand high water levels, locate them so that only shallow pools can form. Tie the ends of silt fence into higher ground to prevent flow around the end of the fence before the pool reaches design level. Silt fence should be curled uphill on each end of the fence in a "J" pattern to prevent end flow and scour. Provide stabilized outlets to protect the fence system and release storm flows that exceed the design storm.

Deposition occurs as the storage pool forms behind the fence. The designer can direct flows to specified deposition areas through appropriate positioning of the fence or by providing an excavated area behind the fence. Plan deposition areas at accessible points to promote routine cleanout and maintenance.

Silt fence serves no function along ridges or near drainage divides where there is little movement of water. Confining or diverting runoff unnecessarily with a sediment fence may create erosion and sedimentation problems that would not otherwise occur.

Anchoring of silt fence is critical. The toe of the fabric must be anchored in a trench backfilled with compacted earth. Mechanical compaction must be provided in order for the fence to effectively pond runoff.

Design Criteria

Silt fence should be installed along the contour, never up or down a slope. This is essential to ensure that the fence will not accidentally concentrate stormwater flows, thus creating worse erosion problems.

Silt fence can be installed without backing or with wire backing.

- The maximum drainage area for a continuous fence without backing shall be 1/4 acre per 100 linear feet of fence length, up to a maximum area of 2 acres. The maximum slope length behind the fence on the upslope side should be 110 feet (as measured along the ground surface).
- The maximum drainage area for a continuous silt fence with backing shall be 1 acre per 150 linear feet of fence length. The slope length above the silt fence with backing should be no more than 300 feet.

Silt fence should be installed so as to be as close as possible to the ground contour. The bottom of the fence at the ground line should be on a 0% grade, plus or minus 0.5%.

When used at the bottom of a slope, silt fence should be installed 5 feet to 7 feet away from the toe to allow extra space for the ponding of water and collection of sediments.

The expected life span of the silt fence is 6 to 12 months. Therefore, projects of long duration may require a complete replacement of the silt fence. The quantity for silt fence to be in place for a long period of time should be based on the assumption that the material will be replaced every 9 months, on the average.

Table 7.34-1 contains the fabric specifications for silt fence with and without backing. For silt fence without backing, posts shall be hardwood posts that are 2.25" (nominal) x 2.25" (nominal) x 58". T-type steel posts also may be used. Silt fence with backing shall be installed on a minimum of 1.25 lb/ft steel posts with 14 gauge wire backing that has a maximum mesh size of 6 inches. Ensure that steel posts have projections for fastening the fabric.

Table 7.34-1 Silt Fence Fabric Specifications

	Test Material	Without backing	With backing
Geotextile fabric type		Woven slit film	Woven monofilament
Apparent opening size	ASTM D4751	#30 to #70 standard sieve	#70 to #100 standard sieve
Water flux	ASTM D4491	≥ 4 gpm/ft^2	≥ 18 gpm/ft^2
Tensile strength	ASTM D4632	≥ 120 lb. (warp direction) 100 lb. (fill direction)	≥ 310 lb. (warp direction) 200 lb. (fill direction)
UV Stability (after 500 hrs)	ASTM D4355	≥ 70%	≥ 90%
Elongation	ASTM D4632	≤ 20% max.	---
Burst strength	ASTM D3786	≥ 250 PSI	≥ 400 psi
Puncture strength	ASTM D4833	≥ 60 lb.	≥ 105 lb.
Trapezoidal tear	ASTM D4533	≥ 50 lb (warp direction) 40 lb (fill direction)	≥ 100 lb (warp direction) 60 lb (fill direction)

Construction Specifications

- Ensure that the height of the sediment fence does not exceed 24 inches above the ground surface. Ponding water depth should not exceed 1.5 feet. (Higher fences may impound volumes of water sufficient to cause failure of the structure.)
- Construct the filter fabric from a continuous roll cut to the length of the barrier to avoid joints. When joints are necessary, securely fasten the filter cloth only at a support post with 4 feet minimum overlap to the next post or roll the fabric together and fasten to one post to create a stronger joint. Where joints are necessary, plan the roll layout so as not to have joints at low points.
- Do not attach filter fabric to trees.
- When silt fence is installed adjacent to streams, wetlands and other natural resources, silt fence with backing should be used.
- Install posts no more than 6 feet apart.
- Install posts 2 feet deep on the downstream side of the silt fence, and as close as possible to the fabric, enabling posts to support the fabric from upstream water pressure.
- Securely attach the silt fence fabric to the posts on the **upstream** side of the posts. For steel posts, attach fabric to the posts using wire or plastic zip ties with a minimum 50 pound tensile strength, at least 5 to a post. Three ties should be installed in the upper 8 inches for top strength. Ties should be installed on the diagonal, as opposed to on the horizontal, to grab more strands. For hardwood posts, attach fabric with 17 gauge wire staples (3/4" wide x 1/2" long), at least 5 to a post. 3 staples should be installed in the upper 8 inches for top strength.
- Install J-hooks for confining the water behind the fence and maximizing the trapping efficiency. See Figure 7.34-1 below.

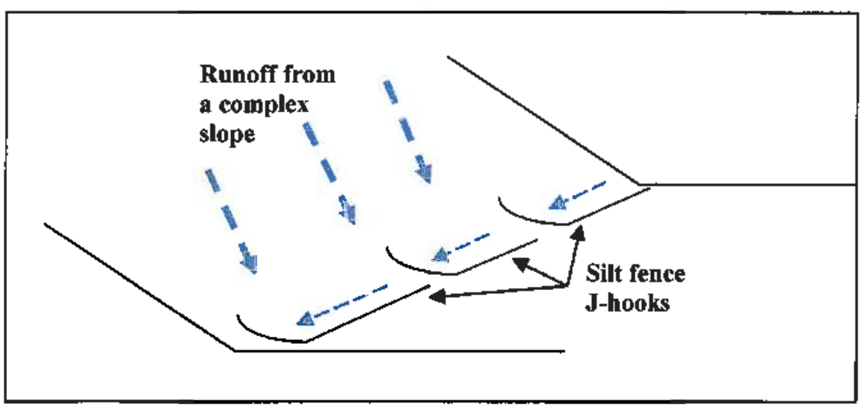


Figure 7.34-1 J-Hook Installation Example

Traditional silt fence trenching method for installation:

- Excavate a trench approximately 4 inches wide and 6 inches deep along the proposed line of posts and upslope from the barrier
- Place 10 inches of the fabric along the bottom and side of the trench. Backfill the trench with soil placed over the filter fabric and compact. Thorough compaction of the backfill is critical to silt fence performance. Poor compaction can cause failure of the silt fence along the toe.
- The base of both end posts should be at least one foot higher than the middle of the fence. Check with a level as necessary.

Slicing method for installation:

- A slicing machine can be used to install silt fence. This method of installation provides excellent compaction and joint integrity along the toe.
- Posts should be set a maximum of 6 feet apart.
- The geotextile fabric should be inserted in a slit in the soil 8-12 inches deep. The slit should be created such that a horizontal chisel point, at the base of a soil-slicing blade, slightly disrupts the soil upward as the blade slices through the soil. This upward disruption minimizes horizontal compaction and creates an optimal soil condition for mechanical compaction against the geotextile. The geotextile should be mechanically inserted directly behind the soil-slicing blade in a simultaneous operation, achieving consistent placement and depth. No turning over (plowing) of soil is allowed for the slicing method.

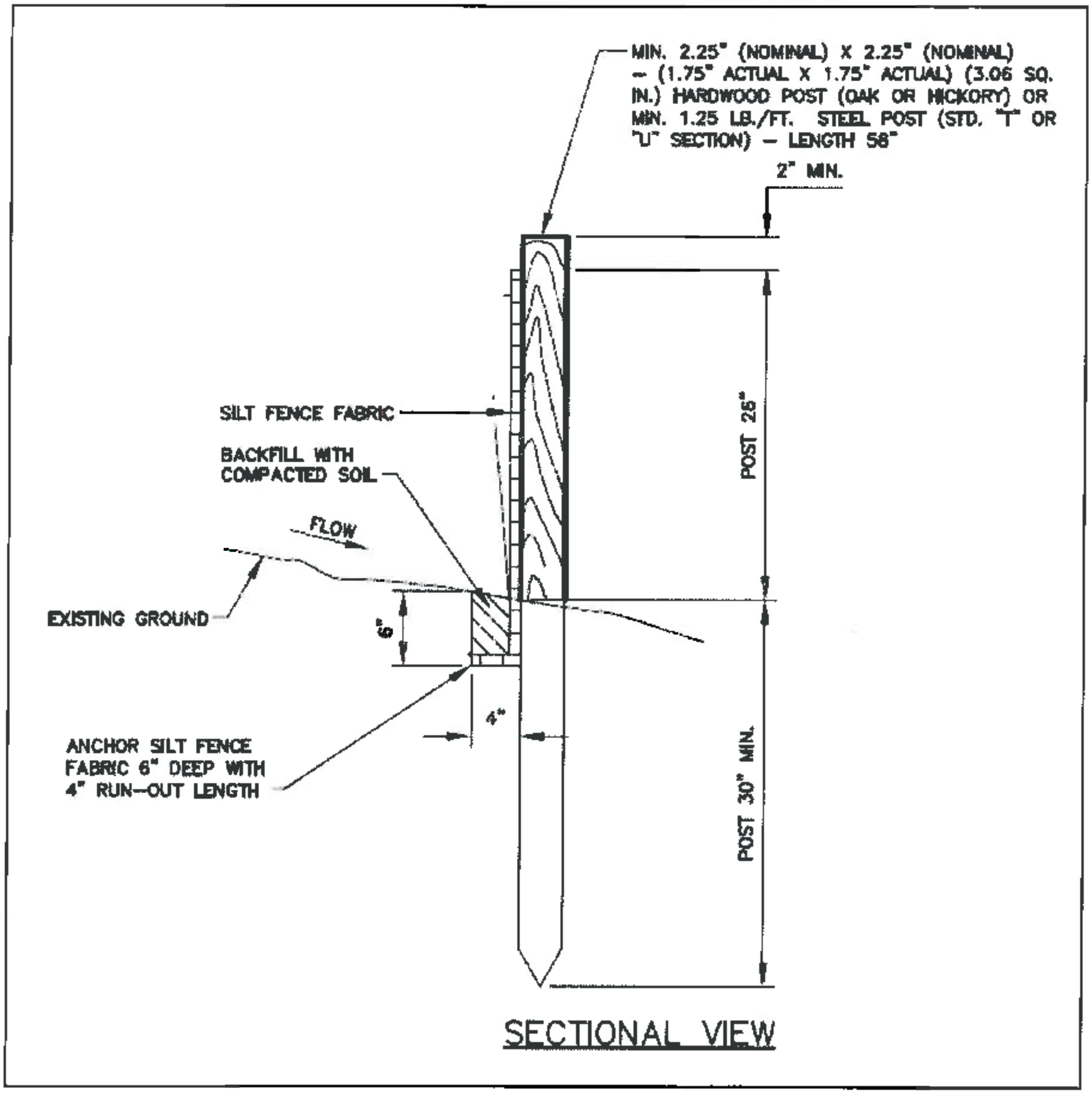


Figure 7.34-2 Silt fence details

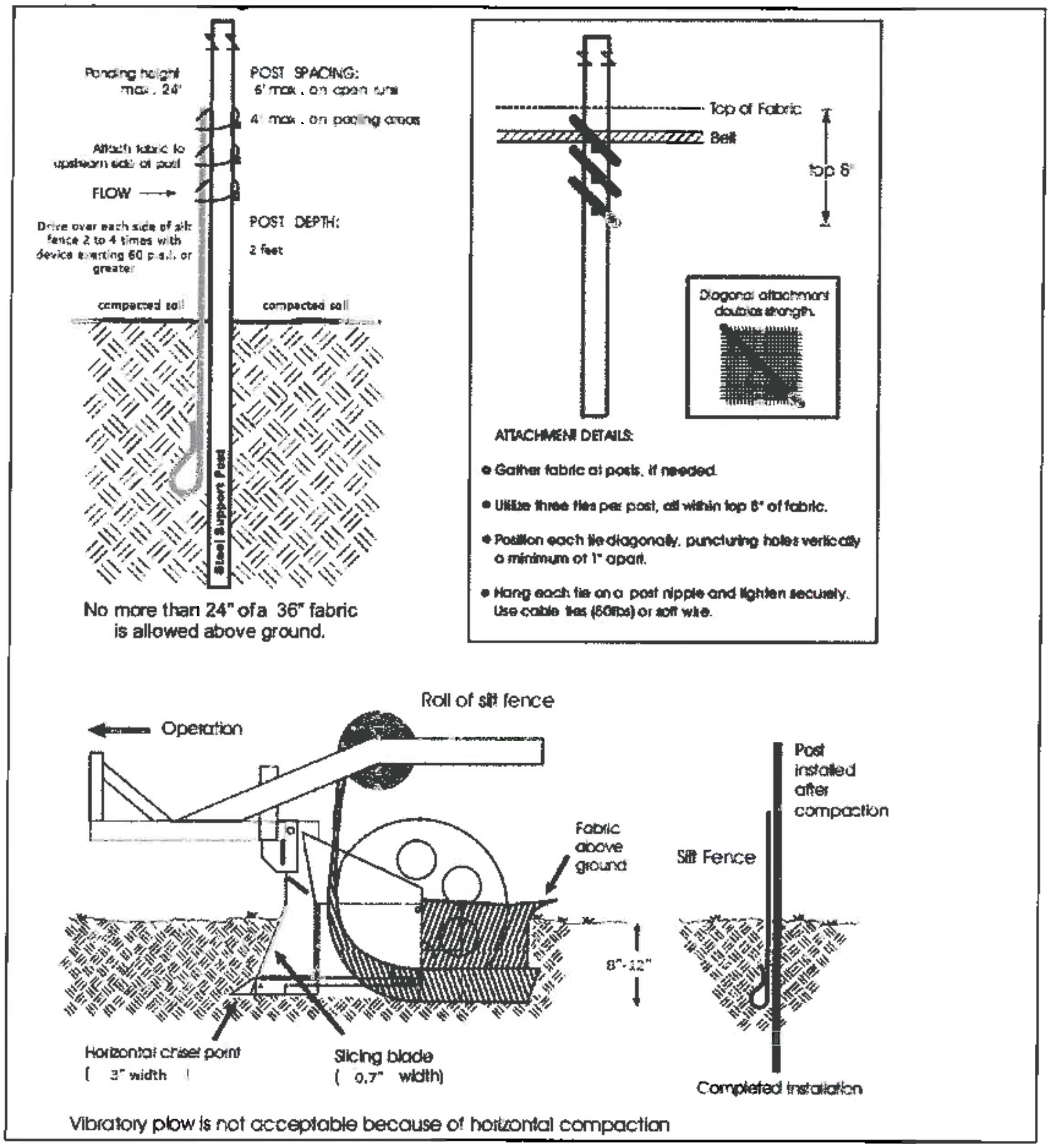


Figure 7.34-3 Silt Fence Slicer Installation Details (*Adapted from Silt Fence That Works)*

Maintenance and Inspection Points

Remove sediment once it has accumulated to ½ the original height of the barrier.

Replace filter fabric whenever it is worn or has deteriorated to such an extent so that the effectiveness of the fabric is reduced.

All sediment accumulated at the fence should be removed and properly disposed of before the fence is removed.

Repair sagging silt fence to prevent failure or overtopping.

Monitor the toe for evidence of piping or erosion along the toe. Install J-hooks wherever runoff flows along the toe of the fencing to prevent undermining.

Silt fence should remain in place until disturbed areas have been permanently stabilized.

References

TDOT Design Division Drainage Manual

TDOT Erosion Control Standard Drawing EC-STR-3B

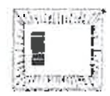
North Carolina Erosion and Sediment Control Planning and Design Manual

Devon Distributing Corporation. http://www.tommy-sfm.com/index.html

Metropolitan Council (Minnesota) Minnesota Urban Small Sites BMP Manual

SEDIMENT CONTROL PRACTICES

7.35 INLET PROTECTION



EXCAVATED INLET PROTECTION

HARDWARE CLOTH AND GRAVEL INLET PROTECTION

ROCK RING INLET PROTECTION

BLOCK AND GRAVEL INLET PROTECTION

Definition A temporary protective device formed around a storm drain drop inlet to trap sediment.

Purpose To prevent sediment from entering the storm drainage system, prior to temporary or permanent stabilization of the disturbed area.

Conditions Where Practice Applies Many different types of inlet protection devices are available. The types highlighted in this section are non-manufactured. Manufactured inlet protection devices are allowable alternatives, provided the following:

- At least 3600 ft^3/acre of drainage is available to store sediment.
- No more than 1 acre of drainage to each measure - 0.5 acre drainage area per each measure is preferable.
- An overflow is provided to safely pass storm events larger than the 5-yr storm.

Non-manufactured inlet protection devices:

<u>Excavated Drop Inlet Protection</u> is applicable where relatively heavy flows are expected and overflow capability is needed.

<u>Hardware Cloth and Gravel Inlet Protection</u> is applicable where the flow is light to moderate. This method is effective where the inlet is expected to drain shallow sheet flow. The immediate land area around the inlet should be relatively flat (less than 1 percent) and located so that accumulated sediment can be easily removed.

<u>Block and Gravel Inlet Protection</u> is applicable to both drop inlets and curb inlets where heavy flows are expected, and an overflow capacity is necessary to prevent excessive ponding around the structure. Shallow temporary flooding after rainfall however, should be expected.

<u>Sod Drop Inlet Protection</u> is applicable where the drainage area of the drop inlet

has been permanently seeded and mulched, and the immediate surrounding area is to remain in dense vegetation. This practice is well suited for lawns adjacent to large buildings.

Rock Ring Inlet Protection is applicable at drop inlets with large drainage areas or at drop inlets that receive high velocity water flows, possibly from many directions.

Rock Pipe Inlet Protection is applicable at pipes with a maximum diameter of 36 inches. This inlet protection may be used to supplement additional sediment traps or basins at the pipe outlet, or used in combination with an excavated sediment storage area to serve as a temporary sediment trap.

Silt fence inlet protection is not allowed, as the failure rate for this type of inlet protection is very high.

Planning Considerations

Inlet protection should be installed at or around all storm drain drop inlets that receive runoff from disturbed areas. Inlet protection should not be used in streams or other natural water resources. It should also not be placed in ditches, swales or other depressions with a depth greater than 1 foot. Due to the high maintenance requirements, inlet protection should be considered secondary sediment controls and not primary sediment controls. These measures should be used in conjunction with other erosion prevention and sediment control measures to be effective. Exercise installation caution so that stormwater runoff cannot back up out adjacent traffic lanes.

Design Criteria

Excavated Drop Inlet Protection (Figure 7.35-1):

- Limit the drainage area to 1 acre. Keep the minimum depth at 1 foot and the maximum depth of 2 feet as measured from the crest of the inlet structure.
- Maintain side slopes around the excavation no steeper than 2:1
- Keep the minimum volume of excavated area around the drop inlet at approximately 3600 ft^3/acre of drainage.
- Shape the sediment storage area to fit site conditions, with the longest dimension oriented toward the longest inflow area to provide maximum trap efficiency.
- Install provisions for draining the temporary pool to improve trapping efficiency for small storms and to avoid problems from standing water after heavy rains.

Hardware Cloth and Gravel Inlet Protection (Figure 7.35-2):

- Ensure that drainage area does not exceed 1 acre per inlet.
- Secure the wire mesh hardware cloth barriers using steel T posts. The posts need to be 1.25 lb/linear ft steel with a minimum length of 5 feet. Make sure the posts have projections to facilitate fastening the hardware cloth. Securely drive each stake into the ground to a minimum depth of 2 feet. The maximum spacing for the posts is 4 feet.
- The wire mesh should be at least a 19-gauge hardware cloth with a ¼ inch mesh opening. The total height should be a minimum of 2 feet. Providing a

flap of hardware cloth on the ground projecting away from the inlet can aid in removal of the stone at the project's completion. Place #57 washed stone to a height of 16 inches on the upstream face of the cloth with an outside slope of 2:1.

- The top elevation of the structure must be at least 12 inches lower than the ground elevation downslope from the inlet. It is important that all storm flows pass over the structure into the storm drain and not bypass the structure. Temporary dikes below the structure may be necessary to prevent bypass flow.

Block and Gravel Inlet Protection (Figure 7.35-3):

- Keep the drainage area no greater than 1 acre unless site conditions allow for frequent removal and adequate disposal of accumulated sediment.
- Keep the height of the barrier at least 12 inches and no greater than 24 inches. Do not use mortar. Limit the height to prevent excess ponding and bypass flow.
- Recess the first course of blocks at least 2 inches below the crest opening of the storm drain for lateral support. Support subsequent courses laterally if needed by placing a 2 x 4-inch wood stud through the block openings that are perpendicular to the block course needing support. Lay some blocks on their side in the bottom row for dewatering the pool.
- Place gravel just below the top of the blocks on slopes of 2:1 or flatter. Place hardware cloth or comparable wire mesh with 1/2-inch openings over all block openings to hold gravel in place.

Sod Drop Inlet Protection (Figure 7.35-4):

- Keep velocity of design flow over the sod area at all points less than 5 ft/sec.
- Place sod to form a turf mat completely covering the soil surface for a minimum distance of 4 feet from each side of the drop inlet where runoff will enter.
- Maintain the slope of the sodded area no greater than 4:1.
- Keep the drainage area no greater than 2 acres; maintain this area undisturbed or stabilize it.

Rock Ring Inlet Protection:

- Place measure at least 30 feet away from vehicular traffic. This inlet protection can be modified to protect one side of the inlet if only one side receives flow.
- Stone – A minimum 1-foot wide level area set 4 inches below the drop inlet crest will add protection against the entrance of material. Structural stone should be Class A-1 riprap with 2:1 side slope, and a minimum crest width of 18 inches. The height of the stone should be from 2 to 3.5 feet. The outside face of the riprap should be covered in a 12-inch thick layer of #5 or #57 washed stone. Wire mesh with 2-inch openings may be placed over the drain grating but must be inspected frequently to avoid blockage by trash.

- The top elevation of the stone structure must be at least 12 inches lower than the ground elevation downslope from the inlet. It is important that all stormwater flow over the structure into the storm drain, and not past the structure. Temporary diking below the structure may be necessary to prevent bypass flow. Material may be excavated from inside the sediment pool for this purpose.

Rock Pipe Inlet Protection (Figure 7.35-5):

- When used in combination with an excavated sediment storage area to serve as a temporary sediment trap, the design criteria for temporary sediment traps must be satisfied. The maximum drainage area should be 5 acres, and 3600 cubic feet of sediment storage per acre of drainage area should be provided.
- The minimum stone height should be 2 feet, with side slopes no steeper than 2:1. The stone "horseshoe" around the pipe inlet should be constructed of Class A-1 or Class B riprap, with a minimum crest width of 3 feet. The outside face of the riprap should be coved with a 12-inch thick layer of #57 washed stone.
- In preparing plans for rock pipe inlet protection, it is important to protect the embankment over the pipe from overtopping. The top of the stone should be a minimum of 1 foot below the top of the fill over the pipe. The stone should tie into the fill on both sides of the pipe. The inside toe of the stone should be no closer than 2 feet from the culvert opening to allow passage of high flows.
- The sediment storage area should be excavated upstream of the rock pipe inlet protection, with a minimum depth of 18 inches below grade.

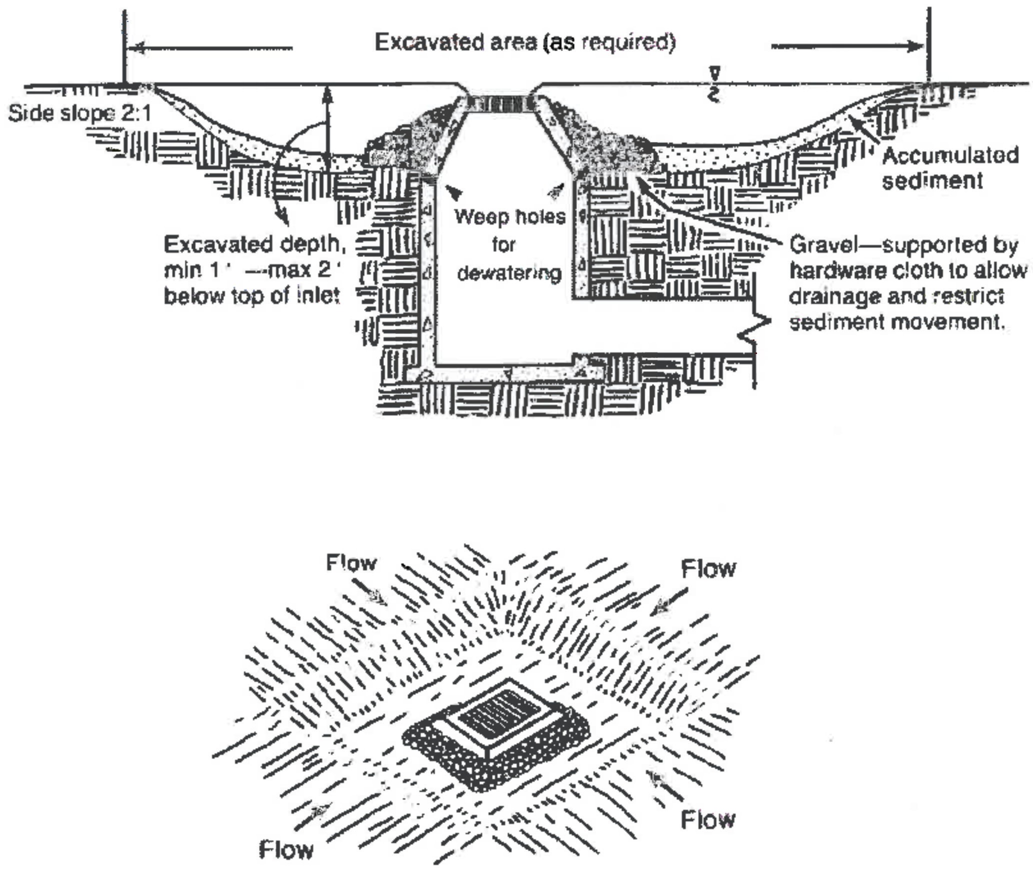


Figure 7.35-1 Excavated Inlet Protection (*Source: NCDENR*)

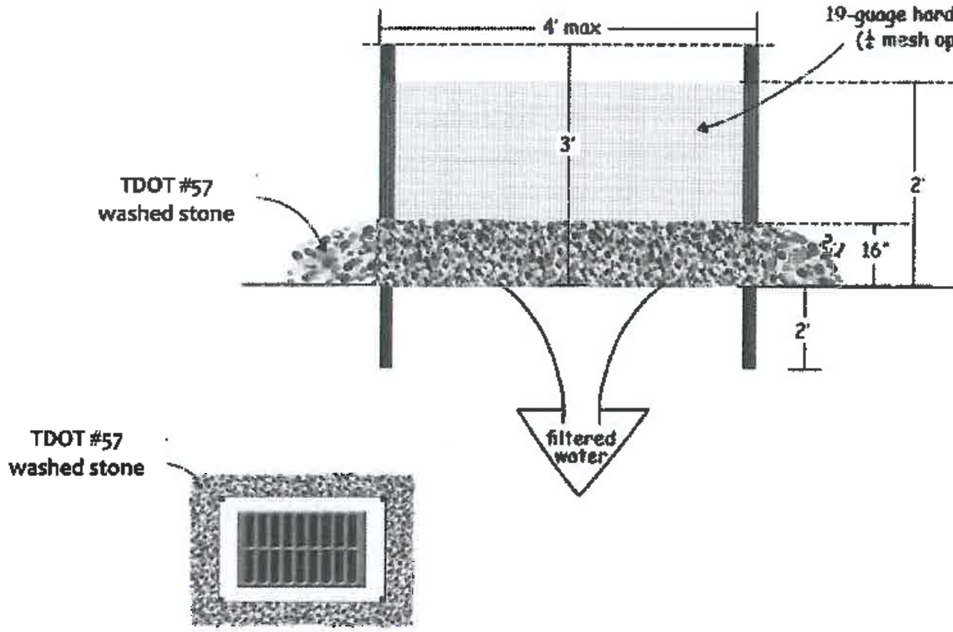


Figure 7.35-2 Hardware Cloth and Gravel Inlet Protection (*Source: NCDENR)*

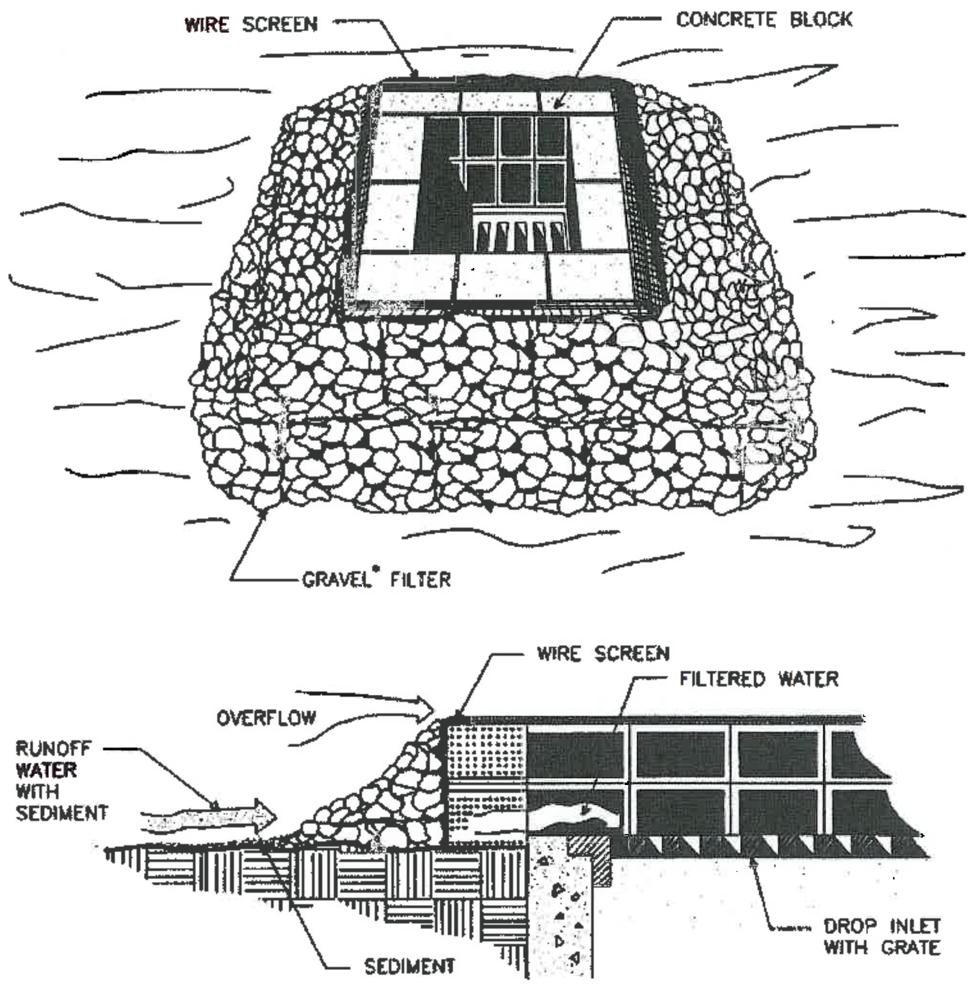


Figure 7.35-3 Block and Gravel Inlet Protection (*Source: VA DSWC*)

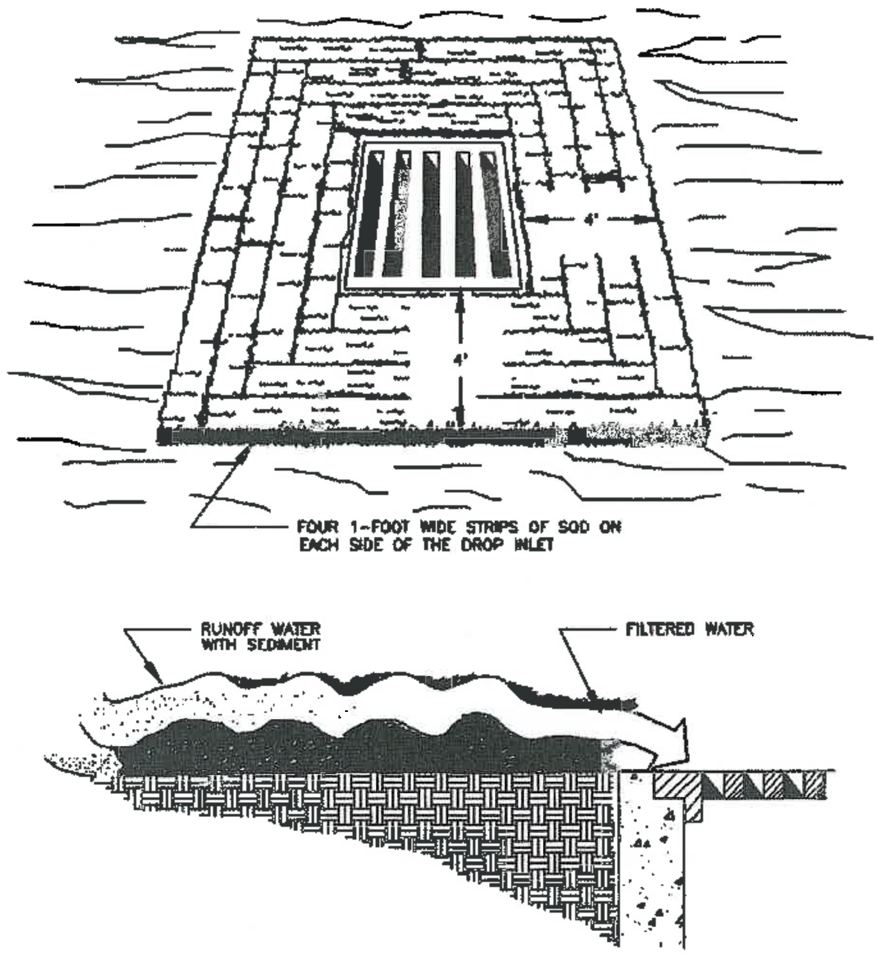


Figure 7.35-4 Sod Inlet Protection Device

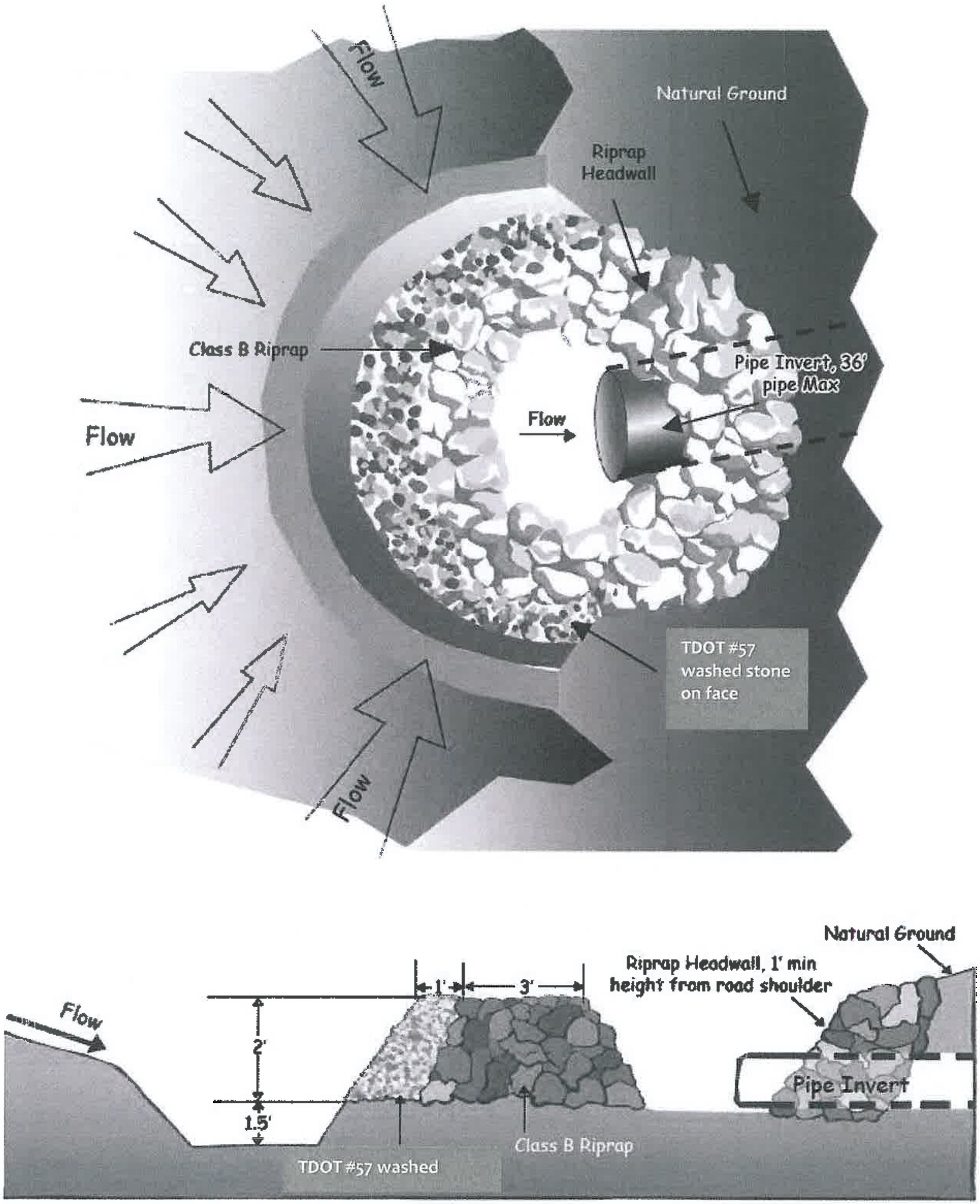


Figure 7.35-5 Rock Pipe Inlet Protection *(Source: NCDENR)*

Construction Specifications

Excavated Drop Inlet Protection:

- Clear the area of all debris that might hinder excavation and disposal of spoil.
- Grade the approach to the inlet uniformly.
- Protect weep holes by gravel.
- When the contributing drainage area has been permanently stabilized, seal weep holes, fill the basin with stable soil to final grading elevations, compact it properly, and stabilize.

Hardware Cloth and Gravel Inlet Protection:

- Uniformly grade a shallow depression approaching the inlet.
- Drive 5-foot steel posts 2 feet into the ground surrounding the inlet. Space posts evenly around the perimeter of the inlet, a maximum of 4 feet apart.
- Surround the posts with wire mesh hardware cloth. Secure the wire mesh to the steel posts at the top, middle, and bottom. Placing a 2-foot flap of the wire mesh under the gravel for anchoring is recommended.
- Place clean gravel (#57 stone) on a 2:1 slope with a height of 16 inches around the wire, and smooth to an even grade.
- Once the contributing drainage area has been stabilized, remove accumulated sediment, and establish final grading elevations.
- Compact the area properly and stabilize it with groundcover.

Block and Gravel Drop Inlet Protection:

- Lay one block on each side of the structure on its side in the bottom row to allow pool drainage. The foundation should be excavated at least 2 inches below the crest of the storm drain. Place the bottom row of blocks against the edge of the storm drain for lateral support and to avoid washouts when overflow occurs. If needed, give lateral support to subsequent rows by placing 2 x 4 wood studs through block openings.
- Carefully fit hardware cloth or comparable wire mesh with ½-inch openings over all block openings to hold gravel in place.
- Use clean gravel, ½- to ¾-inch in diameter, placed 2 inches below the top of the block on a 2:1 slope or flatter and smooth it to an even grade. #57 washed stone is recommended.
- If only stone and gravel are used, keep the slope toward the inlet no steeper than 3:1. Leave a minimum 1-foot wide level stone area between the structure and around the inlet to prevent gravel from entering inlet. On the slope toward the inlet, use stone 3 inches in diameter or larger. On the slope away from the inlet use ½ to ¾-inch gravel (#57 washed stone) at a minimum thickness of 1 foot.

Sod Drop Inlet Protection:

- Bring the area to be sodded to final grade elevation with top soil. Add fertilizer and lime, if necessary.
- Lay all sod strips perpendicular to the direction of flows.
- Keep the width of the sod at least 4 feet in the direction of flows.
- Stagger sod strips so that adjacent strip ends are not aligned.

Rock Doughnut Inlet Protection:

- Clear the area of all debris that might hinder excavation and disposal of spoil.
- Grade shallow depression uniformly towards the inlet with side slopes no greater than 2:1. Grade a 1 foot wide level area set 4 inches below the area adjacent to the inlet.
- Install the Class A-1 or Class B riprap in a circle around the inlet. The minimum crest width of the riprap should be 18 inches, with a minimum bottom width of 7.5 feet. The minimum height of the stone is 2 feet.
- The outside face of the riprap is then lined with 12 inches of #57 washed stone.

Rock Pipe Inlet Protection:

- Clear the area of all debris that might hinder excavation and disposal of spoil.
- Install the Class A-1 or Class B riprap in a semi-circle around the pipe inlet. The stone should be built up higher on each end where it ties into the embankment. The minimum crest width of the riprap should be 3 feet, with a minimum bottom width of 11 feet. The minimum height should be 2 feet, but also 1 foot lower than the shoulder of the embankment or diversions.
- A 1 foot thick layer of #5 or #57 stone should be placed on the outside slope of the riprap.
- The sediment storage area should be excavated around the outside of the stone horseshoe 18 inches below natural grade.
- When the contributing drainage area has been stabilized, fill depression and establish final grading elevations, compact area properly, and stabilize with ground cover.

Maintenance and Inspection Points

Sediment should not be allowed to wash into the inlet. It should be removed from the inlet protection and disposed of and stabilized so that it will not enter the inlet again. Remove sediment from the deposition areas when half the height of the storage area has been filled.

Check measure for damage or evidence of erosion and bypassing around the inlet protection. If inlets are in series, runoff that bypasses an upgradient inlet can overwhelm a downgradient inlet protection device. Sand bags, diversions, or other methods should be used to direct runoff into storm drain inlets.

When the contributing drainage area has been permanently stabilized, all materials and any sediment should be removed, and either salvaged or disposed of properly. The disturbed area should be brought to proper grade, then smoothed and compacted. Appropriately stabilize all disturbed areas around the inlet.

References

TDOT Design Division Drainage Manual

TDOT Erosion Control Standard Drawing EC-STR-11

North Carolina Erosion and Sediment Control Planning and Design Manual

APPENDIX D

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

Davidson County, Tennessee

August 2, 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

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: 1:1,340 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N 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 1:15,800.

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: Davidson County, Tennessee
Survey Area Data: Version 19, Sep 10, 2021

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

Date(s) aerial images were photographed: May 31, 2019—Nov 2, 2019

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
MaB	Maury silt loam, 2 to 7 percent slopes	0.1	2.7%
MmD	Mimosa silt loam, 12 to 25 percent slopes	3.5	90.1%
MrD	Mimosa-Rock outcrop complex, 5 to 20 percent slopes	0.3	7.2%
Totals for Area of Interest		**3.9**	**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.

Davidson County, Tennessee

MaB—Maury silt loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: kknn
Elevation: 390 to 820 feet
Mean annual precipitation: 39 to 57 inches
Mean annual air temperature: 48 to 70 degrees F
Frost-free period: 190 to 205 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Maury and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Maury

Setting

Landform: Hillslopes
Landform position (three-dimensional): Crest
Parent material: Loess over clayey residuum and/or alluvium derived from limestone

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 24 inches: silty clay loam
H3 - 24 to 65 inches: silty clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 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: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

MmD—Mimosa silt loam, 12 to 25 percent slopes

Map Unit Setting

National map unit symbol: kkns
Elevation: 500 to 1,100 feet

Mean annual precipitation: 48 to 54 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 190 to 205 days
Farmland classification: Not prime farmland

Map Unit Composition

Mimosa and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mimosa

Setting

Landform: Hillslopes
Landform position (three-dimensional): Side slope
Parent material: Clayey residuum weathered from limestone

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 14 inches: silty clay
H3 - 14 to 55 inches: clay
R - 55 to 65 inches: bedrock

Properties and qualities

Slope: 12 to 25 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 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: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

MrD—Mimosa-Rock outcrop complex, 5 to 20 percent slopes

Map Unit Setting

National map unit symbol: 2v58p
Elevation: 220 to 1,250 feet
Mean annual precipitation: 48 to 58 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 190 to 230 days
Farmland classification: Not prime farmland

Map Unit Composition

Mimosa and similar soils: 75 percent
Rock outcrop: 15 percent

Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mimosa

Setting

Landform: Escarpments
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Clayey residuum weathered from limestone

Typical profile

Ap - 0 to 6 inches: silt loam
Bt - 6 to 50 inches: clay
C - 50 to 55 inches: clay
R - 55 to 65 inches: bedrock

Properties and qualities

Slope: 5 to 20 percent
Depth to restrictive feature: 39 to 59 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Rock Outcrop

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Minor Components

Gladdice

Percent of map unit: 4 percent
Landform: Escarpments
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ashwood

Percent of map unit: 3 percent

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Barfield

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Qualities and Features

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

Hydrologic Soil Group

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

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

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

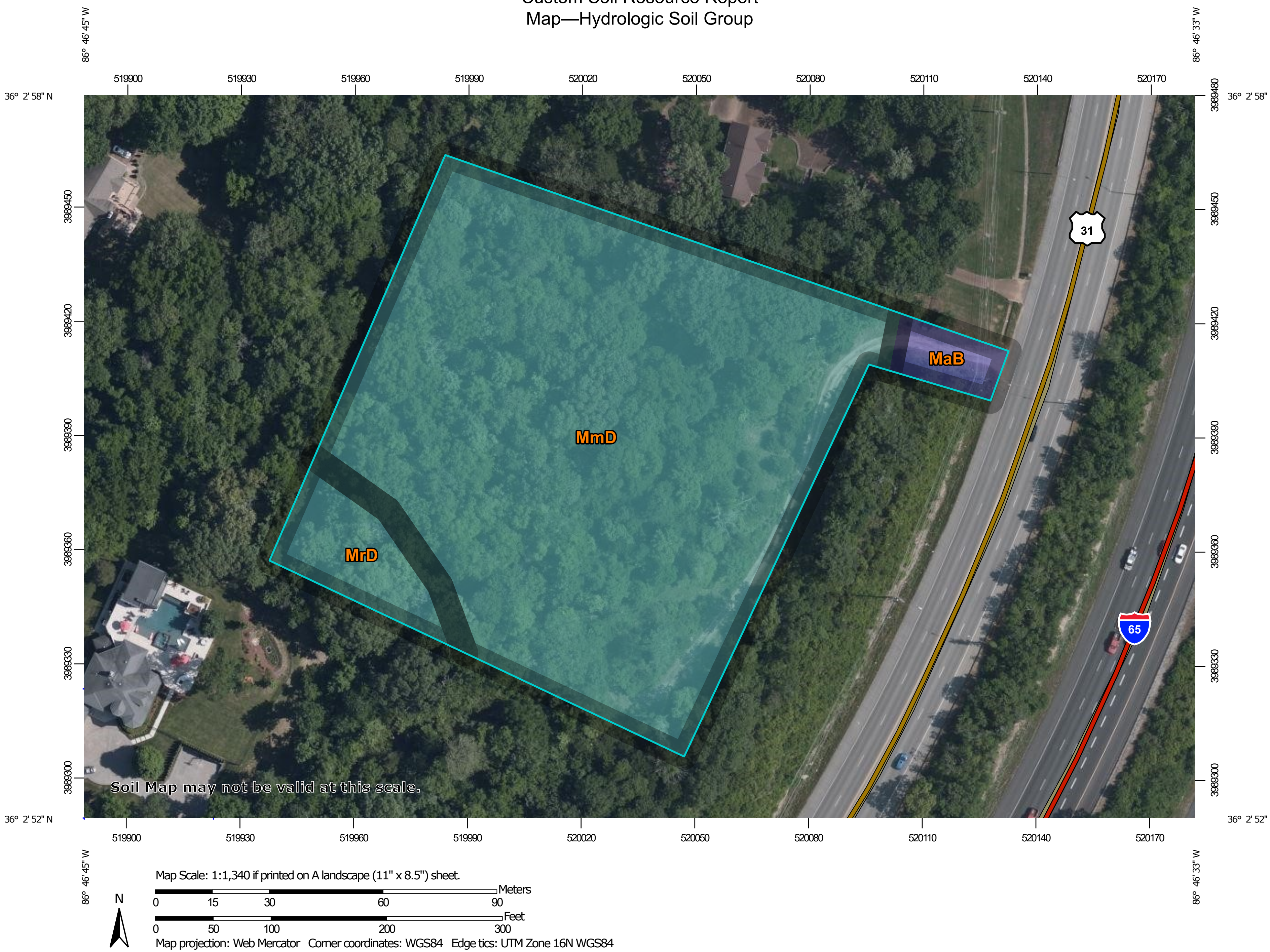
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

Streams and Canals

Transportation

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

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Davidson County, Tennessee
Survey Area Data: Version 19, Sep 10, 2021

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

Date(s) aerial images were photographed: May 31, 2019—Nov 2, 2019

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
MaB	Maury silt loam, 2 to 7 percent slopes	B	0.1	2.7%
MmD	Mimosa silt loam, 12 to 25 percent slopes	C	3.5	90.1%
MrD	Mimosa-Rock outcrop complex, 5 to 20 percent slopes	C	0.3	7.2%
Totals for Area of Interest			**3.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX E

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION (TDEC)
DIVISION OF WATER RESOURCES (DWR)
William R. Snodgrass Tennessee Tower, 312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243
1-888-891-TDEC (8332)

NOTICE OF TERMINATION (NOT) FOR GENERAL NPDES PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES (CGP)

This form is required to be submitted when requesting termination of coverage from the CGP. The purpose of this form is to notify the TDEC that either all stormwater discharges associated with construction activity from the portion of the identified facility where you, as an operator, have ceased or have been eliminated; or you are no longer an operator at the construction site. Submission of this form shall in no way relieve the permittee of permit obligations required prior to submission of this form. Submit this form to the local DWR Environmental Field Office (EFO) address (see table below) or using MyTDEC Forms electronic submittal process. For more information, contact your local EFO at the toll-free number 1-888-891-8332 (TDEC).

Site or Project Name:	**NPDES Tracking Number: TNR**
Street Address or Location:	County(ies):

Name of Permittee Requesting Termination of Coverage:			
Permittee Contact Name:	Title or Position:		
Mailing Address:	City:	State:	Zip:
Phone:	E-mail:		

Check the reason(s) for termination of permit coverage: (check only one)

☐	Primary permittee termination: all requirements for termination under Permit Part 9.1.1. a) through c) have been met. This includes, but is not limited to, for areas the primary permittee has control all earth-disturbing activities at the site are complete and permanent stabilization as defined in Part 10 of the CGP has been achieved. (attach photo documentation).
	When applicable, and you are a primary permittee seeking termination, list who is responsible for ongoing maintenance of stormwater controls left on the site subject for long-term use following termination of coverage:
☐	Secondary permittee termination: all requirements for termination under Permit Part 9.2.1. have been met (no longer an operator at the construction site).

Certification and Signature:

(must be signed by president, vice-president or equivalent ranking elected official)

I certify under penalty of law that either: (a) all stormwater discharges associated with construction activity from the portion of the identified facility where I was an operator have ceased or have been eliminated or (b) I am no longer an operator at the construction site. I understand that by submitting this notice of termination, I am no longer authorized to discharge stormwater associated with construction activity under this general permit, and that discharging pollutants in stormwater associated with construction activity to waters of the state is unlawful under the Tennessee Water Quality Control Act where the discharge is not authorized by a NPDES permit. I also understand that the submittal of this notice of termination does not release an operator from liability for any violations of this permit or the Tennessee Water Quality Control Act. I certify under penalty of law that this document and all attachments were prepared by me, or under my direction or supervision. The submitted information is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. As specified in Tennessee Code Annotated Section 39-16-702(a)(4), this declaration is made under penalty of perjury.

Permittee name (print or type):	Signature:	Date:

EFO	Address	EFO	Street Address
Memphis	8383 Wolf Lake Drive, Bartlett, TN 38133	Cookeville	1221 South Willow Ave., TN 38506
Jackson	1625 Hollywood Drive, TN 38305	Chattanooga	1301 Riverfront Parkway, Ste. 206, TN 37402
Nashville	711 R S Gass Boulevard, TN 37243	Knoxville	3711 Middlebrook Pike, TN 37921
Columbia	1421 Hampshire Pike, TN 38401	Johnson City	2305 Silverdale Road, TN 37601

CN-1175 (Rev. 11-21) RDA 2366

APPENDIX F

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION (TDEC)
DIVISION OF WATER RESOURCES (DWR)
William R. Snodgrass Tennessee Tower, 312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243
1-888-891-8332 (TDEC)

GENERAL NPDES PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITES (CGP) CONSTRUCTION STORMWATER INSPECTION CERTIFICATION (INSPECTION FORM)

Site or Project Name:		**NPDES Tracking Number: TNR**
Primary Permittee Name:		Date of Inspection:
Current approximate disturbed acreage:	Has rainfall been checked/documented daily? ☐ Yes ☐ No	Name of Inspector:
Current weather/ground conditions:	Rainfall total since last inspection:	Inspector's TNEPSC Certification Number:
Site Assessment ☐ Yes ☐ No	Assessor's TN PE registration number:	Assessor's TNEPSC Level II/CPESC number:

Check the box if the following items are on-site:	
☐	Notice of Coverage (NOC)
☐	Stormwater Pollution Prevention Plan (SWPPP)
☐	Weekly inspection documentation
☐	Site contact information
☐	Rain Gage
Off-site Reference Rain Gage Location	

Best Management Practices (BMPs):

Are the Erosion Prevention and Sediment Controls (EPSCs) functioning correctly? If "No," describe below in Comment Section				
1.	Are all applicable EPSCs installed and maintained per the SWPPP per the current phase?		☐ Yes	☐ No
2.	Are EPSCs functioning correctly at all disturbed areas/material storage areas? (permit section 4.1.5)		☐ Yes	☐ No
3.	Are EPSCs functioning correctly at outfall/discharge points such that there is no objectionable color contrast in the receiving stream, and no other water quality impacts? (permit section 5.3.2)		☐ Yes	☐ No
4.	Are EPSCs functioning correctly at ingress/egress points such that there is no evidence of track out?		☐ Yes	☐ No
5.	If applicable, have discharges from dewatering activities been managed by appropriate controls? (permit section 4.1.3) If "No," describe below the measure to be implemented to address deficiencies.	☐ N/A	☐ Yes	☐ No
6.	If construction activity at any location on-site has temporarily/permanently ceased, was the area stabilized within 14 days? (permit section 3.5.3.2) If "No," describe below each location and measures taken to stabilize the area(s).	☐ N/A	☐ Yes	☐ No
7.	Have pollution prevention measures been installed, implemented, and maintained to minimize the discharge of pollutants from wash waters, exposure of materials and discharges from spills and leaks per section 4.1.4? If "No," describe below the measure to be implemented to address deficiencies.	☐ N/A	☐ Yes	☐ No

Site or Project Name:	**NPDES Tracking Number: TNR**
Primary Permittee Name:	Date of Inspection:

8.	If a concrete washout facility is located on site, is it clearly identified on the project and maintained? If "No," describe below the measures to be implemented to address deficiencies.	☐ N/A	☐ Yes	☐ No
9.	Have all previous deficiencies been addressed? If "No," describe the remaining deficiencies in the Comments section. ☐ Check if deficiencies/corrective measures have been reported on a previous form.	☐ N/A	☐ Yes	☐ No

Comment Section. If the answer is "No" for any of the above, describe the problem and summarize corrective actions to be taken. Otherwise, describe any pertinent observations:

Certification and Signature (must be signed by the certified inspector and the permittee per Sections 5.5.3.11 (g) and 8.7.2 of the CGP)

I certify under penalty of law that this document and all attachments were prepared by me, or under my direction or supervision. The submitted information is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. As specified in Tennessee Code Annotated Section 39-16-702(a)(4), this declaration is made under penalty of perjury.

Inspector Name and Title :	Signature:	Date:
Primary Permittee Name and Title:	Signature:	Date:

Construction Stormwater Inspection Certification Form (Inspection Form)

Purpose of this form instructions

An inspection, as described in subsection 5.5.3.9. of the General Permit for Stormwater Discharges from Construction Activities ("Permit"), shall be performed at the specified frequency and documented on this form. Inspections shall be performed at least 72 hours apart. Where sites or portion(s) of construction sites have been temporarily stabilized, or runoff is unlikely due to winter conditions (e.g., site covered with snow or ice), such inspection only has to be conducted once per month until thawing results in runoff or construction activity resumes.

Inspections can be performed by:

a) a person with an valid certification from the "Fundamentals of Erosion Prevention and Sediment Control Level I" course,
b) a licensed professional engineer or landscape architect,
c) a Certified Professional in Erosion and Sediment Control (CPESC), or
d) a person who has successfully completed the "Level II Design Principles for Erosion Prevention and Sediment Control for Construction Sites" course.

Qualified personnel, as defined in subsection 5.5.3.10 of the Permit (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been permanently stabilized, areas used for storage of materials that are exposed to precipitation, structural control measures, locations where vehicles enter or exit the site, and each outfall.

Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the site's drainage system. Erosion prevention and sediment control measures shall be observed to ensure that they are operating correctly.

Outfall points (where discharges leave the site and/or enter waters of the state) shall be inspected to determine whether erosion prevention and sediment control measures are effective in preventing significant impacts to receiving waters. Where discharge locations are inaccessible, nearby downstream locations shall be inspected. Locations where vehicles enter or exit the site shall be inspected for evidence of offsite sediment tracking.

Based on the results of the inspection, any inadequate control measures or control measures in disrepair shall be replaced or modified, or repaired as necessary, before the next rain event if possible, but in no case more than 7 days after the need is identified.

Based on the results of the inspection, the site description identified in the SWPPP in accordance with section 5.5.1 of the Permit and pollution prevention measures identified in the SWPPP in accordance with section 5.5.2 of the Permit, shall be revised as appropriate, but in no case later than 7 days following the inspection. Such modifications shall provide for timely implementation of any changes to the SWPPP, but in no case later than 14 days following the inspection.

All inspections shall be documented on this Construction Stormwater Inspection Certification form. Alternative inspection forms may be used as long as the form contents and the inspection certification language are, at a minimum, equivalent to the division's form and the permittee has obtained a written approval from the Division to use the alternative form. Inspection documentation will be maintained on site and made available to the Division upon request. Inspection reports must be submitted to the Division within 10 days of the request.

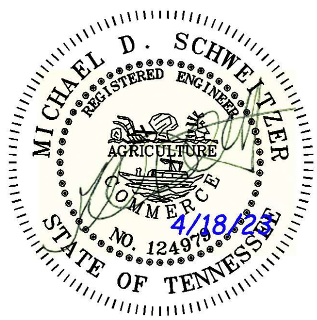
Trained certified inspectors shall complete inspection documentation to the best of their ability. Falsifying inspection records or other documentation or failure to complete inspection documentation shall result in a violation of this permit and any other applicable acts or rules.

SWS Engineering, Inc.

Civil Engineering | Land Surveying | Land Planning

5421/5425/5429 Franklin Pike

Drainage Report



ENGINEER: MIKE SCHWEITZER, PE
SWS ENGINEERING, Inc.

8-2-2022
Revised 2-7-2023
Revised 4-18-2023
Revised 5-17-2023

TABLE OF CONTENTS

APPENDICES

Project Summary

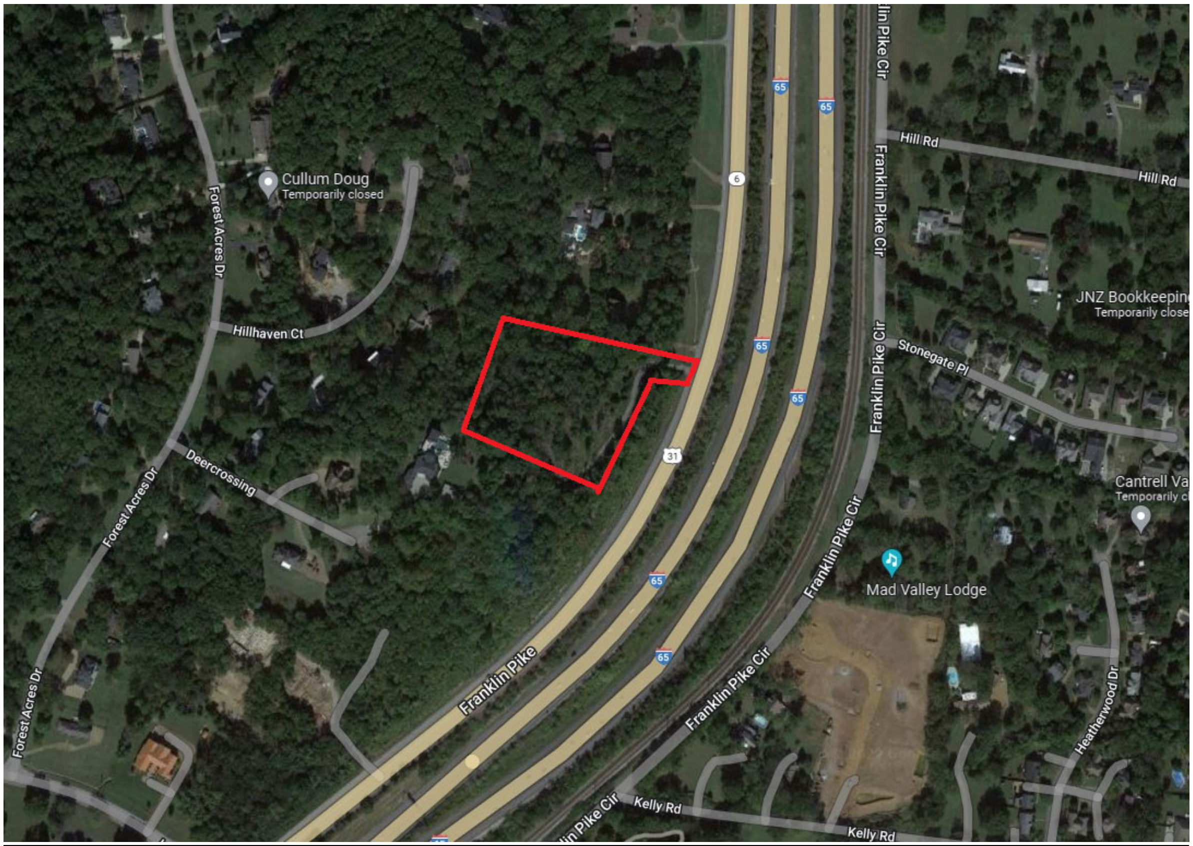
The owner of these three parcels proposes to construct 3 single family homes located at 5421, 5425, 5429 Franklin Pike. The existing topography contains steep slopes ranging from 15 to 25 percent and is primarily covered with trees. The proposed site will contain a 26' wide entrance drive that each lot's private driveway will connect to. Concrete driveway pads and retaining walls are also proposed on the sites. All three lots will contain a Level 1 Bioretention Basin per Metro's LID Manual. Impervious rooftop and concrete hardscape areas will be collected and treated on each Lot. 80% TSS removal has been achieved for the site. Bioretention basins have been oversized to handle the 2-100 year storm events as well. The three basins work together to reduce the proposed stormwater flows to existing levels for the 2-100 year storm event.

Existing and proposed drainage maps can be found in Appendix A. Appendix B provides water quality calculations. Appendix C provides the geotechnical and soils report of the site. The Hydraflow report can be found in Appendix D. Appendix E contains roadside swale calculations.

In order to incorporate the appropriate SF area of infiltration under each Bioretention Basin. An effective depth calculation was used in the Hydra flow modeling. See Bioretention Calculation sheets for further clarification of volumes used.

PRE/POST SITE RUNOFF		
	PRE (CFS)	POST (CFS)
2 YEAR	9.487	9.235
5 YEAR	16.01	15.44
10 YEAR	20.58	20.43
25 YEAR	26.73	26.17
50 YEAR	31.38	30.50
100 YEAR	36.01	35.90

Project Location



APPENDIX A

SWS ENGINEERING, INC.

CIVIL ENGINEERING • LAND PLANNING • SURVEYING
504 Autumn Springs Court, Suite A-6
Franklin, TN 37067
951-704-0890

SAN DIEGO - NASHVILLE - PHOENIX

DATE: Apr 18, 23 12:53pm by: preston.ayer
FILE: N:\2022\22-270T\PROD\Reports\Hydrology\22-270T Existing Conditions.dwg

Tennessee811 Know what's below. Call before you dig.

EXISTING CONDITIONS

DRAINAGE CALCULATIONS
5421/5425 FRANKLIN PIKE
NASHVILLE, TENNESSEE 37220

REV.	COMMENTS	DATE

MAP NO. 16.01 - PARCEL 05.00

PROJECT BENCHMARK
BENCHMARK DESCRIPTION: HYDRANT TAG BOLT
N: 625410.80 ELEVATION: 725.07
E: 1738950.30 (NAVD88)

30' 15' 0' 30' 60'
SCALE IN FEET
GRAPHIC SCALE 1"=30'

JOB NO.: 22-270T

DRAWN BY:	DMO	CHKD BY:	PDA

MAP NO. 16.01 - PARCEL 05.00

PROJECT BENCHMARK
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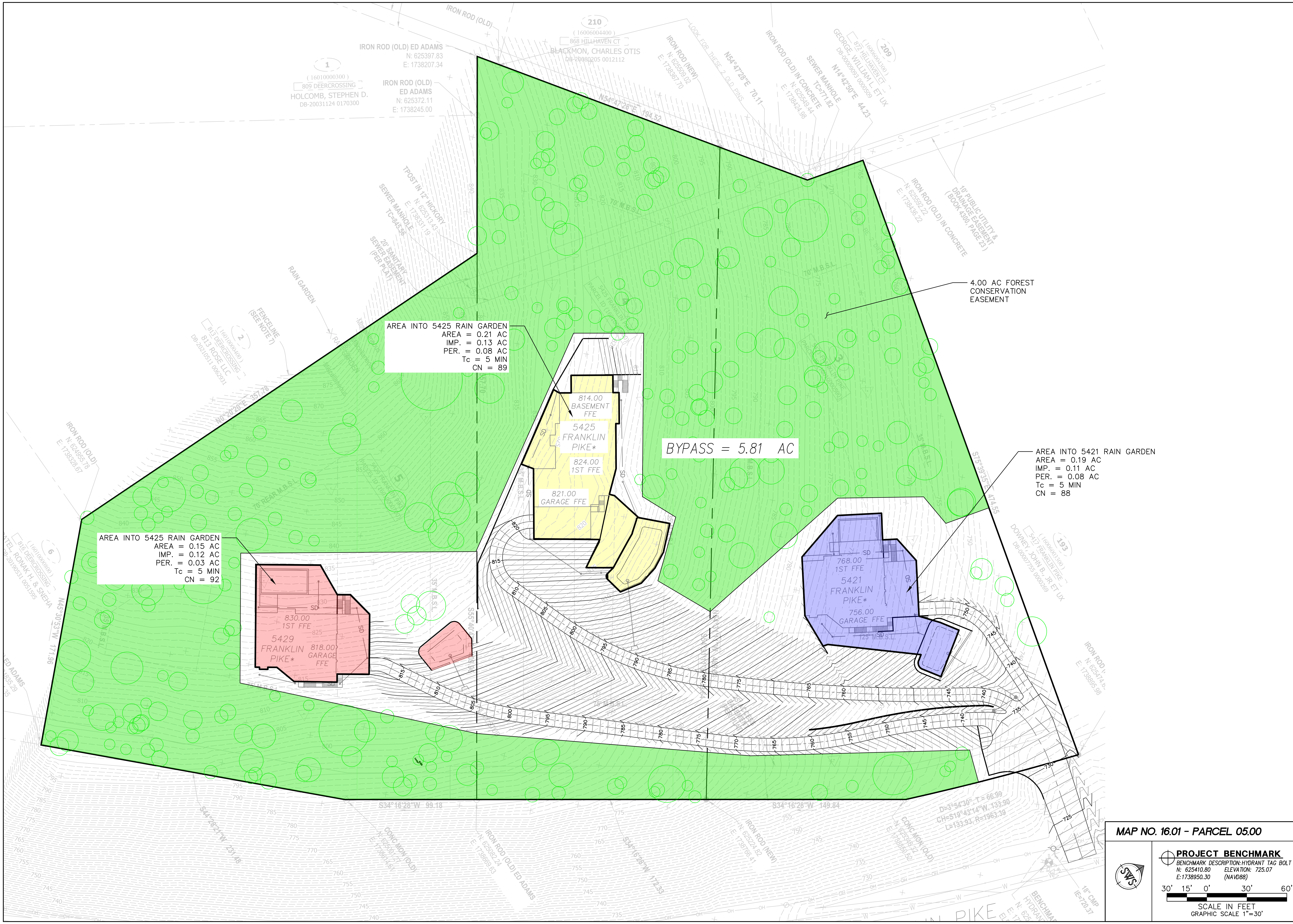
PROPOSED CONDITIONS
DRAINAGE CALCULATIONS
5421/5425 FRANKLIN PIKE
NASHVILLE, TENNESSEE 37220

REV.	COMMENTS	DATE

JOB NO.: 22-270T

DRAWN BY:	DMO	CHKD BY:	PDA



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PROPOSED CONDITIONS

DRAINAGE CALCULATIONS
5421/5425 FRANKLIN PIKE
NASHVILLE, TENNESSEE 37220

REV.	COMMENTS	DATE

JOB NO.: 22-270T

DRAWN BY:	DMO	CHKD BY:	PDA

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DITCH CALCULATIONS

DRAINAGE CALCULATIONS
5421/5425 FRANKLIN PIKE
NASHVILLE, TENNESSEE 37220

REV.	COMMENTS	DATE

JOB NO.: 22-270T

DRAWN BY:	DMO	CHKD BY:	PDA

APPENDIX B

MWS LID Site Design Tool

Project Name	5421, 5425, 5429 Franklin Pike
Parcel Identification #	7202004300
Engineer	Preston Ayer

Combined Sewer Overlay?	**NO**
Pre or Post Development Worksheet?	**Post**
Target Runoff Reduction Requirement =	**80%**

See Section 7.2.1 in Metro SWMM Volume 1

Capture Depth=	**1**	**inch**
Cistern Capture=		**% Total Vol captured**

From Cistern Design Tool

MWS LID SITE DESIGN TOOL VERSION 11 - August 23, 2021

Instructions

1. Input cells are in Green.
2. Break Site Into Sub areas by single soils and land use type combinations.
3. Assign a code to each subarea and input the code into column C. Descriptions can be entered in column B.
4. Input the subarea drainage area in column D.
5. Input treatment credit code (Column F) for the first tier of treatments
6. Input additional treatment code as desired (Column I) for any subarea
7. Adjust until you reach 80% reduction or better (Cell N turns green if 80% reached).
8. If 80% reduction is not reached and it has been decided that GIPs in series is an option use Step 3a to place GIPs in series . Their respective treatment volumes are calculated in column W. This volume is separate from GIPs upstream.

Percent Volume Reduction-Based Calculations

Step 1: Lay out the site and divide it into sub-areas each of a specific land use type and Rv.					Step 1a: Change any basic land use types through reforesting, permeable pavement or green roofs - or through use of open space for a GIP.			Step 2: Treat impervious areas through the use of sheet flow			Step 3: Treat primarily impervious areas with structural GIPs either in series with Step 3 intrinsic GIPs or alone downstream from Steps 1 and 2 land use.			Size controls for Step 3 by assigning structure ID to each sub-area, combining sub-areas into one structure if appropriate.			Step 3a Treatment in Series Calculation - Place Structural GIPs in same row as upstream GIP			Size controls for Step 3a in series by assigning a sequential structure ID to each area treated in series.				
Step1 Basic Land Use					**Step 1a Modified LU**			**Step 2 Intrinsic GIPs**			**Step 3 Structural GIPs**			**Structure ID**	**IA Capture**		**Step 3a Structural GIPs in Series**			**Structure ID**	**IA Capture**		**Nominal Curve Number**	
Subarea	Description	Code	Acres	Base Rv	Code	Acres	Eff Rv1	Code	Trtmt VR1	Eff Rv2	Code	Trtmt VR2	Eff Rv3	Site GIP ID Number	Tv Multiplier	Tv (cf)	Code	Trtmt VR2	Eff Rv4	Site GIP ID Number	Tv Multiplier	Structure in Series Tv (cf)	Step 1	Step 1A
1	Imp. Into 5421 RG	IA	0.11	0.95	IA	0.11	0.95		0	0.95	B1	0.6	0.38		1.10	417		0	0.38		0.00	-	98	98
2	Per. Into 5421 RG	TC	0.08	0.20	TC	0.08	0.20		0	0.20	B1	0.6	0.08		1.10	64		0	0.08		0.00	-	79	79
3				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
4	Imp. Into 5425 RG	IA	0.13	0.95	IA	0.13	0.95		0	0.95	B1	0.6	0.38		1.10	493		0	0.38		0.00	-	98	98
5	Per. Into 5425 RG	TC	0.08	0.20	TC	0.08	0.20		0	0.20	B1	0.6	0.08		1.10	64		0	0.08		0.00	-	79	79
6				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
7	Imp. Into 5429 RG	IA	0.12	0.95	IA	0.12	0.95		0	0.95	B1	0.6	0.38		1.10	455		0	0.38		0.00	-	98	98
8	Per. Into 5429 RG	TC	0.03	0.20	TC	0.03	0.20		0	0.20	B1	0.6	0.08		1.10	24		0	0.08		0.00	-	79	79
9				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
10	Bypass Impervious	IA	0.28	0.95	IA	0.28	0.95		0	0.95		0	0.95		0.00	-		0	0.95		0.00	-	98	98
11	Bypass Pervious	FC	4	0.04	FC	4	0.04		0	0.04		0	0.04		0.00	-		0	0.04		0.00	-	73	73
12	Bypass Pervious	TC	1.53	0.20	TC	1.53	0.20		0	0.20		0	0.20		0.00	-		0	0.20		0.00	-	79	79
13				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
14				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
15				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
16				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
17				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
18				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
47				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
76				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
105				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
134				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
162				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
191				0.00		0	0.00		0	0.00		0	0.00		0.00	-		0	0.00		0.00	-	0	0
		Weighted Rv		0.175	Weighted Rv		0.175	Weighted Rv		0.175	Weighted Rv		0.139		Step 3 Tv Total	1,517			0.139		Final Tv Total	1,517	77.1	77.1
		Total Area=	6.36	1.11	Total Area=	6.36	1.11			1.11			0.88						0.88					
% Removal				82.5%	% Removal		82.5%	% Removal		82.5%	% Removal		**86.1%**				% Removal		**86.1%**					

↑ THIS CELL WILL TURN GREEN WHEN TARGET RUNOFF REDUCTION MET ↑

5421 Bioretention Storage Calculations

Stone Voids =	40%		
Soil Media Voids =	25%		
400 SF Proposed Surface Area			
3.5' of Stone =	756	ft^3	
3' of Soil Media =	405	ft^3	
1' of Ponding =	540	ft^3	
∑ =	1701	ft^3	

Effective Depth - 5421 Bioretention

Tv/Effective Depth = Surface Area

Ponding depth n=1.0	0.67	ft
Soil Media n=0.25	3	ft
Stone Resevoir n=0.40	3.5	ft
Effective Depth	2.82	ft

Tv Required	418	cf
% Upsize	364%	
Tv Provided	1523	cf
Surface Area		
Required	148	sf
Provided	540	sf

5425 Bioretention Storage Calculations

Stone Voids =	40%		
Soil Media Voids =	25%		
600 SF Proposed Surface Area			
3' of Stone =	862	ft^3	
3' of Soil Media =	539	ft^3	
1' of Ponding =	718	ft^3	
∑ =	2119	ft^3	

Effective Depth - 5425 Bioretention

Tv/Effective Depth = Surface Area

Ponding depth n=1.0	0.67	ft
Soil Media n=0.25	3	ft
Stone Resevoir n=0.40	3	ft
Effective Depth	2.62	ft

Tv Required	557	cf
% Upsize	338%	
Tv Provided	1881	cf
Surface Area		
Required	213	sf
Provided	718	sf

5429 Bioretention Storage Calculations

Stone Voids =	40%		
Soil Media Voids =	25%		
400 SF Proposed Surface Area			
3' of Stone =	432	ft^3	
3' of Soil Media =	270	ft^3	
1' of Ponding =	360	ft^3	
∑ =	1062	ft^3	

Effective Depth - 5429 Bioretention

Tv/Effective Depth = Surface Area

Ponding depth n=1.0	0.67	ft
Soil Media n=0.25	3	ft
Stone Resevoir n=0.40	3	ft
Effective Depth	2.62	ft

Tv Required	479	cf
% Upsize	197%	
Tv Provided	943	cf
Surface Area		
Required	183	sf
Provided	360	sf

APPENDIX C

April 5, 2023

Mr. James Douglas.
5421 Franklin Pike, LLC
P.0. Box 5620
Sevierville, TN 37864

ECS Project No. 26:5677-A

Reference: Letter of Subsurface Exploration
5421 Franklin Pike
5421 Franklin Pike
Nashville, Tennessee

Dear Mr. Douglas:

As authorized by your acceptance of our proposal, (ECS Proposal No. 26:10717) dated March 21, 2023, ECS Southeast, LLP (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This letter has been prepared to provide additional information and should be considered an addendum to our initial report (ECS Report No. 26:5677) dated August 2, 2022. It should be noted that the structure layout as shown in the initial report and the Construction Plans prepared by SWS Engineering, Inc. dated April 21, 2022, are different and soils conditions may change. ECS recommends the foundation excavations be observed by the geotechnical engineer of record at the time of construction.

SITE AND SUBSURFACE CONDITIONS

Test Pits

The site subsurface conditions were evaluated with eight (8) test pits at the approximate locations shown on the Exploration Location Diagram in the Appendix. The quantity of test pits, locations, and excavation depths were determined in the field during this subsurface exploration.

A surficial layer of topsoil was measured at approximately 6- to 12- inches thick at the test pit locations. Below the topsoil, native light brown LEAN and FAT CLAY (CL, CH) was encountered. This material was typically brown in color and contained varying amounts of sand and gravel. Test pit refusal in the vicinity of the structure and wall was encountered at approximate depths ranging from 2- to 3-feet below the ground surface. The remaining test pits encountered refusal at approximate depths of 1 to 5 feet.

Groundwater was not encountered in the test pits at the time of excavation. It is possible for perched water to exist within the depths explored during other times of the year depending upon climatic and rainfall conditions. Additionally, discontinuous zones of perched water may exist within the overburden materials. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

Laboratory Testing Program

A geotechnical engineer classified each soil sample on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS, ASTM D 2487). The group symbols for each soil type are indicated in parentheses following the soil descriptions on each boring log. A brief explanation of the USCS is included in the Appendix. The engineer grouped the various soil types into the major zones noted on the test pit logs. The stratification lines designating the interfaces between materials on the exploration records should be considered approximate; in situ, the transitions may be gradual.

Representative soil samples were selected and tested in our laboratory to check field classifications and to determine pertinent index properties. The laboratory testing program included:

- Natural moisture content determinations (ASTM D 2216)
- Atterberg Limits tests (ASTM D 4318)

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition. The results of the laboratory testing is included in the Appendix.

Laboratory index test results indicate the in-situ moisture content of the tested samples ranged from approximately 29 to 34 percent.

An Atterberg Limits test performed on a select soil sample from Test Pit TP-07A indicated FAT CLAY (CH) with a Liquid Limit of 75 and a Plasticity Index of 52. The results have been included on the Laboratory Testing Summary in the Appendix.

Infiltration Testing

Two (2) drop rate tests were performed on March 13 and 14, 2023, in general conformance with recognized drop rate test procedures. To perform the test, an auger boring was extended to the depth shown in the table below, beneath the existing ground surface. Following completion of the auger boring, a 6-inch diameter casing was installed, generally flush with the bottom of the borehole. The casing was then filled with water to a depth of approximately 2 feet above the bottom of the hole and left to pre-soak for 24 hours. After the pre-soak period, approximately 2 feet of water was again added and the rate of water level drop was then observed for a 1 hour period. This procedure was then repeated three times over a total 4-hour period. A summary of the test results is presented in Table 1.

Table 1 - In-Situ Drop Rate Test Results

Boring No.	Boring Depth (ft)	USCS Classification	Groundwater Observations During Drilling (ft)	Average Drop Rate (inches per hour)	Last Hour Drop Rate (inches per hour)
I-1	8	CH	-	4.5	3.6
I-2	8	CH	-	7.5	4.8

While ECS is not aware of specific design infiltration rates desired for this project, we recommend an appropriate factor of safety be applied to the field results presented above. It is our experience that many times construction disturbance and compaction can reduce near surface pre-construction in-situ infiltration rates. Please note that the "drop rate" reported above does not equate to an in-situ permeability.

SLOPE ANALYSIS

Based on the initial test pits and the test pits completed as part of this addendum and the proposed finish floor elevation and the wall elevations, the residential structure and wall will be founded on bedrock. Most of the wall excavations will extend into bedrock several feet. Therefore, the slope stability analysis was well above a factor of safety of 2.5.

In general, compacted soil fill embankments on stiff undisturbed soils should be constructed no steeper than a ratio of 3.0 horizontal (H) to 1.0 vertical (V). We recommend cut slopes not be steeper than a ratio of 3.0 (H) to 1.0 (V).

Surface water runoff should be routed from flowing over the slope face. For cut slopes, the area above the slope crest should be constructed with a reverse slope to reduce the likelihood of surface water runoff from flowing over the slope face. Additionally, we recommend a drainage swale or other provisions be constructed near the crest of each cut slope to divert water away from the cut face.

Material should not be stockpiled within 10 feet of the crest of cut or fill slopes. In addition, both cut and fill slope faces should be protected from erosion using a vegetative cover. Seed and mulch, or erosion matting with embedded seed, are options for developing a vegetative cover.

CONCLUSIONS AND RECOMMENDATIONS

Based on the test pit observations and laboratory test results, we offer the following conclusions and recommendations to help guide you in further decision making:

Highly Plastic Soils – Highly-expansive and compressible FAT CLAY (CH) soils were encountered on-site during our exploration. It is our opinion that the on-site highly plastic FAT CLAY (CH) soils should not be utilized for the direct support of the proposed foundations or slab on grades and should only be re-used as engineered fill in deeper fill sections, i.e., greater than 4 feet below planned grades. If this material is encountered in cut sections, a minimum of a 2-foot cap of low plasticity clay should be placed above the highly plastic clay material.

Rock Excavation – In general, the test pits encountered shallow bedrock in the upper approximate 1 to 5 feet as indicated by the Test Pit Logs. Based on our understanding of the proposed excavations required at the site, the use of special excavation techniques (i.e., blasting or hoe-ramming) will be required for excavations beyond the depth of bucket refusal.

Colluvial Soils – Colluvial soils were not encountered during our test pit exploration. However, if these soils are encountered during construction, ECS recommends removing these materials to the depth of stiff residual soils or bedrock within and 10 feet outside the planned construction limits and placing and compacting adequate structural fill.

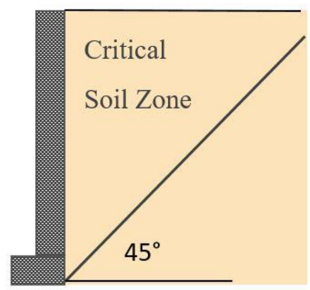
Site Retaining Walls – The retaining walls are expected to be founded on bedrock and most of the wall will be into bedrock. If MSE walls are going to be used as planned, the owner should expect overblasting to install grids. ECS recommends a cast in place (CIP) wall for this residence.

Unlike below grade walls, site retaining walls are free to rotate at the top (not restrained). For these walls the "Active" (k_a) soil condition should be used along with a triangular distribution of earth pressures. In addition, site retaining walls should be designed to withstand lateral earth pressures exerted by the backfill and surcharge loads within the "Critical Soil Zone". The Critical Zone is defined as the area between the back of the retaining wall footing and an imaginary line projected upward and rearward at a 45-degree angle (see figure below).

The lateral earth pressures developed behind site retaining walls are a function of the backfill soil type, backfill slope angle, and surcharge loads. For the design of site retaining walls, we recommend the parameters provided below.

Retaining Wall Backfill in the Critical Zone

Soil Parameter	Select Granular Fill	No. 57 or No. 67 Stone
Coefficient of Active Earth Pressure (K_a)	0.31	0.22
Retained Soil Moist Unit Weight (γ)	130 pcf	105 pcf
Cohesion (C)	0 psf	0 psf
Angle of Internal Friction (ϕ)	32°	40°
Friction Coefficient [Concrete on Soil] (μ)	0.30	0.30
Active Equivalent Fluid Pressure	83H (psf)	72H (psf)



Foundation Parameters

Soil Parameter	Estimated value
Allowable Bearing Pressure (weathered bedrock)	5,000 psf
Minimum Wall Embedment Below Grade	18 inches
Coefficient of Passive Earth Pressure (K_p) (bedrock)	4.60
Rock Unit Weight (γ)	145 pcf
Cohesion (C)	0 psf
Interface Friction Angle [Concrete on Rock] (ϕ_f)	40°
Sliding Friction Coefficient [Concrete on Rock] (μ)	0.50
Passive Equivalent Fluid Pressure	660H (psf)

It is critical that the soils used for backfill of the retaining walls meet the soil parameters recommended above. If the soils available do not meet those parameters, then ECS should be contacted to provide revised values, and to confirm that only adequate granular materials will be used for wall backfill.

Care should be used to avoid the operation of heavy equipment to compact the wall backfill since it may overload and damage the wall. In addition, such loads are not typically considered in the design of site retaining walls, and are not provided for in our recommendations.

Wall Drainage: Retaining walls should be provided with a wall and foundation drainage system to relieve hydrostatic pressures which may develop behind the walls. This system should consist of weepholes through the wall and/or a 4-inch perforated, closed joint drain line located along the backside of the walls above the top of the footing. The drain line should be surrounded by a minimum of 6 inches of AASHTO #57 Stone wrapped with an approved non-woven geotextile, such as Mirafi 140-N or equivalent. Wall drains can consist of a 12-inch wide zone of free draining gravel, such as AASHTO #57 Stone, employed directly behind the wall and separated from the soils beyond with a non-woven geotextile. Alternatively, the wall drain can consist of an adequate geocomposite drainage board material. The wall drain should be hydraulically connected to the foundation drain.

Closing

Our professional services have been performed, our findings obtained, and our conclusions prepared in accordance with generally accepted geotechnical engineering principles and practices. ECS is not responsible for the conclusions, opinions, or recommendations made by others based on these data. No third party is given the right to rely on this report without express written permission. We appreciate this opportunity to be of service to you during the design phase of this project.

If you have any questions with regard to the information and recommendations presented in this report, please do not hesitate to contact us.

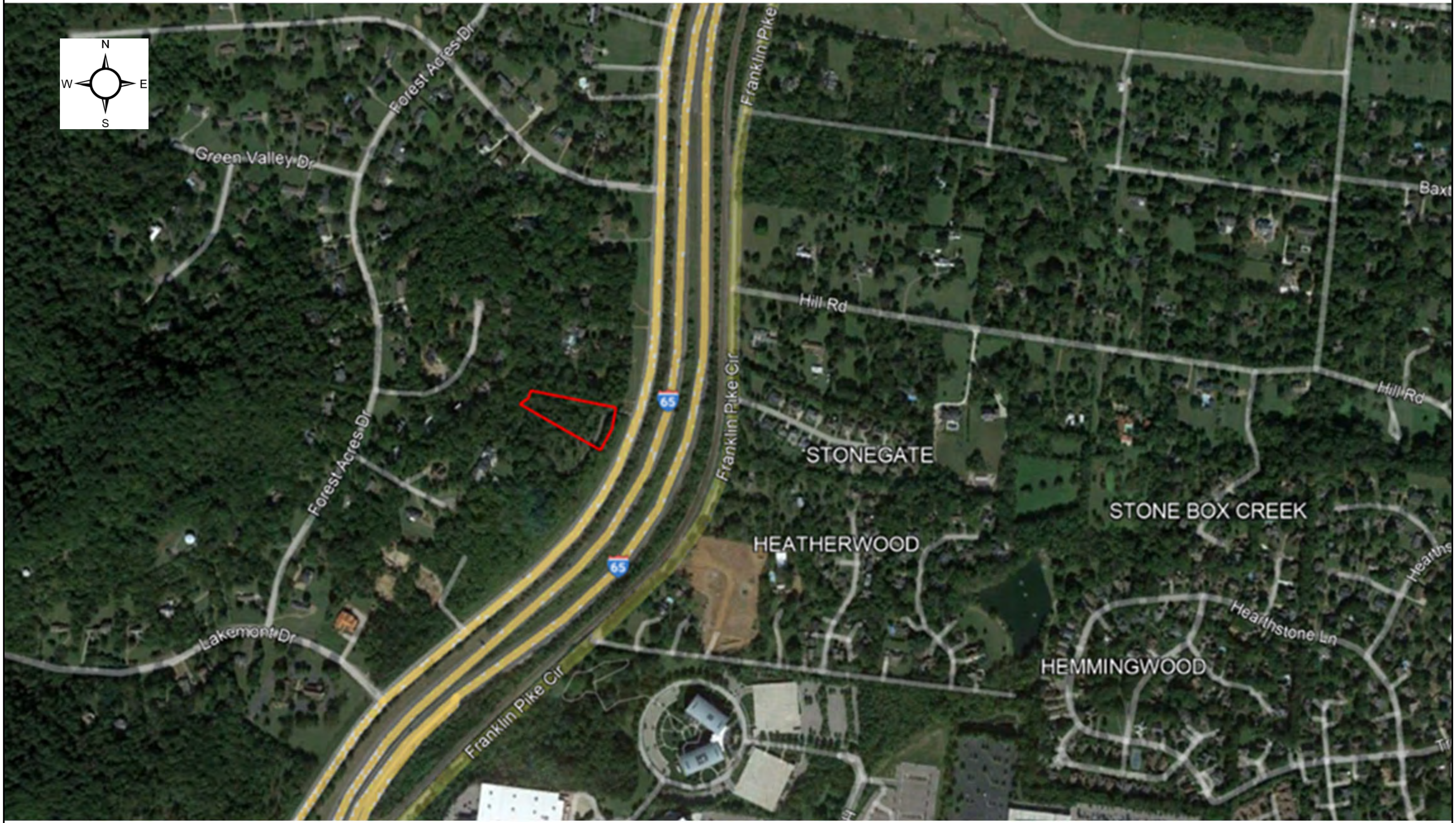
Respectfully,
ECS SOUTHEAST, LLP

4-5-2023

Trevor Nugent
Geotechnical Staff Project Manager

John D. Godfrey Jr., P.E.
Principal Engineer

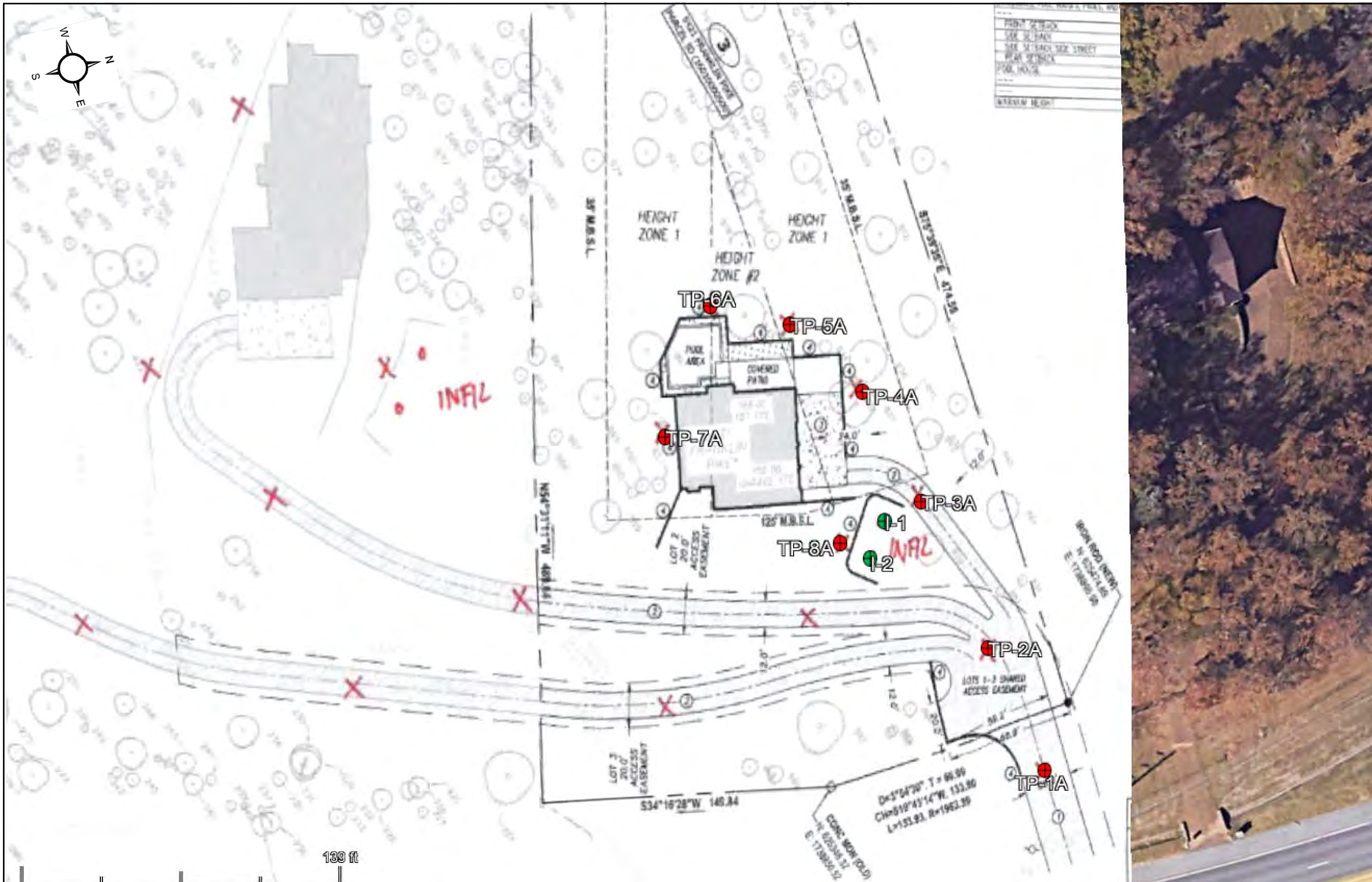
Attachments:
- Site Location Diagram
- Exploration Location Diagram
- Test Pit Logs
- Liquid and Plastic Limit Test Report
- Laboratory Test Results Summary
- Important Information



5421 Franklin Pike Geotechnical Exploration

5421 Franklin Pike
Nashville, Tennessee
ECS Project No. 26:5677-A

Site Location Diagram
(approximate site location outlined in red)

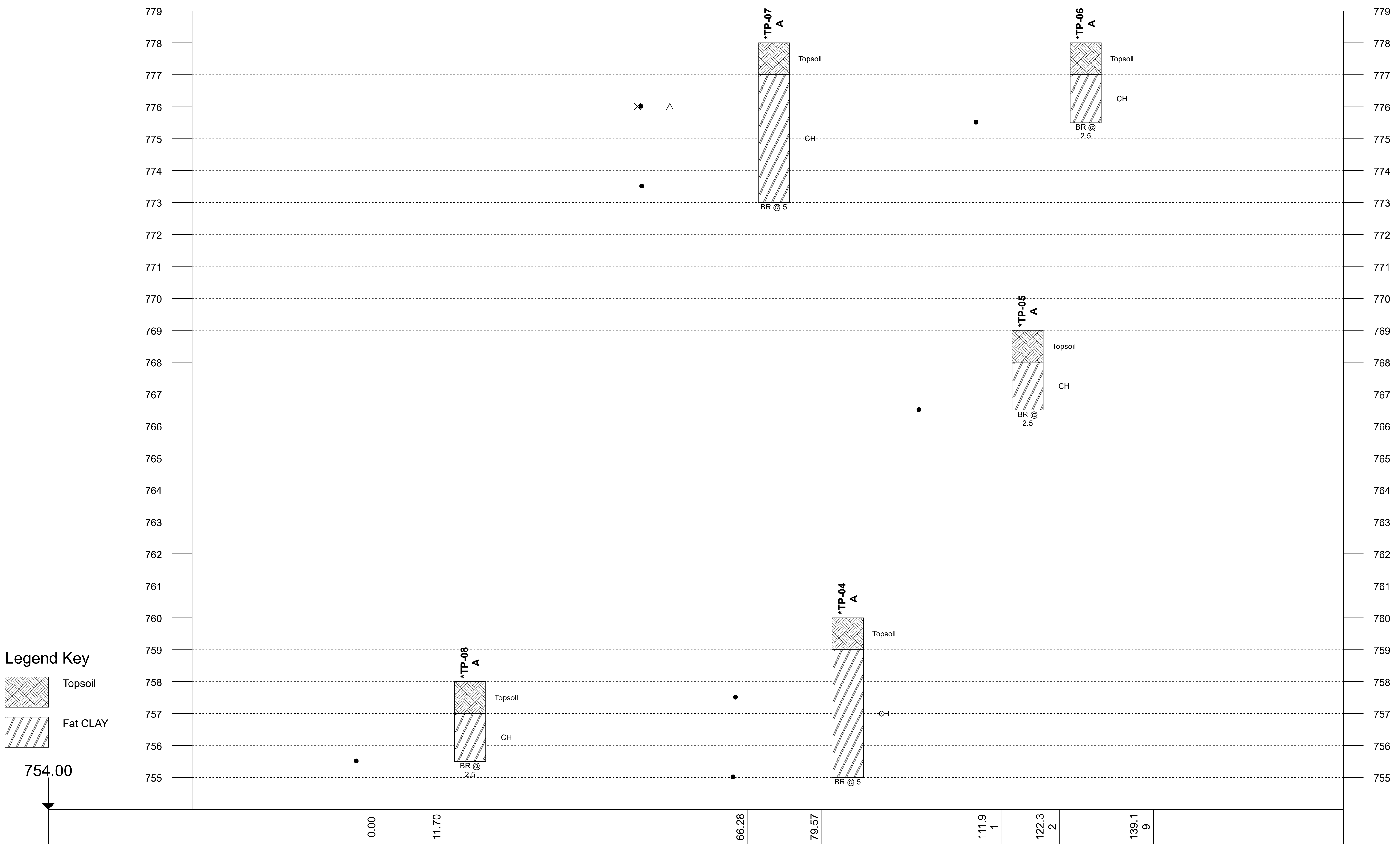


5421 Franklin Pike Geotechnical Exploration

5421 Franklin Pike
Nashville, Tennessee
ECS Project No. 26:5677-A

Exploration Location Diagram

Approximate Boring Locations
Approximate Infiltration Locations



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit X——●——△	WL (First Encountered)	Fill
[FINES CONTENT%]	WL (Completion)	Possible Fill
BOTTOM OF CASING	WL (Estimated Seasonal High Water)	Probable Fill
LOSS OF CIRCULATION	WL (Stabilized)	Rock

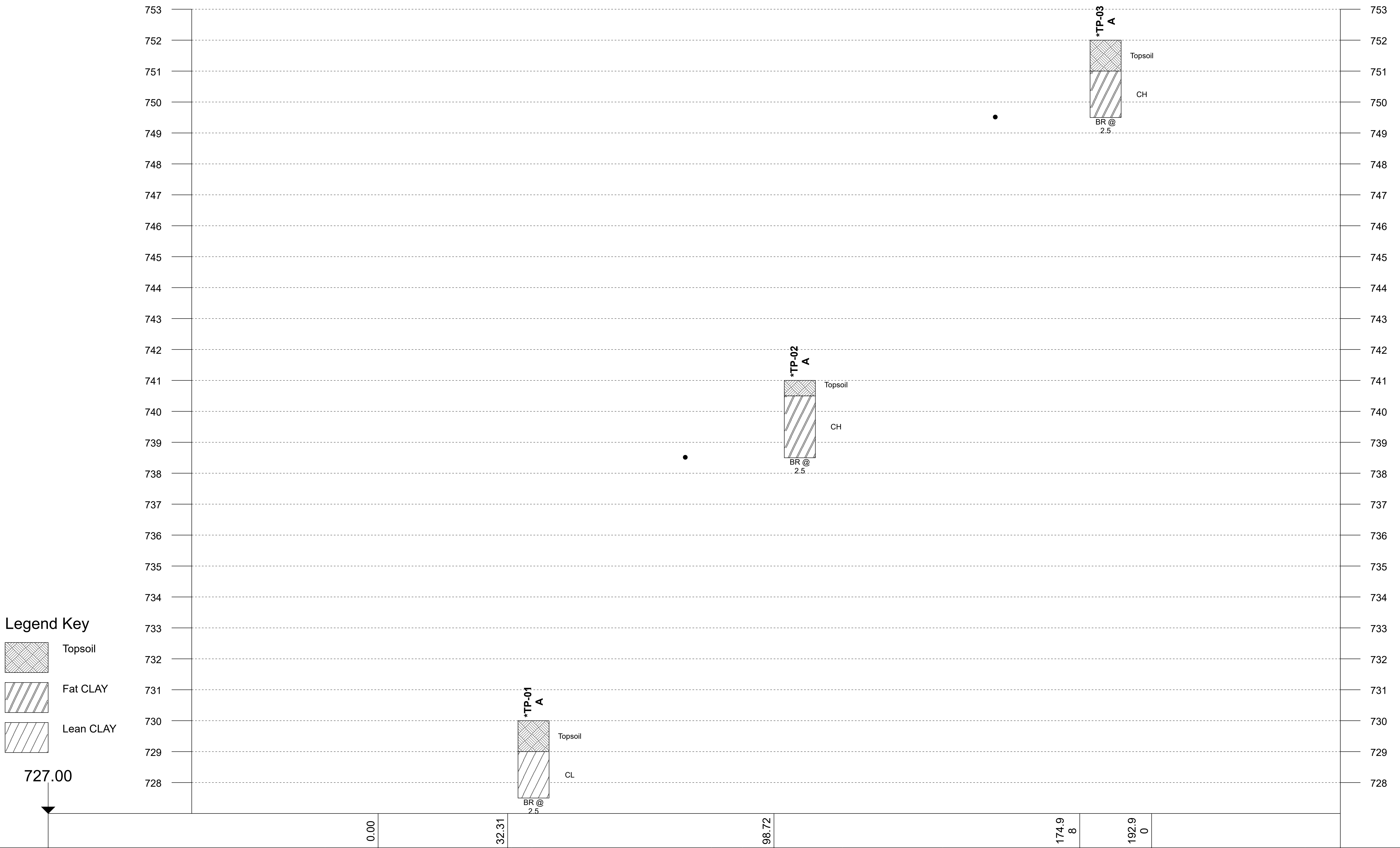
GENERALIZED SUBSURFACE SOIL PROFILE Section line A-A'

5421 Franklin Pike Add'l Geotechnical Exploration

Urban Development Group LLC

5421 Franklin Pike, Nashville, Tennessee, 37220

Project No:	26:5677-A	Date:	03/21/2023



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit X——●——△	WL (First Encountered)	Fill
[FINES CONTENT%]	WL (Completion)	Possible Fill
BOTTOM OF CASING	WL (Estimated Seasonal High Water)	Probable Fill
LOSS OF CIRCULATION	WL (Stabilized)	Rock

ECS

GENERALIZED SUBSURFACE SOIL PROFILE Section line B-B'

5421 Franklin Pike Add'l Geotechnical Exploration

Urban Development Group LLC

5421 Franklin Pike, Nashville, Tennessee, 37220

Project No:	26:5677-A	Date:	03/21/2023

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5677-A**	**1 of 1**
PROJECT NAME: **5421 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-01A**	SURFACE ELEVATION: **730**
SITE LOCATION: **5421 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625446.0**	EASTING: **1738903.1**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			BUCKET REFUSAL AT 1 FT					
							S-1	
5		725						
10		720						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5677-A**	**1 of 1**
PROJECT NAME: **5421 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-02A**	SURFACE ELEVATION: **741**
SITE LOCATION: **5421 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625451.6**	EASTING: **1738837.0**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[6"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, stiff			2.00	S-1	29.0
			BUCKET REFUSAL AT 2.5 FT					
5		736						
10		731						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5677-A**	**1 of 1**
PROJECT NAME: **5421 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-03A**	SURFACE ELEVATION: **752**
SITE LOCATION: **5421 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625458.8**	EASTING: **1738761.1**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, stiff			2.00	S-1	32.4
			BUCKET REFUSAL AT 2.5 FT					
5		747						
10		742						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5677-A**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
5421 Franklin Pike Add'l Geotechnical Exploration	**TP-04A**	**760**
SITE LOCATION:		STATION:
5421 Franklin Pike, Nashville, Tennessee, 37220		
NORTHING: **625460.7**	EASTING:	**1738703.7**

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, stiff to very stiff					
						2.00	S-1	31.0
5		755	**BUCKET REFUSAL AT 5 FT**			2.50	S-2	29.1
10		750						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5677-A**	**1 of 1**
PROJECT NAME: **5421 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-05A**	SURFACE ELEVATION: **769**
SITE LOCATION: **5421 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625447.6**	EASTING: **1738661.3**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, stiff			2.00	S-1	33.8
			BUCKET REFUSAL AT 2.5 FT					
5		764						
10		759						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5677-A**	**1 of 1**
PROJECT NAME: **5421 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-06A**	SURFACE ELEVATION: **778**
SITE LOCATION: **5421 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625421.2**	EASTING: **1738636.9**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, stiff			2.00	S-1	33.1
			BUCKET REFUSAL AT 2.5 FT					
5		773						
10		768						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

∇ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: ECS	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5677-A**	**1 of 1**
PROJECT NAME: **5421 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-07A**	SURFACE ELEVATION: **778**
SITE LOCATION: **5421 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625375.0**	EASTING: **1738676.7**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, stiff			1.50	S-1	29.2
						2.00	S-2	30.3
5		773	**BUCKET REFUSAL AT 5 FT**					
10		768						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5677-A**	**1 of 1**
PROJECT NAME: **5421 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-08A**	SURFACE ELEVATION: **758**
SITE LOCATION: **5421 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625417.3**	EASTING: **1738758.1**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, stiff			2.00	S-1	29.8
			BUCKET REFUSAL AT 2.5 FT					
5		753						
10		748						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

Photo 1 – Test Pit-1A Excavation

Photo 2 – Test Pit-1A Spoils

Photo 3 – Test Pit-2A Excavation

Photo 4 – Test Pit-2A Spoils

Photolog		5421 Franklin Pike Nashville,Tennessee ECS Project No. 26:5677-A

Photo 5 – Not Available

Photo 6 – Test Pit-3A Spoils

Photolog		5421 Franklin Pike Nashville,Tennessee ECS Project No. 26:5677-A

Photo 7 – Test Pit-4A Excavation

Photo 8 – Test Pit-4A Spoils

Photo 9 – Test Pit-5A Excavation

Photo 10 – Test Pit-5A Spoils

Photolog		5421 Franklin Pike Nashville,Tennessee ECS Project No. 26:5677-A

Photo 11 – Test Pit-6A Excavation

Photo 12 – Test Pit-6A Spoils

Photo 13 – Test Pit-7A Excavation

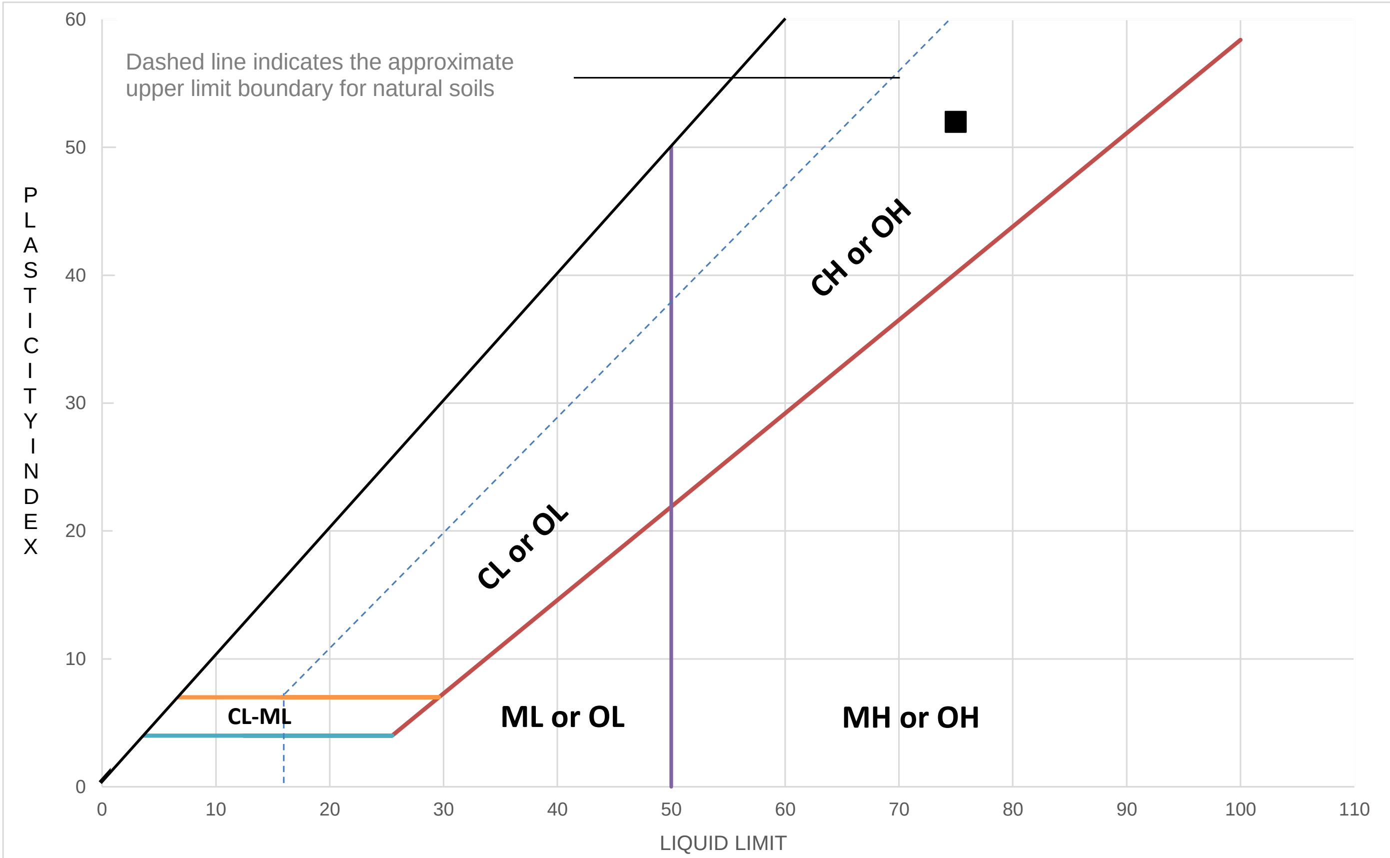
Photo 14 – Test Pit-7A Spoils

Photolog	5421 Franklin Pike Nashville,Tennessee ECS Project No. 26:5677-A

Photo 15 – Test Pit-8A Excavation

Photo 16 – Test Pit-8A Spoils

LIQUID AND PLASTIC LIMITS TEST REPORT



TEST RESULTS (ASTM D4318-10 (MULTIPOINT TEST))

	Sample Location	Sample Number	Sample Depth (ft)	LL	PL	PI	%<#40	%<#200	AASHTO	USCS	Material Description
■	TP-07A	S-1	2	75	23	52					(CH) Fat Clay, Light Tannish Brown

Project: 5421 Franklin Pike Add'l Geotechnical Exploration
Client: Urban Development Group LLC

Project No.: 26:5677-A
Date Reported: 3/20/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Nashville	318 Seaboard Lane Suite 208 Franklin, TN 37067	(615)885-4983 (615)771-4134

Tested by	Checked by	Approved by	Date Received
BHeineman	rbanner	rbanner	3/13/2023

Laboratory Testing Summary

Sample Location	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
TP-02A	S-1	2.5	29.0										
TP-03A	S-1	2.5	32.4										
TP-04A	S-1	2.5	31.0										
TP-04A	S-2	5	29.1										
TP-05A	S-1	2.5	33.8										
TP-06A	S-1	2.5	33.1										
TP-07A	S-1	2	29.2		75	23	52						
TP-07A	S-2	4.5	30.3										
TP-08A	S-1	2.5	29.8										

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: 5421 Franklin Pike Add'l Geotechnical Exploration
Client: Urban Development Group LLC

Project No.: 26:5677-A
Date Reported: 3/20/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Nashville	318 Seaboard Lane Suite 208 Franklin, TN 37067	(615)885-4983 (615)771-4134

Tested by	Checked by	Approved by	Date Received
LMinella	rbanner	rbanner	3/13/2023

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

April 5, 2023

Mr. Jeremy Walker
Urban Development Group, LLC
P.O. Box 90288
Nashville, TN 37209

ECS Project No. 26:5678-A

Reference: Letter of Subsurface Exploration
5425 Franklin Pike
5425 Franklin Pike
Nashville, Tennessee

Dear Mr. Walker:

As authorized by your acceptance of our proposal, (ECS Proposal No. 26:10717) dated March 21, 2023, ECS Southeast, LLP (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This letter has been prepared to provide additional information and should be considered an addendum to our initial report (ECS Report No. 26:5678) dated August 2, 2022.

SITE AND SUBSURFACE CONDITIONS

Test Pits

The site subsurface conditions were evaluated with seven (7) test pits at the approximate locations shown on the Exploration Location Diagram in the Appendix. The quantity of test pits, locations, and excavation depths were determined in the field during this subsurface exploration.

A surficial layer of topsoil was measured at approximately 6- to 18- inches thick at the test pit locations. Below the topsoil, native light brown LEAN and FAT CLAY (CL, CH) was encountered. This material was typically brown in color and contained varying amounts of sand and gravel. Test pit refusal was encountered at most test pit locations at approximate depths ranging from 1-½ to 7-½ feet below the ground surface. Test Pits TP-4A and TP-7A did not encounter refusal and instead reached the extent of the bucket reach, approximately 10 feet.

Groundwater was not encountered in the test pits at the time of excavation. It is possible for perched water to exist within the depths explored during other times of the year depending upon climatic and rainfall conditions. Additionally, discontinuous zones of perched water may exist within the overburden materials. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

Laboratory Testing Program

A geotechnical engineer classified each soil sample on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS, ASTM D 2487). The group symbols for each soil type are indicated in parentheses following the soil descriptions on each boring log. A brief explanation of the USCS is included in the Appendix. The engineer grouped the various soil types into the major zones noted on the test pit logs. The stratification lines designating the interfaces between materials on the exploration records should be considered approximate; in situ, the transitions may be gradual.

Representative soil samples were selected and tested in our laboratory to check field classifications and to determine pertinent index properties. The laboratory testing program included:

- Natural moisture content determinations (ASTM D 2216)
- Atterberg Limits tests (ASTM D 4318)

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition. The results of the laboratory testing is included in the Appendix.

Laboratory index test results indicate the in-situ moisture content of the tested samples ranged from approximately 18 to 29 percent.

An Atterberg Limits test performed on a select soil sample from Test Pit TP-06A indicated FAT CLAY (CH) with a Liquid Limit of 59 and a Plasticity Index of 40. The results have been included on the Laboratory Testing Summary in the Appendix.

Infiltration Testing

Two (2) drop rate tests were performed on March 13 and 14, 2023, in general conformance with recognized drop rate test procedures. To perform the test, an auger boring was extended to the depth shown in the table below, beneath the existing ground surface. Following completion of the auger boring, a 6-inch diameter casing was installed, generally flush with the bottom of the borehole. The casing was then filled with water to a depth of approximately 2 feet above the bottom of the hole and left to pre-soak for 24 hours. After the pre-soak period, approximately 2 feet of water was again added and the rate of water level drop was then observed for a 1 hour period. This procedure was then repeated three times over a total 4-hour period. A summary of the test results is presented in Table 1.

Table 1 - In-Situ Drop Rate Test Results

Boring No.	Boring Depth (ft)	USCS Classification	Groundwater Observations During Drilling (ft)	Average Drop Rate (inches per hour)	Last Hour Drop Rate (inches per hour)
I-1	8	CH	-	2.3	0.6
I-2	8	CH	-	2.4	1.2

While ECS is not aware of specific design infiltration rates desired for this project, we recommend an appropriate factor of safety be applied to the field results presented above. It is our experience that many times construction disturbance and compaction can reduce near surface pre-construction in-situ infiltration rates. Please note that the “drop rate” reported above does not equate to an in-situ permeability.

SLOPE ANALYSIS

Based on the initial test pits and the test pits completed as part of this addendum and the proposed finish floor elevation and the wall elevations, the residential structure and wall will be founded mostly on new structural fill. Most of the wall excavations will extend into some bedrock.

The slope stability analyses utilized for this project were based on two dimensional limit plastic equilibrium methods. In this method, a trial failure surface is assumed. The mass of soil above the failure surface is divided into vertical strips called slices. The forces acting on each slice are estimated. The forces are separated into those tending to cause failure and those tending to resist failure. The sum of the two sets of forces for a trial failure surface are tabulated and compared by dividing the forces resisting failure by those causing failure. This ratio is termed the factor of safety (FS). When the FS is 1.0, failure of the slope is imminent. When the FS exceeds 1.3, it is generally assumed the slope is adequate. However, there are certain minimum factors of safety which, by experience, are acceptable. In general, these minimum values of FS depend on the consequences of failure as well as the anticipated loading condition.

To determine the forces necessary to perform the analyses, the slope geometry, stratigraphy, soil strength parameters, groundwater levels, and extraneous loads must be determined. The slope geometry is modeled to represent the existing slope configuration. Test pits were used in the determination of the stratigraphy of the site and the soil parameters.

The RocScience SLIDE2 computer program was used to evaluate the slope stability at each cross section. For this study, Bishop's Modified Method of Slices was used. Based on the existing grades, the slope analyzed was located in the native and proposed fill soils. Native soil and rock parameters were chosen conservatively from published tables and formulas correlating soil and rock classifications with strength parameters.

Illustrations of the failure surfaces for each target condition are attached at the end of this report. The analysis was performed along critical slope heights and the slopes analyzed met and exceeded the target factor of safety. Our analyses indicated minimum factors of safety for short and long term of 6.382 and 6.854, respectively.

In general, compacted soil fill embankments on stiff undisturbed soils should be constructed no steeper than a ratio of 3.0 horizontal (H) to 1.0 vertical (V). We recommend cut slopes not be steeper than a ratio of 3.0 (H) to 1.0 (V).

Surface water runoff should be routed from flowing over the slope face. For cut slopes, the area above the slope crest should be constructed with a reverse slope to reduce the likelihood of surface water runoff from flowing over the slope face. Additionally, we recommend a drainage swale or other provisions be constructed near the crest of each cut slope to divert water away from the cut face.

Material should not be stockpiled within 10 feet of the crest of cut or fill slopes. In addition, both cut and fill slope faces should be protected from erosion using a vegetative cover. Seed and mulch, or erosion matting with embedded seed, are options for developing a vegetative cover.

CONCLUSIONS AND RECOMMENDATIONS

Based on the test pit observations and laboratory test results, we offer the following conclusions and recommendations to help guide you in further decision making:

Foundations – Due to the amount of new structural fill required to reach the proposed finish floor elevation subgrade and the slope of the existing topography, ECS recommends that the residential foundations extend through the structural fill and be founded on the stiff native soils or bedrock. This is recommended as a concern for differential settlement exceeding acceptable tolerances for the structure.

Highly Plastic Soils – Highly-expansive and compressible FAT CLAY (CH) soils were encountered on-site during our exploration. It is our opinion that the on-site highly plastic FAT CLAY (CH) soils should not be utilized for the direct support of the proposed foundations or slab on grades and should only be re-used as engineered fill in deeper fill sections, i.e., greater than 4 feet below planned grades. If this material is encountered in cut sections, a minimum of a 2-foot cap of low plasticity clay should be placed above the highly plastic clay material.

Rock Excavation – In general, the test pits encountered shallow bedrock in the upper approximate 1 to 8 feet as indicated by the Test Pit Logs. Based on our understanding of the proposed excavations required at the site, the use of special excavation techniques (i.e., blasting or hoe-ramming) will be required for excavations beyond the depth of bucket refusal.

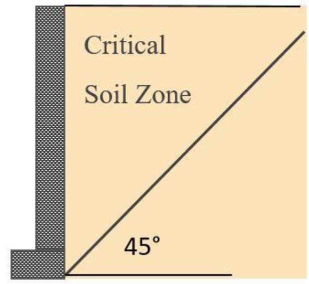
Colluvial Soils – Colluvial soils were not encountered during our test pit exploration. However, if these soils are encountered during construction, ECS recommends removing these materials to the depth of stiff residual soils or bedrock within and 10 feet outside the planned construction limits and placing and compacting adequate structural fill.

Site Retaining Walls – The retaining walls are expected to be founded on native soils. Unlike below grade walls, site retaining walls are free to rotate at the top (not restrained). For these walls the "Active" (k_a) soil condition should be used along with a triangular distribution of earth pressures. In addition, site retaining walls should be designed to withstand lateral earth pressures exerted by the backfill and surcharge loads within the "Critical Soil Zone". The Critical Zone is defined as the area between the back of the retaining wall footing and an imaginary line projected upward and rearward at a 45-degree angle (see figure below).

The lateral earth pressures developed behind site retaining walls are a function of the backfill soil type, backfill slope angle, and surcharge loads. For the design of site retaining walls, we recommend the parameters provided below.

Retaining Wall Backfill in the Critical Zone

Soil Parameter	Select Granular Fill	No. 57 or No. 67 Stone
Coefficient of Active Earth Pressure (K_a)	0.31	0.22
Retained Soil Moist Unit Weight (γ)	130 pcf	105 pcf
Cohesion (C)	0 psf	0 psf
Angle of Internal Friction (ϕ)	32°	40°
Friction Coefficient [Concrete on Soil] (μ)	0.30	0.30
Active Equivalent Fluid Pressure	83H (psf)	72H (psf)



Foundation Parameters

Soil Parameter	Estimated value
Allowable Bearing Pressure (Native Soil)	3,000 psf
Minimum Wall Embedment Below Grade	18 inches
Coefficient of Passive Earth Pressure (K_p)	2.76
Rock Unit Weight (γ)	120 pcf
Cohesion (C)	500 psf
Interface Friction Angle [Concrete on Soil] (ϕ_f)	28°
Sliding Friction Coefficient [Concrete on Rock] (μ)	0.30
Passive Equivalent Fluid Pressure	295H (psf)

It is critical that the soils used for backfill of the retaining walls meet the soil parameters recommended above. If the soils available do not meet those parameters, then ECS should be contacted to provide revised values, and to confirm that only adequate granular materials will be used for wall backfill.

Care should be used to avoid the operation of heavy equipment to compact the wall backfill since it may overload and damage the wall. In addition, such loads are not typically considered in the design of site retaining walls, and are not provided for in our recommendations.

Wall Drainage: Retaining walls should be provided with a wall and foundation drainage system to relieve hydrostatic pressures which may develop behind the walls. This system should consist of weepholes through the wall and/or a 4-inch perforated, closed joint drain line located along the backside of the walls above the top of the footing. The drain line should be surrounded by a minimum of 6 inches of AASHTO #57 Stone wrapped with an approved non-woven geotextile, such as Mirafi 140-N or equivalent. Wall drains can consist of a 12-inch wide zone of free draining gravel, such as AASHTO #57 Stone, employed directly behind the wall and separated from the soils beyond with a non-woven geotextile. Alternatively, the wall drain can consist of an adequate geocomposite drainage board material. The wall drain should be hydraulically connected to the foundation drain.

Closing

Our professional services have been performed, our findings obtained, and our conclusions prepared in accordance with generally accepted geotechnical engineering principles and practices. ECS is not responsible for the conclusions, opinions, or recommendations made by others based on these data. No third party is given the right to rely on this report without express written permission. We appreciate this opportunity to be of service to you during the design phase of this project.

If you have any questions with regard to the information and recommendations presented in this report, please do not hesitate to contact us.

Respectfully,
ECS SOUTHEAST, LLP

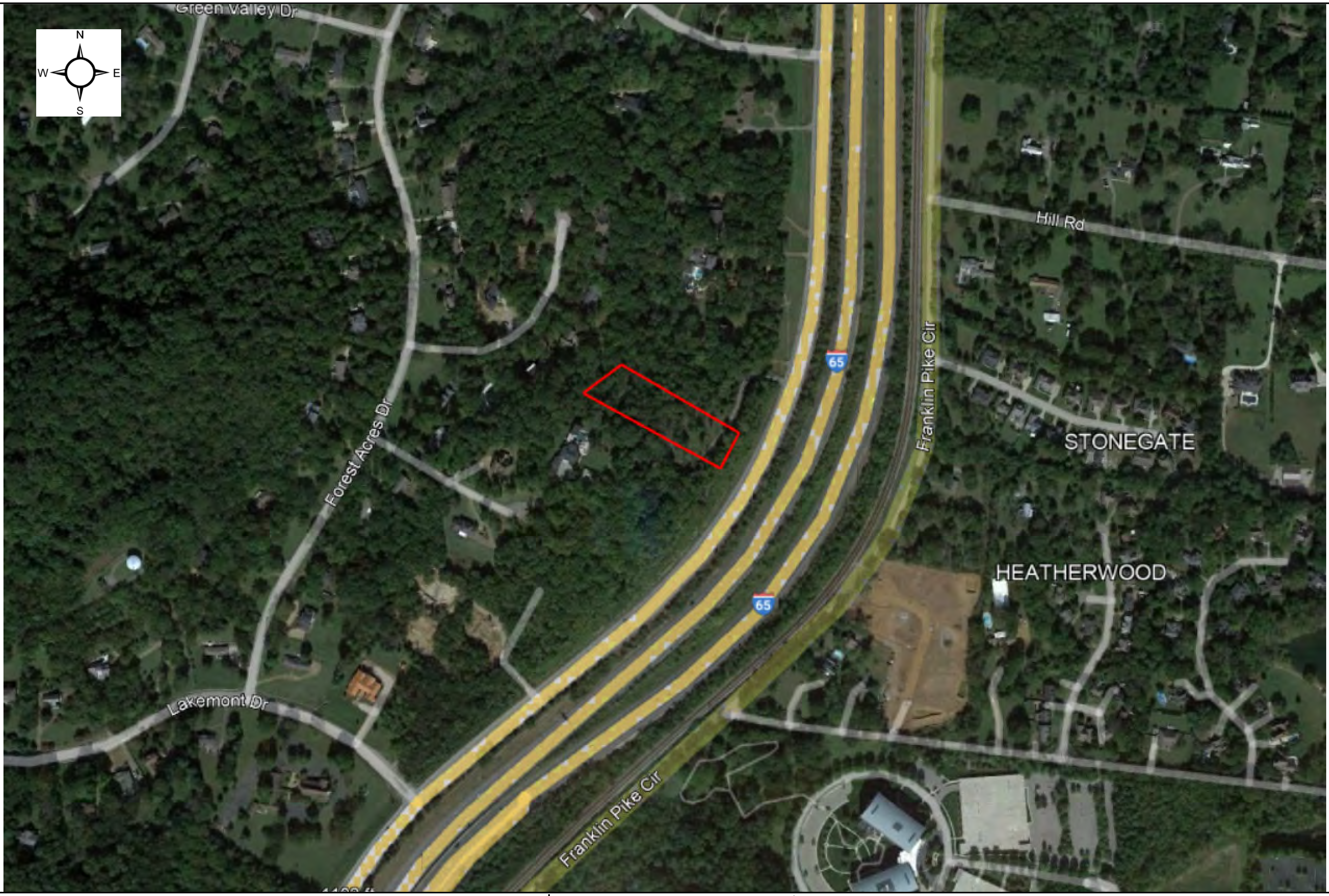
Trevor Nugent

4-5-2023

Trevor Nugent
Geotechnical Staff Project Manager

John D. Godfrey Jr., P.E.
Principal Engineer

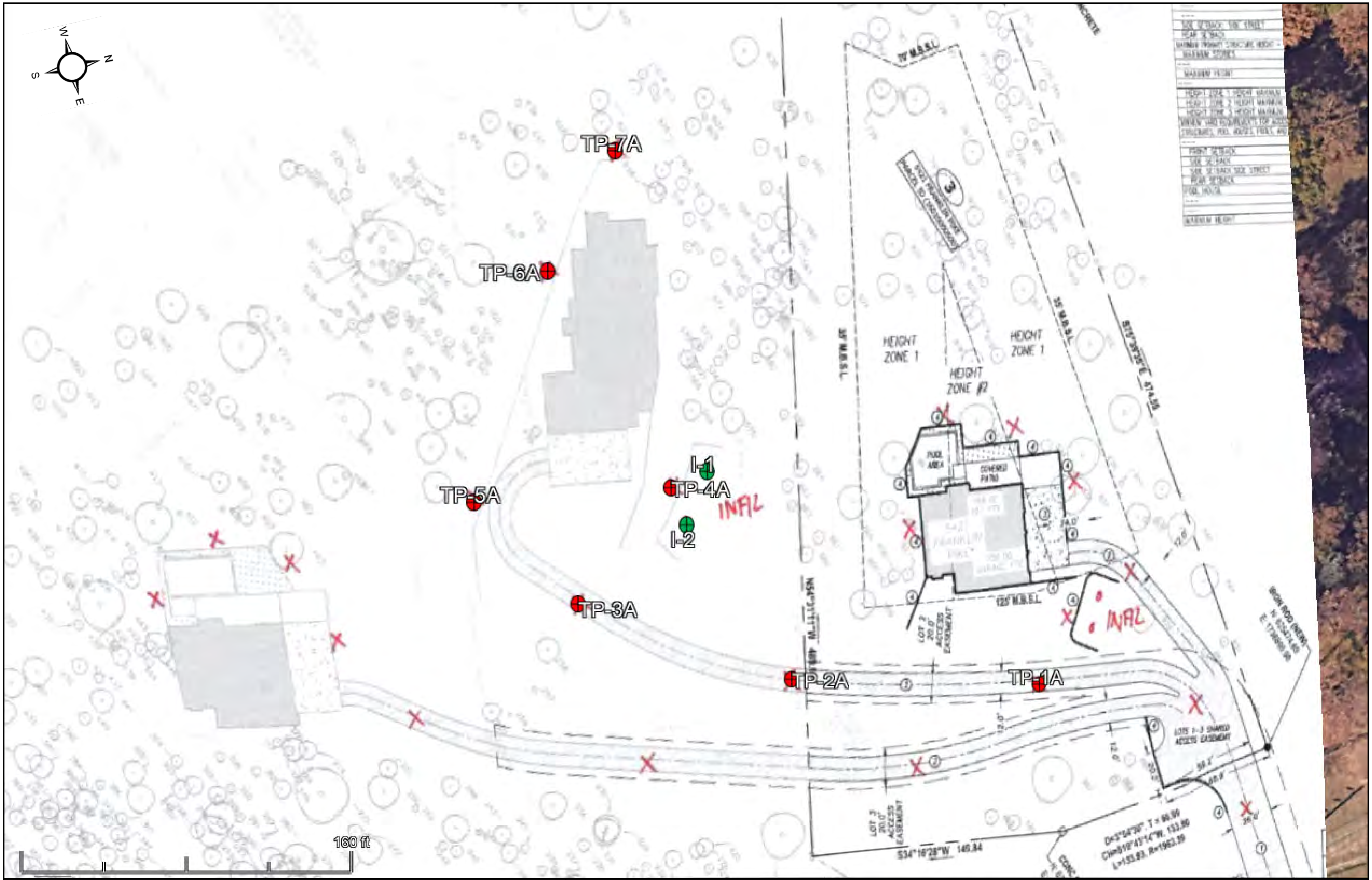
Attachments:
- Site Location Diagram
- Exploration Location Diagram
- Test Pit Logs
- Slope Stability Analysis Results
- Liquid and Plastic Limit Test Report
- Laboratory Test Results Summary
- Important Information



5425 Franklin Pike Geotechnical Exploration

5425 Franklin Pike
Nashville, Tennessee
ECS Project No. 26:5678-A

Site Location Diagram
(approximate site location outlined in red)

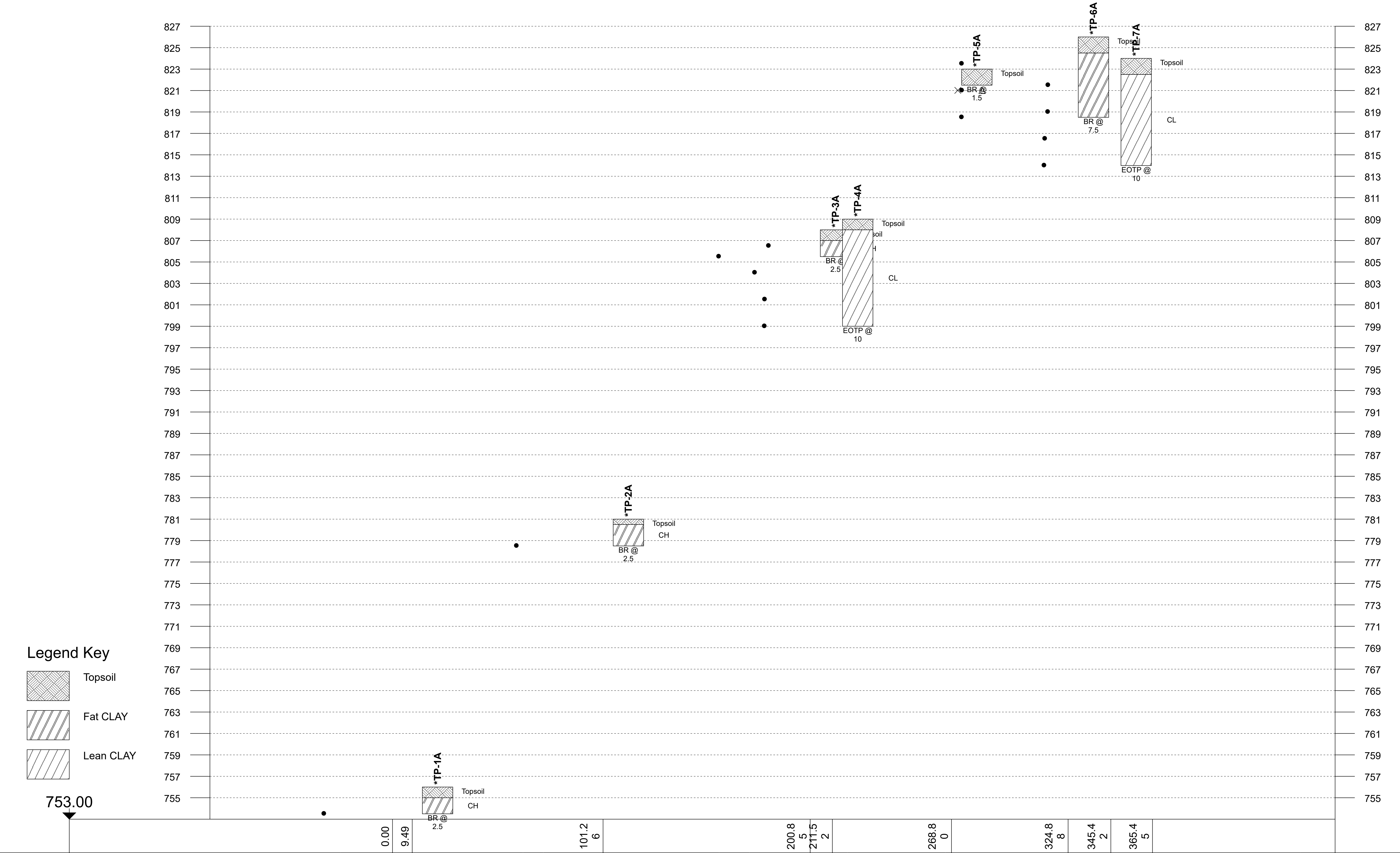


5425 Franklin Pike Geotechnical Exploration

5425 Franklin Pike
Nashville, Tennessee
ECS Project No. 26:5678-A

Exploration Location Diagram

Approximate Boring Locations
Approximate Infiltration Locations



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit	WL (First Encountered)	Fill	
[FINES CONTENT%]	WL (Completion)	Possible Fill	
BOTTOM OF CASING	WL (Estimated Seasonal High Water)	Probable Fill	
LOSS OF CIRCULATION	WL (Stabilized)	Rock	

ECS

GENERALIZED SUBSURFACE SOIL PROFILE Section line A-A'

5425 Franklin Pike Add'l Geotechnical Exploration

Urban Development Group LLC

5425 Franklin Pike, Nashville, Tennessee, 37220

Project No: 26:5678-A Date: 03/21/2023

CLIENT: **Urban Development Group LLC**	PROJECT NO.: **26:5678-A**	SHEET: **1 of 1**	
PROJECT NAME: **5425 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-1A**	SURFACE ELEVATION: **756**	
SITE LOCATION: **5425 Franklin Pike, Nashville, Tennessee, 37220**		STATION:	
NORTHING: **625387.7**	EASTING:	**1738780.9**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FAT CLAY, trace gravel, trace sand, trace organics, dark brown, moist, stiff			1.25	S-1	27.7
			BUCKET REFUSAL AT 2.5 FT					
5		751						
10		746						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

WL (First Encountered)	WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
WL (Completion)		**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT: Urban Development Group LLC	PROJECT NO.: 26:5678-A	SHEET: 1 of 1
PROJECT NAME: 5425 Franklin Pike Add'l Geotechnical Exploration	TEST PIT NO.: TP-2A	SURFACE ELEVATION: 781
SITE LOCATION: 5425 Franklin Pike, Nashville, Tennessee, 37220		STATION:
NORTHING: 625285.6	EASTING: 1738706.2	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[6"]					
			(CH) FAT CLAY, trace gravel, trace sand, trace organics, dark brown, moist, very stiff			2.75	S-1	29.1
			BUCKET REFUSAL AT 2.5 FT					
5		776						
10		771						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: ECS	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: Mar 13 2023	UNITS: English	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5678-A**	**1 of 1**
PROJECT NAME: **5425 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-3A**	SURFACE ELEVATION: **808**
SITE LOCATION: **5425 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625222.6**	EASTING: **1738616.4**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, very stiff			2.50	S-1	25.1
			BUCKET REFUSAL AT 2.5 FT					
5		803						
10		798						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

TEST PIT LOG

CLIENT: **Urban Development Group LLC**	PROJECT NO.: **26:5678-A**	SHEET: **1 of 1**	
PROJECT NAME: **5425 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-4A**	SURFACE ELEVATION: **809**	
SITE LOCATION: **5425 Franklin Pike, Nashville, Tennessee, 37220**		STATION:	
NORTHING: **625290.1**	EASTING: **1738593.3**		

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
0–1			Topsoil Thickness[12"]					
1–10			(CL) LEAN CLAY, trace gravel, trace sand, brown, moist, stiff					
2.5						2.00	S-1	23.9
5		804					S-2	18.2
7.5							S-3	22.3
10		799	END OF TEST PIT AT 10 FT				S-4	22.2
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5678-A**	**1 of 1**
PROJECT NAME: **5425 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-5A**	SURFACE ELEVATION: **823**
SITE LOCATION: **5425 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625210.8**	EASTING: **1738549.5**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[18"]					
			BUCKET REFUSAL AT 1.5 FT					
5		818						
10		813						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered) ▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)	**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5678-A**	**1 of 1**
PROJECT NAME: **5425 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-6A**	SURFACE ELEVATION: **826**
SITE LOCATION: **5425 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625298.3**	EASTING: **1738476.6**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[18"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, very stiff			2.50	S-1	25.5
5		821					S-2	25.7
			BUCKET REFUSAL AT 7.5 FT				S-3	25.4
10		816						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT: **Urban Development Group LLC**	PROJECT NO.: **26:5678-A**	SHEET: **1 of 1**	
PROJECT NAME: **5425 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-7A**	SURFACE ELEVATION: **824**	
SITE LOCATION: **5425 Franklin Pike, Nashville, Tennessee, 37220**		STATION:	
NORTHING: **625355.0**	EASTING: **1738445.4**		

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
0		824	Topsoil Thickness[18"]					
1.5			(CL) LEAN CLAY, trace gravel, trace sand, brown, moist, very stiff			2.50	S-1	24.3
5		819					S-2	24.2
							S-3	23.0
10		814	**END OF TEST PIT AT 10 FT**				S-4	22.7
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

Photo 1 – Test Pit-1A Excavation

Photo 2 – Test Pit-1A Spoils

Photolog		5425 Franklin Pike Nashville,Tennessee ECS Project No. 26:5678-A

Photo 3 – Test Pit-2A Excavation

Photo 4 – Test Pit-2A Spoils

Photo 5 – Test Pit-3A Excavation

Photo 6 – Test Pit-3A Spoils

Photo 7 – Test Pit-4A Excavation

Photo 8 – Test Pit-4A Spoils

Photo 9 – Test Pit-5A Excavation

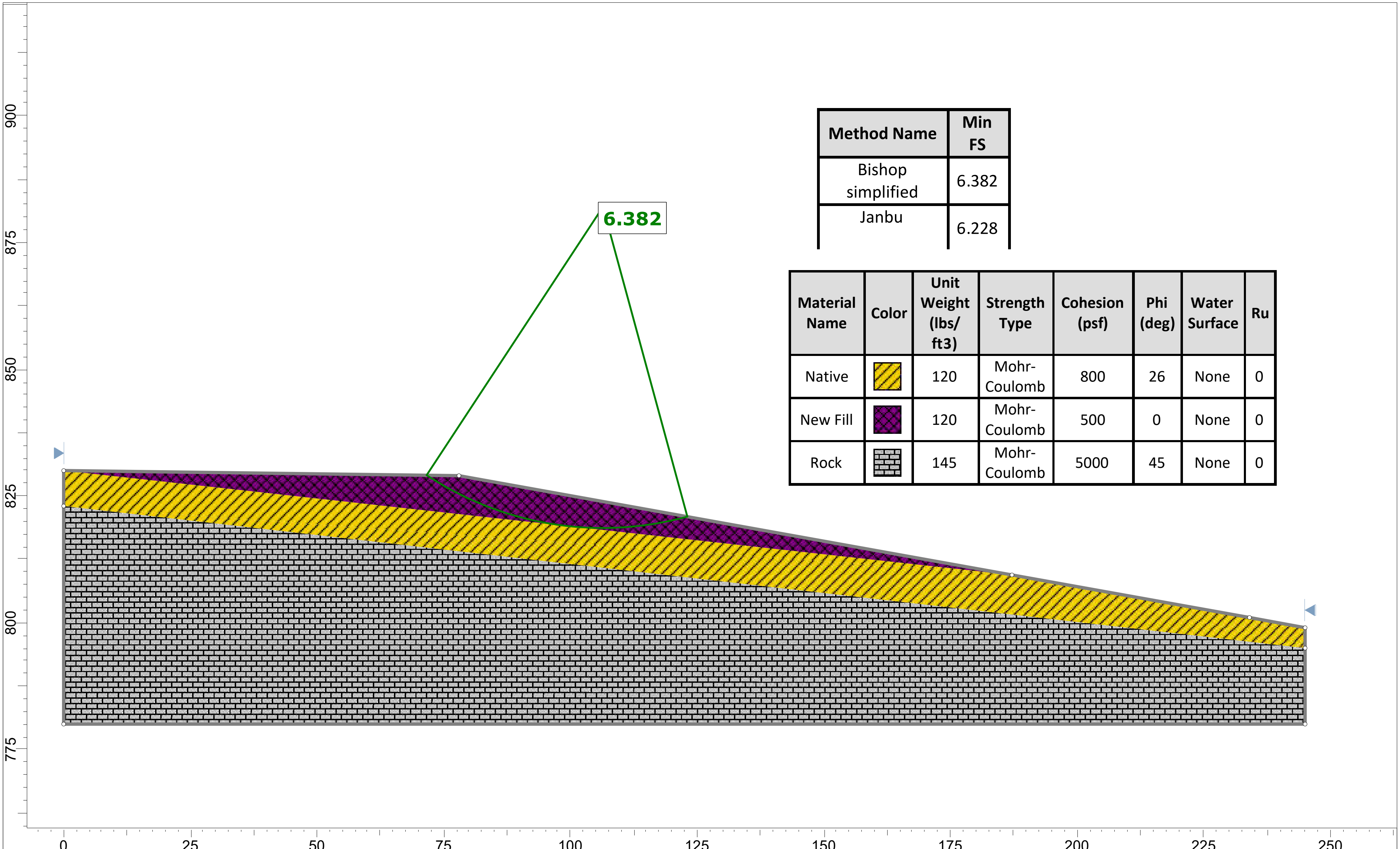
Photo 10 – Test Pit-5A Spoils

Photo 11 – Test Pit-6A Excavation

Photo 12 – Test Pit-6A Spoils

Photo 13 – Test Pit-7A Excavation

Photo 14 – Test Pit-7A Spoils



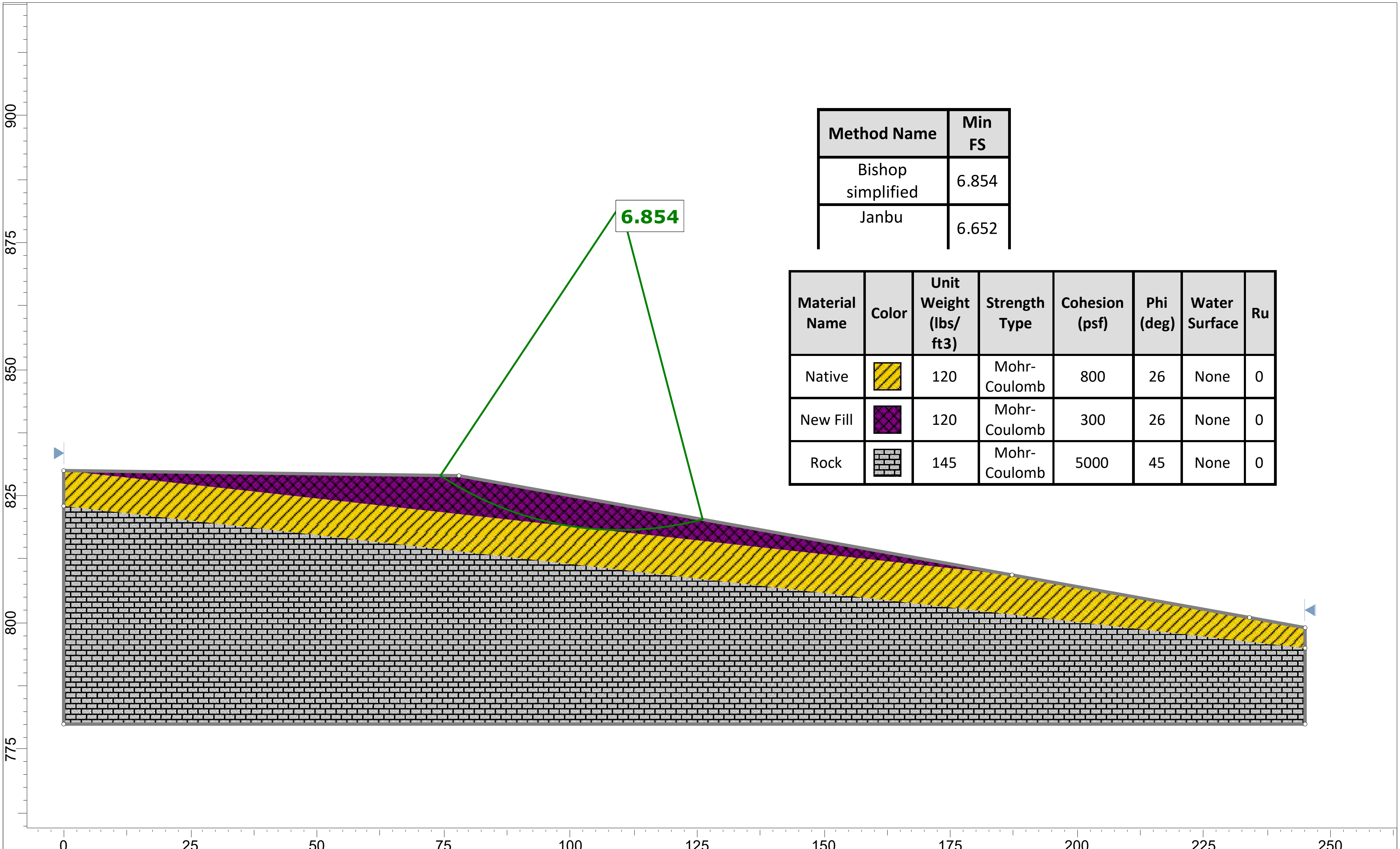
Method Name	Min FS
Bishop simplified	6.382
Janbu	6.228

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Native		120	Mohr-Coulomb	800	26	None	0
New Fill		120	Mohr-Coulomb	500	0	None	0
Rock		145	Mohr-Coulomb	5000	45	None	0

rocscience

SLIDEINTERPRET 9.027

Project	5425		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	JG	*Company*	ECS
Date	4/5/2023, 3:47:12 PM	*File Name*	5425 Lot.slmd



Method Name	Min FS
Bishop simplified	6.854
Janbu	6.652

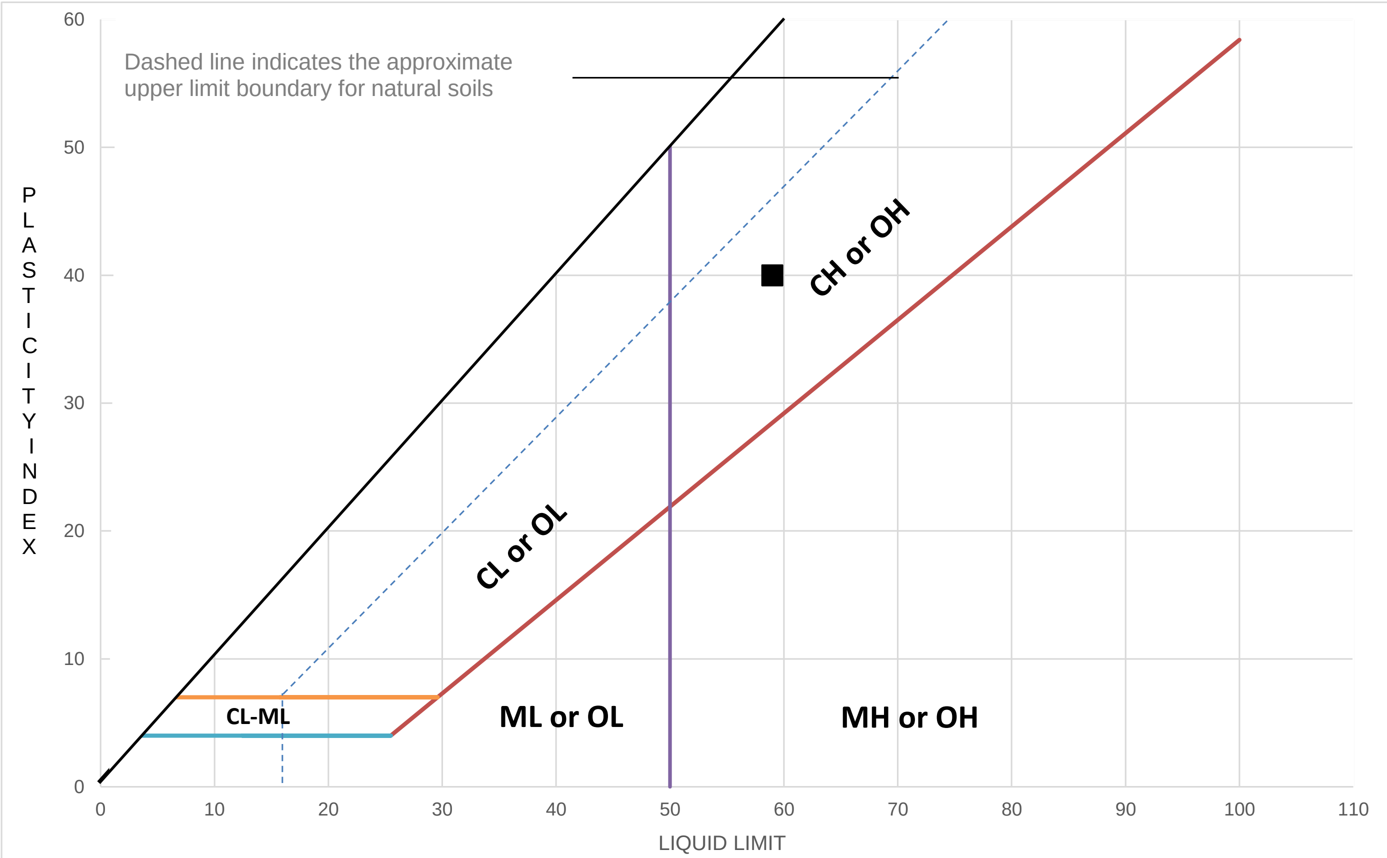
Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Native		120	Mohr-Coulomb	800	26	None	0
New Fill		120	Mohr-Coulomb	300	26	None	0
Rock		145	Mohr-Coulomb	5000	45	None	0

rocscience

SLIDEINTERPRET 9.027

Project	5425		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	JG	*Company*	ECS
Date	4/5/2023, 3:47:12 PM	*File Name*	5425 Lot.slmd

LIQUID AND PLASTIC LIMITS TEST REPORT



TEST RESULTS (ASTM D4318-10 (MULTIPOINT TEST))

	Sample Location	Sample Number	Sample Depth (ft)	LL	PL	PI	%<#40	%<#200	AASHTO	USCS	Material Description
■	TP-6A	S-2	5	59	19	40					(CH) Fat Clay, Dark Brown

Project: 5425 Franklin Pike Add'l Geotechnical Exploration
Client: Urban Development Group LLC

Project No.: 26:5678-A
Date Reported: 3/20/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Nashville	318 Seaboard Lane Suite 208 Franklin, TN 37067	(615)885-4983 (615)771-4134

Tested by	Checked by	Approved by	Date Received
BHeineman	rbanner	rbanner	3/13/2023

Laboratory Testing Summary

Sample Location	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
TP-1A	S-1	2.5	27.7										
TP-2A	S-1	2.5	29.1										
TP-3A	S-1	2.5	25.1										
TP-4A	S-1	2.5	23.9										
TP-4A	S-2	5	18.2										
TP-4A	S-3	7.5	22.3										
TP-4A	S-4	10	22.2										
TP-6A	S-1	2.5	25.5										
TP-6A	S-2	5	25.7		59	19	40						
TP-6A	S-3	7.5	25.4										

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: 5425 Franklin Pike Add'l Geotechnical Exploration
Client: Urban Development Group LLC

Project No.: 26:5678-A
Date Reported: 3/20/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Nashville	318 Seaboard Lane Suite 208 Franklin, TN 37067	(615)885-4983 (615)771-4134

Tested by	Checked by	Approved by	Date Received
LMinella	rbanner	rbanner	3/13/2023

Laboratory Testing Summary

Sample Location	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
TP-7A	S-1	2.5	24.3										
TP-7A	S-2	5	24.2										
TP-7A	S-3	7.5	23.0										
TP-7A	S-4	10	22.7										

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: 5425 Franklin Pike Add'l Geotechnical Exploration
Client: Urban Development Group LLC

Project No.: 26:5678-A
Date Reported: 3/20/2023

ECS

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Tested by	Checked by	Approved by	Date Received
LMinella	rbanner	rbanner	3/13/2023

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

April 5, 2023

Mr. Jeremy Walker
Urban Development Group, LLC
P.0. Box 90288
Nashville, TN 37209

ECS Project No. 26:5679-A

Reference: Letter of Subsurface Exploration
5429 Franklin Pike
5429 Franklin Pike
Nashville, Tennessee

Dear Mr. Walker:

As authorized by your acceptance of our proposal, (ECS Proposal No. 26:10717) dated March 21, 2023, ECS Southeast, LLP (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This letter has been prepared to provide additional information and should be considered an addendum to our initial report (ECS Report No. 26:5679) dated August 2, 2022. It should be noted that the structure layout as shown in the initial report and the Construction Plans prepared by SWS Engineering, Inc. dated April 21, 2022, are different and soils conditions may change. ECS recommends the foundation excavations be observed by the geotechnical engineer of record at the time of construction.

SITE AND SUBSURFACE CONDITIONS

Test Pits

The site subsurface conditions were evaluated with seven (7) test pits at the approximate locations shown on the Exploration Location Diagram in the Appendix. The quantity of test pits, locations, and excavation depths were determined in the field during this subsurface exploration.

A surficial layer of topsoil was measured at approximately 12- to 18- inches thick at the test pit locations. Below the topsoil, native light brown LEAN and FAT CLAY (CL, CH) was encountered. This material was typically brown in color and contained varying amounts of sand and gravel. At the structure location, refusal materials ranged from approximately 5 to 6 feet below existing grades. Test pit refusal was encountered at most test pit locations at approximate depths ranging from 2 ½ - to 7 ½-feet below the ground surface. Test Pit TP-7A did not encounter refusal and instead reached the extent of the bucket reach.

Groundwater was not encountered in the test pits at the time of excavation. It is possible for perched water to exist within the depths explored during other times of the year depending upon climatic and rainfall conditions. Additionally, discontinuous zones of perched water may exist within the overburden materials. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

Laboratory Testing Program

A geotechnical engineer classified each soil sample on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS, ASTM D 2487). The group symbols for each soil type are indicated in parentheses following the soil descriptions on each boring log. A brief explanation of the USCS is included in the Appendix. The engineer grouped the various soil types into the major zones noted on the test pit logs. The stratification lines designating the interfaces between materials on the exploration records should be considered approximate; in situ, the transitions may be gradual.

Representative soil samples were selected and tested in our laboratory to check field classifications and to determine pertinent index properties. The laboratory testing program included:

- Natural moisture content determinations (ASTM D 2216)
- Atterberg Limits tests (ASTM D 4318)

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition. The results of the laboratory testing is included in the Appendix.

Laboratory index test results indicate the in-situ moisture content of the tested samples ranged from approximately 21 to 32 percent.

An Atterberg Limits test performed on a select soil sample from Test Pit TP-04A indicated LEAN CLAY (CL) with a Liquid Limit of 39 and a Plasticity Index of 21. The results have been included on the Laboratory Testing Summary in the Appendix.

Infiltration Testing

Two (2) drop rate tests were performed on March 13 and 14, 2023, in general conformance with recognized drop rate test procedures. To perform the test, an auger boring was extended to the depth shown in the table below, beneath the existing ground surface. Following completion of the auger boring, a 6-inch diameter casing was installed, generally flush with the bottom of the borehole. The casing was then filled with water to a depth of approximately 2 feet above the bottom of the hole and left to pre-soak for 24 hours. After the pre-soak period, approximately 2 feet of water was again added and the rate of water level drop was then observed for a 1 hour period. This procedure was then repeated three times over a total 4-hour period. A summary of the test results is presented in Table 1.

Table 1 - In-Situ Drop Rate Test Results

Boring No.	Boring Depth (ft)	USCS Classification	Groundwater Observations During Drilling (ft)	Average Drop Rate (inches per hour)	Last Hour Drop Rate (inches per hour)
I-1	8	CH	-	1.7	0.6
I-2	8	CH	-	2	0.6

While ECS is not aware of specific design infiltration rates desired for this project, we recommend an appropriate factor of safety be applied to the field results presented above. It is our experience that many times construction disturbance and compaction can reduce near surface pre-construction in-situ infiltration rates. Please note that the “drop rate” reported above does not equate to an in-situ permeability.

SLOPE ANALYSIS

Based on the initial test pits and the test pits completed as part of this addendum and the proposed finish floor elevation and the wall elevations, the residential structure and wall will be founded mostly on native soils. Most of the wall excavations will extend into native soil and some bedrock.

The slope stability analyses utilized for this project were based on two dimensional limit plastic equilibrium methods. In this method, a trial failure surface is assumed. The mass of soil above the failure surface is divided into vertical strips called slices. The forces acting on each slice are estimated. The forces are separated into those tending to cause failure and those tending to resist failure. The sum of the two sets of forces for a trial failure surface are tabulated and compared by dividing the forces resisting failure by those causing failure. This ratio is termed the factor of safety (FS). When the FS is 1.0, failure of the slope is imminent. When the FS exceeds 1.3, it is generally assumed the slope is adequate. However, there are certain minimum factors of safety which, by experience, are acceptable. In general, these minimum values of FS depend on the consequences of failure as well as the anticipated loading condition.

To determine the forces necessary to perform the analyses, the slope geometry, stratigraphy, soil strength parameters, groundwater levels, and extraneous loads must be determined. The slope geometry is modeled to represent the existing slope configuration. Test pits were used in the determination of the stratigraphy of the site and the soil parameters.

The RocScience SLIDE2 computer program was used to evaluate the slope stability at each cross section. For this study, Bishop's Modified Method of Slices was used. Based on the existing grades, the slope analyzed was in mostly native soils. Native soil and rock parameters were chosen conservatively from published tables and formulas correlating soil and rock classifications with strength parameters.

Illustrations of the failure surface for the target condition is attached at the end of this report. The analysis was performed along critical slope heights and the slopes analyzed met and exceeded the target factor of safety. Our analyses indicated a minimum factor of safety for long term of 9.285.

In general, compacted soil fill embankments on stiff undisturbed soils should be constructed no steeper than a ratio of 3.0 horizontal (H) to 1.0 vertical (V). We recommend cut slopes not be steeper than a ratio of 3.0 (H) to 1.0 (V).

Surface water runoff should be routed from flowing over the slope face. For cut slopes, the area above the slope crest should be constructed with a reverse slope to reduce the likelihood of surface water runoff from flowing over the slope face. Additionally, we recommend a drainage swale or other provisions be constructed near the crest of each cut slope to divert water away from the cut face.

Material should not be stockpiled within 10 feet of the crest of cut or fill slopes. In addition, both cut and fill slope faces should be protected from erosion using a vegetative cover. Seed and mulch, or erosion matting with embedded seed, are options for developing a vegetative cover.

CONCLUSIONS AND RECOMMENDATIONS

Based on the test pit observations and laboratory test results, we offer the following conclusions and recommendations to help guide you in further decision making:

Foundations – ECS recommends that the residential foundations extend through the structural fill and be founded on the stiff native soils or bedrock. This is recommended as a concern for differential settlement exceeding acceptable tolerances for the structure. Where bedrock is encountered at the footing bearing level, we recommend undercutting the bedrock to allow for a 24 inch cushion of low plasticity lean clay soils. The soil backfill should be compacted to 95% of the standard Proctor maximum dry density.

Highly Plastic Soils – Highly-expansive and compressible FAT CLAY (CH) soils were encountered on-site during our exploration. It is our opinion that the on-site highly plastic FAT CLAY (CH) soils should not be utilized for the direct support of the proposed foundations or slab on grades and should only be re-used as engineered fill in deeper fill sections, i.e., greater than 4 feet below planned grades. If this material is encountered in cut sections, a minimum of a 2-foot cap of low plasticity clay should be placed above the highly plastic clay material.

Rock Excavation – In general, the test pits encountered shallow bedrock in the upper approximate 2 ½ - to 7 ½- feet as indicated by the Test Pit Logs. Based on our understanding of the proposed excavations required at the site, the use of special excavation techniques (i.e., blasting or hoe-ramming) will be required for excavations beyond the depth of bucket refusal.

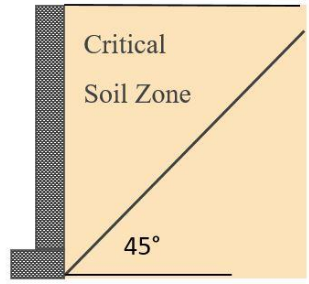
Colluvial Soils – Colluvial soils were not encountered during our test pit exploration. However, if these soils are encountered during construction, ECS recommends removing these materials to the depth of stiff residual soils or bedrock within and 10 feet outside the planned construction limits and placing and compacting adequate structural fill.

Site Retaining Walls – The retaining walls are expected to be founded on native soils and bedrock. Unlike below grade walls, site retaining walls are free to rotate at the top (not restrained). For these walls the "Active" (k_a) soil condition should be used along with a triangular distribution of earth pressures. In addition, site retaining walls should be designed to withstand lateral earth pressures exerted by the backfill and surcharge loads within the “Critical Soil Zone”. The Critical Zone is defined as the area between the back of the retaining wall footing and an imaginary line projected upward and rearward at a 45-degree angle (see figure below).

The lateral earth pressures developed behind site retaining walls are a function of the backfill soil type, backfill slope angle, and surcharge loads. For the design of site retaining walls, we recommend the parameters provided below.

Retaining Wall Backfill in the Critical Zone

Soil Parameter	Select Granular Fill	No. 57 or No. 67 Stone
Coefficient of Active Earth Pressure (K_a)	0.31	0.22
Retained Soil Moist Unit Weight (γ)	130 pcf	105 pcf
Cohesion (C)	0 psf	0 psf
Angle of Internal Friction (ϕ)	32°	40°
Friction Coefficient [Concrete on Soil] (μ)	0.30	0.30
Active Equivalent Fluid Pressure	83H (psf)	72H (psf)



Foundation Parameters

Soil Parameter	Estimated value
Allowable Bearing Pressure (Native Soil)	3,000 psf
Minimum Wall Embedment Below Grade	18 inches
Coefficient of Passive Earth Pressure (K_p)	2.76
Rock Unit Weight (γ)	120 pcf
Cohesion (C)	500 psf
Interface Friction Angle [Concrete on Soil] (ϕ_f)	28°
Sliding Friction Coefficient [Concrete on Rock] (μ)	0.30
Passive Equivalent Fluid Pressure	295H (psf)

It is critical that the soils used for backfill of the retaining walls meet the soil parameters recommended above. If the soils available do not meet those parameters, then ECS should be contacted to provide revised values, and to confirm that only adequate granular materials will be used for wall backfill.

Care should be used to avoid the operation of heavy equipment to compact the wall backfill since it may overload and damage the wall. In addition, such loads are not typically considered in the design of site retaining walls, and are not provided for in our recommendations.

Wall Drainage: Retaining walls should be provided with a wall and foundation drainage system to relieve hydrostatic pressures which may develop behind the walls. This system should consist of weepholes through the wall and/or a 4-inch perforated, closed joint drain line located along the backside of the walls above the top of the footing. The drain line should be surrounded by a minimum of 6 inches of AASHTO #57 Stone wrapped with an approved non-woven geotextile, such as Mirafi 140-N or equivalent. Wall drains can consist of a 12-inch wide zone of free draining gravel, such as AASHTO #57 Stone, employed directly behind the wall and separated from the soils beyond with a non-woven geotextile. Alternatively, the wall drain can consist of an adequate geocomposite drainage board material. The wall drain should be hydraulically connected to the foundation drain.

Closing

Our professional services have been performed, our findings obtained, and our conclusions prepared in accordance with generally accepted geotechnical engineering principles and practices. ECS is not responsible for the conclusions, opinions, or recommendations made by others based on these data. No third party is given the right to rely on this report without express written permission. We appreciate this opportunity to be of service to you during the design phase of this project.

If you have any questions with regard to the information and recommendations presented in this report, please do not hesitate to contact us.

Respectfully,
ECS SOUTHEAST, LLP

Trevor Nugent

John D. Godfrey Jr.

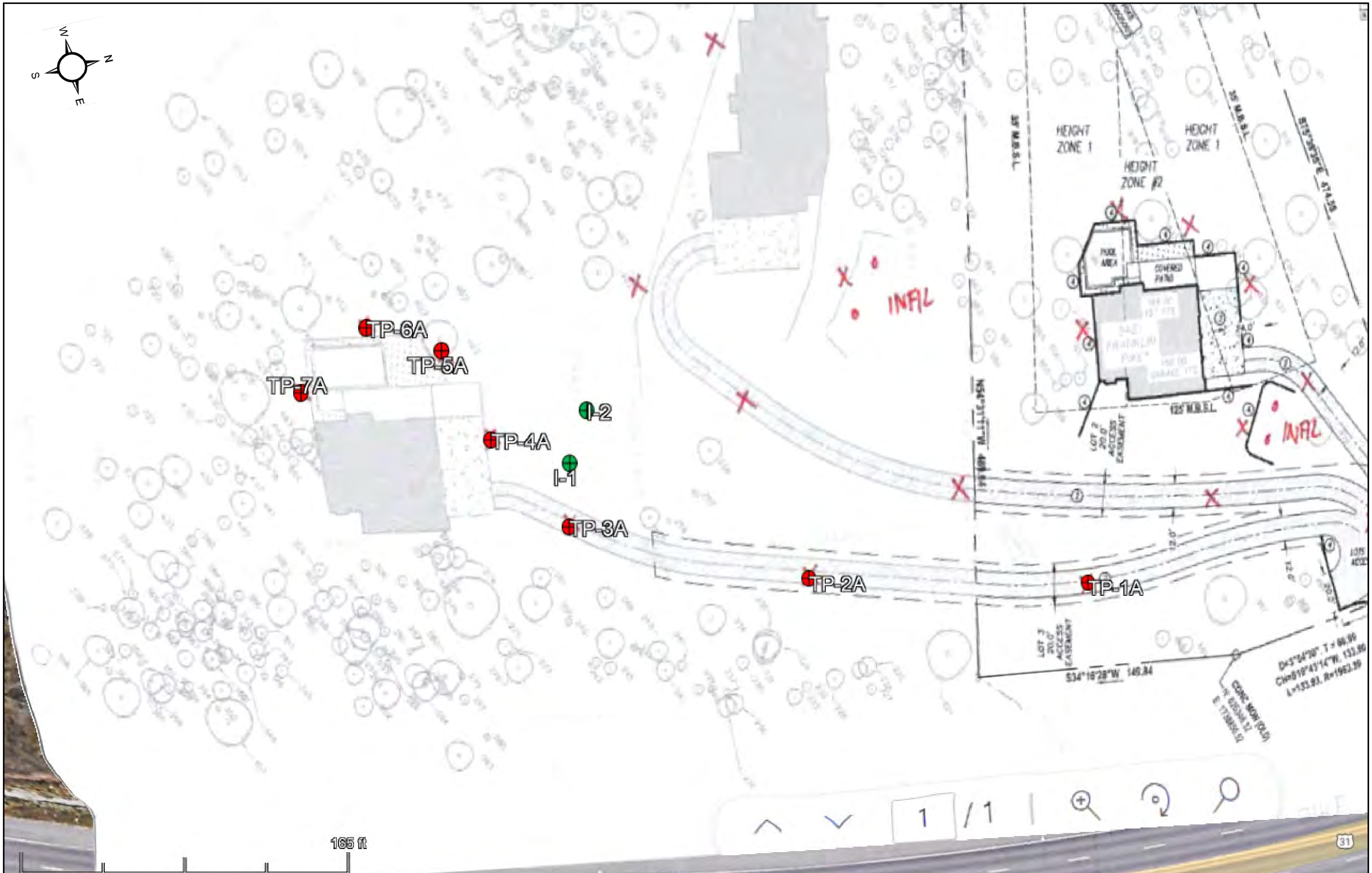
4-5-2023

Trevor Nugent
Geotechnical Staff Project Manager

John D. Godfrey Jr., P.E.
Principal Engineer

Attachments:
- Site Location Diagram
- Exploration Location Diagram
- Test Pit Logs
- Slope Stability Results
- Liquid and Plastic Limit Test Report
- Laboratory Test Results Summary
- Important Information

5429 Franklin Pike Geotechnical Exploration 5429 Franklin Pike Nashville, Tennessee ECS Project No. 26:5679-A	ECS	Site Location Diagram (approximate site location outlined in red)

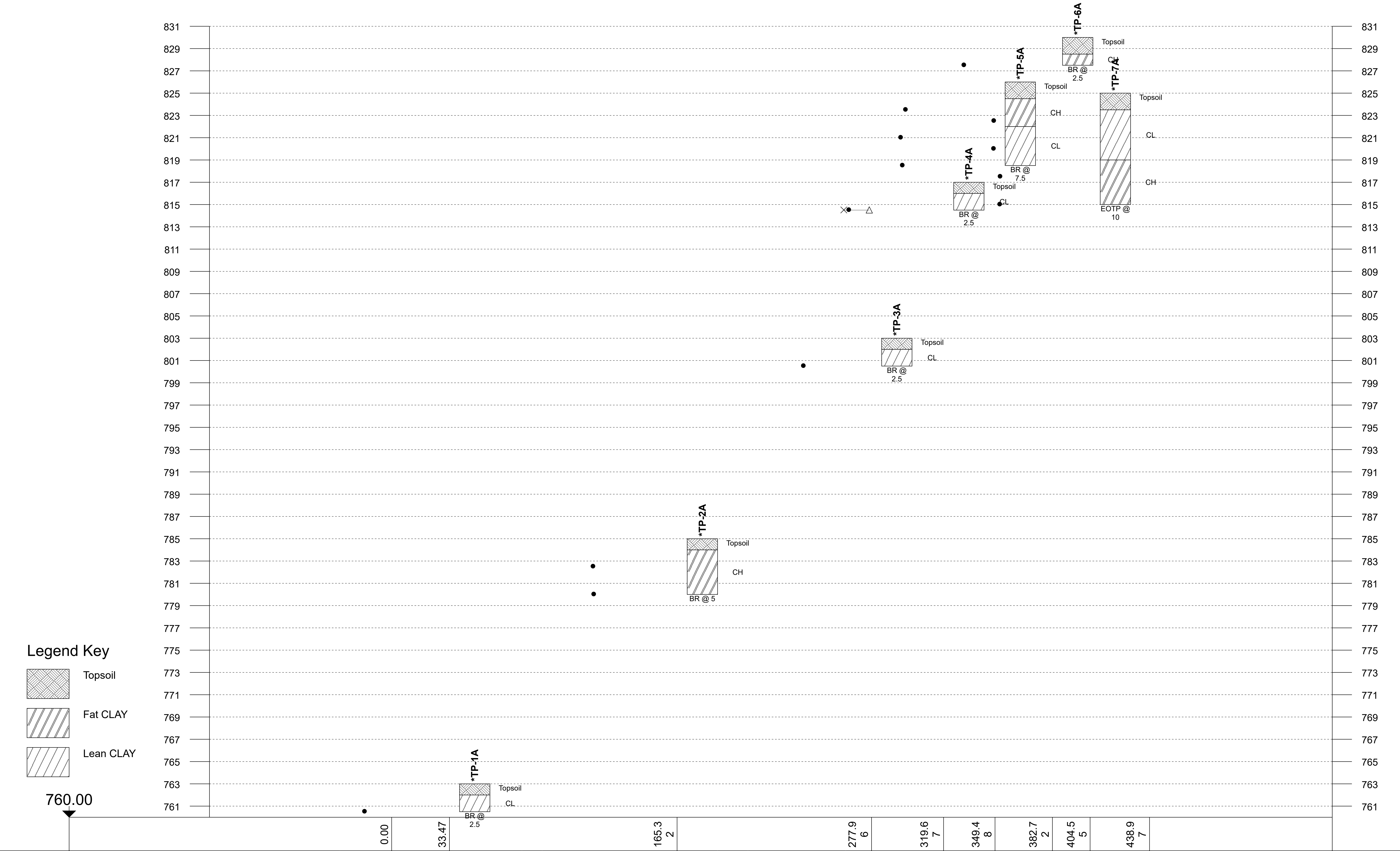


5429 Franklin Pike Geotechnical Exploration

5429 Franklin Pike
Nashville, Tennessee
ECS Project No. 26:5679-A

Exploration Location Diagram

Approximate Boring Locations
Approximate Infiltration Locations



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit	WL (First Encountered)	Fill
[FINES CONTENT%]	WL (Completion)	Possible Fill
BOTTOM OF CASING	WL (Estimated Seasonal High Water)	Probable Fill
LOSS OF CIRCULATION	WL (Stabilized)	Rock

GENERALIZED SUBSURFACE SOIL PROFILE Section line A-A'

5429 Franklin Pike Add'l Geotechnical Exploration

Urban Development Group LLC

5429 Franklin Pike, Nashville, Tennessee, 37220

Project No: 26:5679-A Date: 03/21/2023

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5679-A**	**1 of 1**
PROJECT NAME: **5429 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-1A**	SURFACE ELEVATION: **763**
SITE LOCATION: **5429 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625313.4**	EASTING: **1738780.9**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CL) LEAN CLAY, trace gravel, trace sand, trace organics, dark brown, moist, stiff			1.75	S-1	30.4
			BUCKET REFUSAL AT 2.5 FT					
5		758						
10		753						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

WL (First Encountered)	WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5679-A**	**1 of 1**
PROJECT NAME: **5429 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-2A**	SURFACE ELEVATION: **785**
SITE LOCATION: **5429 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625202.6**	EASTING: **1738703.4**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CH) FATCLAY WITH SAND, trace gravel, brown, moist				S-1	31.1
5		780	**BUCKET REFUSAL AT 5 FT**				S-2	31.7
10		775						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5679-A**	**1 of 1**
PROJECT NAME: **5429 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-3A**	SURFACE ELEVATION: **803**
SITE LOCATION: **5429 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625124.6**	EASTING: **1738622.1**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CL) LEAN CLAY WITH SAND, trace gravel, brown, moist				S-1	22.1
			BUCKET REFUSAL AT 2.5 FT					
5		798						
10		793						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered) ▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)	**ECS**		
ECS REP.: / DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT: Urban Development Group LLC	PROJECT NO.: 26:5679-A	SHEET: 1 of 1
PROJECT NAME: 5429 Franklin Pike Add'l Geotechnical Exploration	TEST PIT NO.: TP-4A	SURFACE ELEVATION: 817
SITE LOCATION: 5429 Franklin Pike, Nashville, Tennessee, 37220		STATION:
NORTHING: 625119.2	EASTING: 1738570.6	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[12"]					
			(CL) LEAN CLAY WITH SAND, trace gravel, brown, moist				S-1	22.3
			BUCKET REFUSAL AT 2.5 FT					
5		812						
10		807						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

∇ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR: ECS	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)				
ECS REP.:	DATE COMPLETED: Mar 13 2023	UNITS: English	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5679-A**	**1 of 1**
PROJECT NAME: **5429 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-5A**	SURFACE ELEVATION: **826**
SITE LOCATION: **5429 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625123.9**	EASTING: **1738526.0**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[18"]					
			(CH) SANDY FAT CLAY, light brown, moist				S-1	26.6
			(CL) LEAN CLAY WITH SAND, trace gravel, brown, moist					
5		821					S-2	22.6
							S-3	24.0
			BUCKET REFUSAL AT 7.5 FT					
10		816						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

WL (First Encountered)	WL (Seasonal High)	CONTRACTOR: **ECS**	OPERATOR:	MAKE/MODEL:
WL (Completion)				
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5679-A**	**1 of 1**
PROJECT NAME: **5429 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-6A**	SURFACE ELEVATION: **830**
SITE LOCATION: **5429 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625102.7**	EASTING: **1738500.4**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[18"]					
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, very stiff				S-1	27.4
			BUCKET REFUSAL AT 2.5 FT					
5		825						
10		820						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered) ▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)	**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Urban Development Group LLC	**26:5679-A**	**1 of 1**
PROJECT NAME: **5429 Franklin Pike Add'l Geotechnical Exploration**	TEST PIT NO.: **TP-7A**	SURFACE ELEVATION: **825**
SITE LOCATION: **5429 Franklin Pike, Nashville, Tennessee, 37220**		STATION:
NORTHING: **625061.8**	EASTING: **1738508.1**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			Topsoil Thickness[18"]					
			(CL) LEAN CLAY, trace gravel, trace sand, brown, moist, very stiff			2.50	S-1	21.0
5		820					S-2	20.8
			(CH) FAT CLAY, trace gravel, trace sand, brown, moist, very stiff				S-3	26.2
10		815	**END OF TEST PIT AT 10 FT**				S-4	25.9
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**ECS**		
ECS REP.:	DATE COMPLETED: **Mar 13 2023**	UNITS: **English**	CAVE-IN-DEPTH:	

TEST PIT LOG

Photo 1 – Test Pit-1A Excavation

Photo 2 – Test Pit-1A Spoils

Photolog		5429 Franklin Pike Nashville,Tennessee ECS Project No. 26:5679-A

Photo 3 – Test Pit-2A Excavation

Photo 4 – Test Pit-2A Spoils

Photo 5 – Test Pit-3A Excavation

Photo 6 – Test Pit-3A Spoils

Photo 7 – Test Pit-4A Excavation

Photo 8 – Test Pit-4A Spoils

Photo 9 – Test Pit-5A Excavation

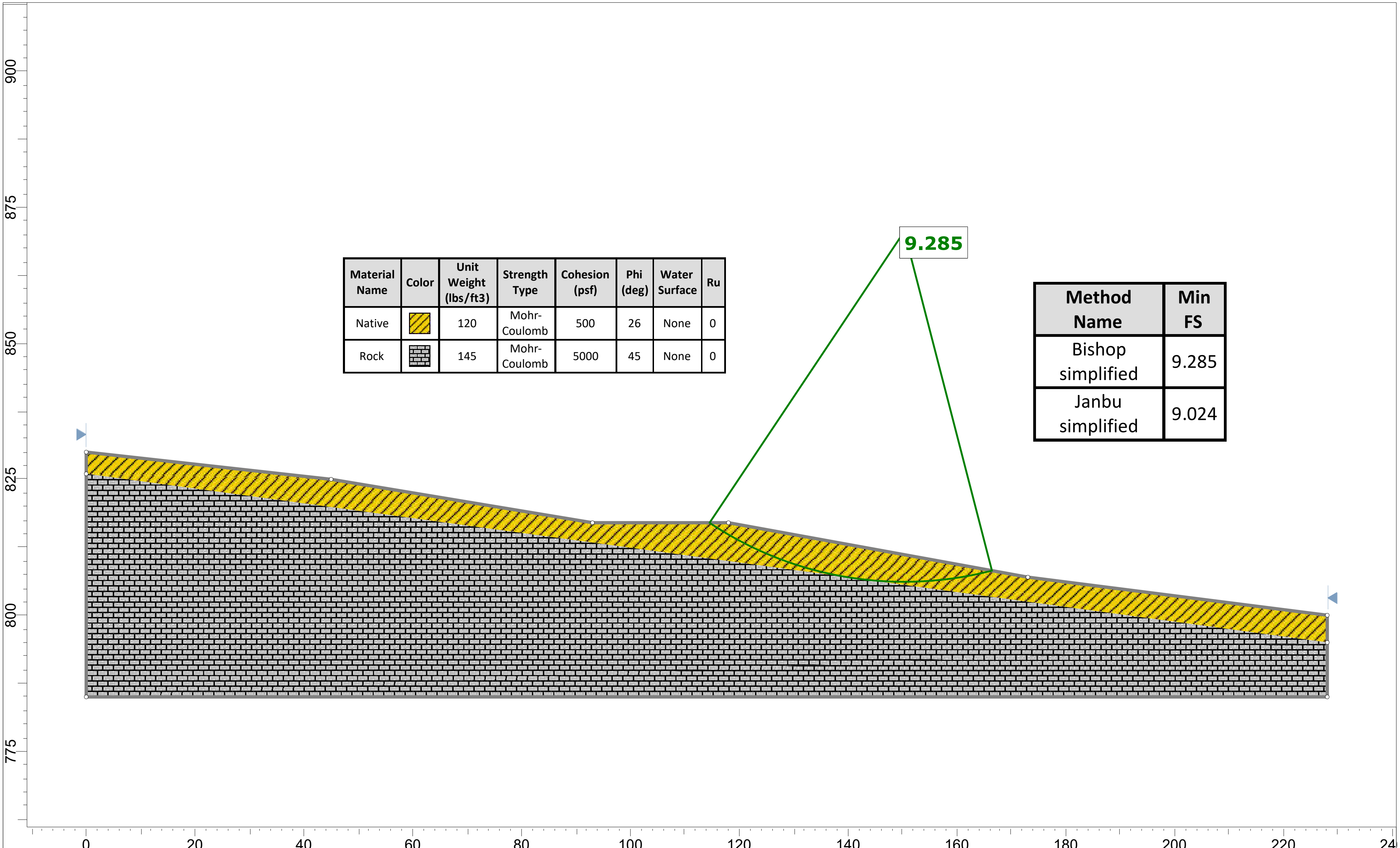
Photo 10 – Test Pit-5A Spoils

Photo 11 – Test Pit-6A Excavation

Photo 12 – Test Pit-6A Spoils

Photo 13 – Test Pit-7A Excavation

Photo 14 – Test Pit-7A Spoils



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Native		120	Mohr-Coulomb	500	26	None	0
Rock		145	Mohr-Coulomb	5000	45	None	0

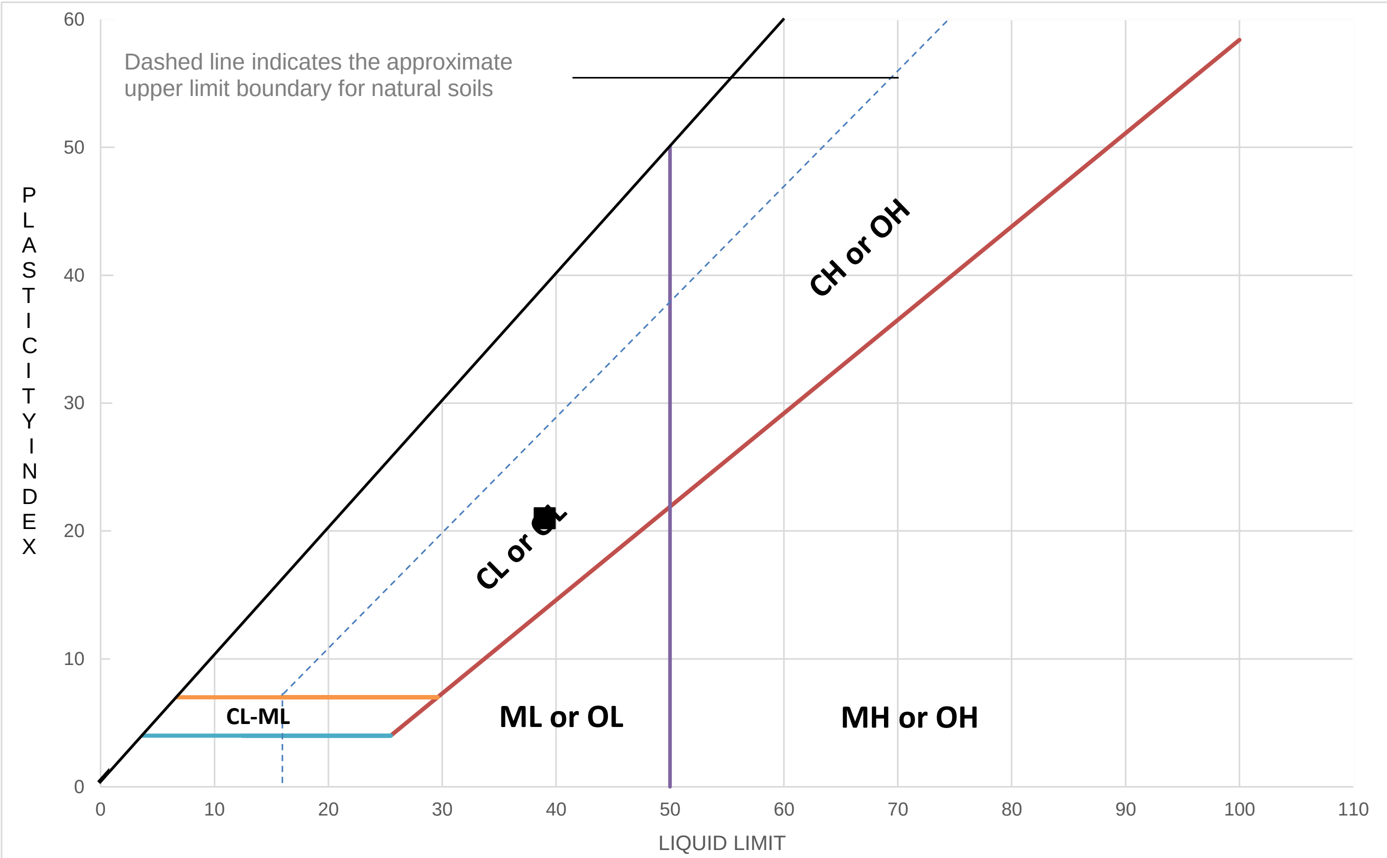
Method Name	Min FS
Bishop simplified	9.285
Janbu simplified	9.024

rocscience

SLIDEINTERPRET 9.027

Project	5429		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	JG	*Company*	ECS
Date	4/5/2023, 4:29:42 PM	*File Name*	5429 Lot.slmd

LIQUID AND PLASTIC LIMITS TEST REPORT



TEST RESULTS (ASTM D4318-10 (MULTIPOINT TEST))

	Sample Location	Sample Number	Sample Depth (ft)	LL	PL	PI	%<#40	%<#200	AASHTO	USCS	Material Description
■	TP-4A	S-1	2.5	39	18	21					(CL) Lean Clay, Light Tannish Brown

Project: 5429 Franklin Pike Add'l Geotechnical Exploration
Client: Urban Development Group LLC

Project No.: 26:5679-A
Date Reported: 3/20/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Nashville	318 Seaboard Lane Suite 208 Franklin, TN 37067	(615)885-4983 (615)771-4134

Tested by	Checked by	Approved by	Date Received
BHeineman	rbanner	rbanner	3/13/2012

Laboratory Testing Summary

Sample Location	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
TP-1A	S-1	2.5	30.4										
TP-2A	S-1	2.5	31.1										
TP-2A	S-2	5	31.7										
TP-3A	S-1	2.5	22.1										
TP-4A	S-1	2.5	22.3		39	18	21						
TP-5A	S-1	2.5	26.6										
TP-5A	S-2	5	22.6										
TP-5A	S-3	7.5	24.0										
TP-6A	S-1	2.5	27.4										
TP-7A	S-1	2.5	21.0										

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: 5429 Franklin Pike Add'l Geotechnical Exploration
Client: Urban Development Group LLC

Project No.: 26:5679-A
Date Reported: 3/20/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Nashville	318 Seaboard Lane Suite 208 Franklin, TN 37067	(615)885-4983 (615)771-4134

Tested by	Checked by	Approved by	Date Received
LMinella	rbanner	rbanner	3/13/2012

Laboratory Testing Summary

Sample Location	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
TP-7A	S-2	5	20.8										
TP-7A	S-3	7.5	26.2										
TP-7A	S-4	10	25.9										

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: 5429 Franklin Pike Add'l Geotechnical Exploration
Client: Urban Development Group LLC

Project No.: 26:5679-A
Date Reported: 3/20/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Nashville	318 Seaboard Lane Suite 208 Franklin, TN 37067	(615)885-4983 (615)771-4134

Tested by	Checked by	Approved by	Date Received
LMinella	rbanner	rbanner	3/13/2012

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

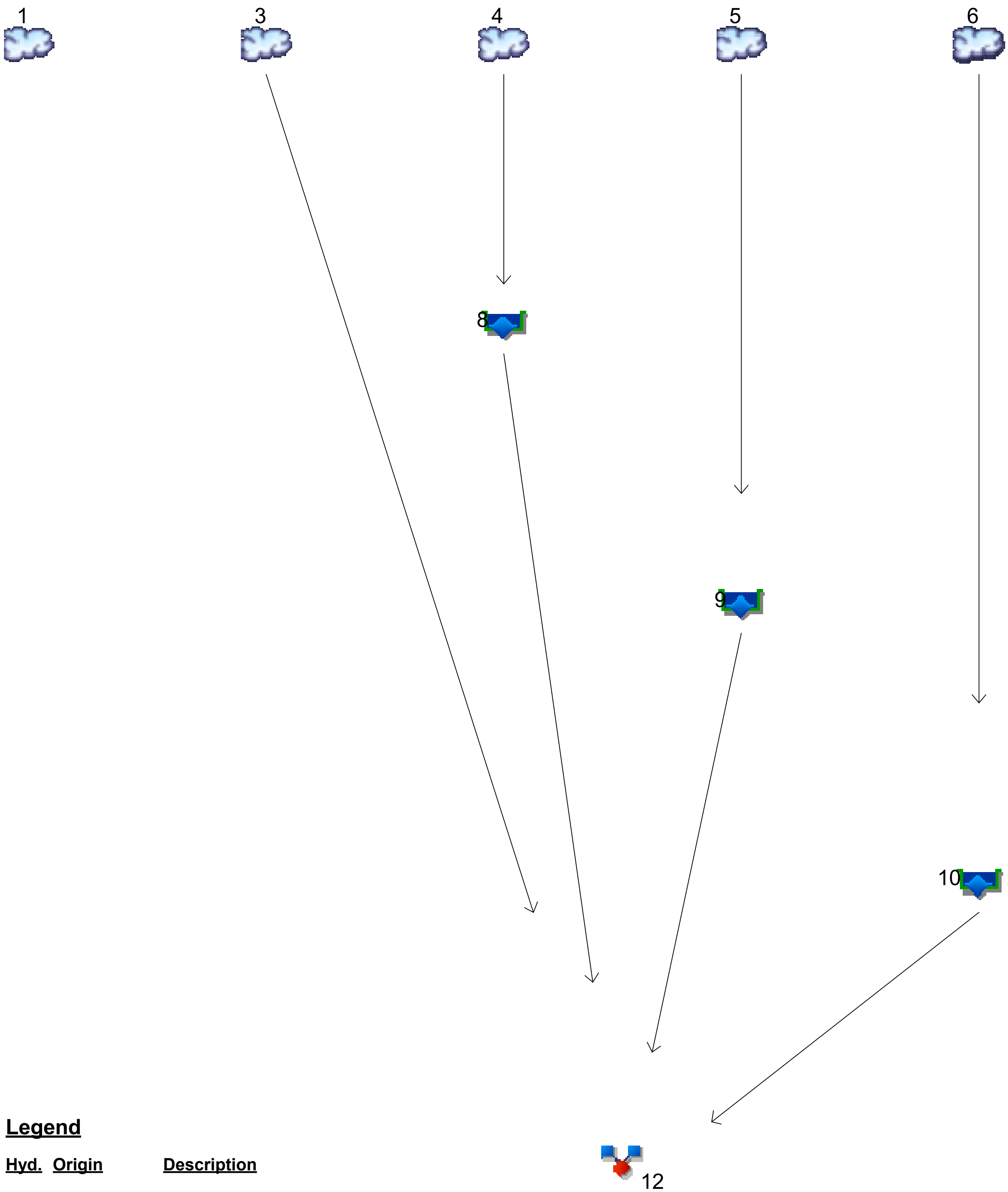
GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX D

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022



Legend

Hyd.	Origin	Description
1	SCS Runoff	Existing Conditions
3	SCS Runoff	Proposed Bypass
4	SCS Runoff	Area into 5421 BIO
5	SCS Runoff	Area into 5425 BIO
6	SCS Runoff	Area into 5429 BIO
8	Reservoir	5421 BIO ROUTING
9	Reservoir	5425 BIO ROUTING
10	Reservoir	5429 BIO ROUTING
12	Combine	Total Proposed

Project: Hydraflow 4-17.gpw

Tuesday, 04 / 18 / 2023

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	9.487	-------	16.01	20.58	26.73	31.38	36.01	Existing Conditions
3	SCS Runoff	------	-------	9.235	-------	15.15	19.36	24.87	29.01	33.12	Proposed Bypass
4	SCS Runoff	------	-------	0.682	-------	0.986	1.186	1.440	1.628	1.812	Area into 5421 BIO
5	SCS Runoff	------	-------	0.779	-------	1.116	1.336	1.616	1.823	2.025	Area into 5425 BIO
6	SCS Runoff	------	-------	0.690	-------	0.961	1.137	1.361	1.526	1.688	Area into 5429 BIO
8	Reservoir	4	-------	0.000	-------	0.000	0.000	0.274	0.939	1.552	5421 BIO ROUTING
9	Reservoir	5	-------	0.000	-------	0.000	0.000	0.152	1.179	1.986	5425 BIO ROUTING
10	Reservoir	6	-------	0.030	-------	0.939	1.112	1.327	1.488	1.643	5429 BIO ROUTING
12	Combine	3, 8, 9, 10,	-------	9.235	-------	15.44	20.43	26.17	30.50	35.90	Total Proposed

Proj. file: Hydraflow 4-17.gpw

Tuesday, 04 / 18 / 2023

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	9.487	2	718	18,984	------	------	------	Existing Conditions
3	SCS Runoff	9.235	2	718	18,470	------	------	------	Proposed Bypass
4	SCS Runoff	0.682	2	716	1,402	------	------	------	Area into 5421 BIO
5	SCS Runoff	0.779	2	716	1,612	------	------	------	Area into 5425 BIO
6	SCS Runoff	0.690	2	716	1,465	------	------	------	Area into 5429 BIO
8	Reservoir	0.000	2	992	0	4	743.19	775	5421 BIO ROUTING
9	Reservoir	0.000	2	1908	0	5	800.45	1,039	5425 BIO ROUTING
10	Reservoir	0.030	2	760	123	6	808.58	927	5429 BIO ROUTING
12	Combine	9.235	2	718	18,593	3, 8, 9, 10,	------	------	Total Proposed

Hydraflow 4-17.gpw	Return Period: 2 Year	Tuesday, 04 / 18 / 2023

Hydrograph Report

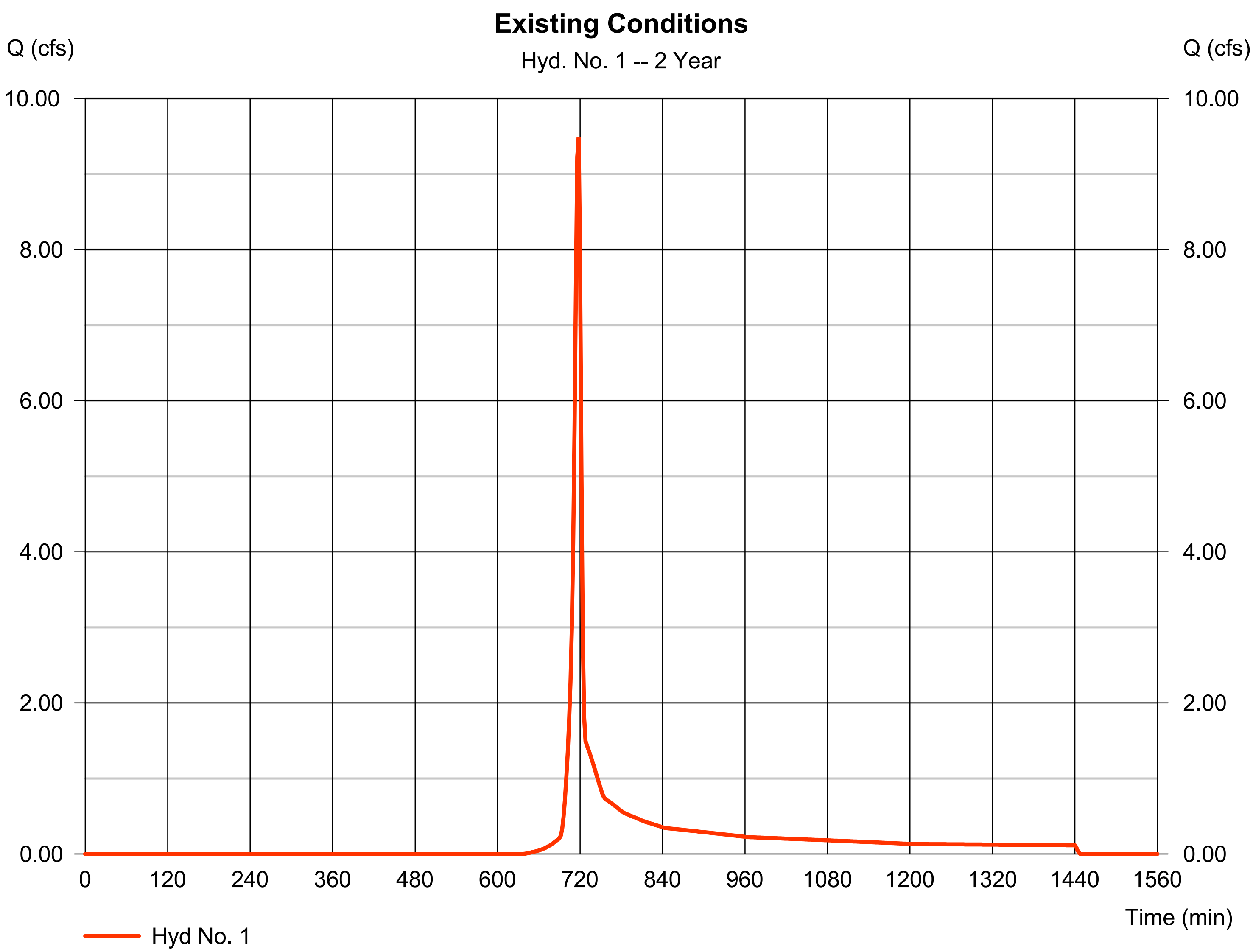
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Tuesday, 04 / 18 / 2023

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 9.487 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 18,984 cuft
Drainage area	= 4.790 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.50 min
Total precip.	= 3.39 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 89) + (0.200 x 79) + (4.720 x 73)] / 4.790



Hydrograph Report

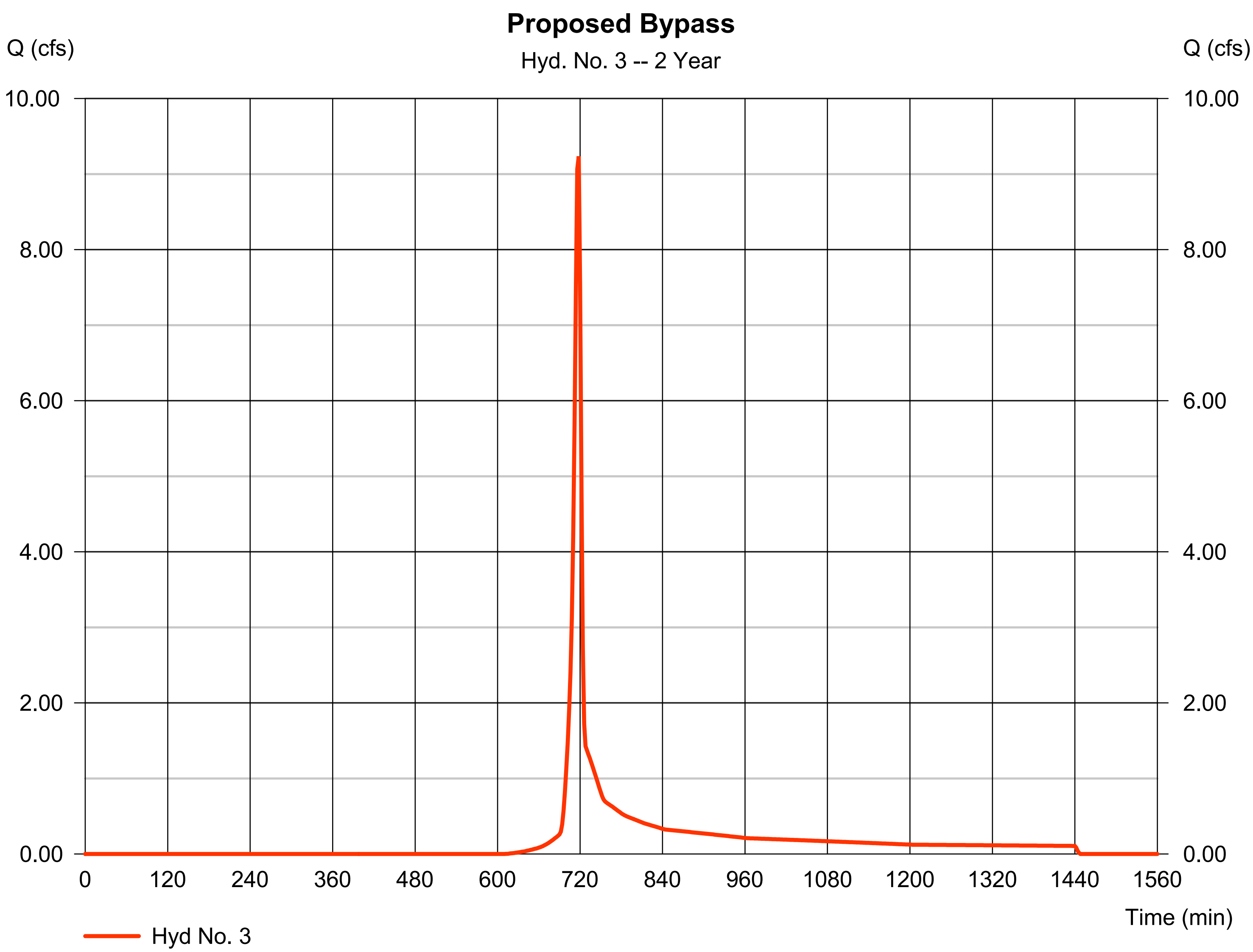
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 3

Proposed Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 9.235 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 18,470 cuft
Drainage area	= 4.220 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.50 min
Total precip.	= 3.39 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.280 x 73) + (0.280 x 98) + (0.660 x 79)] / 4.220



Hydrograph Report

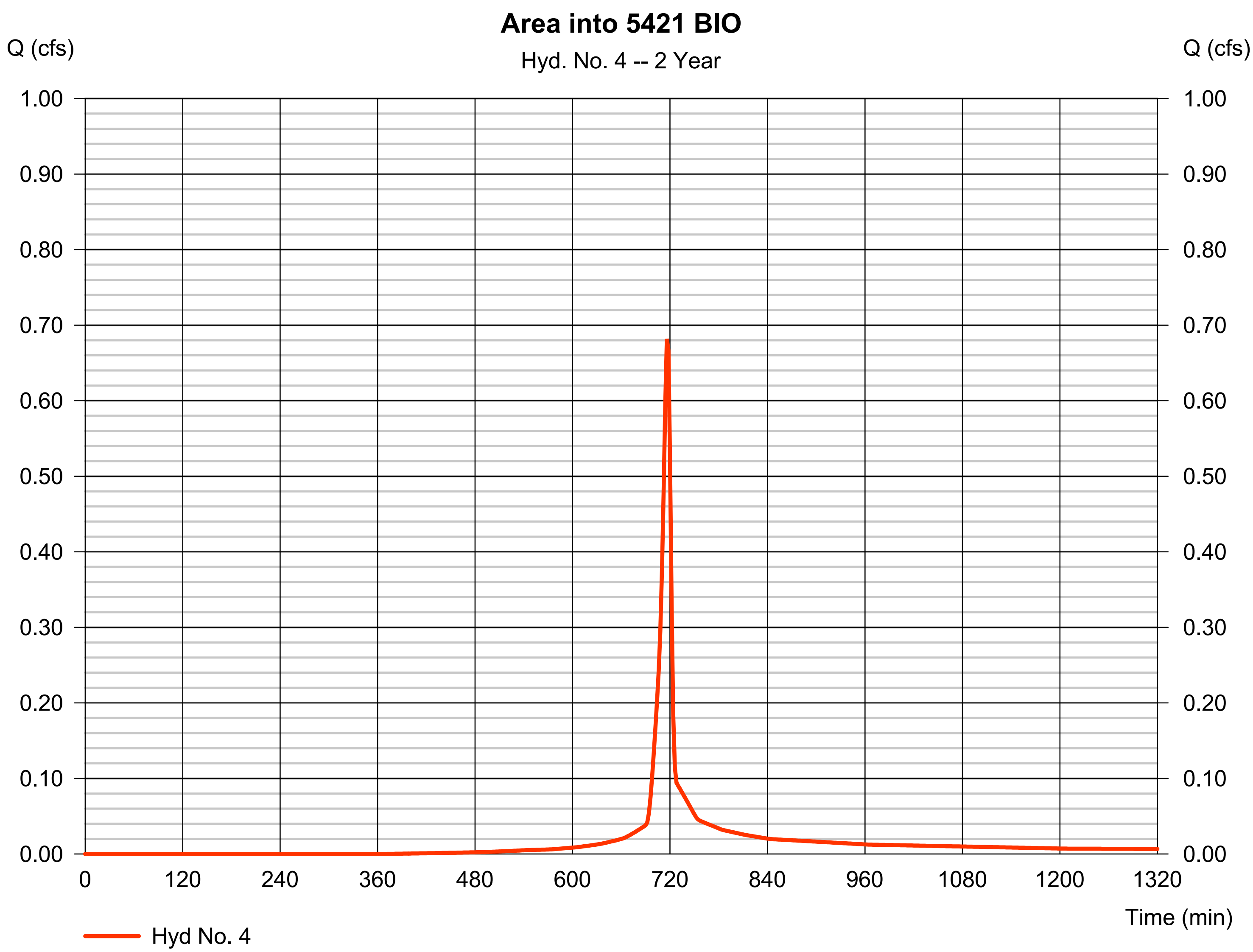
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 4

Area into 5421 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 0.682 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 1,402 cuft
Drainage area	= 0.190 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.39 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.060 x 79) + (0.120 x 98)] / 0.190



Hydrograph Report

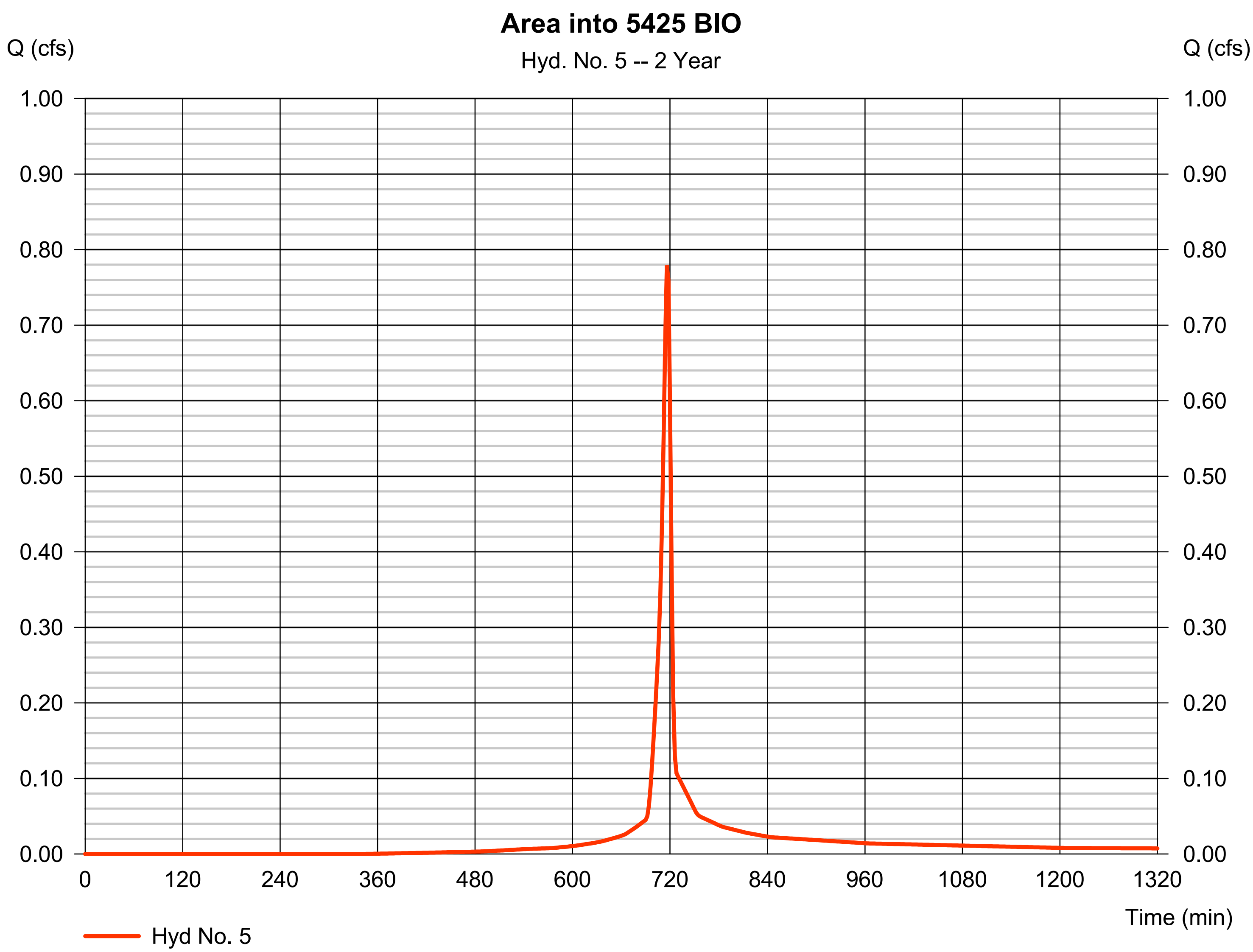
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 5

Area into 5425 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 0.779 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 1,612 cuft
Drainage area	= 0.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.39 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.030 x 79) + (0.130 x 98)] / 0.210



Hydrograph Report

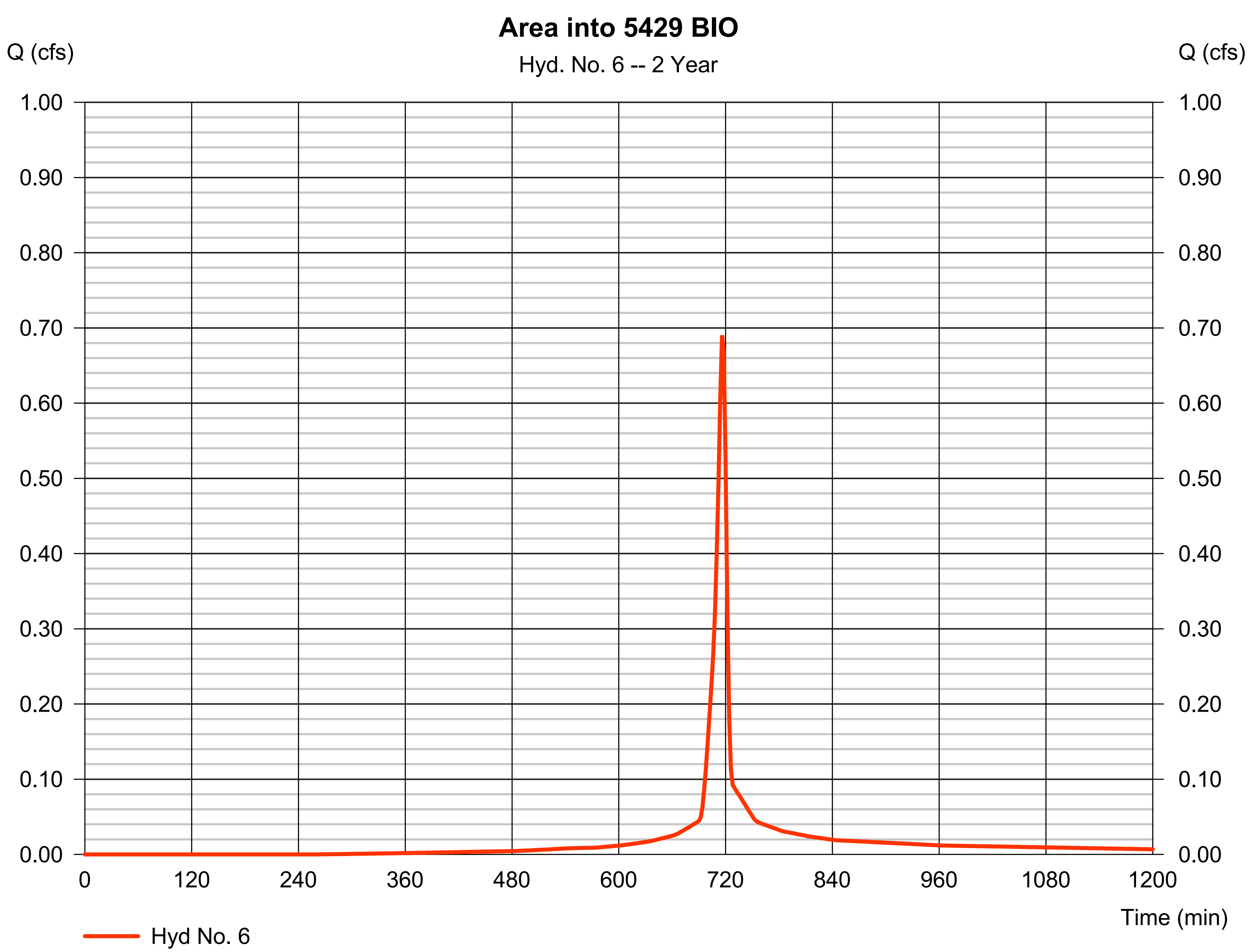
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 6

Area into 5429 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 0.690 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 1,465 cuft
Drainage area	= 0.170 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.39 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 98) + (0.050 x 79)] / 0.170



Hydrograph Report

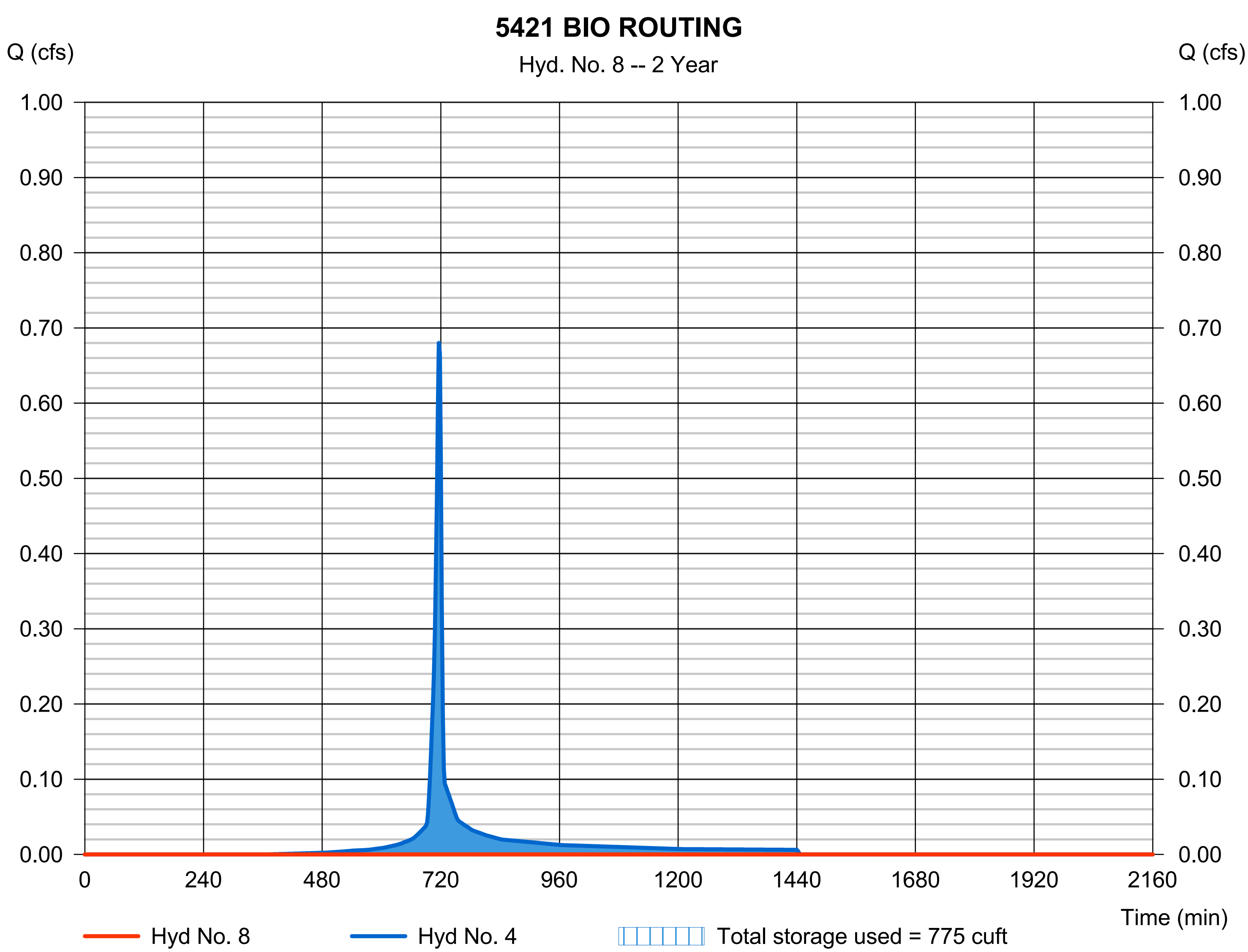
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 8

5421 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 992 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 4 - Area into 5421 BIO	Max. Elevation	= 743.19 ft
Reservoir name	= 5421 Rain Garden W INFIL	Max. Storage	= 775 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Pond No. 5 - 5421 Rain Garden W INFIL

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 741.75 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	741.75	538	0	0
2.15	743.90	539	1,158	1,158
3.15	744.90	540	539	1,697

Culvert / Orifice Structures

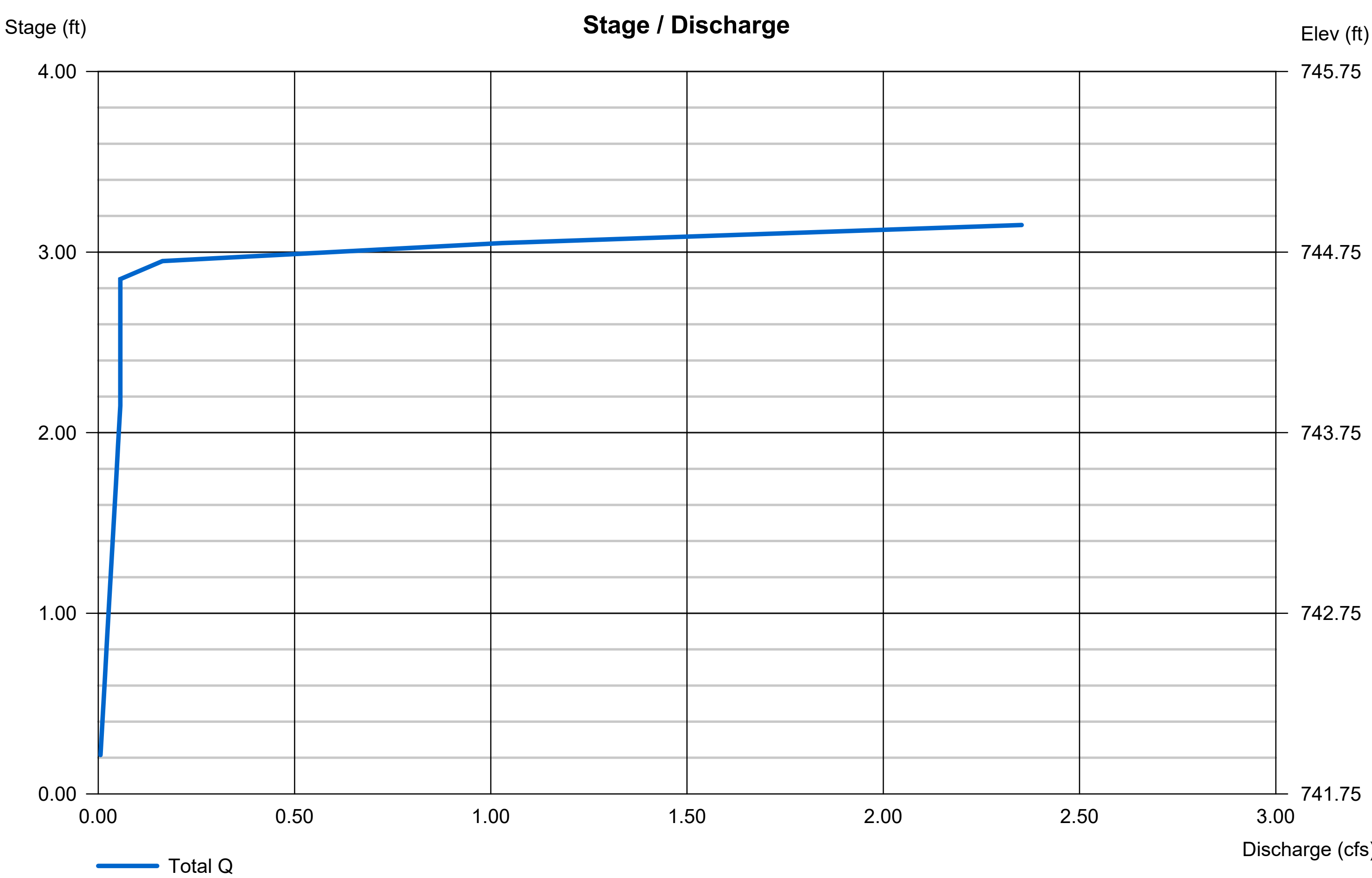
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 741.75	0.00	0.00	0.00
Length (ft)	= 47.00	0.00	0.00	0.00
Slope (%)	= 18.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.25	0.00	0.00	0.00
Crest El. (ft)	= 744.67	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 4.500 (by Contour)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Report

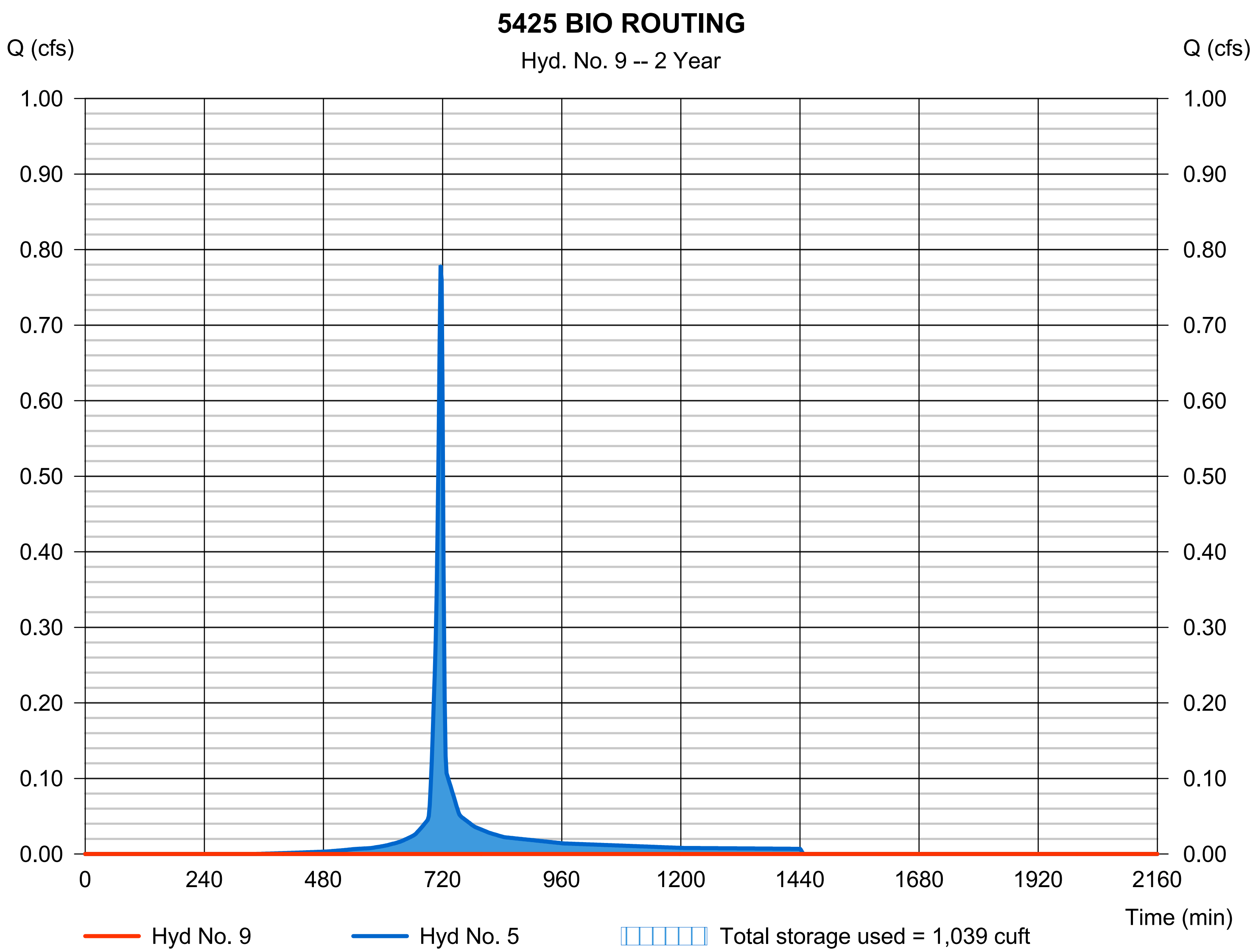
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 9

5425 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 1908 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 5 - Area into 5425 BIO	Max. Elevation	= 800.45 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 1,039 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Pond No. 6 - 5425 Rain Garden W INFIL

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 799.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	799.00	716	0	0
1.95	800.87	717	1,397	1,397
2.95	801.95	718	718	2,115

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 6.00	0.00	0.00	0.00
Span (in)	= 6.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 741.75	0.00	0.00	0.00
Length (ft)	= 47.00	0.00	0.00	0.00
Slope (%)	= 20.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

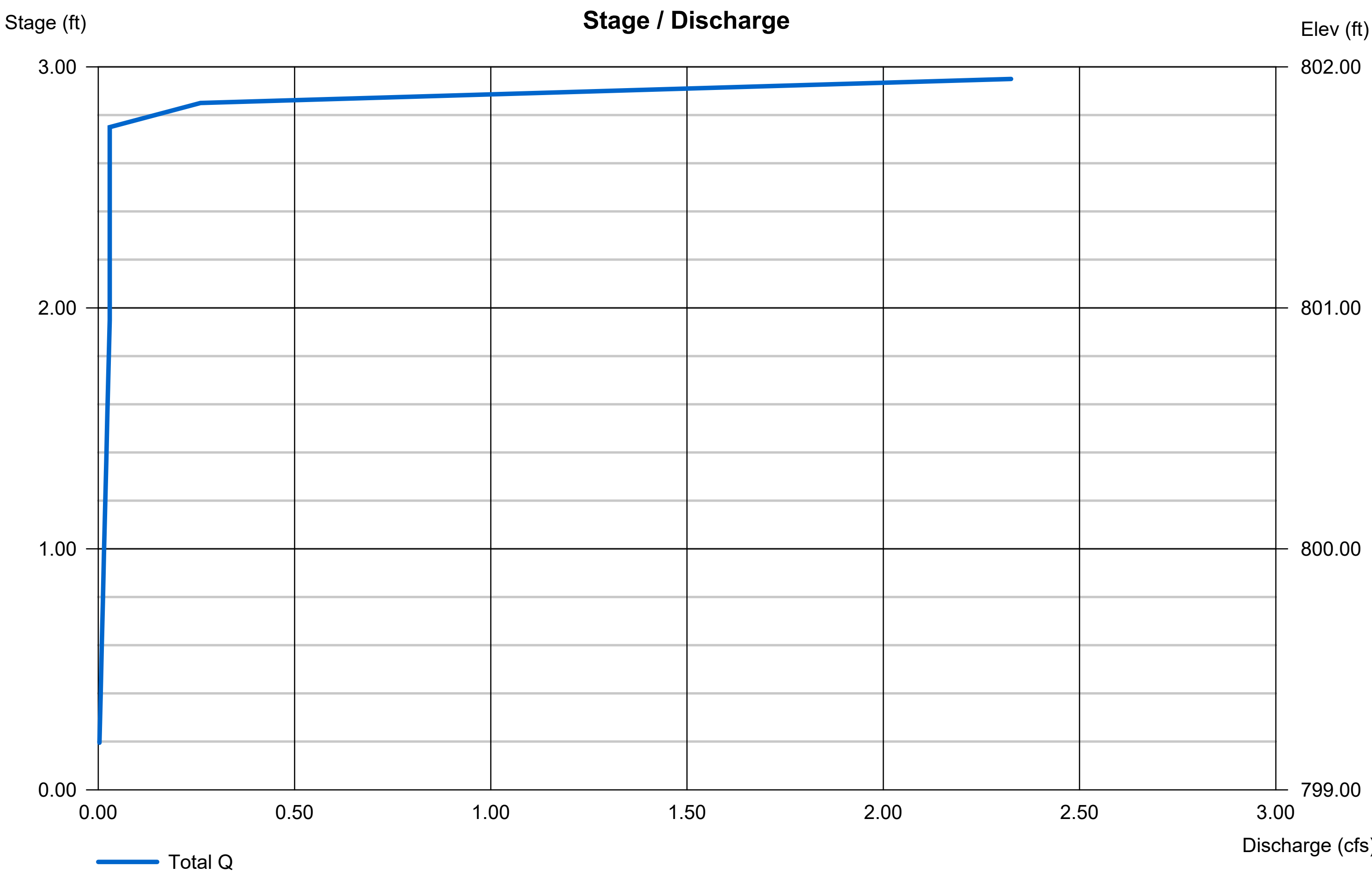
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.25	0.00	0.00	0.00
Crest El. (ft)	= 801.72	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 1.750 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Report

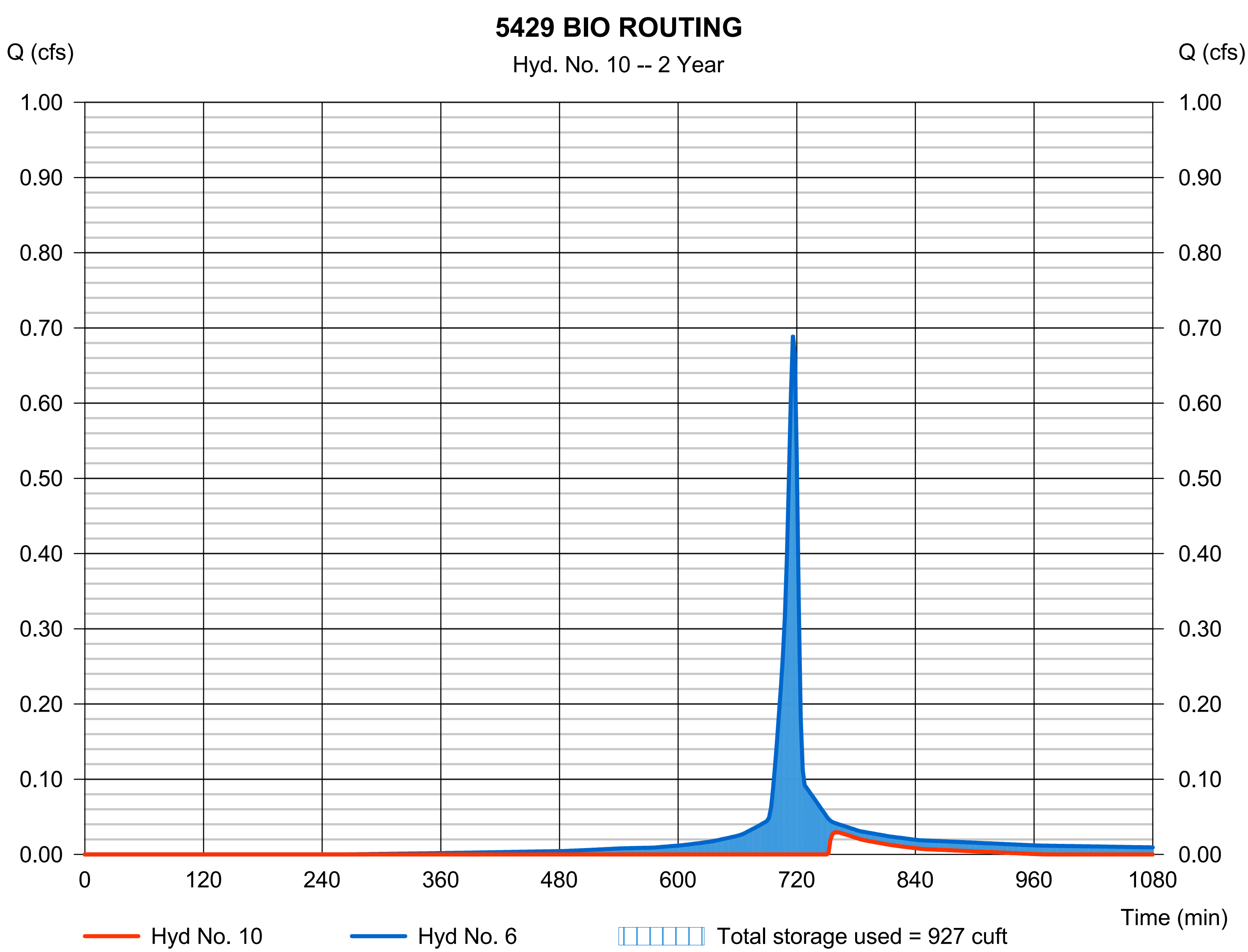
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 10

5429 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.030 cfs
Storm frequency	= 2 yrs	Time to peak	= 760 min
Time interval	= 2 min	Hyd. volume	= 123 cuft
Inflow hyd. No.	= 6 - Area into 5429 BIO	Max. Elevation	= 808.58 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 927 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 7 - 5425 Rain Garden W INFIL

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 806.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	806.00	358	0	0
1.87	807.87	359	670	670
2.87	808.87	360	360	1,030

Culvert / Orifice Structures

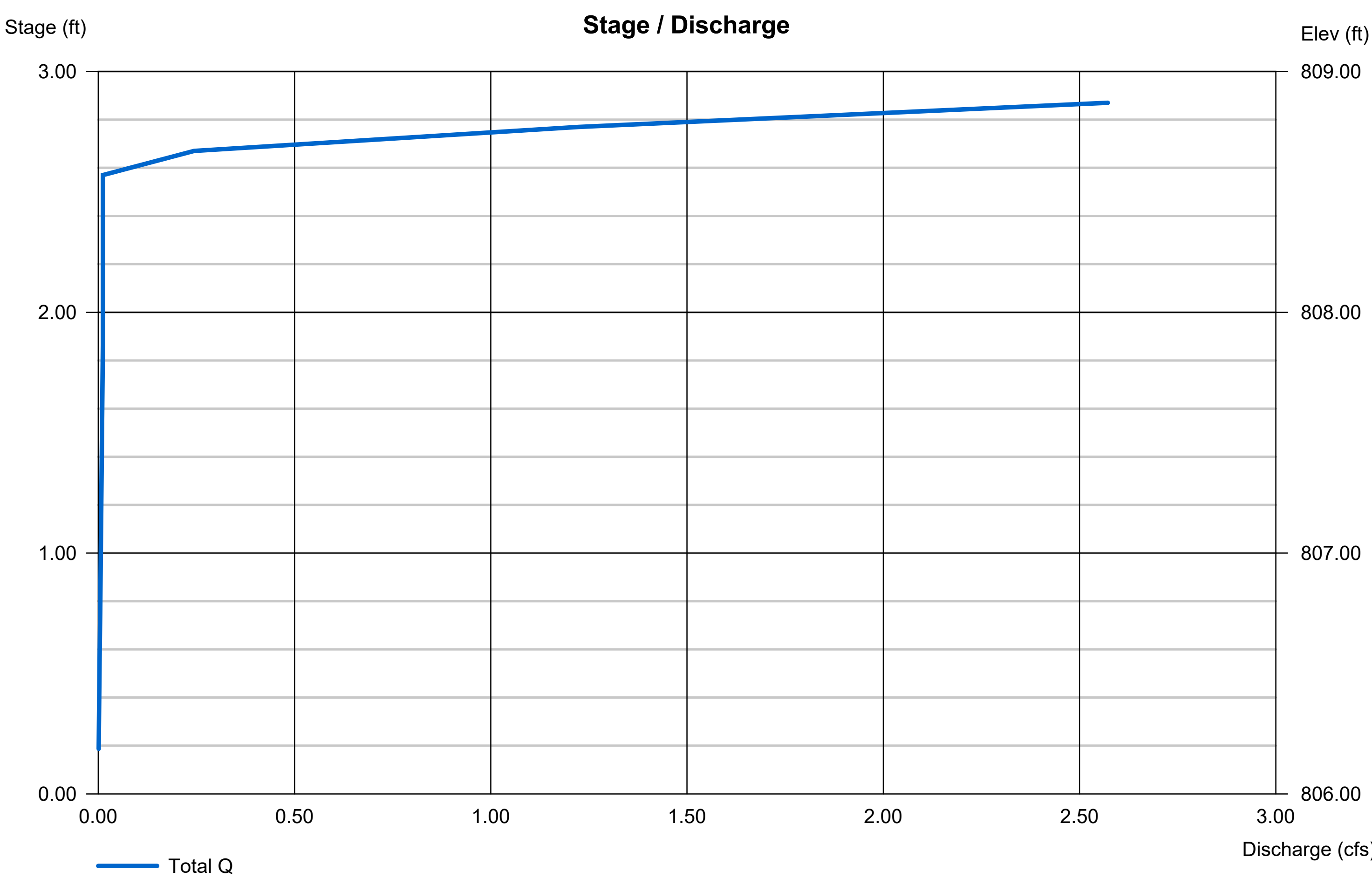
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 8.00	0.00	0.00	0.00
Span (in)	= 8.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 806.00	0.00	0.00	0.00
Length (ft)	= 47.00	0.00	0.00	0.00
Slope (%)	= 6.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	0.00	0.00	0.00
Crest El. (ft)	= 808.62	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 1.400 (by Contour)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



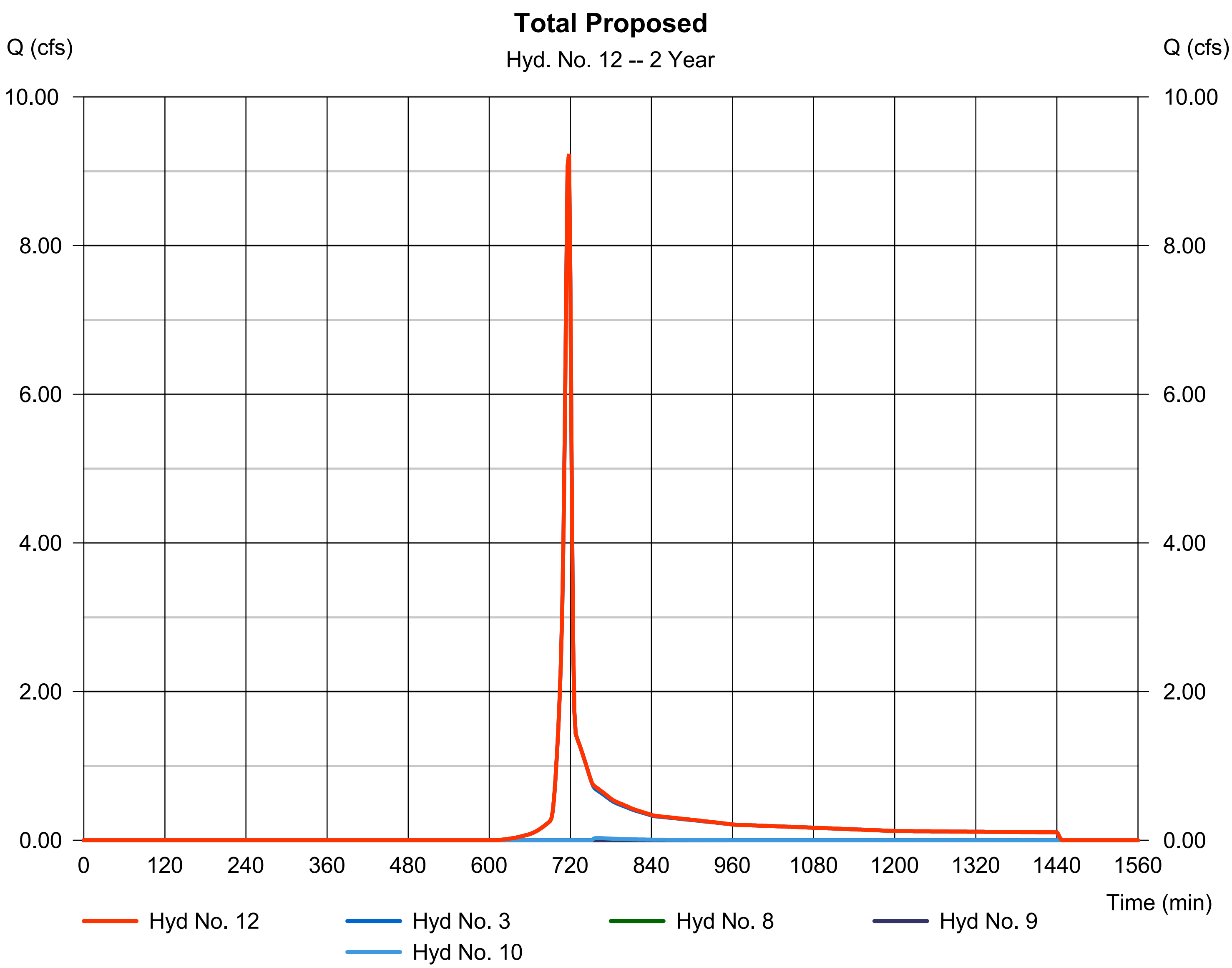
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 12

Total Proposed

Hydrograph type	= Combine	Peak discharge	= 9.235 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 18,593 cuft
Inflow hyds.	= 3, 8, 9, 10	Contrib. drain. area	= 4.220 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	16.01	2	718	32,151	------	------	------	Existing Conditions
3	SCS Runoff	15.15	2	718	30,587	------	------	------	Proposed Bypass
4	SCS Runoff	0.986	2	716	2,067	------	------	------	Area into 5421 BIO
5	SCS Runoff	1.116	2	716	2,355	------	------	------	Area into 5425 BIO
6	SCS Runoff	0.961	2	716	2,084	------	------	------	Area into 5429 BIO
8	Reservoir	0.000	2	754	0	4	743.90	1,159	5421 BIO ROUTING
9	Reservoir	0.000	2	2216	0	5	801.08	1,547	5425 BIO ROUTING
10	Reservoir	0.939	2	720	662	6	808.74	984	5429 BIO ROUTING
12	Combine	15.44	2	718	31,248	3, 8, 9, 10,	------	------	Total Proposed

Hydrograph Report

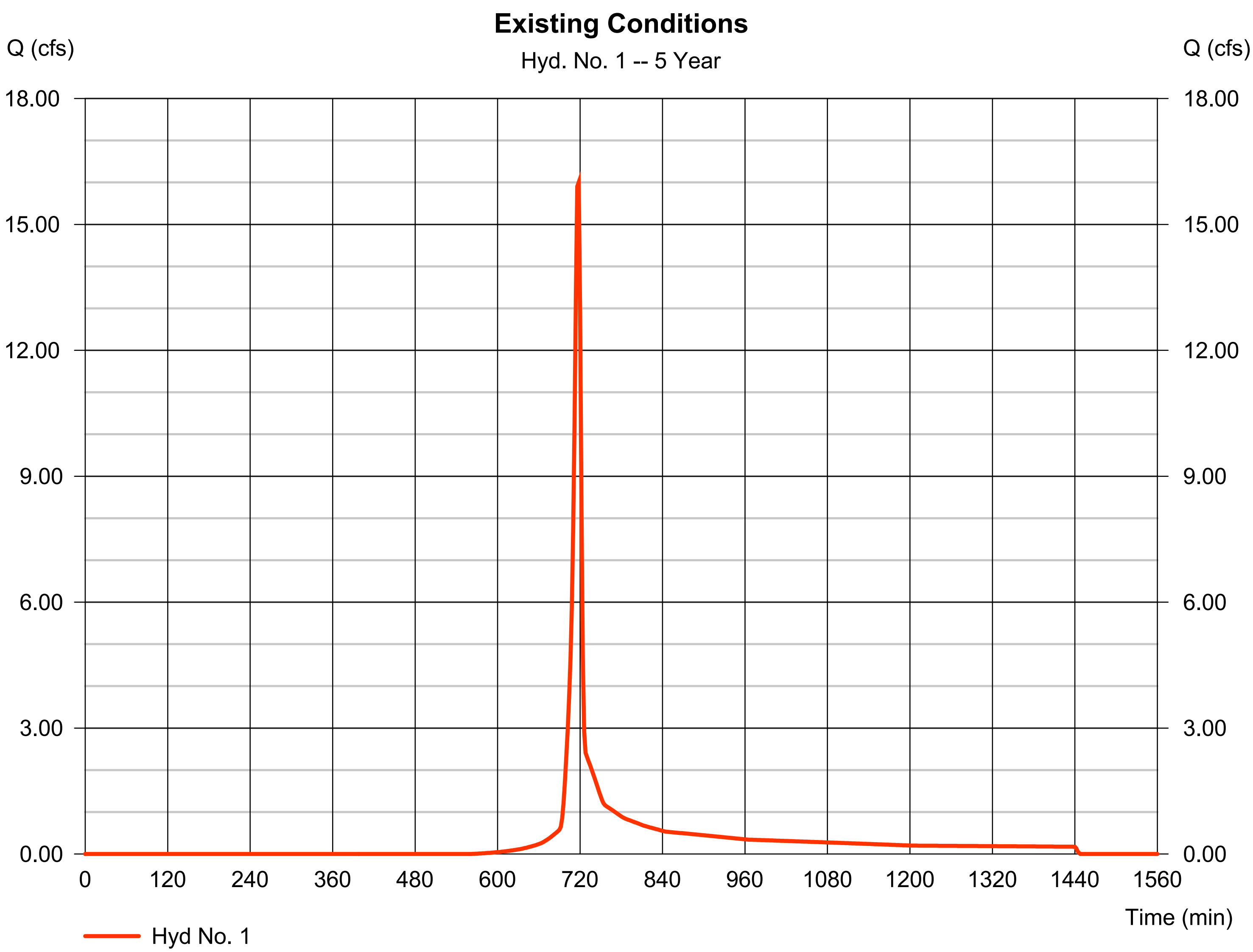
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 16.01 cfs
Storm frequency	= 5 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 32,151 cuft
Drainage area	= 4.790 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.50 min
Total precip.	= 4.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 89) + (0.200 x 79) + (4.720 x 73)] / 4.790



Hydrograph Report

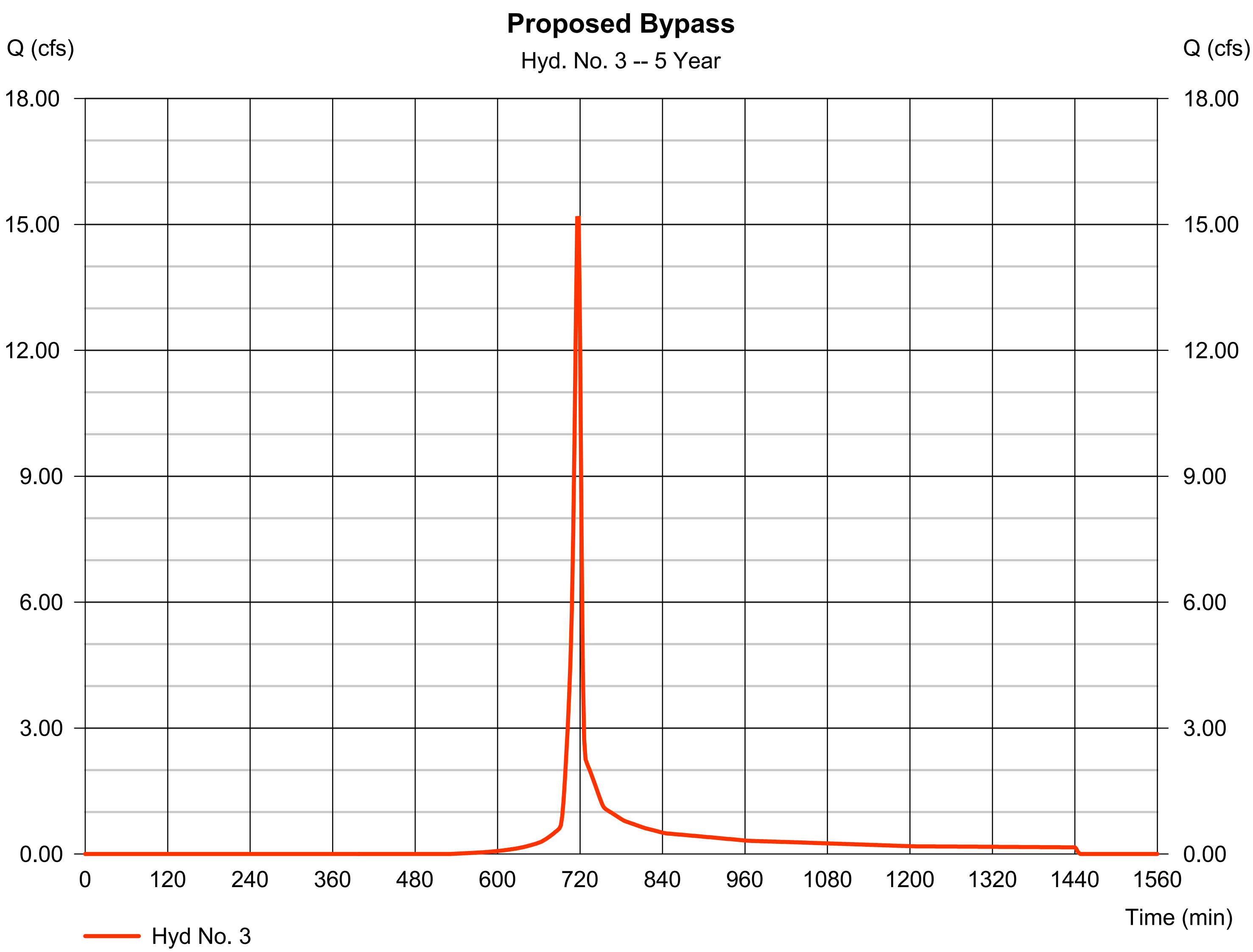
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 3

Proposed Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 15.15 cfs
Storm frequency	= 5 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 30,587 cuft
Drainage area	= 4.220 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.50 min
Total precip.	= 4.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.280 x 73) + (0.280 x 98) + (0.660 x 79)] / 4.220



Hydrograph Report

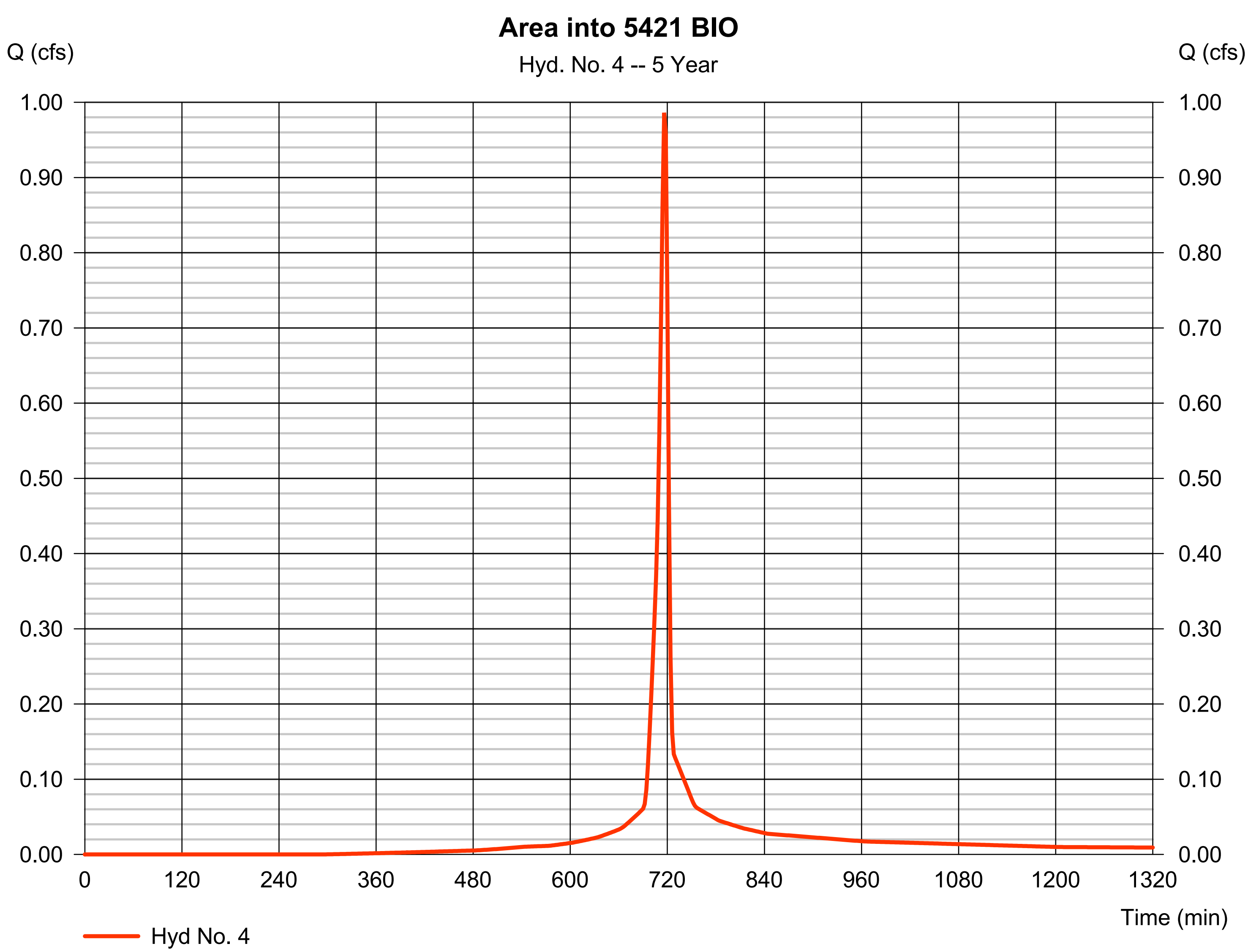
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 4

Area into 5421 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 0.986 cfs
Storm frequency	= 5 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 2,067 cuft
Drainage area	= 0.190 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.060 x 79) + (0.120 x 98)] / 0.190



Hydrograph Report

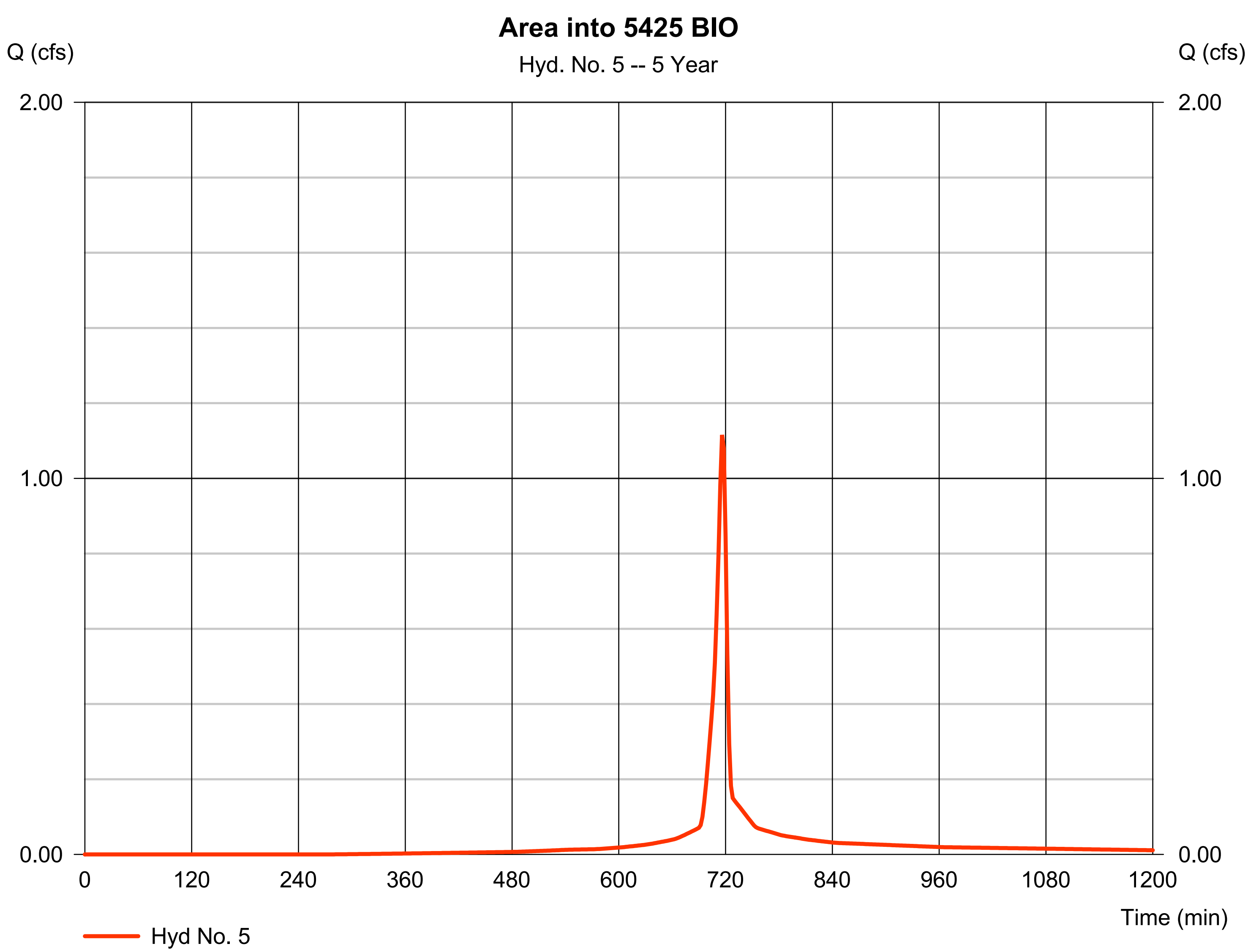
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 5

Area into 5425 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.116 cfs
Storm frequency	= 5 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 2,355 cuft
Drainage area	= 0.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.030 x 79) + (0.130 x 98)] / 0.210



Hydrograph Report

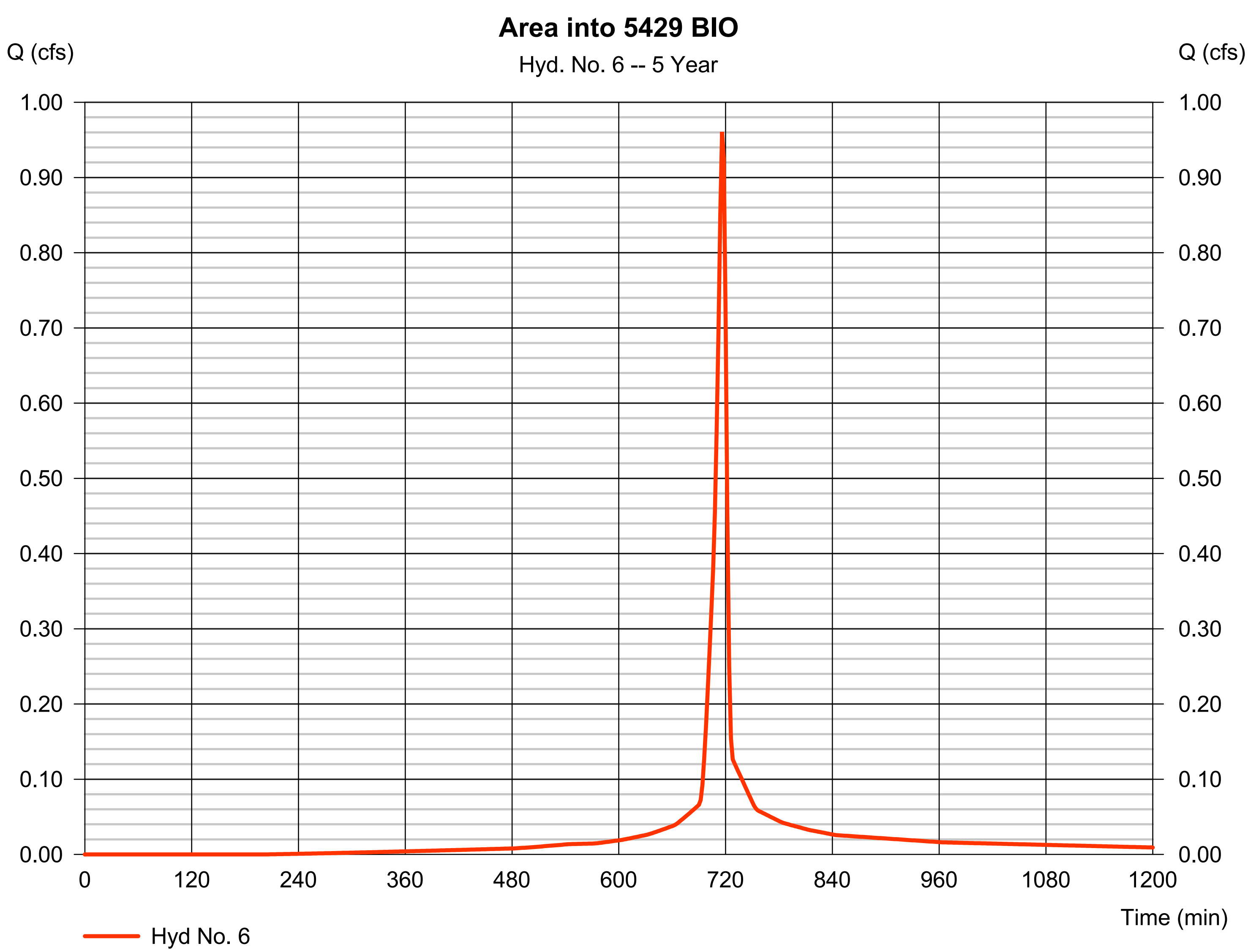
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 6

Area into 5429 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 0.961 cfs
Storm frequency	= 5 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 2,084 cuft
Drainage area	= 0.170 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 98) + (0.050 x 79)] / 0.170



Hydrograph Report

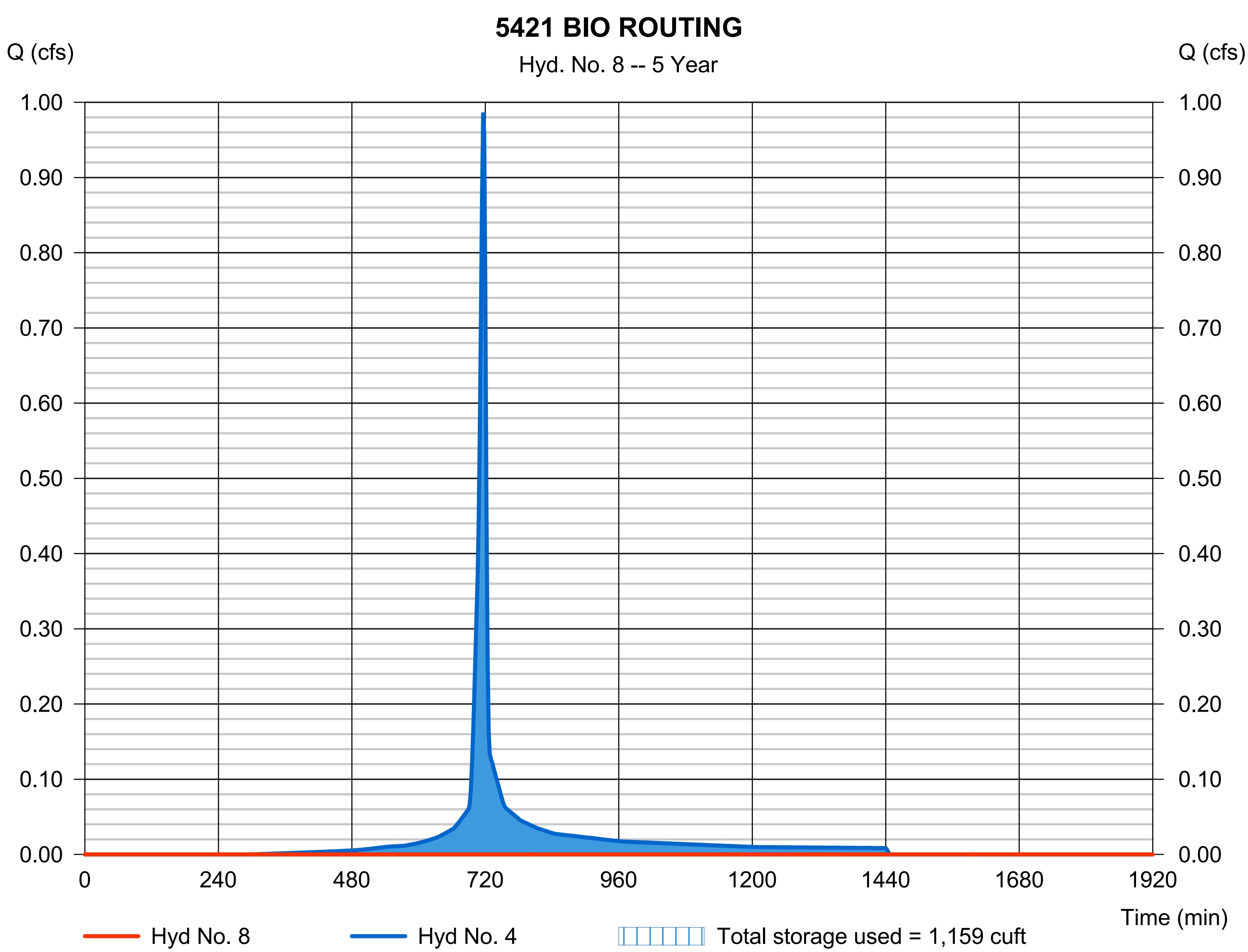
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 8

5421 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 5 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 4 - Area into 5421 BIO	Max. Elevation	= 743.90 ft
Reservoir name	= 5421 Rain Garden W INFIL	Max. Storage	= 1,159 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

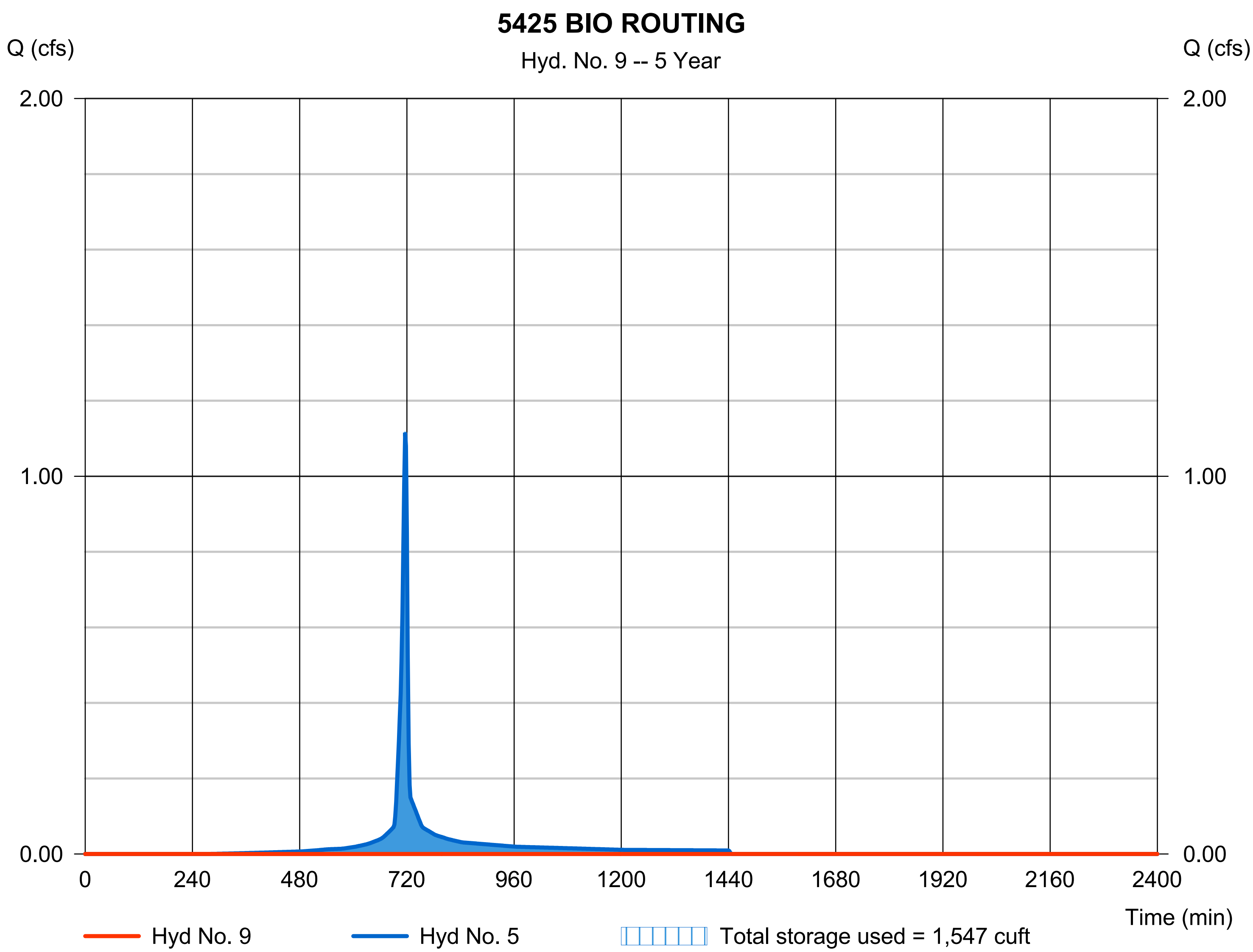
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 9

5425 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 5 yrs	Time to peak	= 2216 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 5 - Area into 5425 BIO	Max. Elevation	= 801.08 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 1,547 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

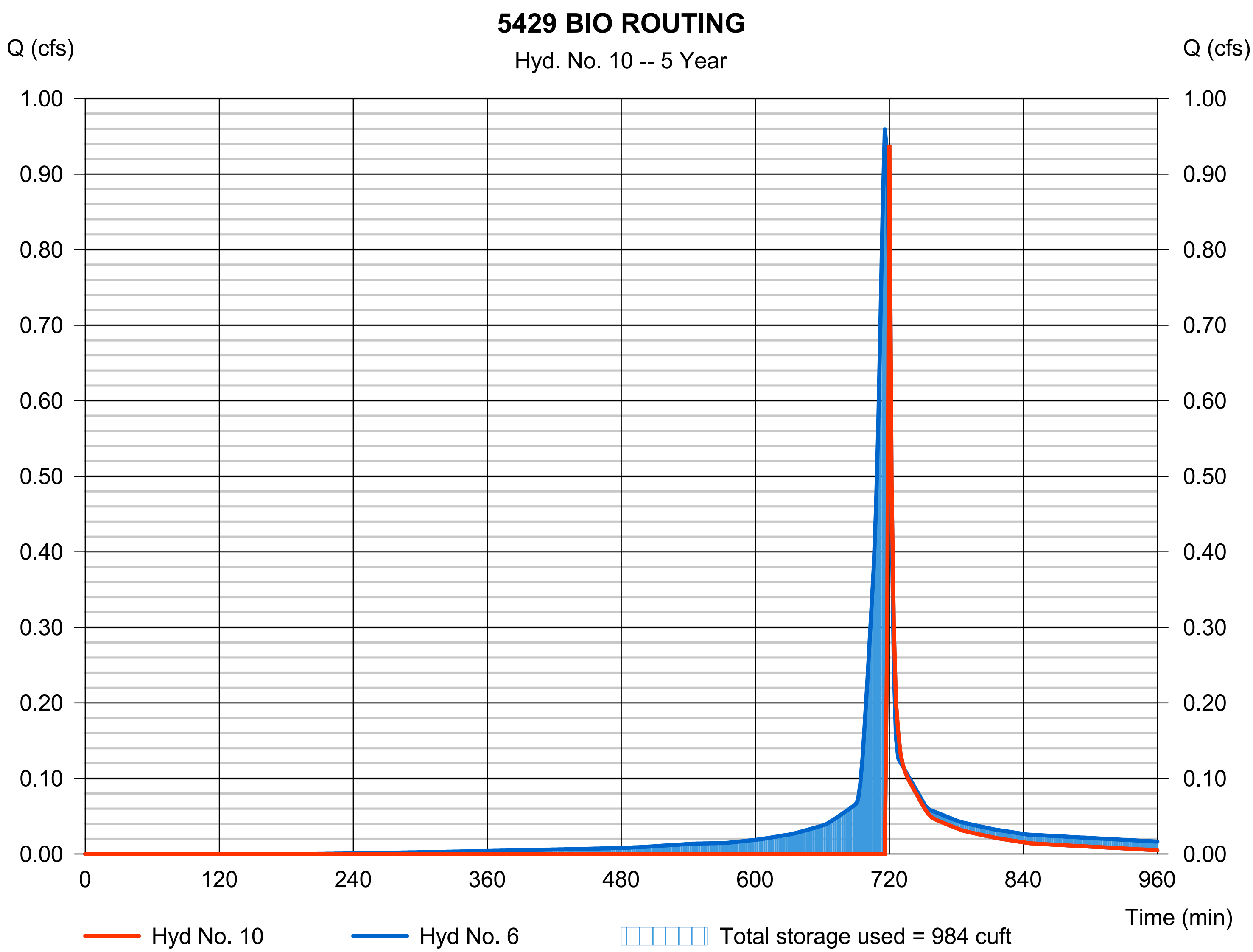
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 10

5429 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.939 cfs
Storm frequency	= 5 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 662 cuft
Inflow hyd. No.	= 6 - Area into 5429 BIO	Max. Elevation	= 808.74 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 984 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



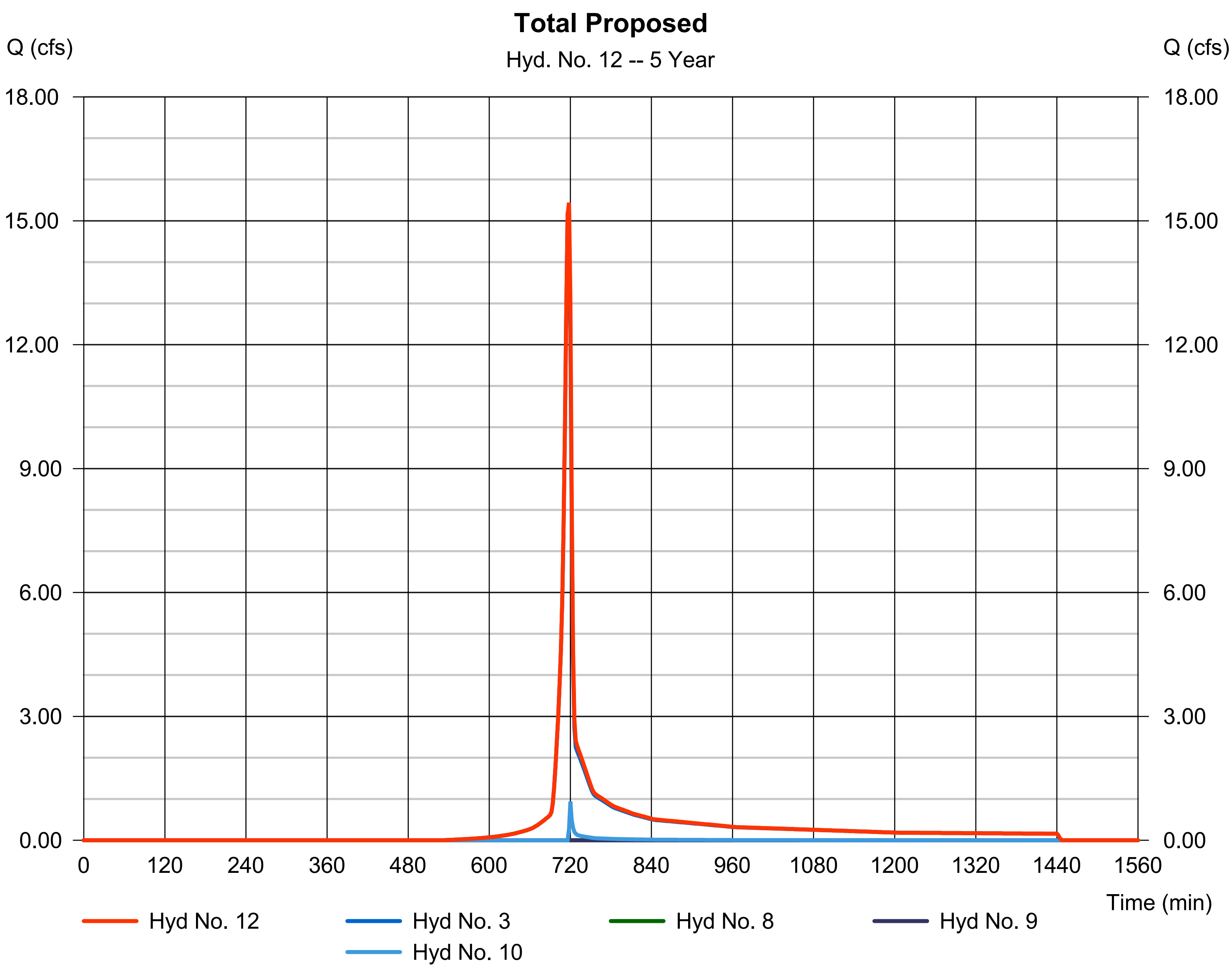
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Tuesday, 04 / 18 / 2023

Hyd. No. 12

Total Proposed

Hydrograph type	= Combine	Peak discharge	= 15.44 cfs
Storm frequency	= 5 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 31,248 cuft
Inflow hyds.	= 3, 8, 9, 10	Contrib. drain. area	= 4.220 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	20.58	2	716	41,552	------	------	------	Existing Conditions
3	SCS Runoff	19.36	2	716	39,152	------	------	------	Proposed Bypass
4	SCS Runoff	1.186	2	716	2,514	------	------	------	Area into 5421 BIO
5	SCS Runoff	1.336	2	716	2,853	------	------	------	Area into 5425 BIO
6	SCS Runoff	1.137	2	716	2,496	------	------	------	Area into 5429 BIO
8	Reservoir	0.000	2	976	0	4	744.44	1,450	5421 BIO ROUTING
9	Reservoir	0.000	2	2478	0	5	801.63	1,940	5425 BIO ROUTING
10	Reservoir	1.112	2	718	1,032	6	808.76	990	5429 BIO ROUTING
12	Combine	20.43	2	716	40,184	3, 8, 9, 10,	------	------	Total Proposed

Hydraflow 4-17.gpw	Return Period: 10 Year	Tuesday, 04 / 18 / 2023

Hydrograph Report

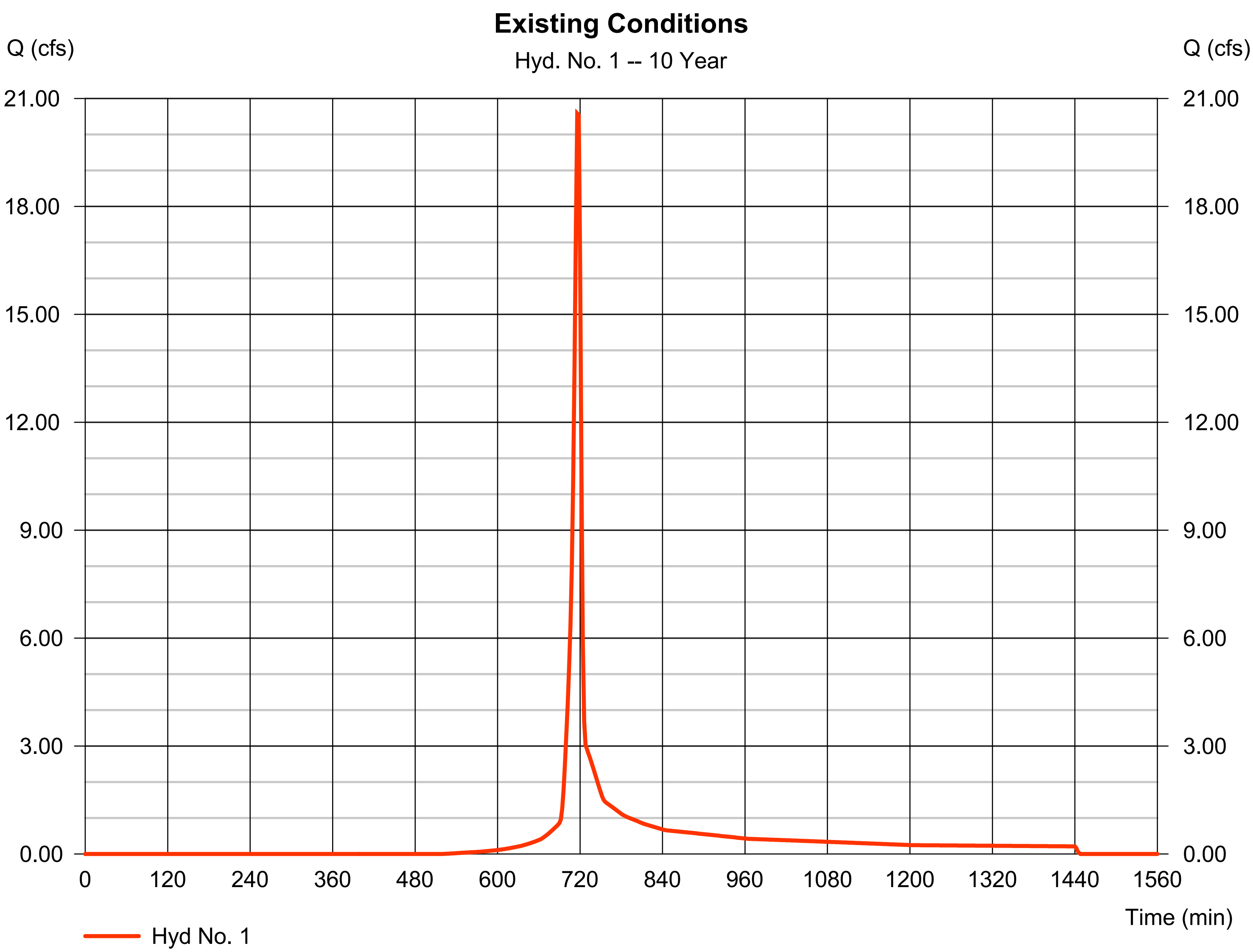
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 20.58 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 41,552 cuft
Drainage area	= 4.790 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.50 min
Total precip.	= 5.23 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 89) + (0.200 x 79) + (4.720 x 73)] / 4.790



Hydrograph Report

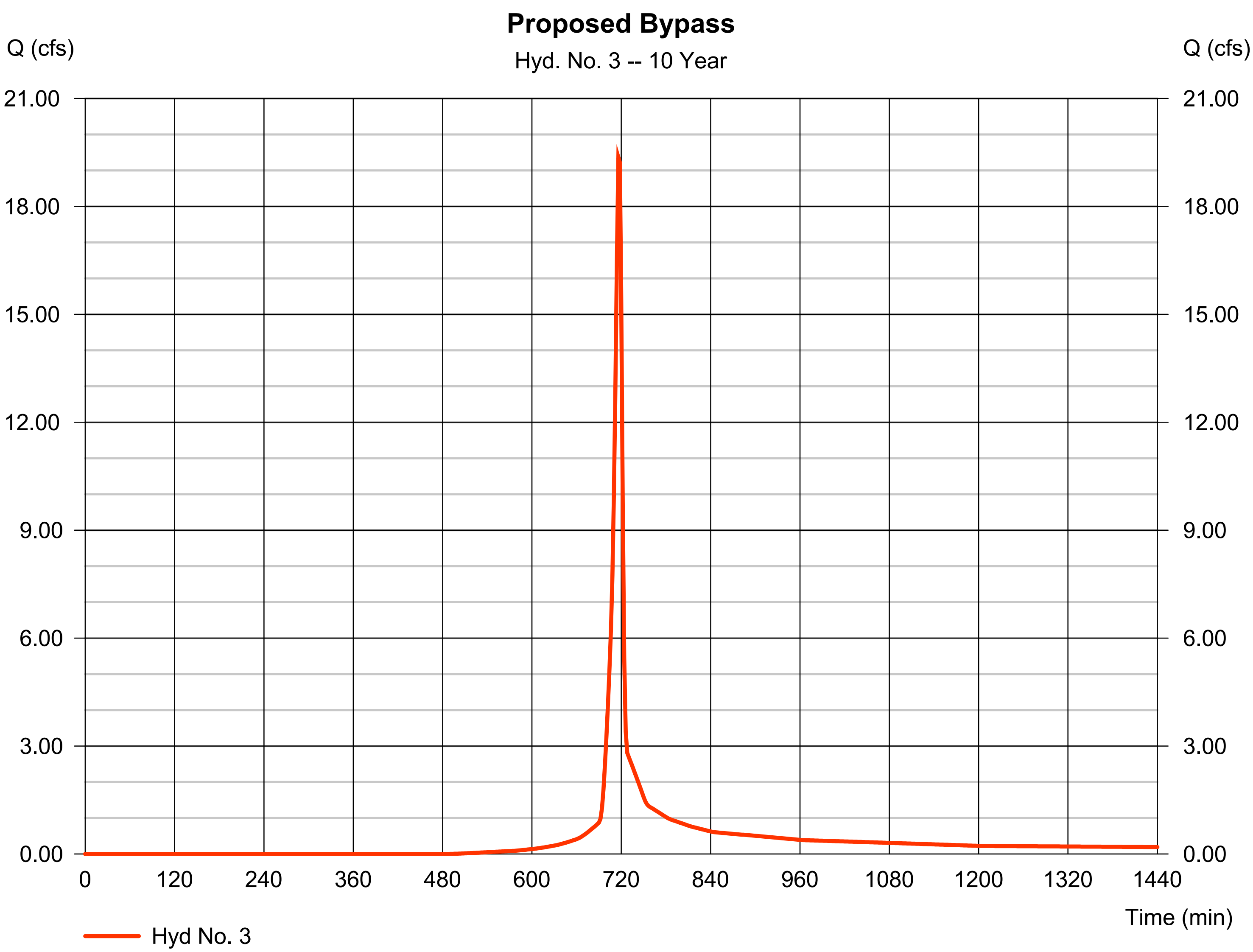
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 3

Proposed Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 19.36 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 39,152 cuft
Drainage area	= 4.220 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.50 min
Total precip.	= 5.23 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.280 x 73) + (0.280 x 98) + (0.660 x 79)] / 4.220



Hydrograph Report

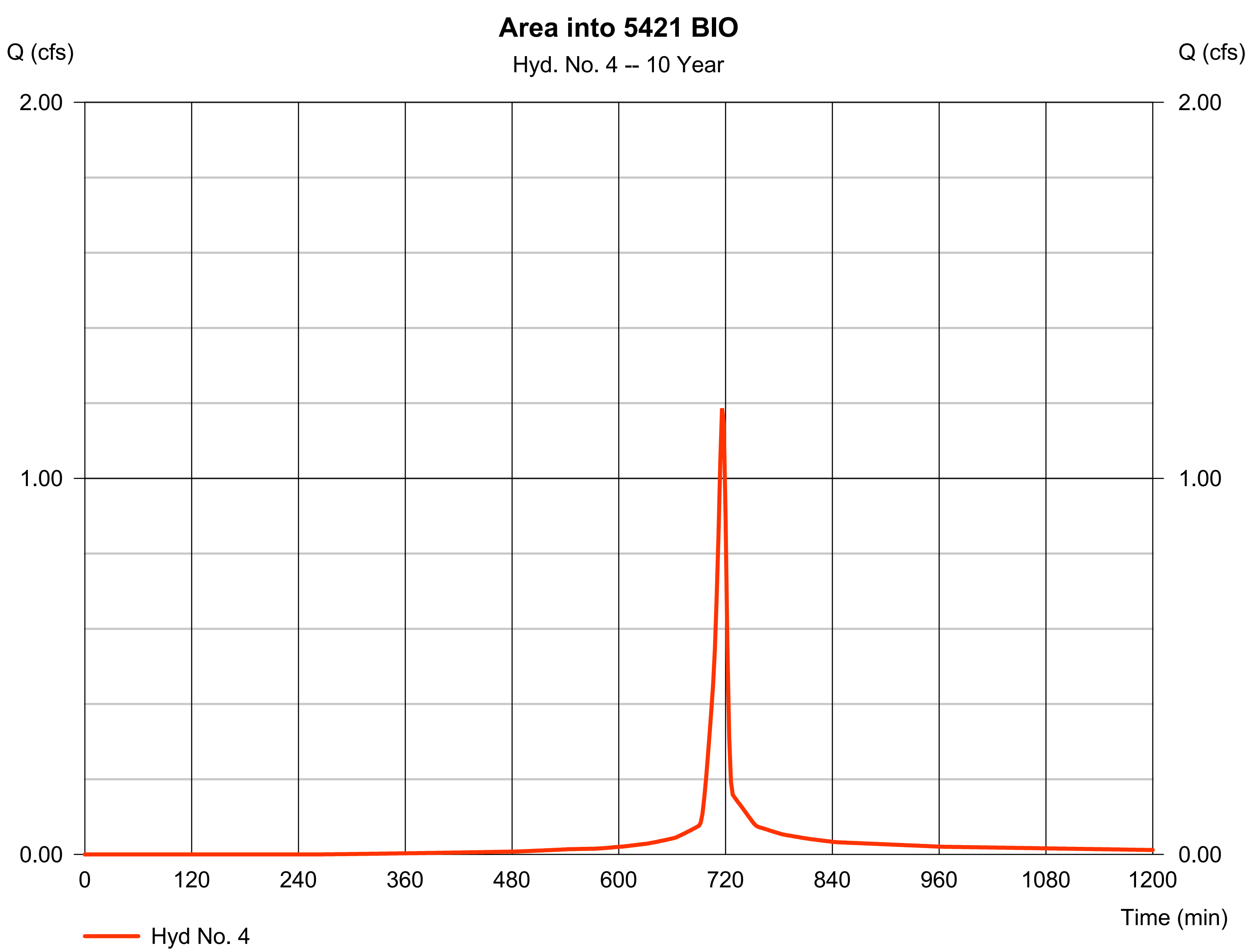
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Tuesday, 04 / 18 / 2023

Hyd. No. 4

Area into 5421 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.186 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 2,514 cuft
Drainage area	= 0.190 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.23 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.060 x 79) + (0.120 x 98)] / 0.190



Hydrograph Report

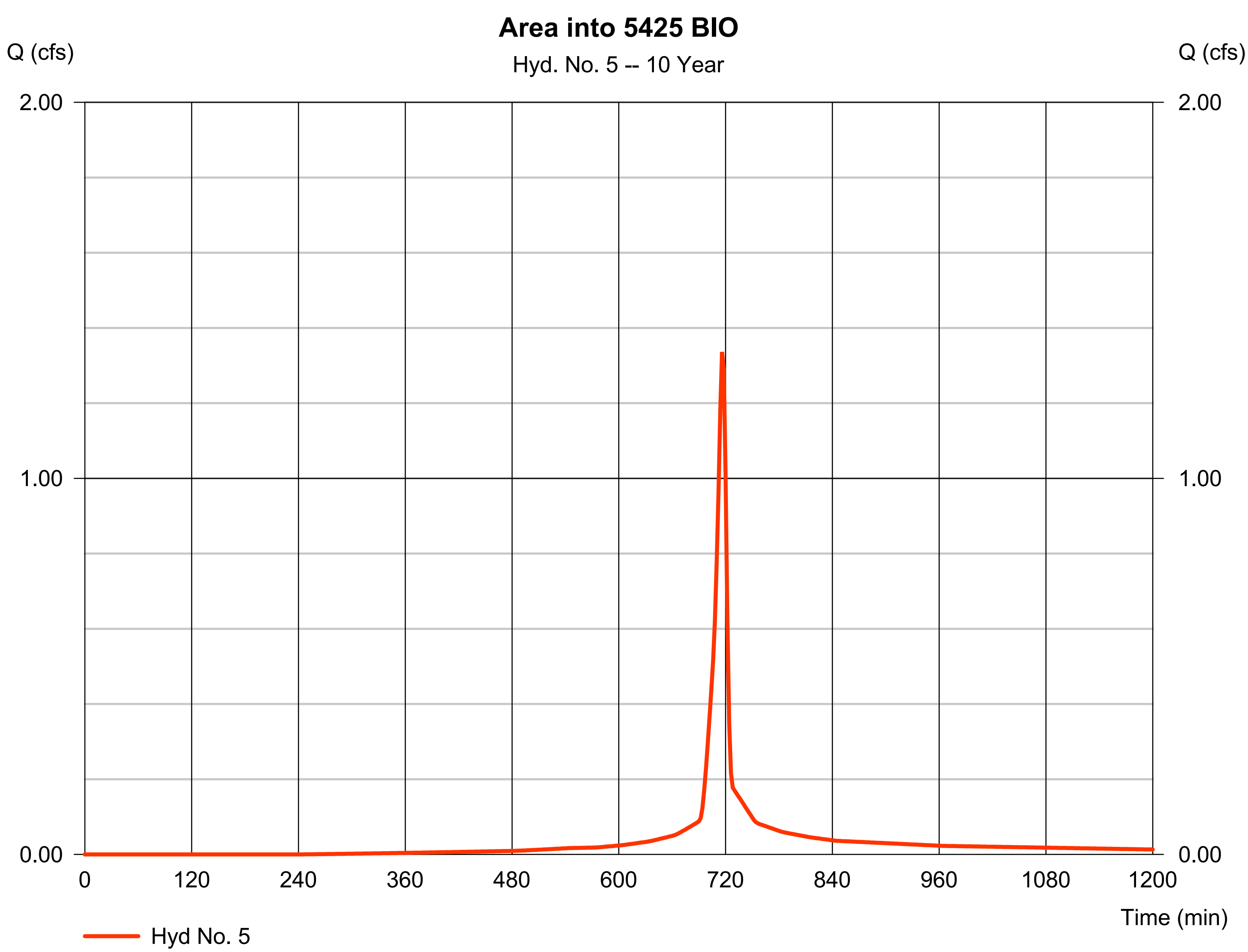
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Tuesday, 04 / 18 / 2023

Hyd. No. 5

Area into 5425 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.336 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 2,853 cuft
Drainage area	= 0.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.23 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.030 x 79) + (0.130 x 98)] / 0.210



Hydrograph Report

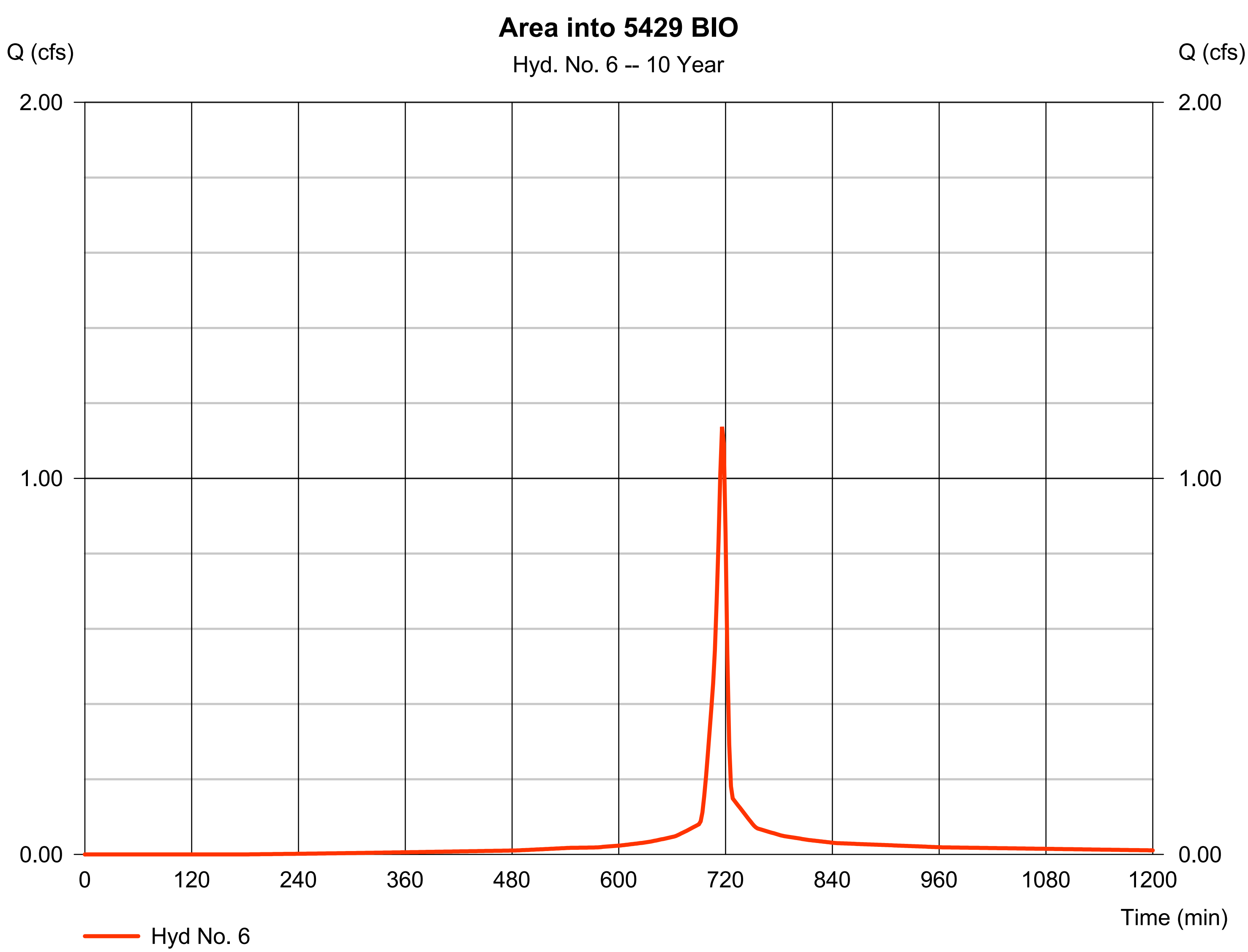
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 6

Area into 5429 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.137 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 2,496 cuft
Drainage area	= 0.170 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.23 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 98) + (0.050 x 79)] / 0.170



Hydrograph Report

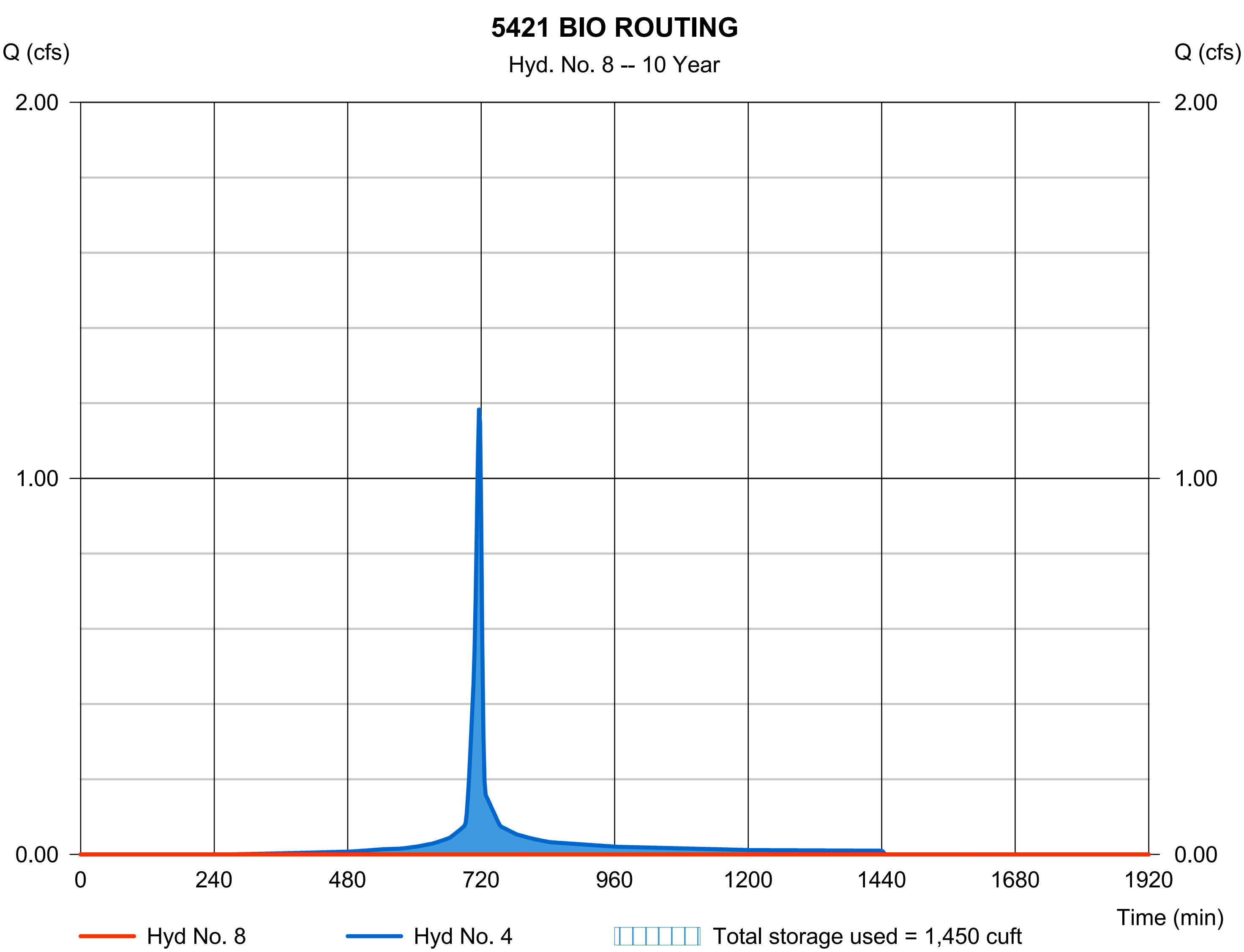
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 8

5421 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= 976 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 4 - Area into 5421 BIO	Max. Elevation	= 744.44 ft
Reservoir name	= 5421 Rain Garden W INFIL	Max. Storage	= 1,450 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

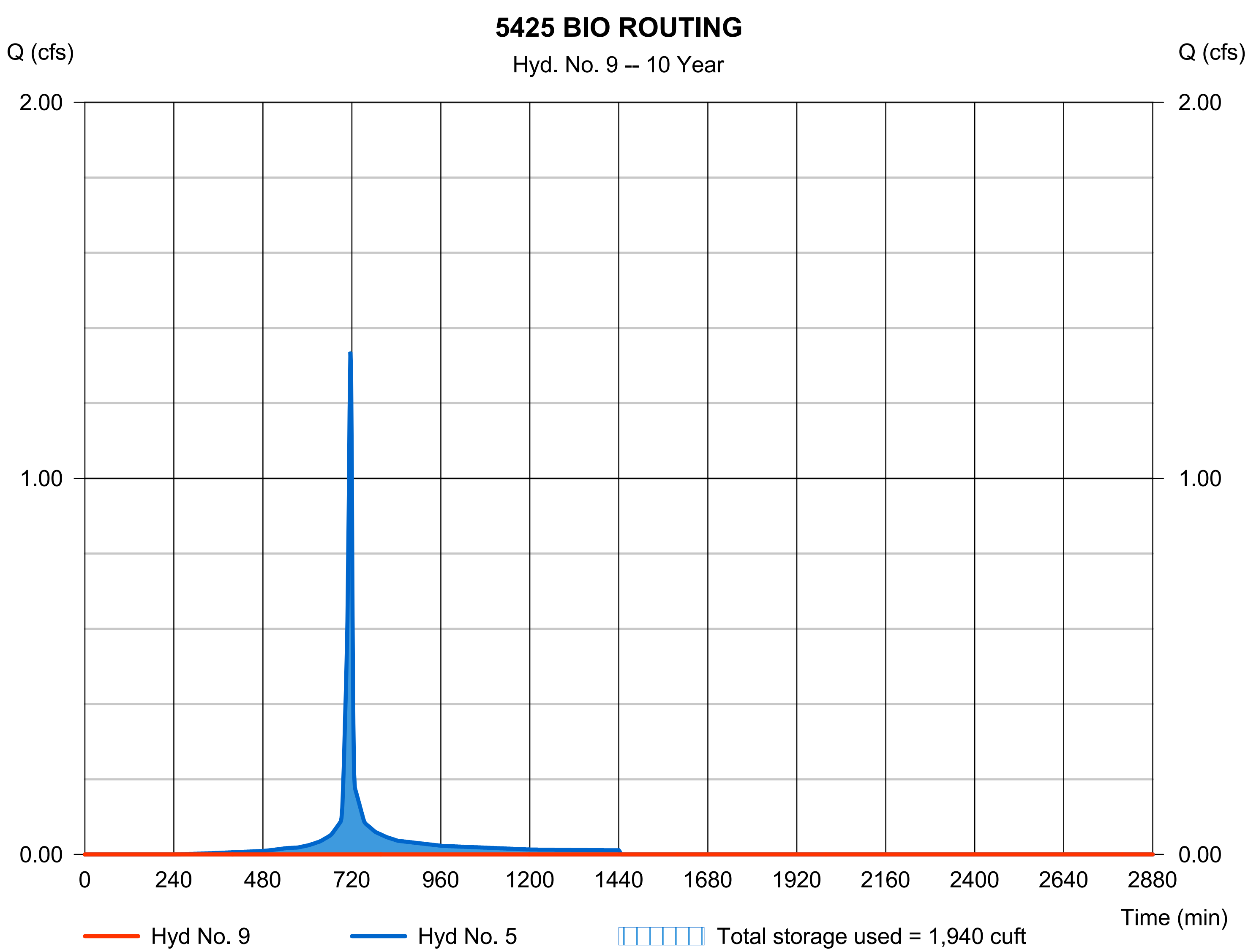
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 9

5425 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= 2478 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 5 - Area into 5425 BIO	Max. Elevation	= 801.63 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 1,940 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

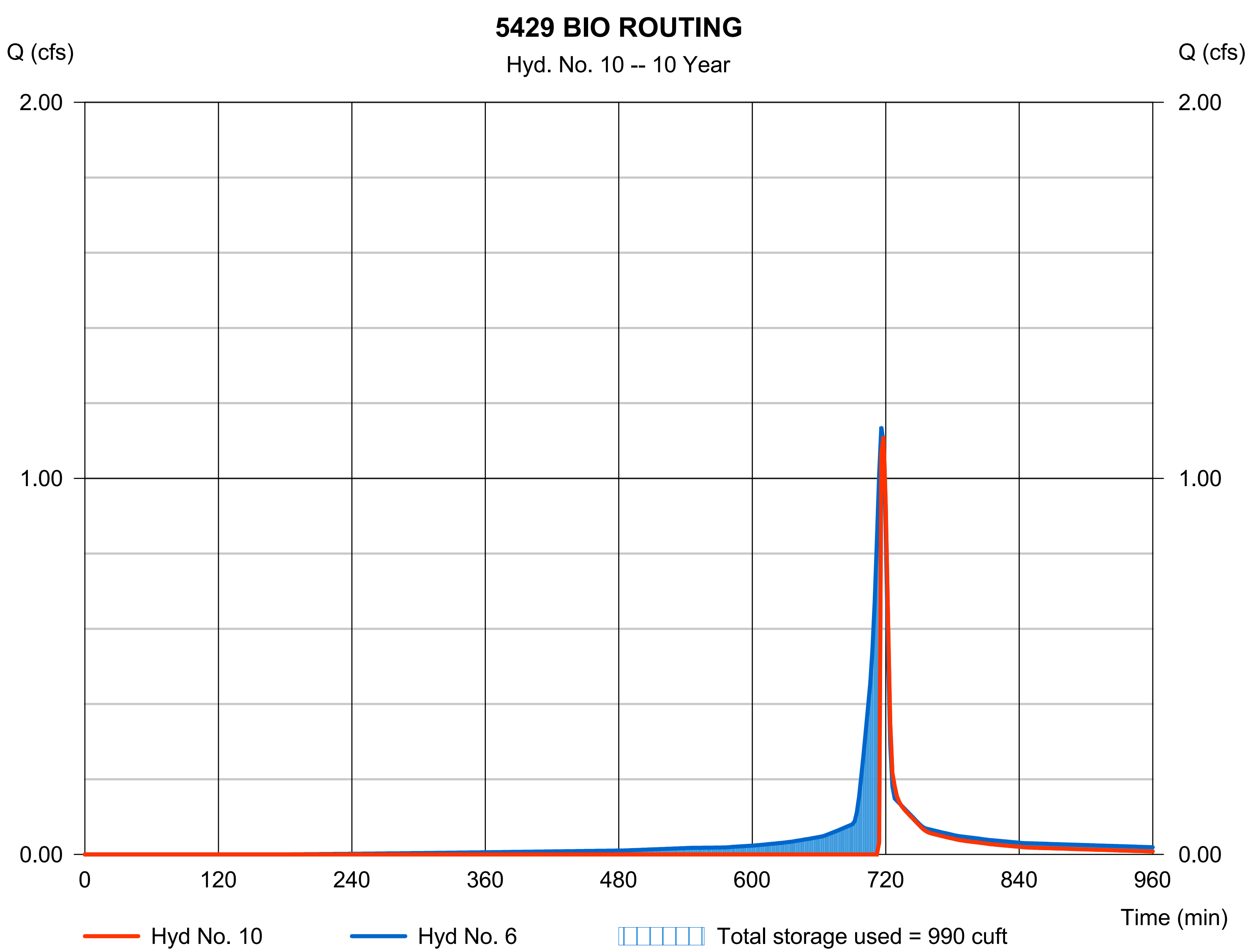
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 10

5429 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 1.112 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,032 cuft
Inflow hyd. No.	= 6 - Area into 5429 BIO	Max. Elevation	= 808.76 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 990 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



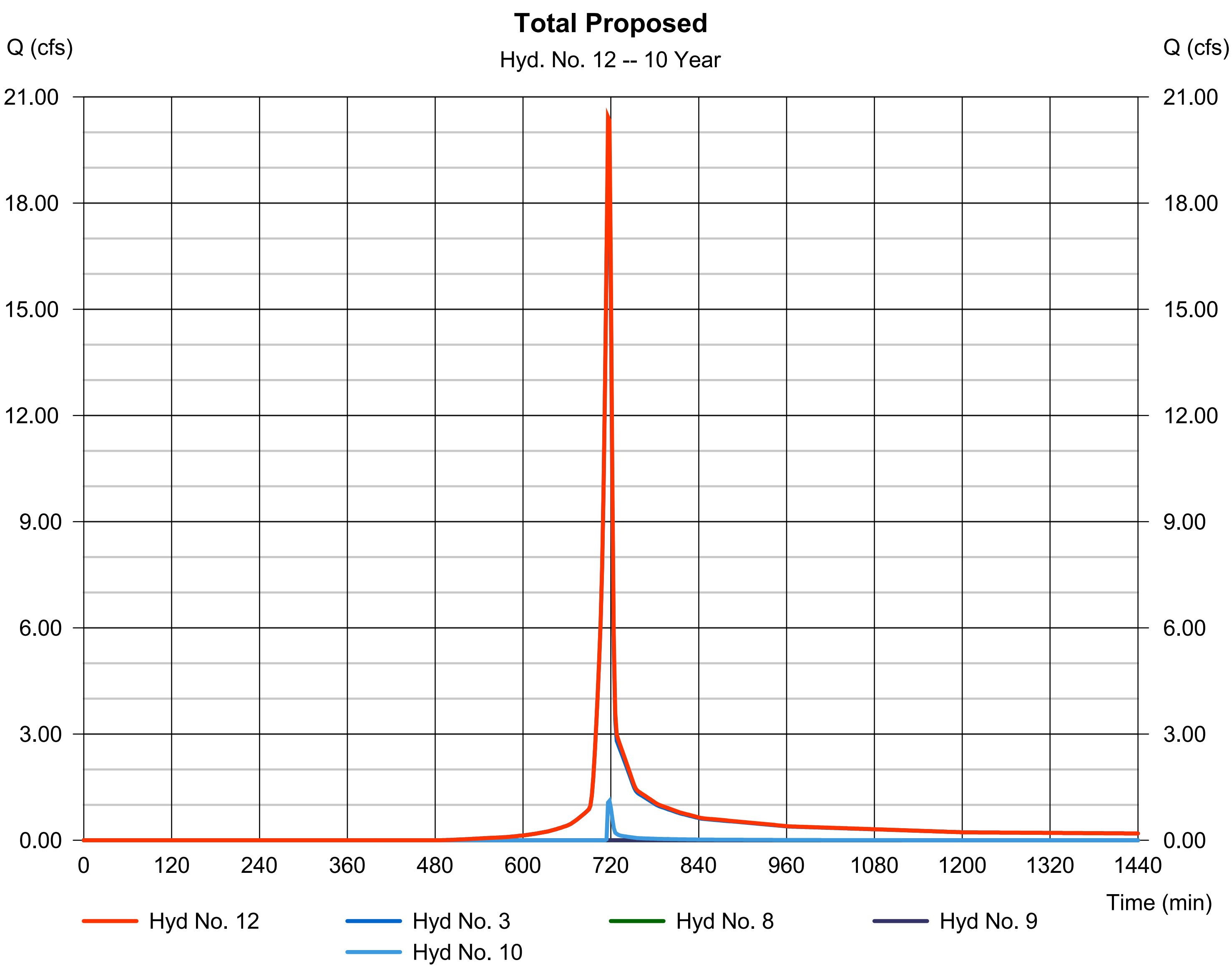
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 12

Total Proposed

Hydrograph type	= Combine	Peak discharge	= 20.43 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 40,184 cuft
Inflow hyds.	= 3, 8, 9, 10	Contrib. drain. area	= 4.220 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	26.73	2	716	54,117	------	------	------	Existing Conditions
3	SCS Runoff	24.87	2	716	50,531	------	------	------	Proposed Bypass
4	SCS Runoff	1.440	2	716	3,091	------	------	------	Area into 5421 BIO
5	SCS Runoff	1.616	2	716	3,495	------	------	------	Area into 5425 BIO
6	SCS Runoff	1.361	2	716	3,024	------	------	------	Area into 5429 BIO
8	Reservoir	0.274	2	724	307	4	744.72	1,600	5421 BIO ROUTING
9	Reservoir	0.152	2	736	492	5	801.74	2,018	5425 BIO ROUTING
10	Reservoir	1.327	2	718	1,516	6	808.78	997	5429 BIO ROUTING
12	Combine	26.17	2	716	52,845	3, 8, 9, 10,	------	------	Total Proposed

Hydrograph Report

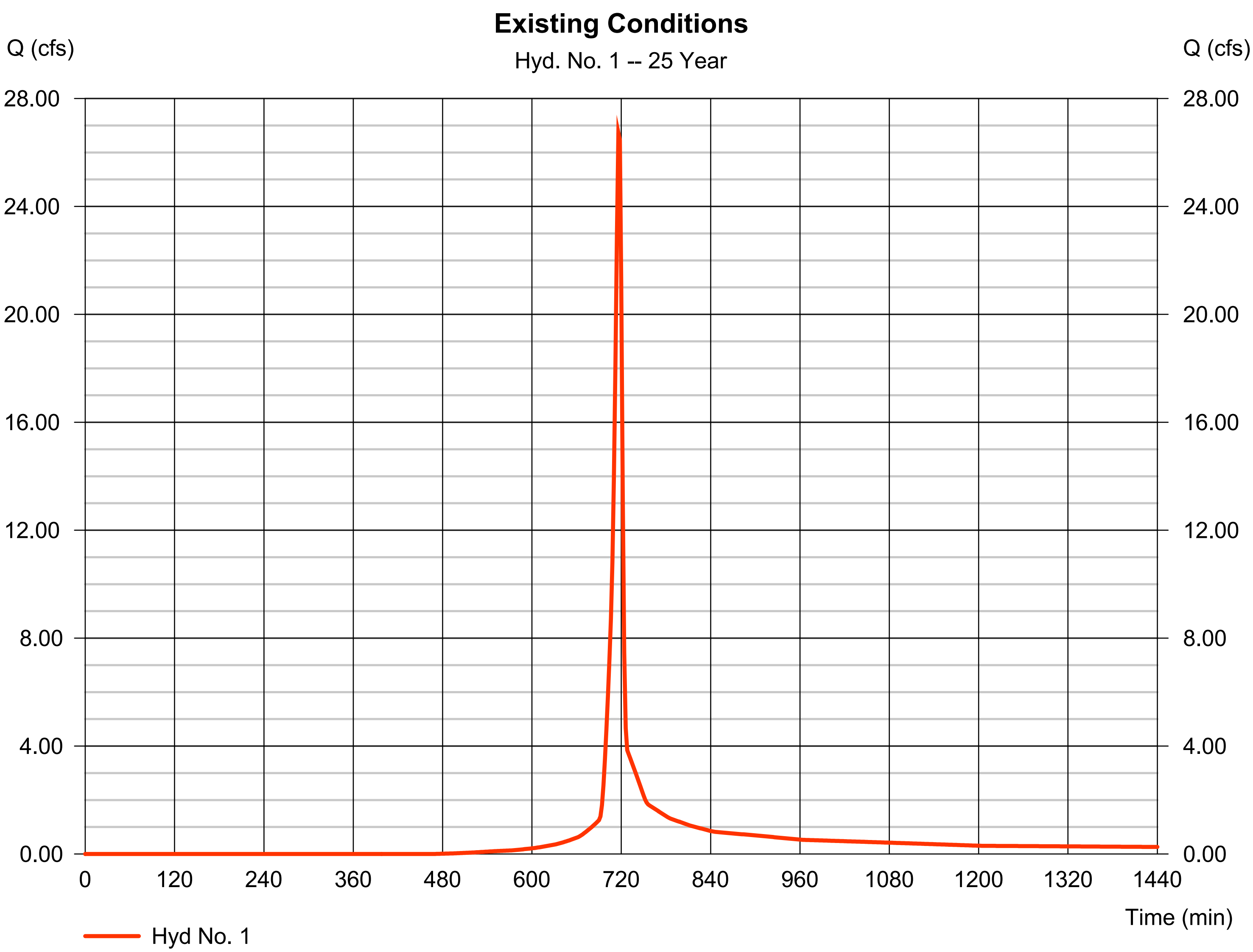
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 26.73 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 54,117 cuft
Drainage area	= 4.790 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.50 min
Total precip.	= 6.16 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 89) + (0.200 x 79) + (4.720 x 73)] / 4.790



Hydrograph Report

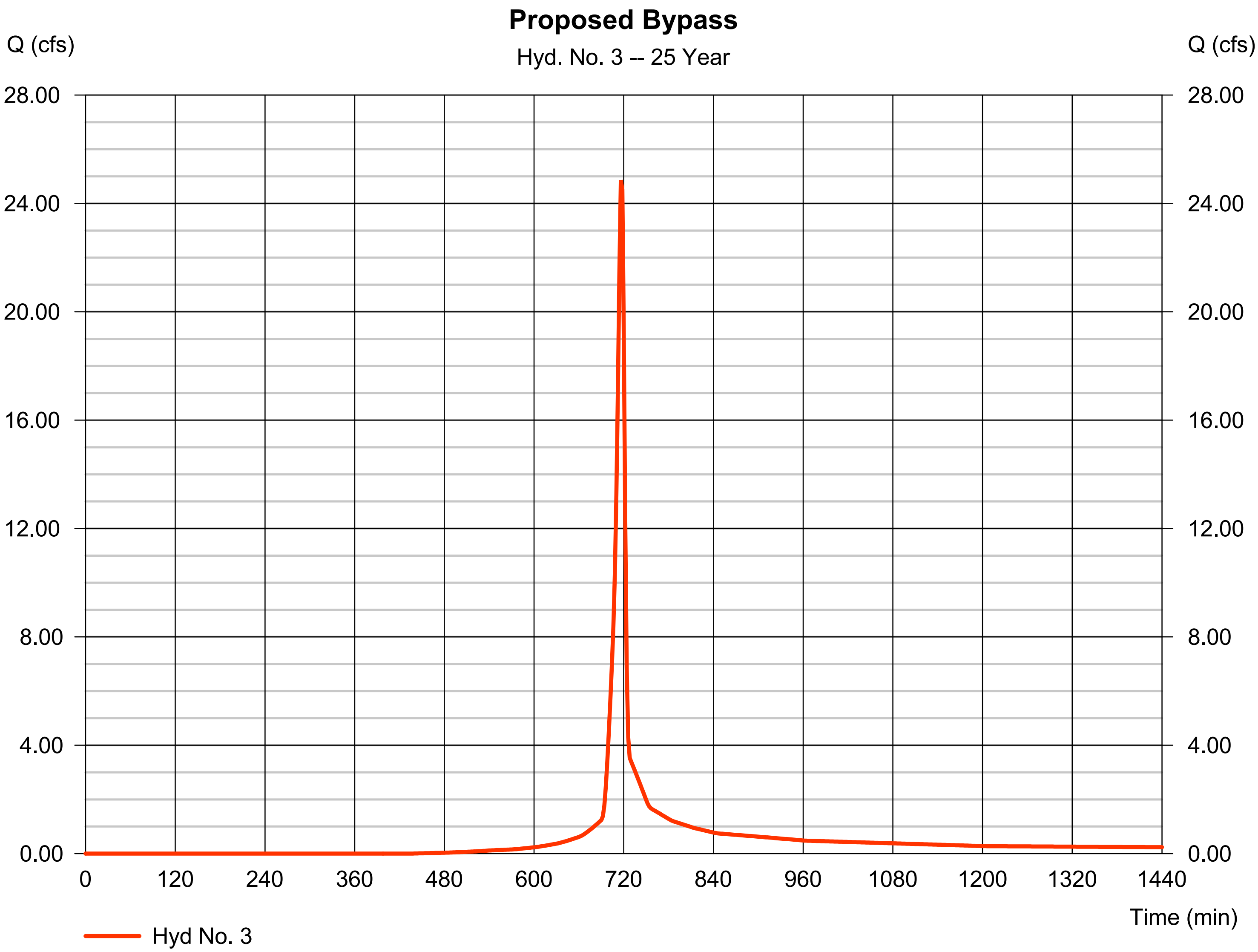
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 3

Proposed Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 24.87 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 50,531 cuft
Drainage area	= 4.220 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.50 min
Total precip.	= 6.16 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.280 x 73) + (0.280 x 98) + (0.660 x 79)] / 4.220



Hydrograph Report

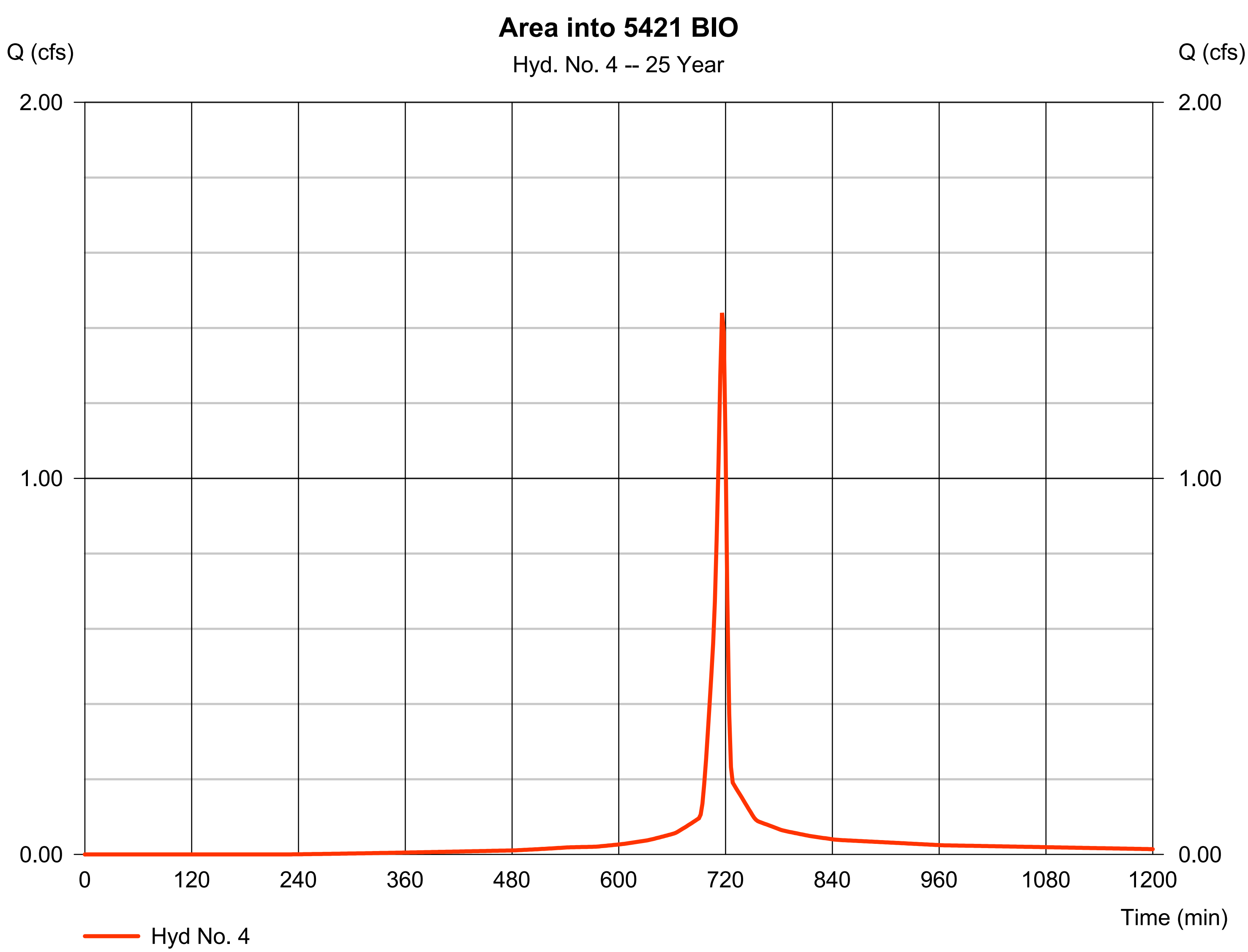
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 4

Area into 5421 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.440 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,091 cuft
Drainage area	= 0.190 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.16 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.060 x 79) + (0.120 x 98)] / 0.190



Hydrograph Report

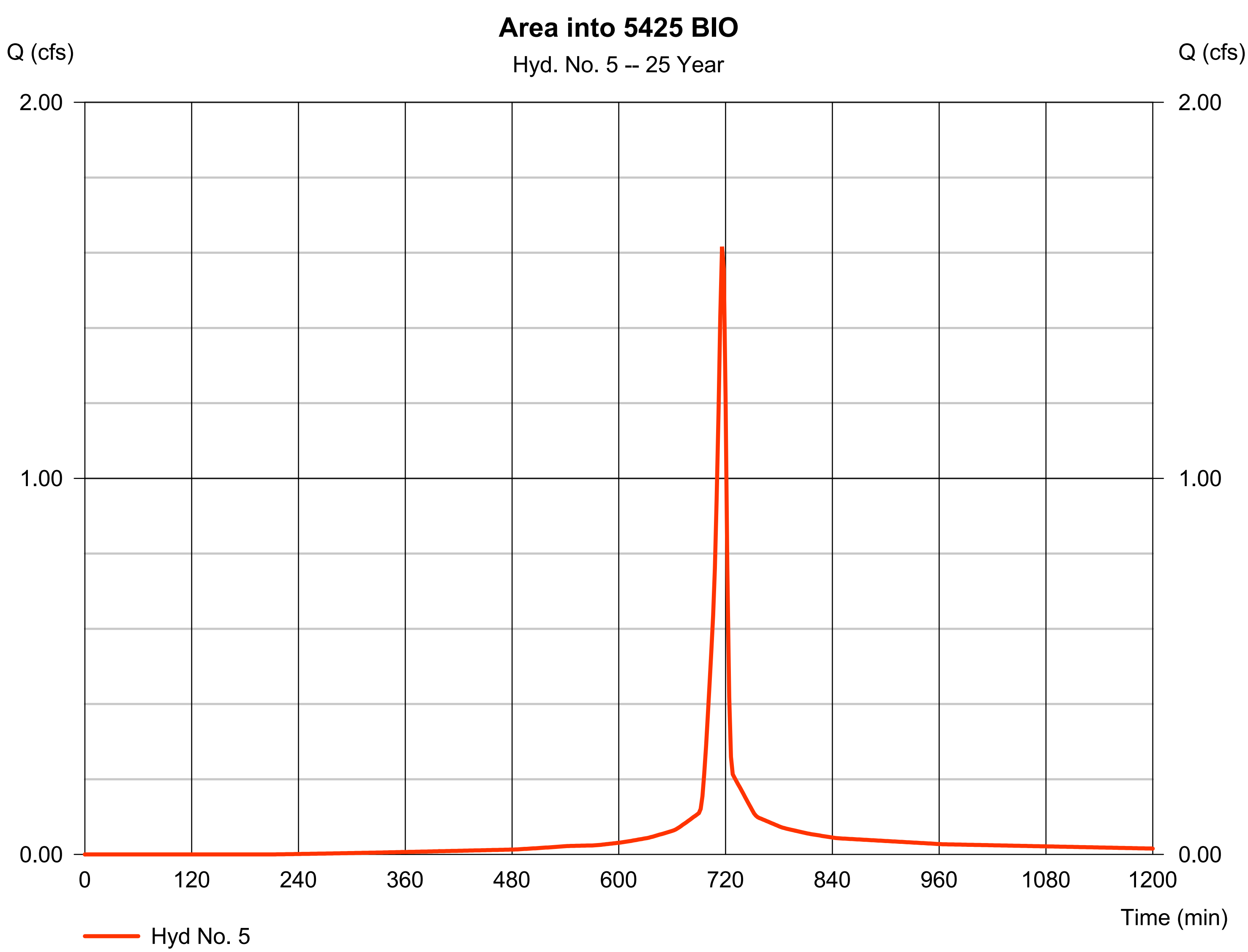
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 5

Area into 5425 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.616 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,495 cuft
Drainage area	= 0.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.16 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.030 x 79) + (0.130 x 98)] / 0.210



Hydrograph Report

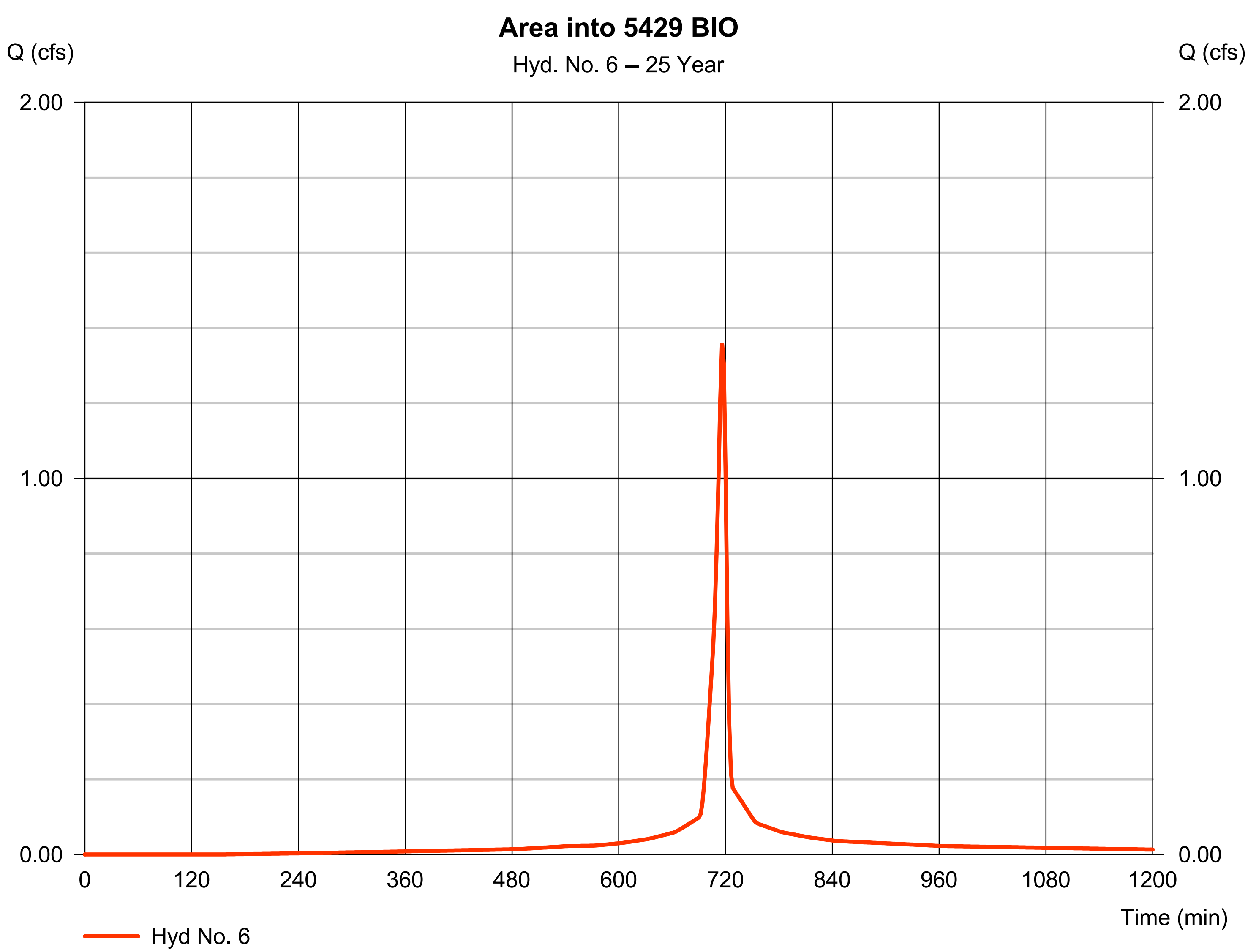
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Tuesday, 04 / 18 / 2023

Hyd. No. 6

Area into 5429 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.361 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,024 cuft
Drainage area	= 0.170 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.16 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 98) + (0.050 x 79)] / 0.170



Hydrograph Report

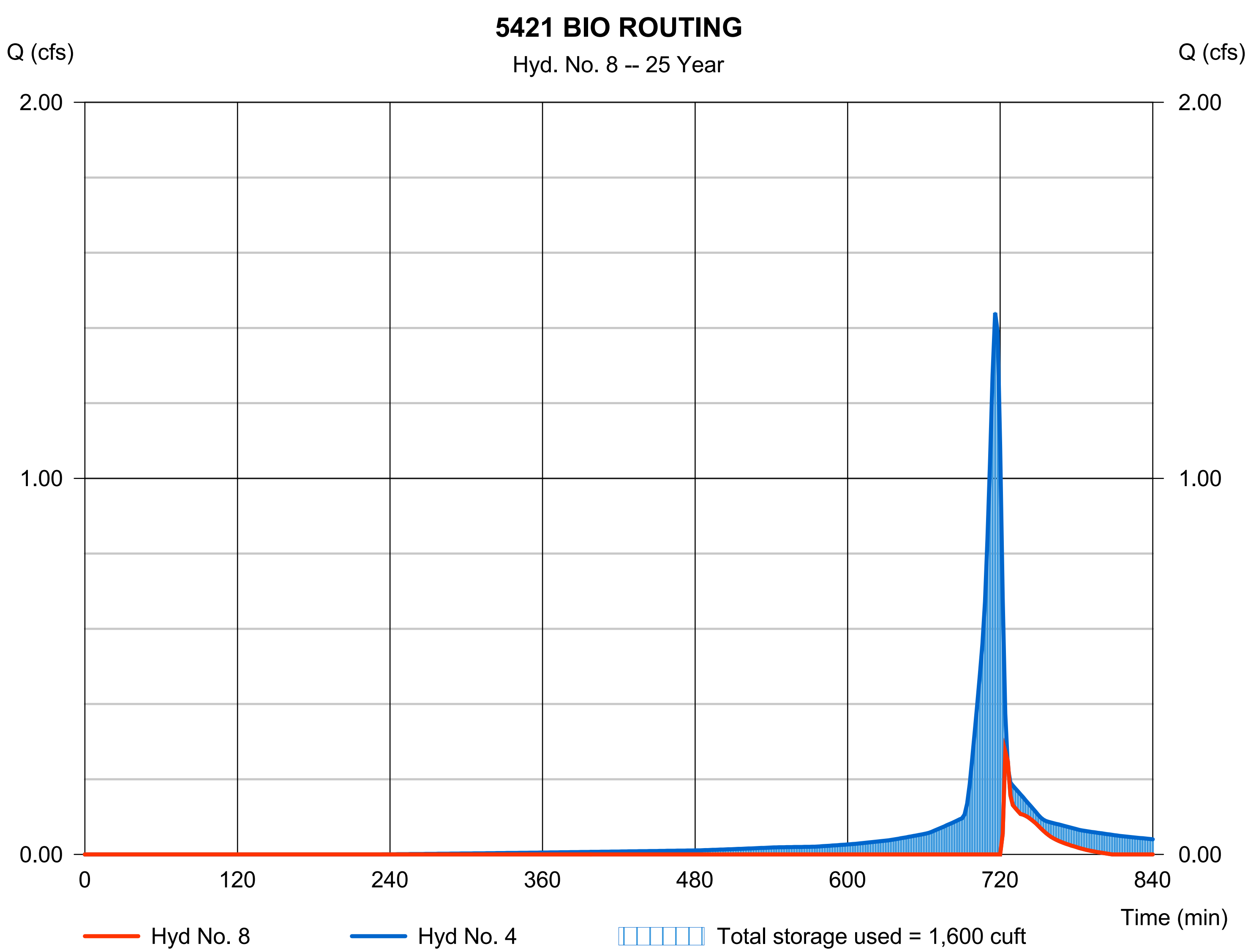
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 8

5421 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.274 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 307 cuft
Inflow hyd. No.	= 4 - Area into 5421 BIO	Max. Elevation	= 744.72 ft
Reservoir name	= 5421 Rain Garden W INFIL	Max. Storage	= 1,600 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

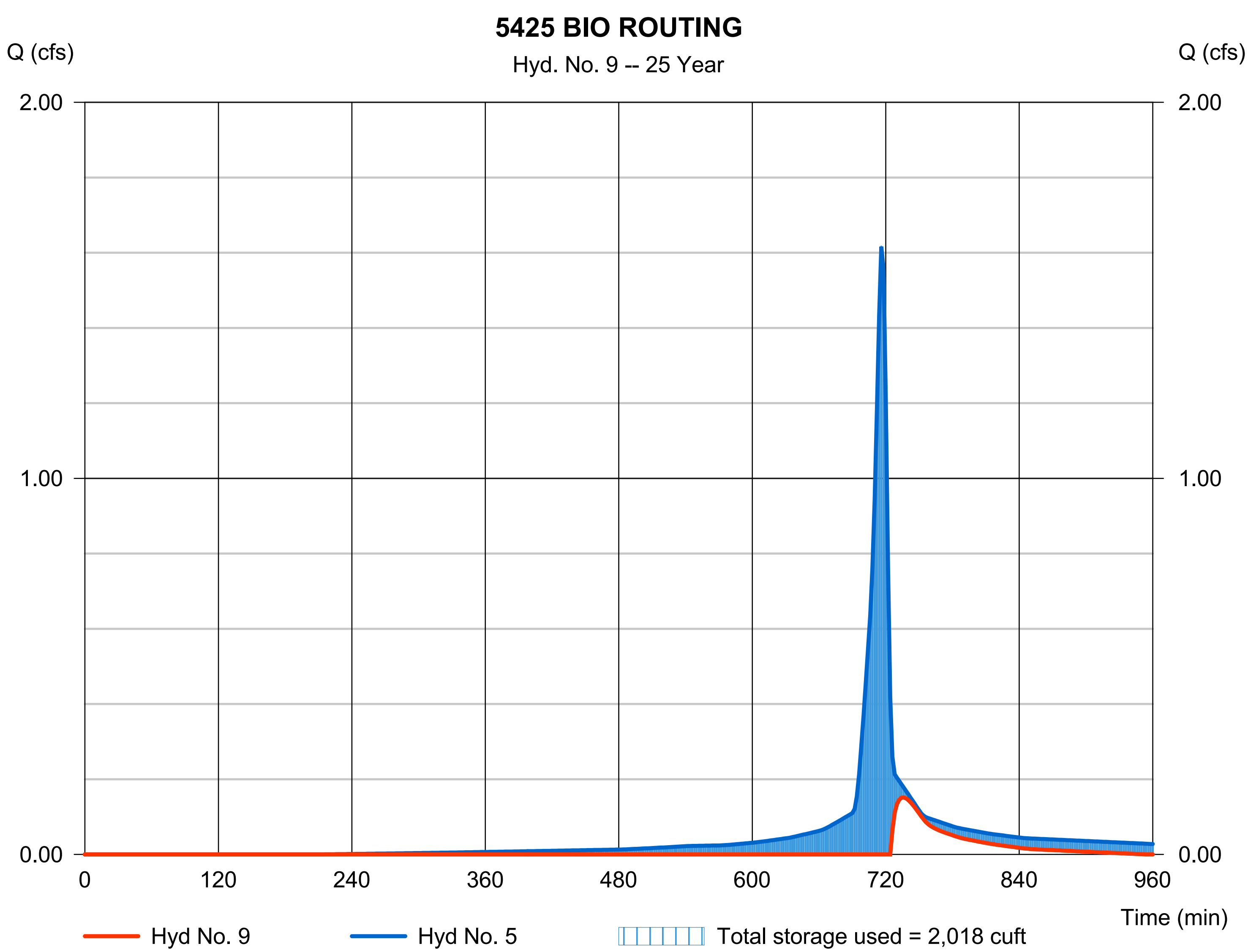
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 9

5425 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.152 cfs
Storm frequency	= 25 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 492 cuft
Inflow hyd. No.	= 5 - Area into 5425 BIO	Max. Elevation	= 801.74 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 2,018 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

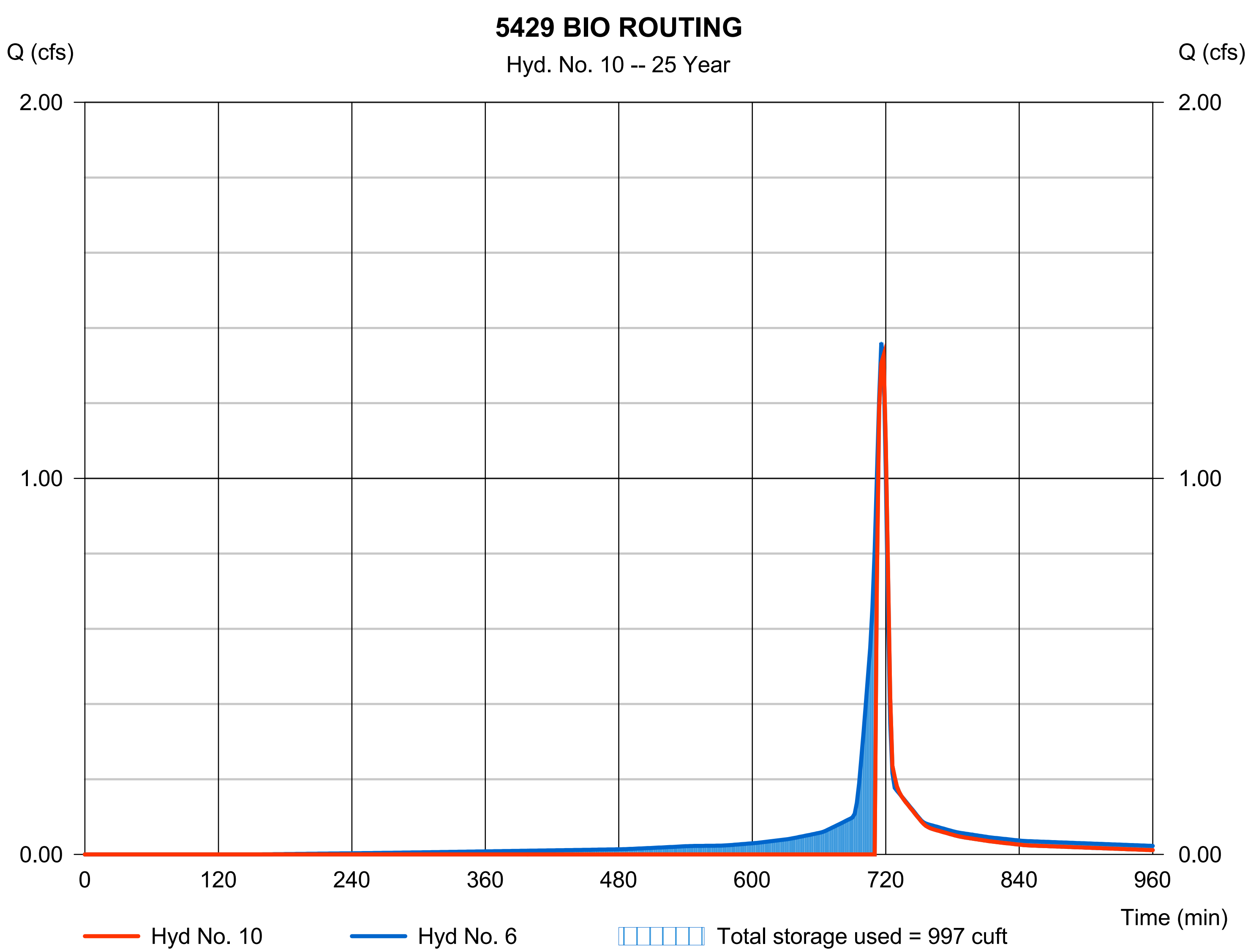
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 10

5429 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 1.327 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,516 cuft
Inflow hyd. No.	= 6 - Area into 5429 BIO	Max. Elevation	= 808.78 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 997 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

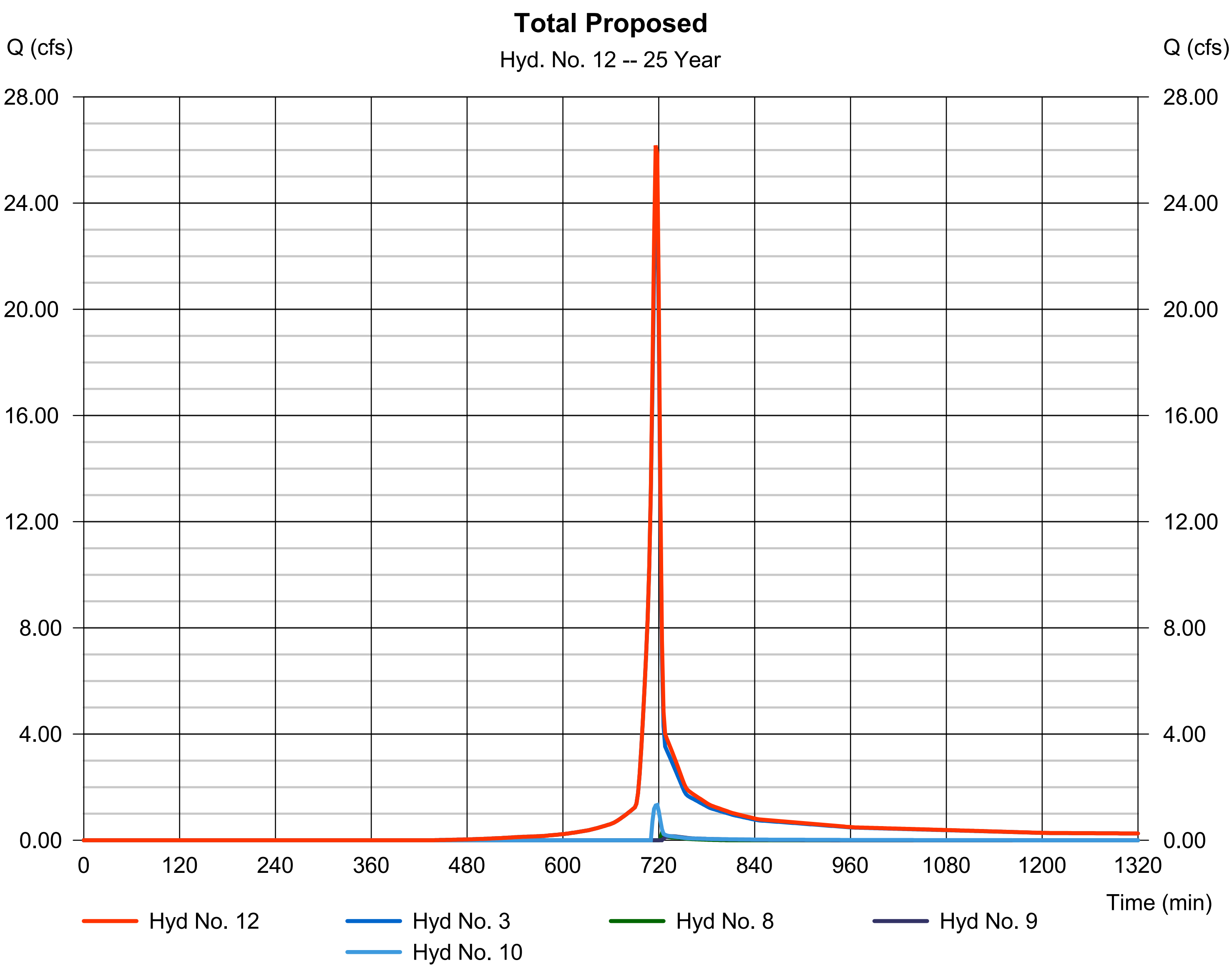


Hydrograph Report

Hyd. No. 12

Total Proposed

Hydrograph type	= Combine	Peak discharge	= 26.17 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 52,845 cuft
Inflow hyds.	= 3, 8, 9, 10	Contrib. drain. area	= 4.220 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	31.38	2	716	63,763	------	------	------	Existing Conditions
3	SCS Runoff	29.01	2	716	59,227	------	------	------	Proposed Bypass
4	SCS Runoff	1.628	2	716	3,523	------	------	------	Area into 5421 BIO
5	SCS Runoff	1.823	2	716	3,975	------	------	------	Area into 5425 BIO
6	SCS Runoff	1.526	2	716	3,417	------	------	------	Area into 5429 BIO
8	Reservoir	0.939	2	722	608	4	744.80	1,641	5421 BIO ROUTING
9	Reservoir	1.179	2	722	890	5	801.85	2,076	5425 BIO ROUTING
10	Reservoir	1.488	2	716	1,891	6	808.79	1,001	5429 BIO ROUTING
12	Combine	30.50	2	716	62,616	3, 8, 9, 10,	------	------	Total Proposed

Hydraflow 4-17.gpw	Return Period: 50 Year	Tuesday, 04 / 18 / 2023

Hydrograph Report

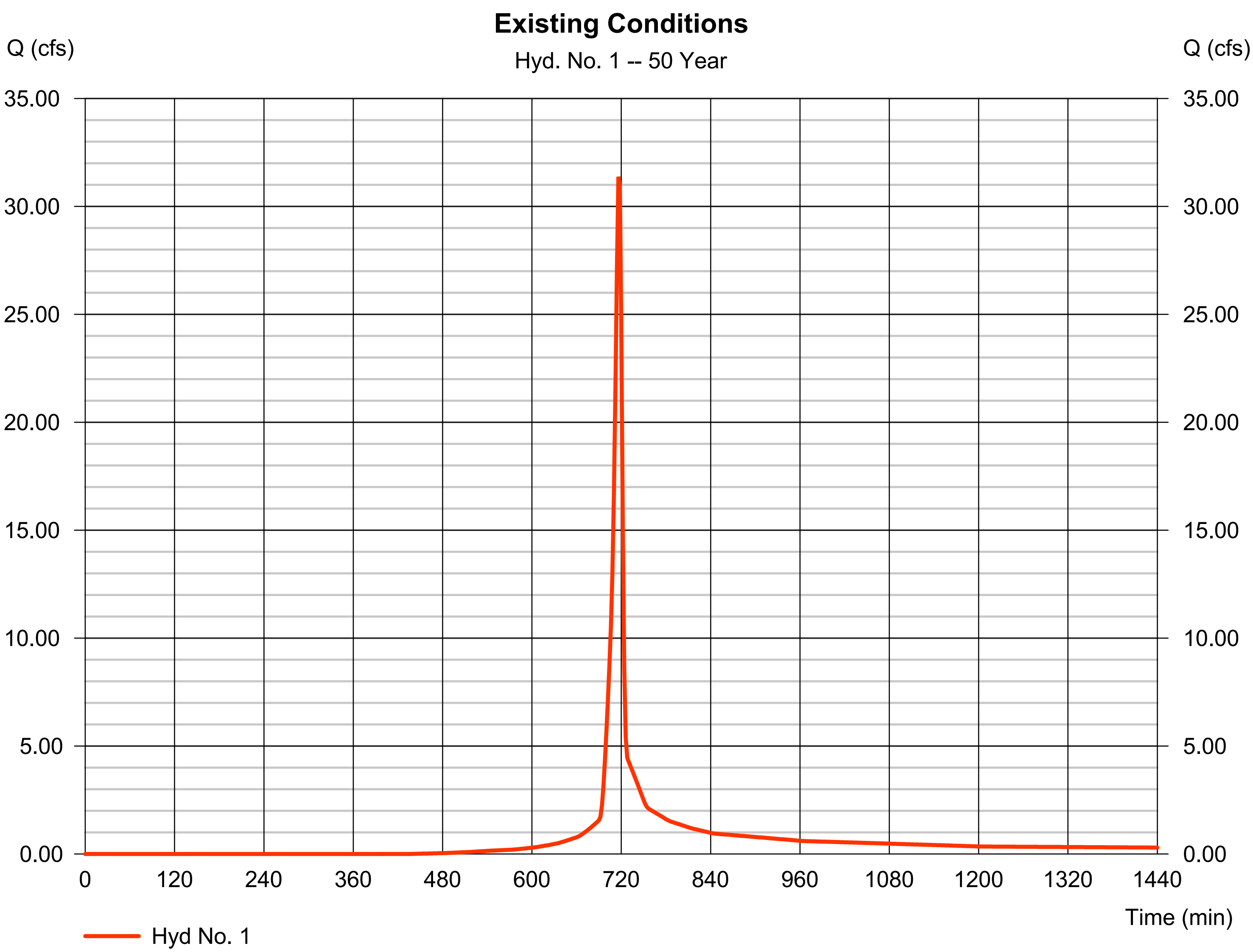
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 31.38 cfs
Storm frequency	= 50 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 63,763 cuft
Drainage area	= 4.790 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.50 min
Total precip.	= 6.85 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 89) + (0.200 x 79) + (4.720 x 73)] / 4.790



Hydrograph Report

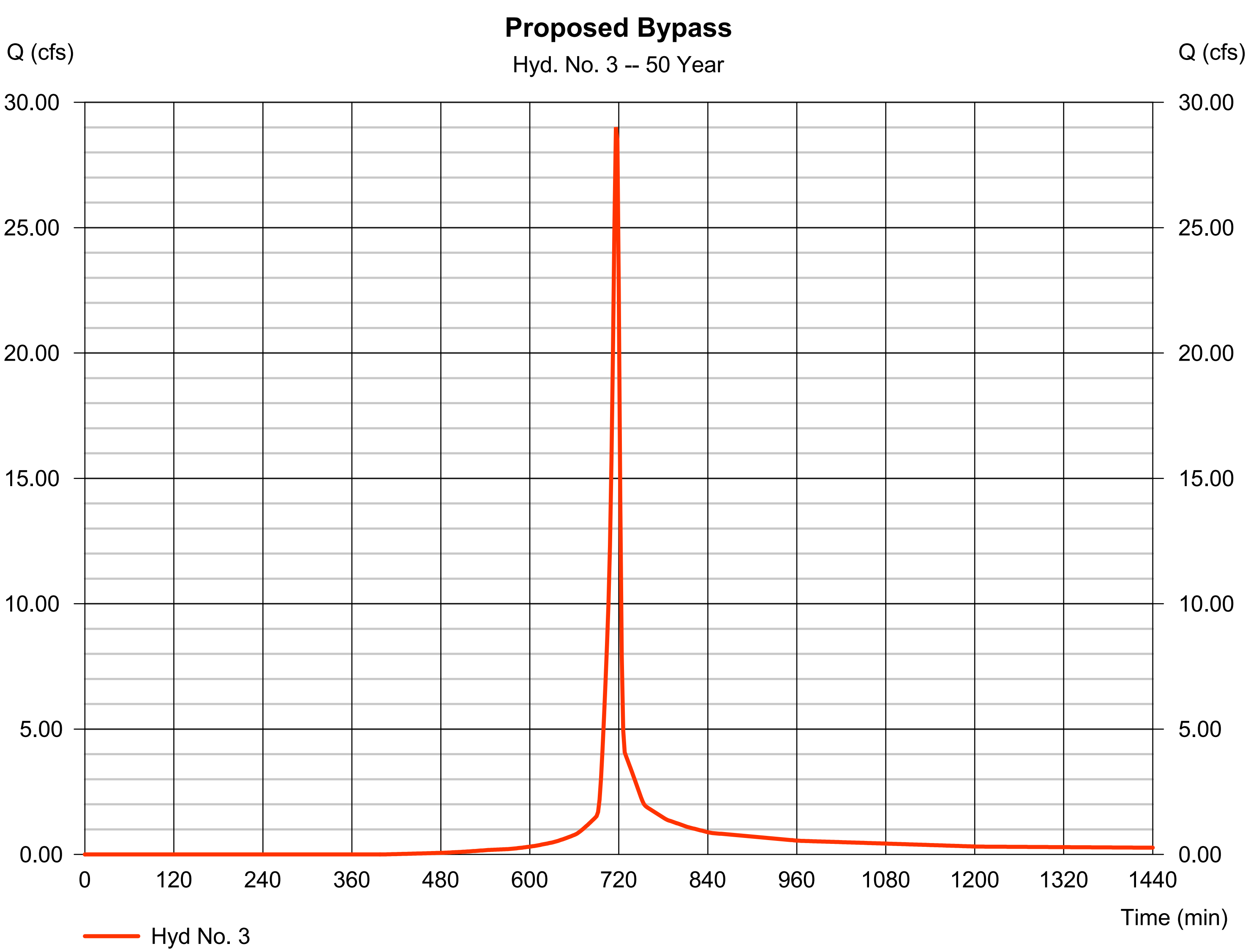
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 3

Proposed Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 29.01 cfs
Storm frequency	= 50 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 59,227 cuft
Drainage area	= 4.220 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.50 min
Total precip.	= 6.85 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.280 x 73) + (0.280 x 98) + (0.660 x 79)] / 4.220



Hydrograph Report

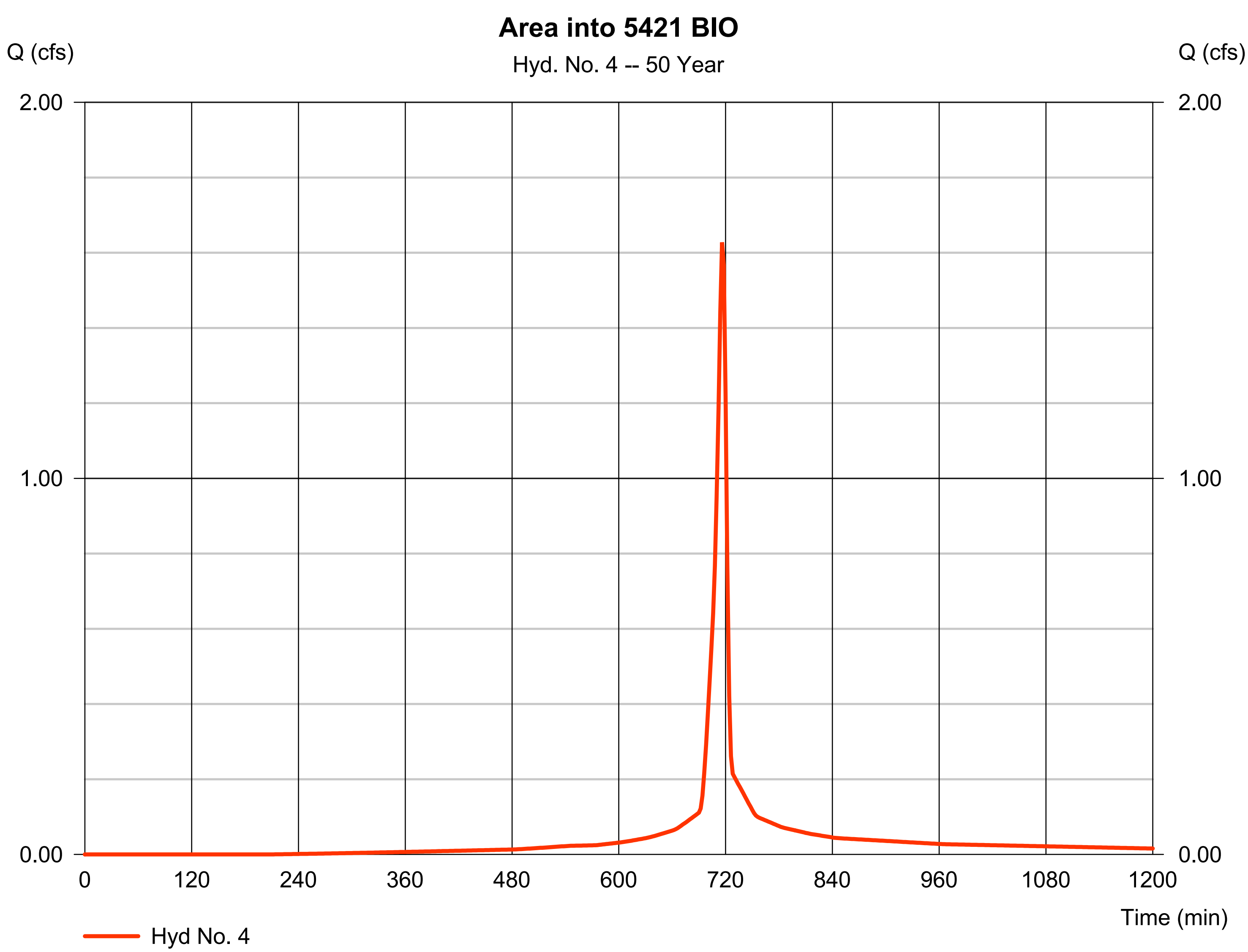
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 4

Area into 5421 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.628 cfs
Storm frequency	= 50 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,523 cuft
Drainage area	= 0.190 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.85 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.060 x 79) + (0.120 x 98)] / 0.190



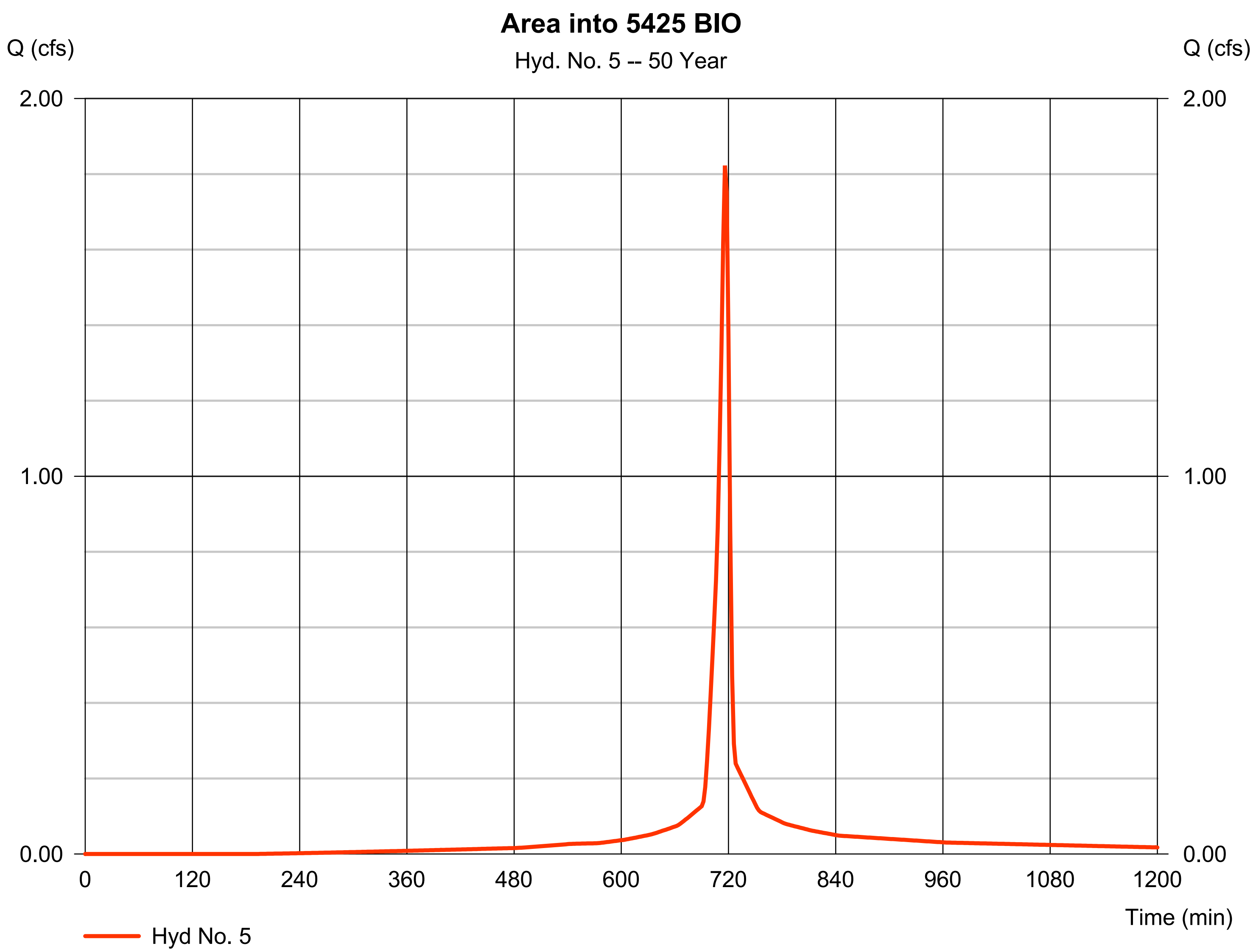
Hydrograph Report

Hyd. No. 5

Area into 5425 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.823 cfs
Storm frequency	= 50 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,975 cuft
Drainage area	= 0.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.85 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.030 x 79) + (0.130 x 98)] / 0.210



Hydrograph Report

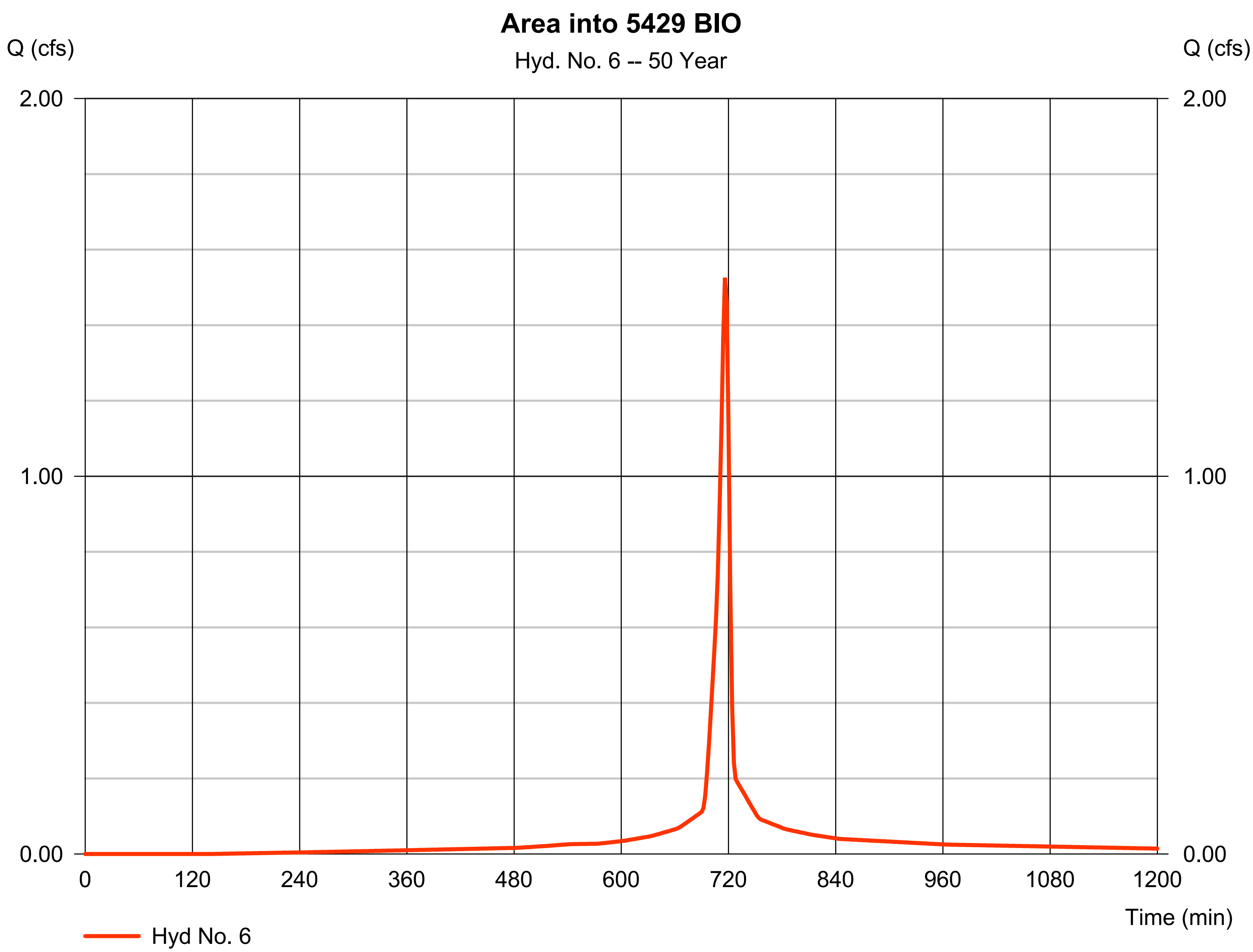
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 6

Area into 5429 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.526 cfs
Storm frequency	= 50 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,417 cuft
Drainage area	= 0.170 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.85 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 98) + (0.050 x 79)] / 0.170



Hydrograph Report

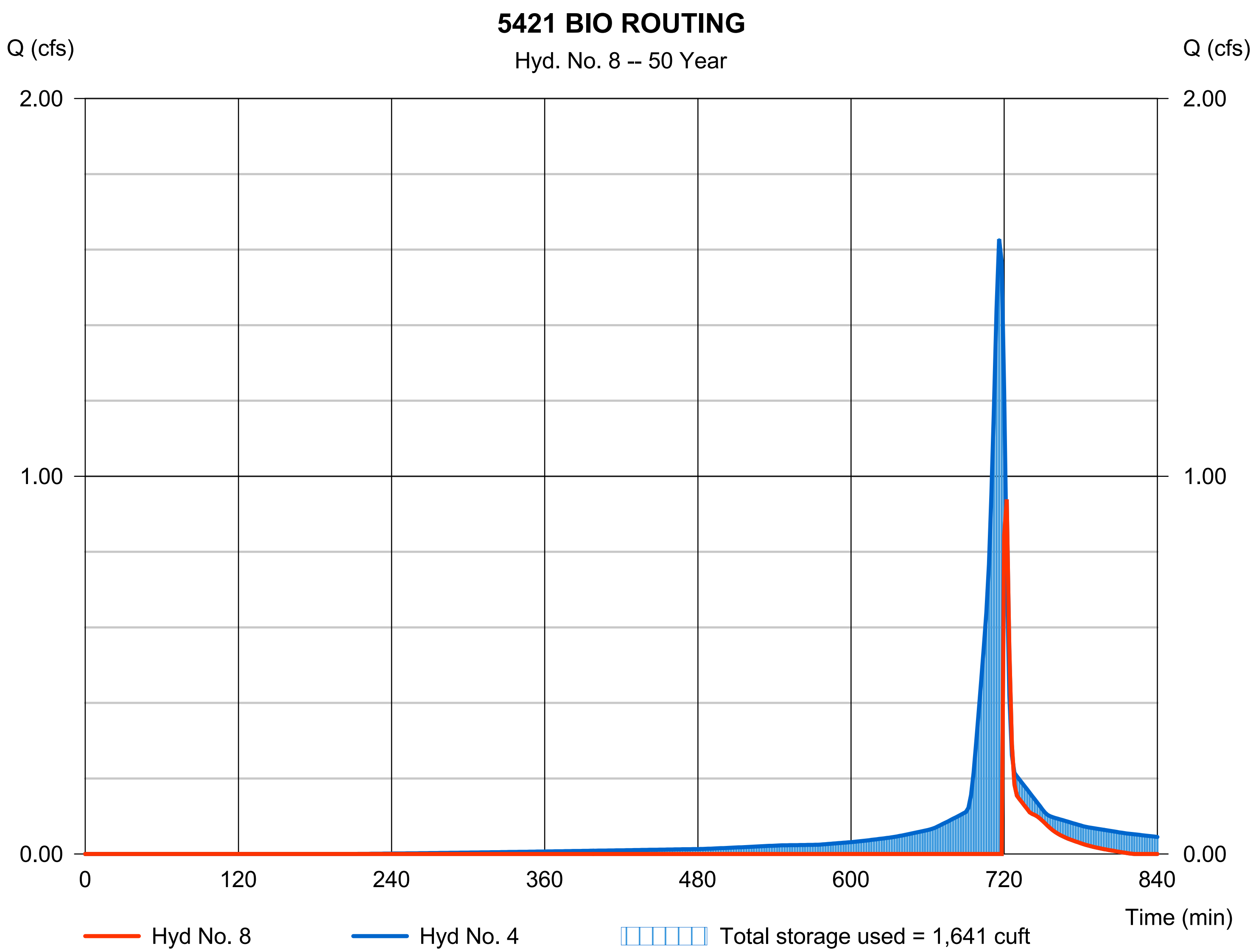
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 8

5421 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.939 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 608 cuft
Inflow hyd. No.	= 4 - Area into 5421 BIO	Max. Elevation	= 744.80 ft
Reservoir name	= 5421 Rain Garden W INFIL	Max. Storage	= 1,641 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

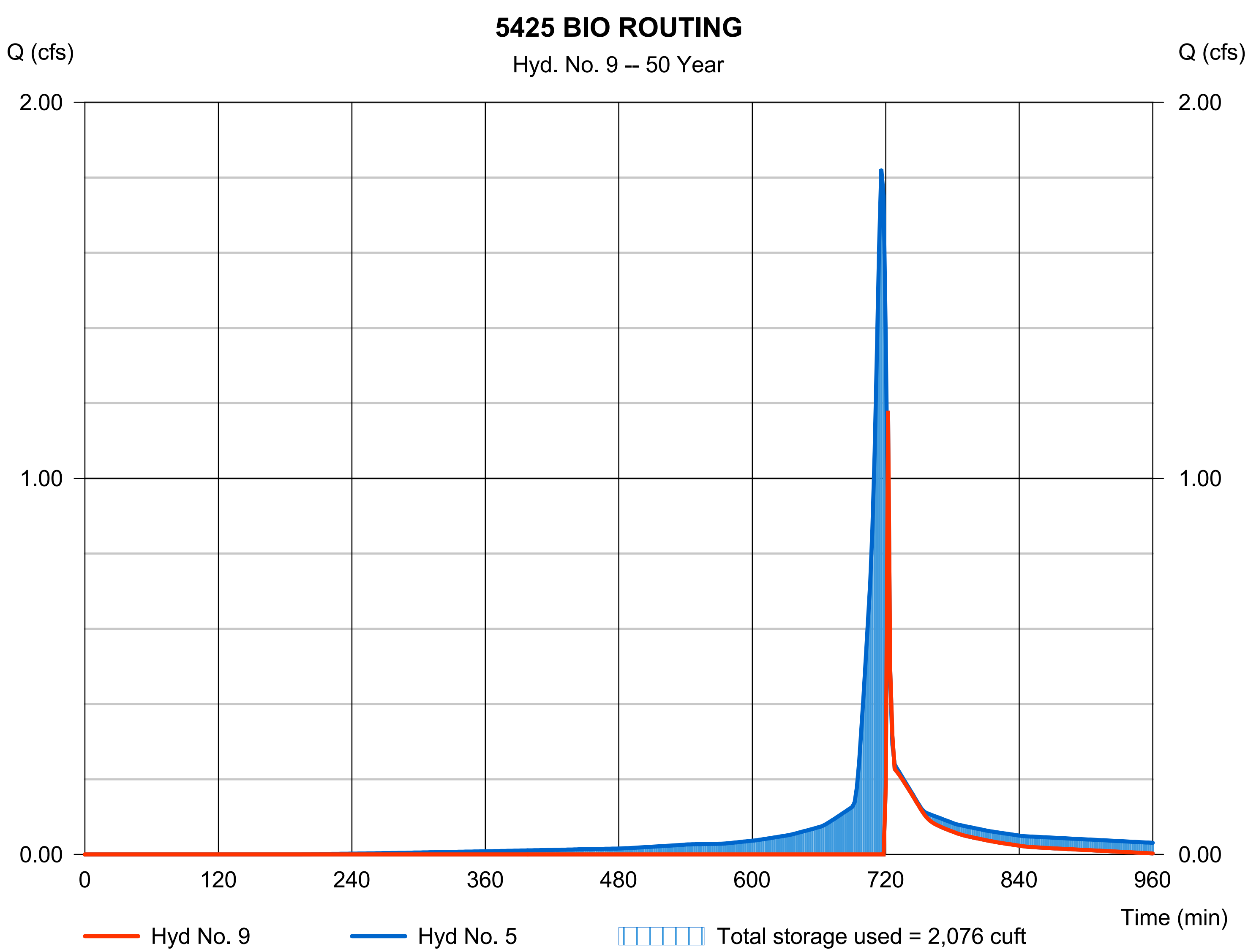
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 9

5425 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 1.179 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 890 cuft
Inflow hyd. No.	= 5 - Area into 5425 BIO	Max. Elevation	= 801.85 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 2,076 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

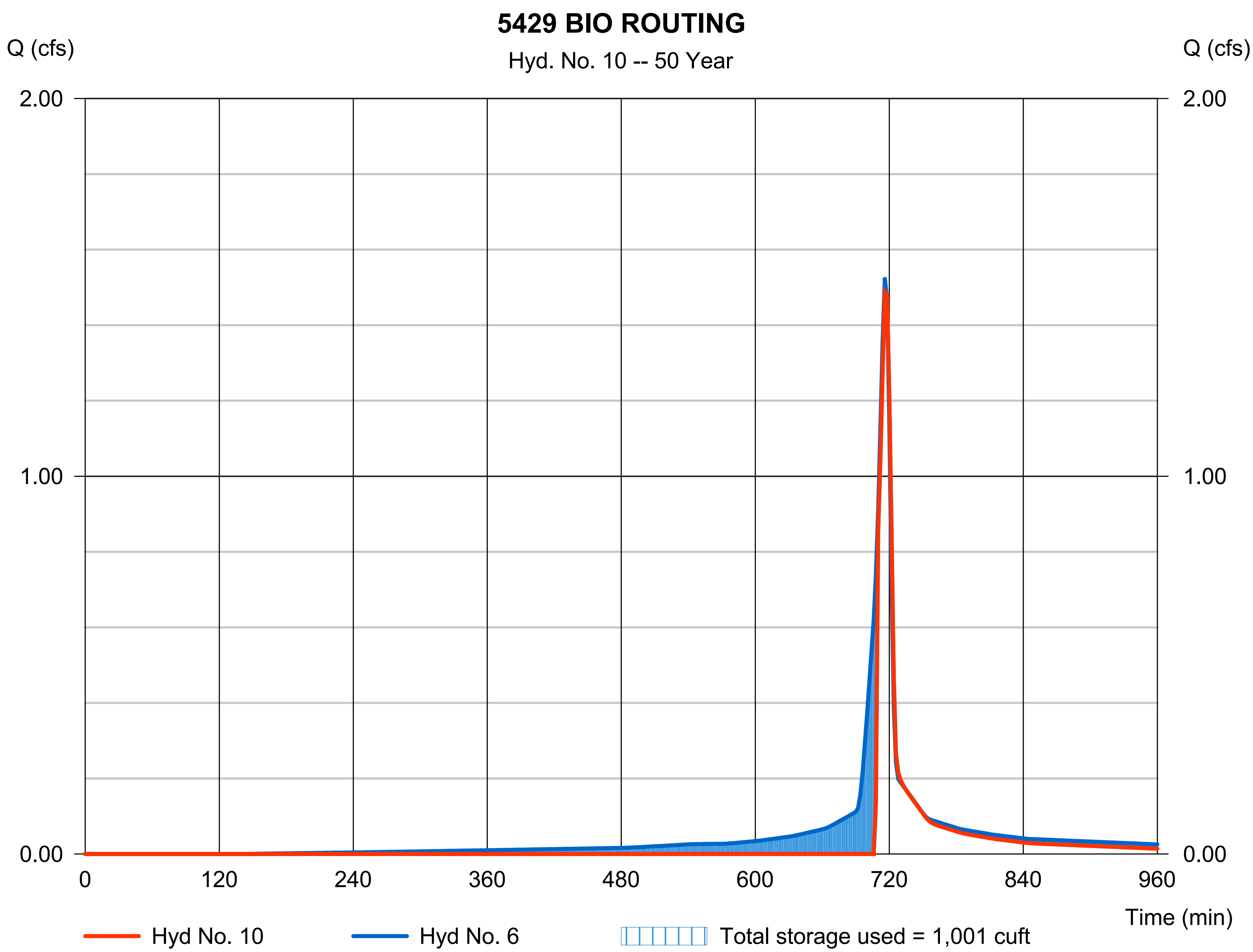
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Tuesday, 04 / 18 / 2023

Hyd. No. 10

5429 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 1.488 cfs
Storm frequency	= 50 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 1,891 cuft
Inflow hyd. No.	= 6 - Area into 5429 BIO	Max. Elevation	= 808.79 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 1,001 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



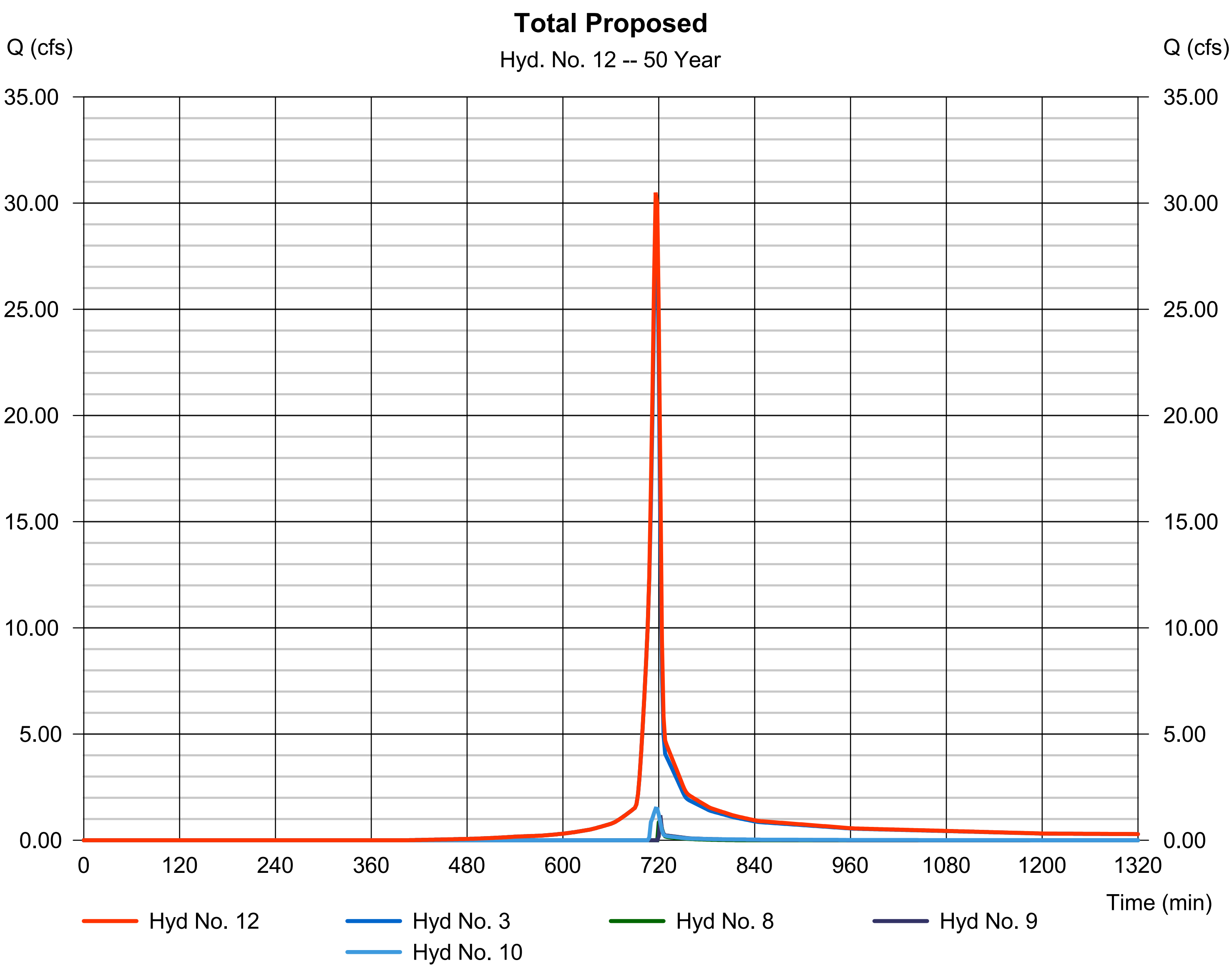
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 12

Total Proposed

Hydrograph type	= Combine	Peak discharge	= 30.50 cfs
Storm frequency	= 50 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 62,616 cuft
Inflow hyds.	= 3, 8, 9, 10	Contrib. drain. area	= 4.220 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	36.01	2	716	73,478	------	------	------	Existing Conditions
3	SCS Runoff	33.12	2	716	67,960	------	------	------	Proposed Bypass
4	SCS Runoff	1.812	2	716	3,950	------	------	------	Area into 5421 BIO
5	SCS Runoff	2.025	2	716	4,450	------	------	------	Area into 5425 BIO
6	SCS Runoff	1.688	2	716	3,806	------	------	------	Area into 5429 BIO
8	Reservoir	1.552	2	720	912	4	744.84	1,667	5421 BIO ROUTING
9	Reservoir	1.986	2	720	1,293	5	801.92	2,104	5425 BIO ROUTING
10	Reservoir	1.643	2	716	2,264	6	808.80	1,005	5429 BIO ROUTING
12	Combine	35.90	2	718	72,429	3, 8, 9, 10,	------	------	Total Proposed

Hydrograph Report

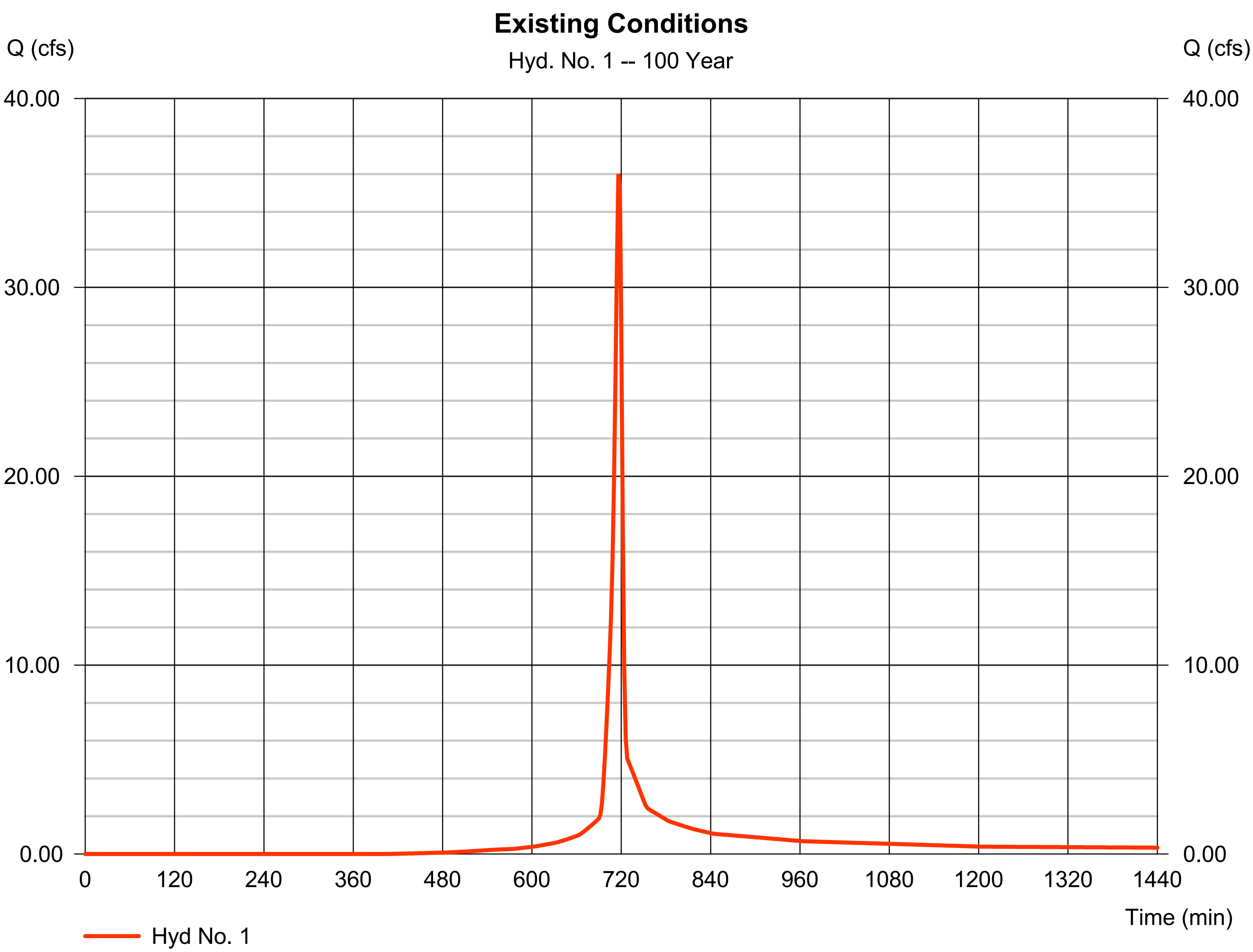
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Tuesday, 04 / 18 / 2023

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 36.01 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 73,478 cuft
Drainage area	= 4.790 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.50 min
Total precip.	= 7.53 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 89) + (0.200 x 79) + (4.720 x 73)] / 4.790



Hydrograph Report

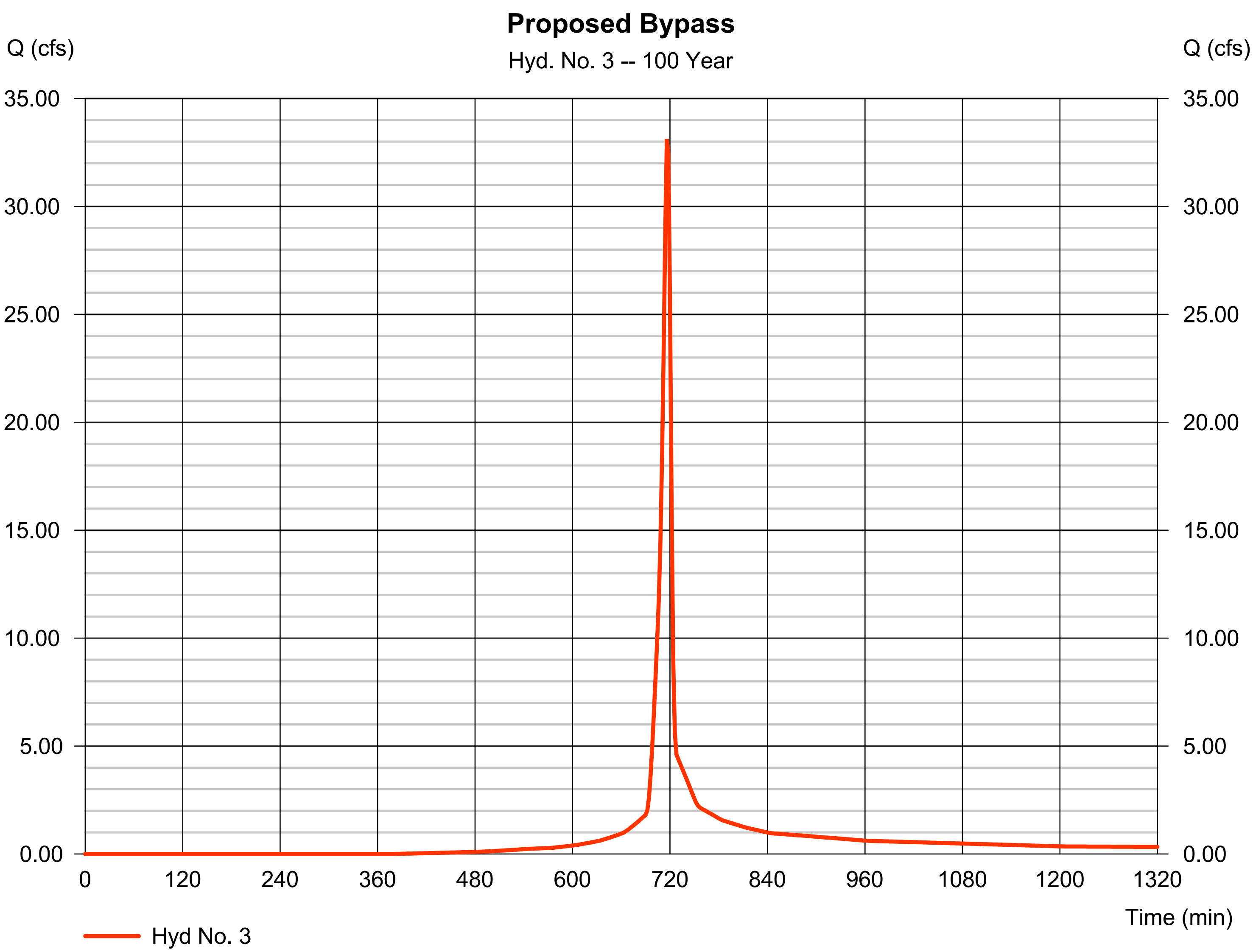
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Tuesday, 04 / 18 / 2023

Hyd. No. 3

Proposed Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 33.12 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 67,960 cuft
Drainage area	= 4.220 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.50 min
Total precip.	= 7.53 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.280 x 73) + (0.280 x 98) + (0.660 x 79)] / 4.220



Hydrograph Report

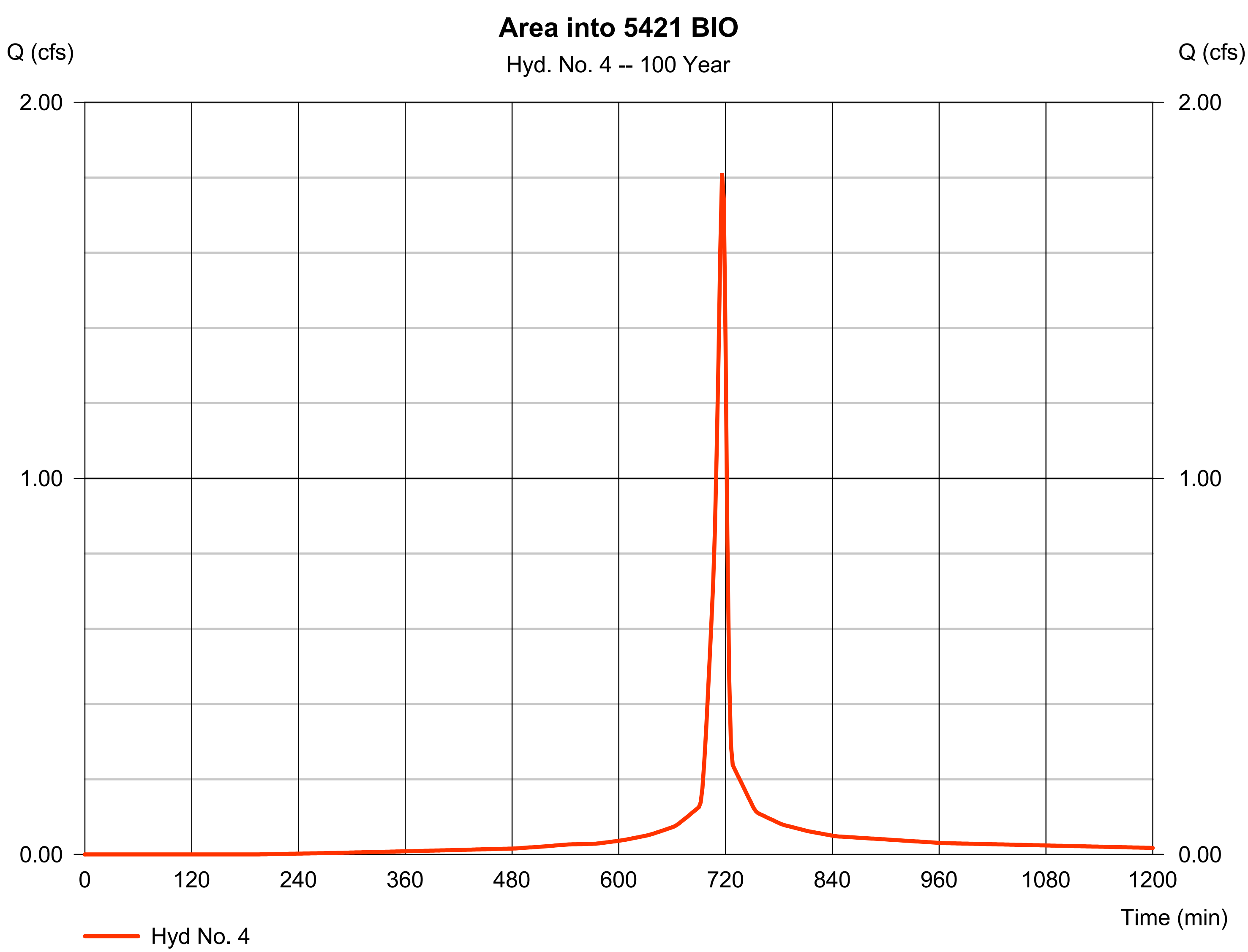
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 | Tuesday, 04 / 18 / 2023

Hyd. No. 4

Area into 5421 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.812 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,950 cuft
Drainage area	= 0.190 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.53 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.060 x 79) + (0.120 x 98)] / 0.190



Hydrograph Report

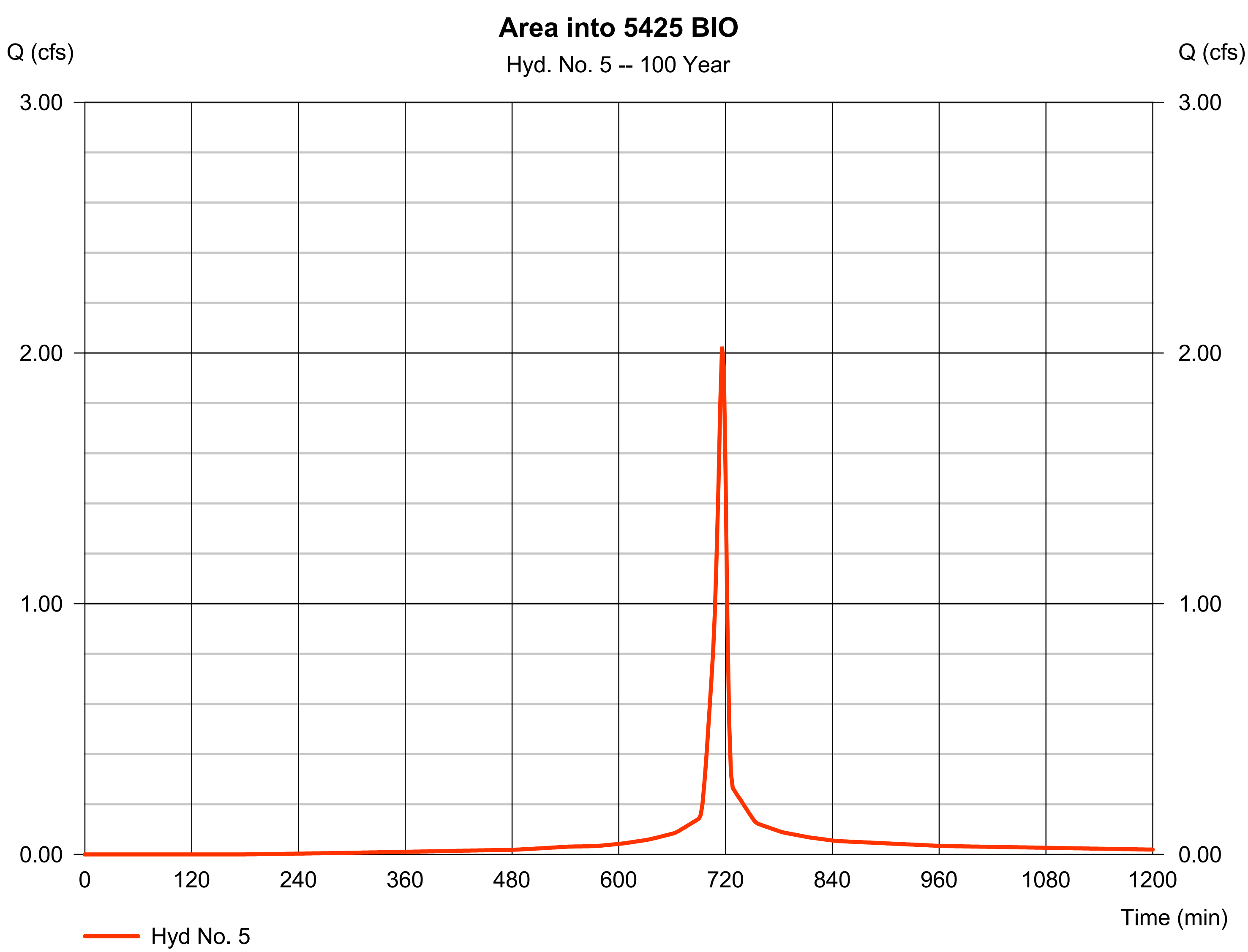
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 5

Area into 5425 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 2.025 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 4,450 cuft
Drainage area	= 0.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.53 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.030 x 79) + (0.130 x 98)] / 0.210



Hydrograph Report

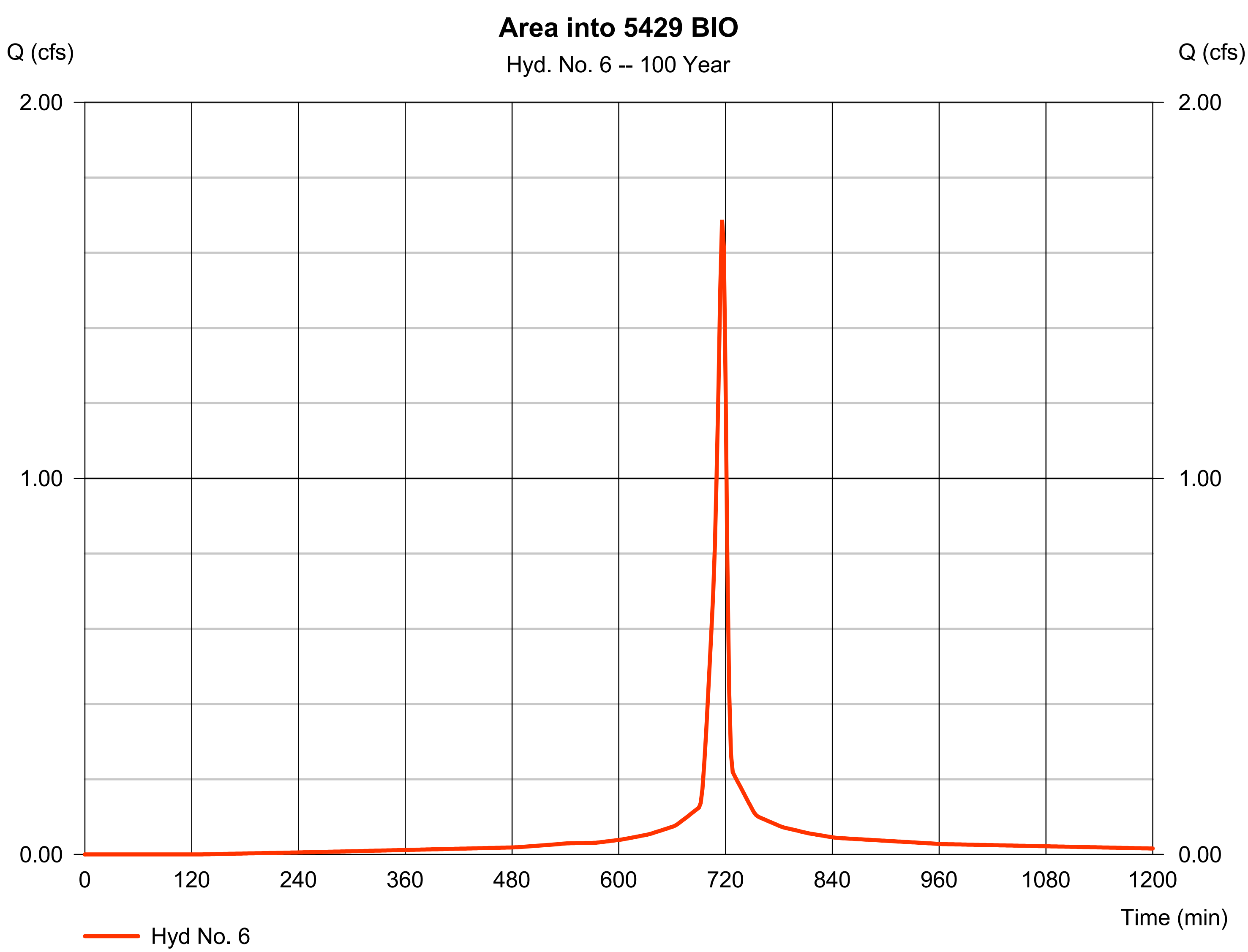
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 6

Area into 5429 BIO

Hydrograph type	= SCS Runoff	Peak discharge	= 1.688 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,806 cuft
Drainage area	= 0.170 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.53 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 98) + (0.050 x 79)] / 0.170



Hydrograph Report

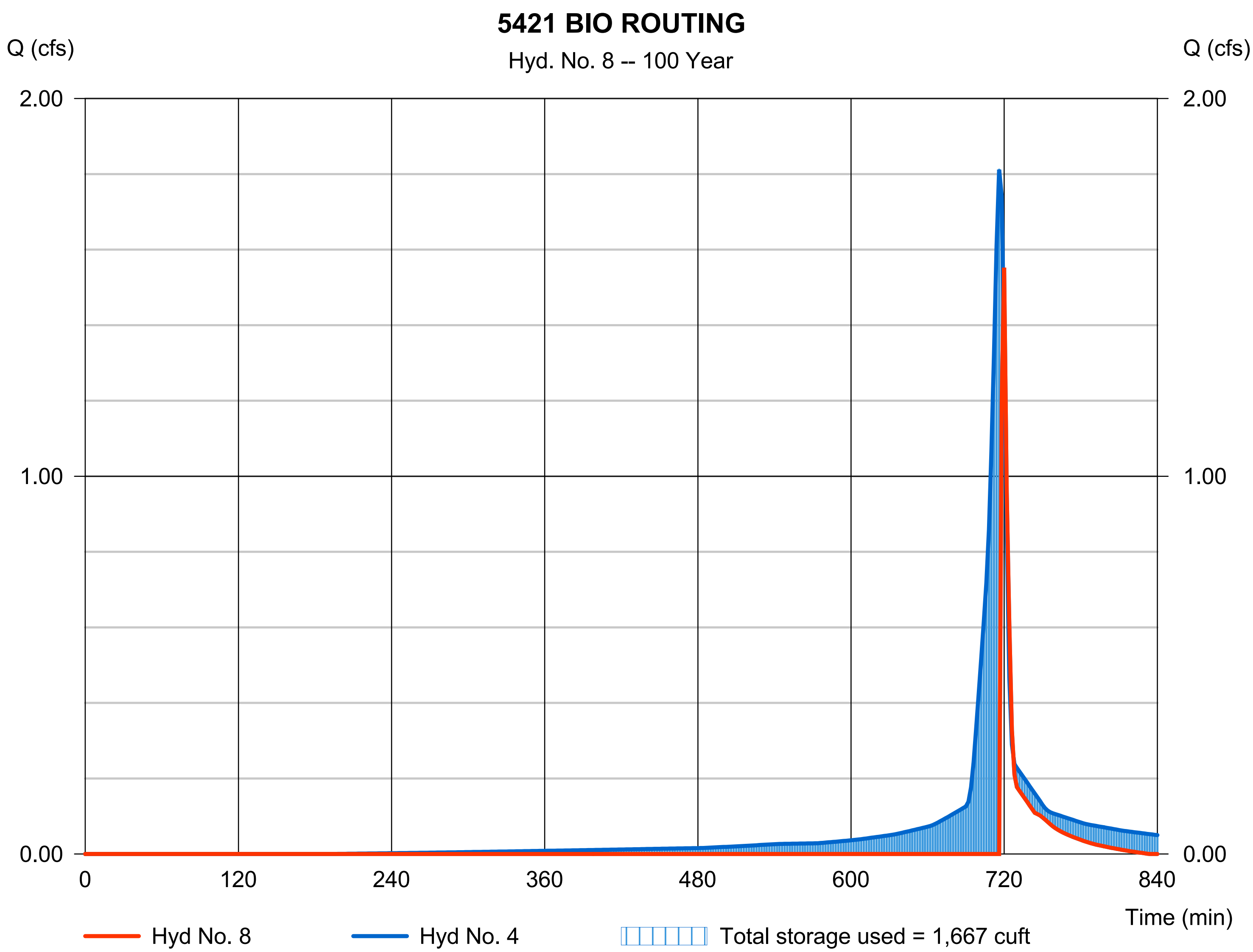
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 8

5421 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 1.552 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 912 cuft
Inflow hyd. No.	= 4 - Area into 5421 BIO	Max. Elevation	= 744.84 ft
Reservoir name	= 5421 Rain Garden W INFIL	Max. Storage	= 1,667 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

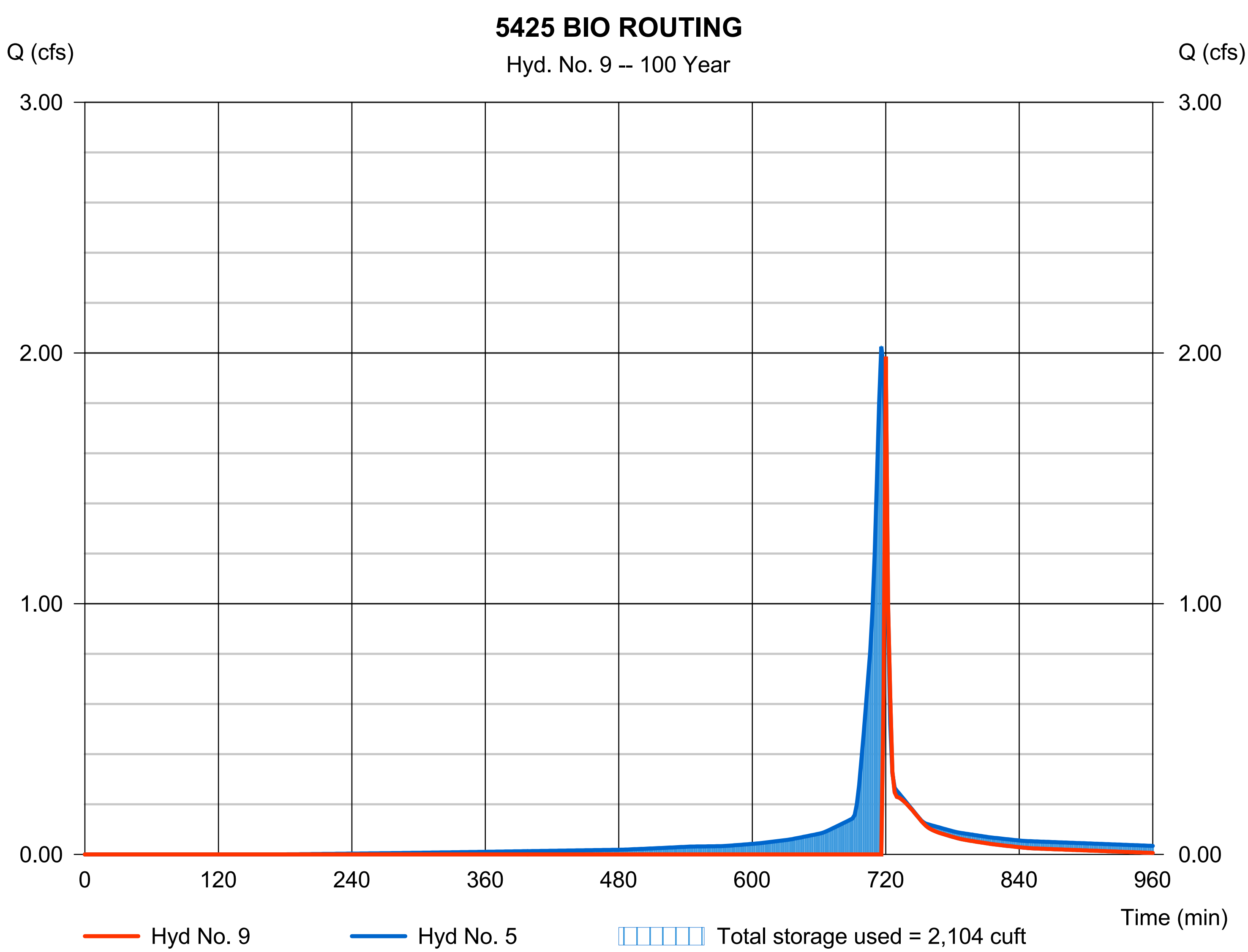
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 9

5425 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 1.986 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 1,293 cuft
Inflow hyd. No.	= 5 - Area into 5425 BIO	Max. Elevation	= 801.92 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 2,104 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

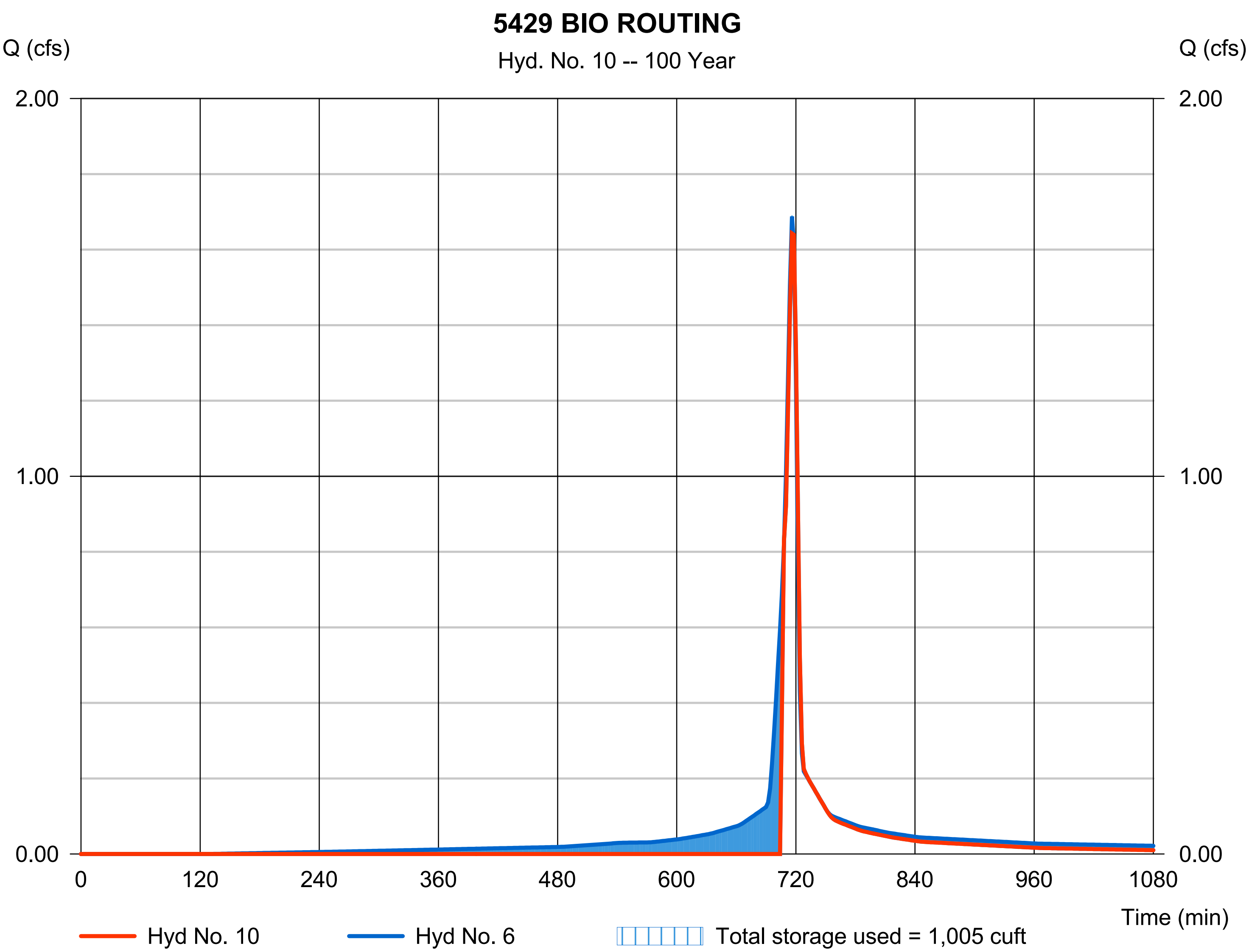
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 10

5429 BIO ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 1.643 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 2,264 cuft
Inflow hyd. No.	= 6 - Area into 5429 BIO	Max. Elevation	= 808.80 ft
Reservoir name	= 5425 Rain Garden W INFIL	Max. Storage	= 1,005 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



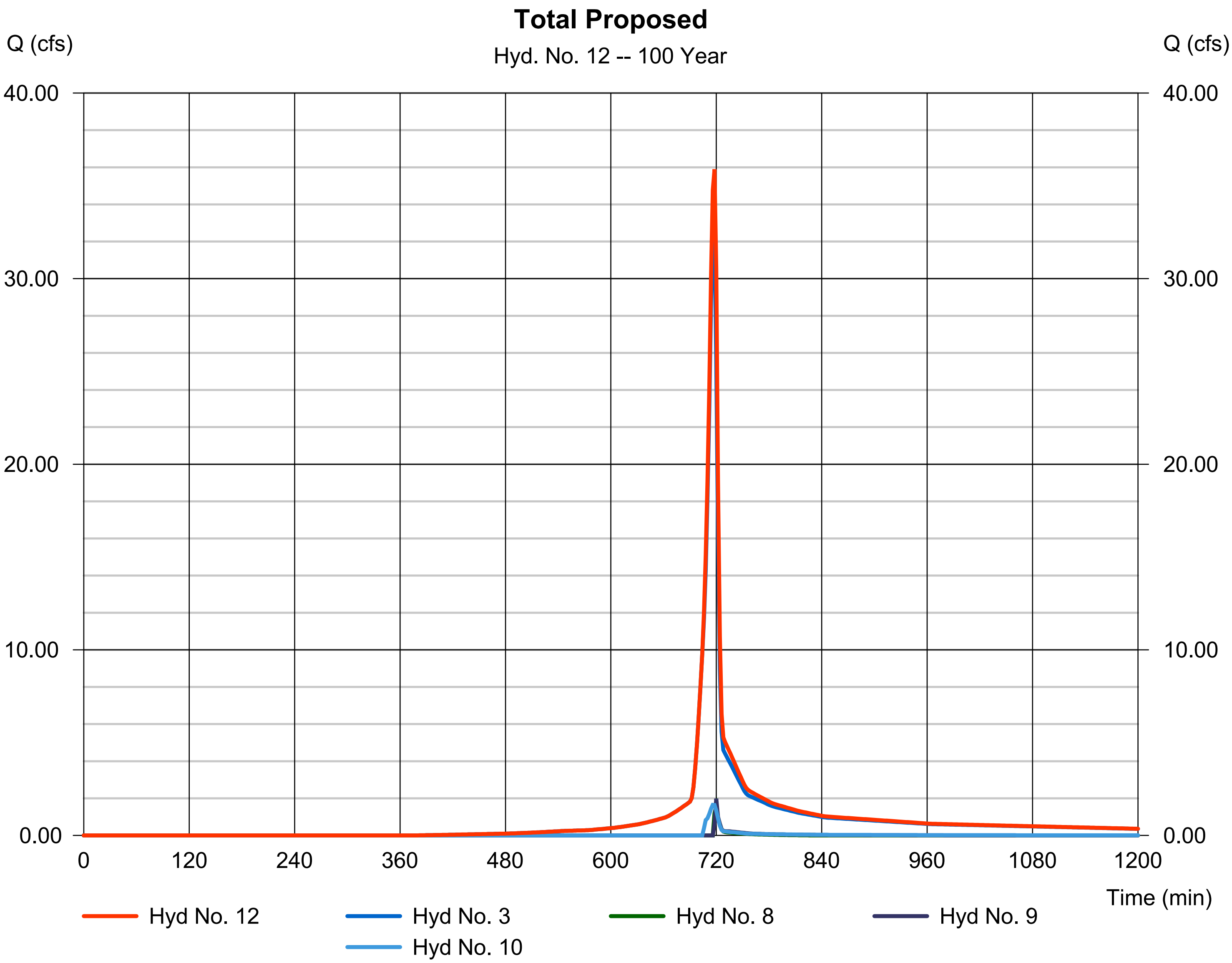
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 04 / 18 / 2023

Hyd. No. 12

Total Proposed

Hydrograph type	= Combine	Peak discharge	= 35.90 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 72,429 cuft
Inflow hyds.	= 3, 8, 9, 10	Contrib. drain. area	= 4.220 ac



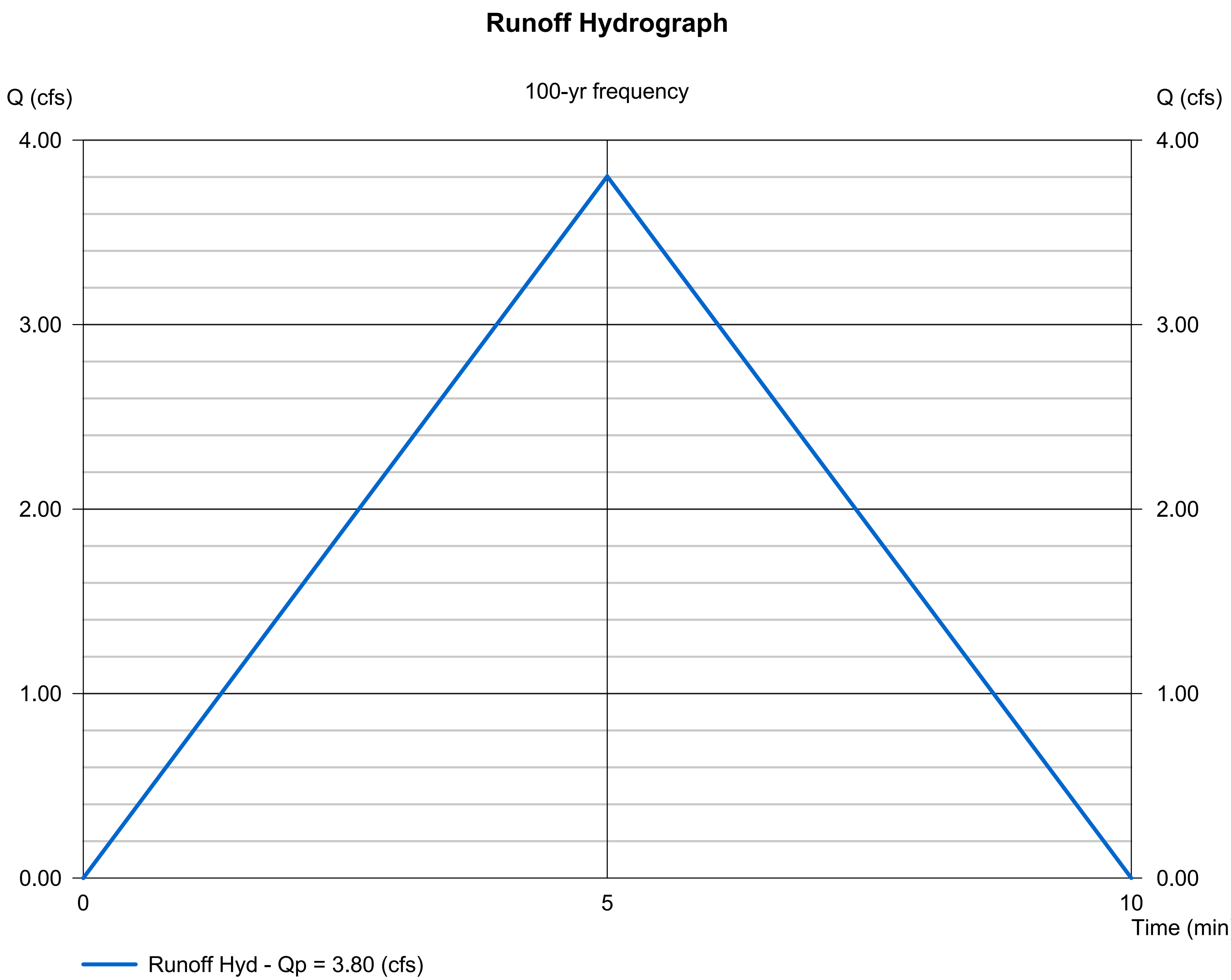
APPENDIX E

Hydrology Report

Ditch #1 Hydrology

Hydrograph type	=	Rational	Peak discharge (cfs)	=	3.804
Storm frequency (yrs)	=	100	Time interval (min)	=	1
Drainage area (ac)	=	1.030	Runoff coeff. (C)	=	0.38
Rainfall Inten (in/hr)	=	9.719	Tc by User (min)	=	5
IDF Curve	=	Nashville.IDF	Rec limb factor	=	1.00

Hydrograph Volume = 1,141 (cuft); 0.026 (acft)



Channel Report

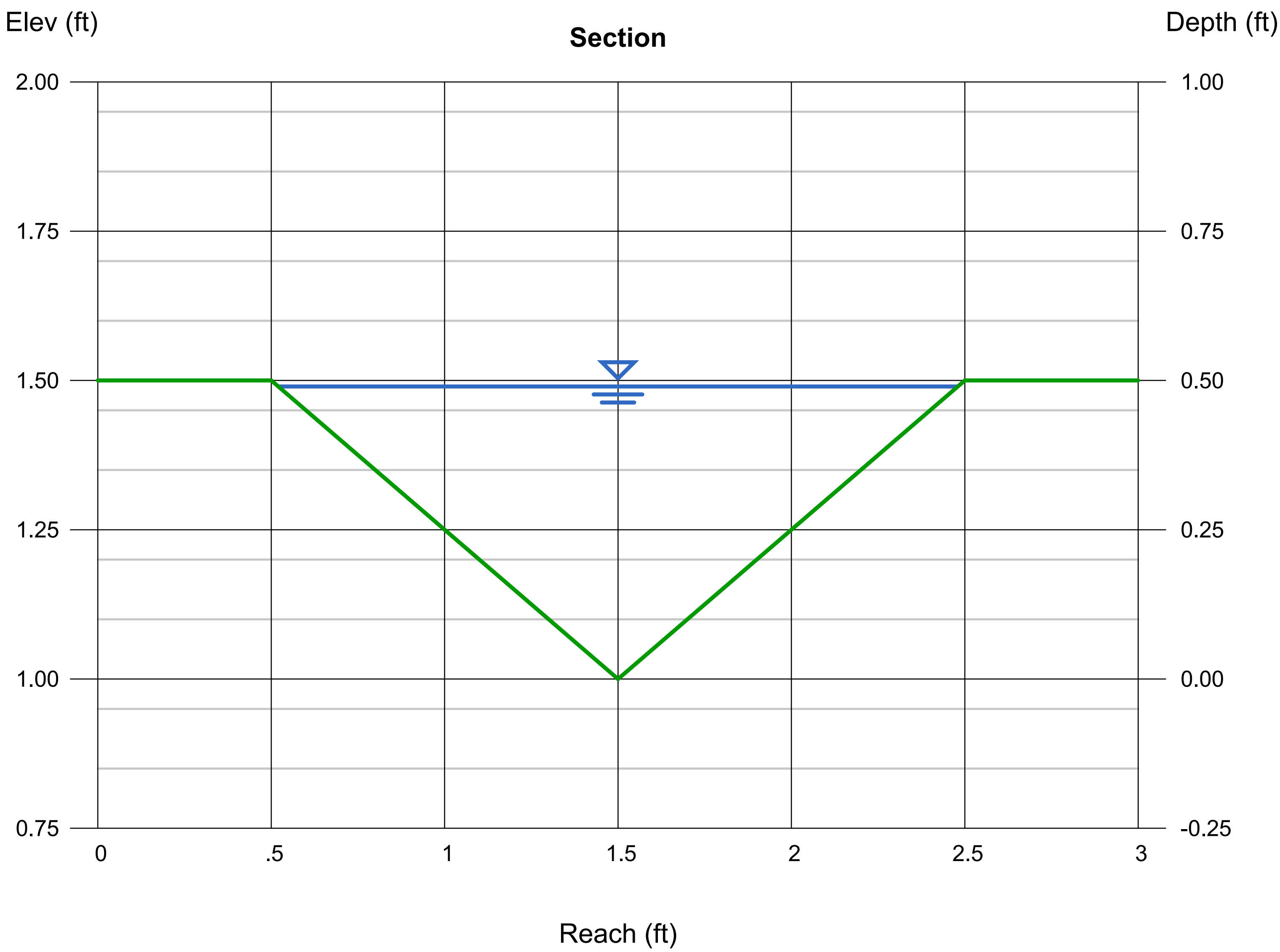
DITCH #1

Triangular
Side Slopes (z:1) = 2.00, 2.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 1.00
Slope (%) = 20.00
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 3.80

Highlighted
Depth (ft) = 0.49
Q (cfs) = 3.800
Area (sqft) = 0.48
Velocity (ft/s) = 7.91
Wetted Perim (ft) = 2.19
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 1.96
EGL (ft) = 1.46

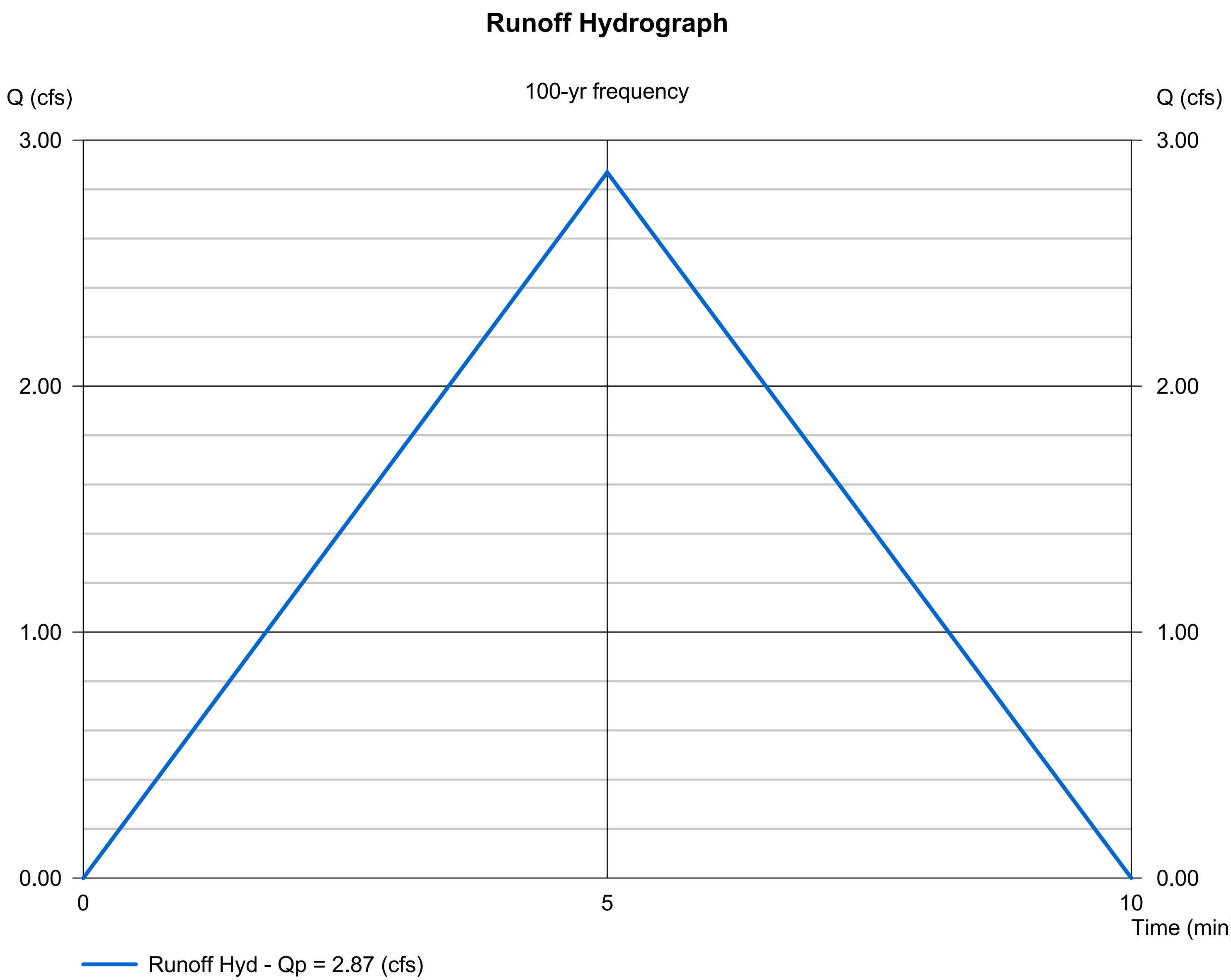


Hydrology Report

Ditch #2 Hydrology

Hydrograph type	= Rational	Peak discharge (cfs)	= 2.869
Storm frequency (yrs)	= 100	Time interval (min)	= 1
Drainage area (ac)	= 0.720	Runoff coeff. (C)	= 0.41
Rainfall Inten (in/hr)	= 9.719	Tc by User (min)	= 5
IDF Curve	= Nashville.IDF	Rec limb factor	= 1.00

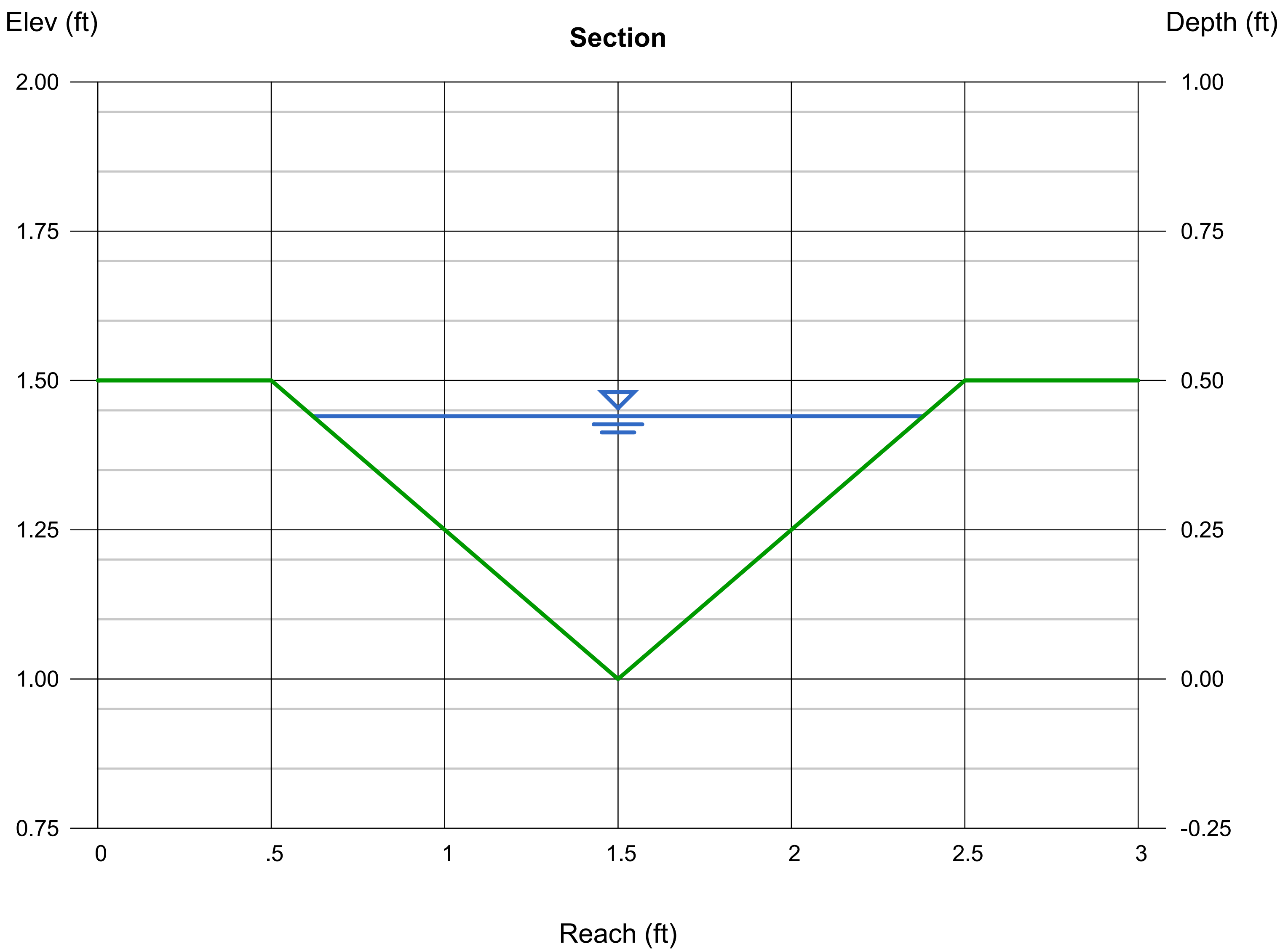
Hydrograph Volume = 861 (cuft); 0.020 (acft)

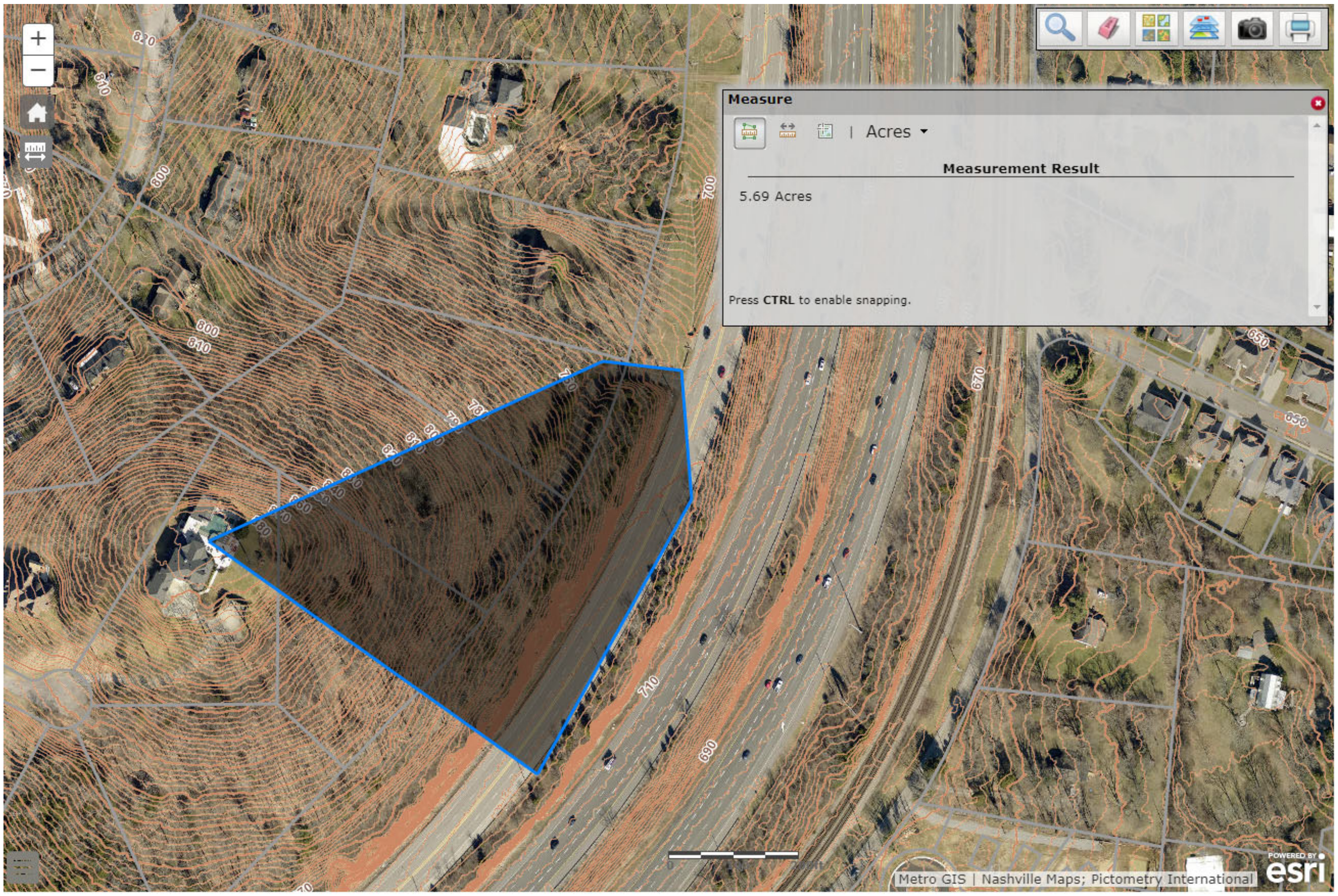


Channel Report

DITCH #2

Triangular		**Highlighted**	
Side Slopes (z:1)	= 2.00, 2.00	Depth (ft)	= 0.44
Total Depth (ft)	= 0.50	Q (cfs)	= 2.870
		Area (sqft)	= 0.39
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 7.41
Slope (%)	= 20.00	Wetted Perim (ft)	= 1.97
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.50
		Top Width (ft)	= 1.76
Calculations		EGL (ft)	= 1.29
Compute by:	Known Q		
Known Q (cfs)	= 2.87		




Measure
Acres
Measurement Result
5.69 Acres
Press CTRL to enable snapping.
Metro GIS | Nashville Maps; Pictometry International
esri

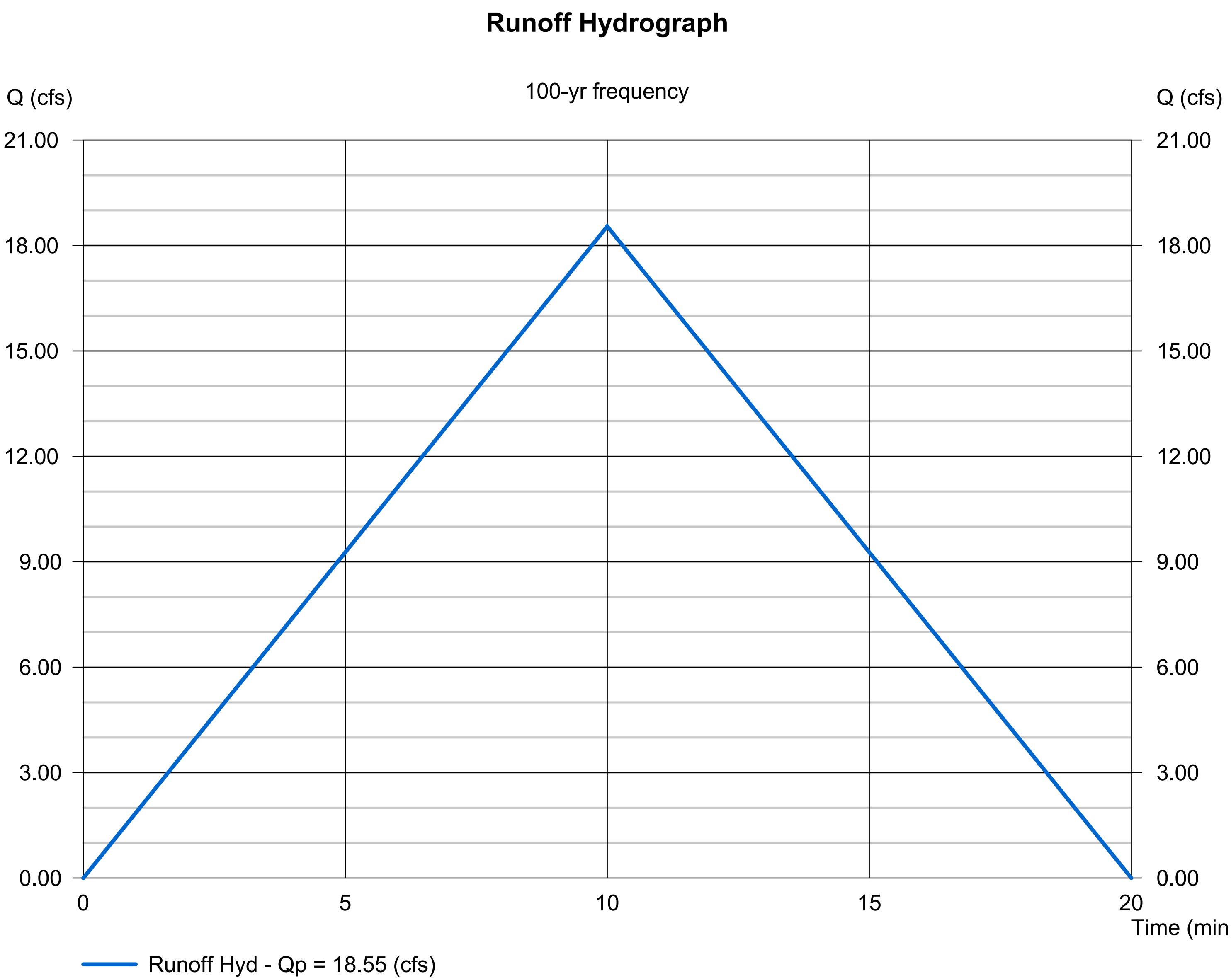
Hydrology Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 18 2023

100 Year Flow to Offsite Culvert

Hydrograph type	= Rational	Peak discharge (cfs)	= 18.55
Storm frequency (yrs)	= 100	Time interval (min)	= 1
Drainage area (ac)	= 5.700	Runoff coeff. (C)	= 0.4
Rainfall Inten (in/hr)	= 8.135	Tc by User (min)	= 10
IDF Curve	= Nashville.IDF	Rec limb factor	= 1.00

Hydrograph Volume = 11,128 (cuft); 0.255 (acft)




704
692
698
702
706
694
696
708
722
724
722

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 18 2023

Downstream Culvert - 100 Year

Invert Elev Dn (ft)	=	1.00
Pipe Length (ft)	=	12.00
Slope (%)	=	5.00
Invert Elev Up (ft)	=	1.60
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.017
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

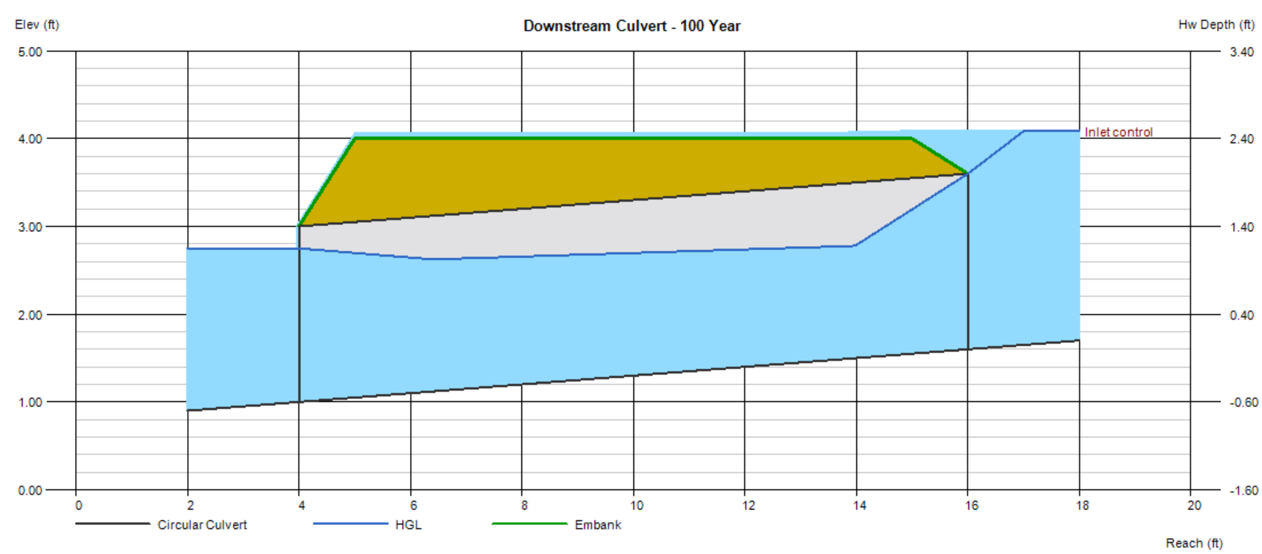
Top Elevation (ft)	=	4.00
Top Width (ft)	=	10.00
Crest Width (ft)	=	10.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	18.50
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

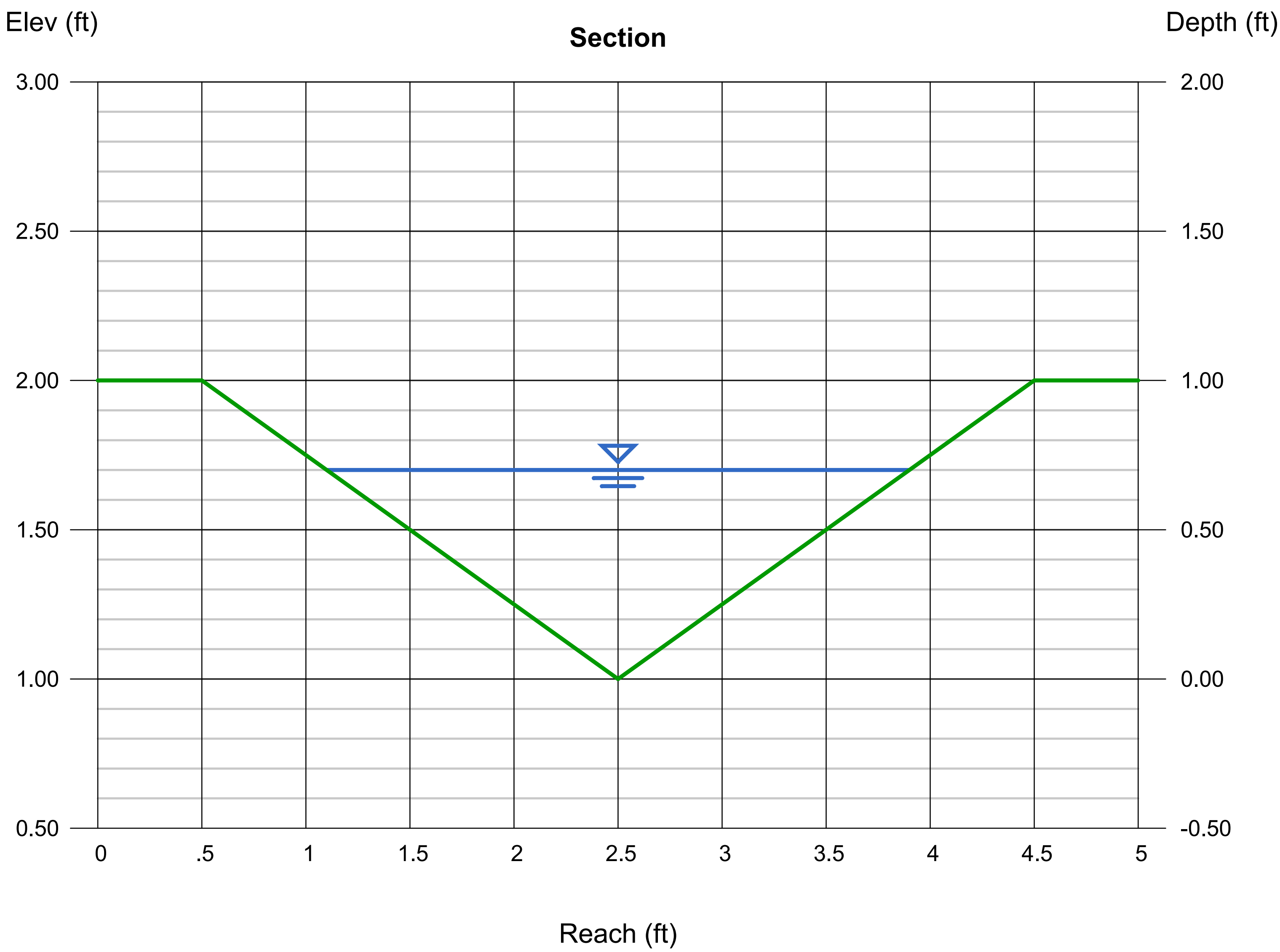
Qtotal (cfs)	=	18.00
Qpipe (cfs)	=	17.35
Qovertop (cfs)	=	0.65
Veloc Dn (ft/s)	=	5.95
Veloc Up (ft/s)	=	6.86
HGL Dn (ft)	=	2.75
HGL Up (ft)	=	3.10
Hw Elev (ft)	=	4.09
Hw/D (ft)	=	1.24
Flow Regime	=	Inlet Control



Channel Report

100 Year Downstream Concrete Channel

Triangular		**Highlighted**	
Side Slopes (z:1)	= 2.00, 2.00	Depth (ft)	= 0.70
Total Depth (ft)	= 1.00	Q (cfs)	= 18.50
		Area (sqft)	= 0.98
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 18.88
Slope (%)	= 13.70	Wetted Perim (ft)	= 3.13
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.00
		Top Width (ft)	= 2.80
Calculations		EGL (ft)	= 6.24
Compute by:	Known Q		
Known Q (cfs)	= 18.50		



Planning, Design & Research Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee 37203-5509
615-298-2065 jgoff@pdre.net

April 15, 2023

Mr. Jeremy Walker
Urban Development Group LLC
PO Box 90288
Nashville, Tennessee 37209

**RE: STABILITY CERTIFICATION FOR STRUCTURES AND SLOPES
5421, 5425 & 5429 FRANKLIN PIKE
OAKHILL, TENNESSEE**

Dear Mr. Walker:

This letter is to certify that Jon Goff, PE with Planning, Design & Research Engineers, Inc. (PDRE) has reviewed the geotechnical report prepared by ECS Southeast, LLP dated April 5, 2023 and has designed the retaining walls in accordance with that report. It should be noted that the geotechnical reported indicated that bedrock was located at 2.5' to 5' below grade. Additionally, the site contained areas with unsuitable soils (Fat Clay (CH)) which are unsuitable to support the retaining walls. Based upon this information PDRE designed the walls based upon removal of all soils to the top of bedrock, ie. the walls are founded on competent bedrock.

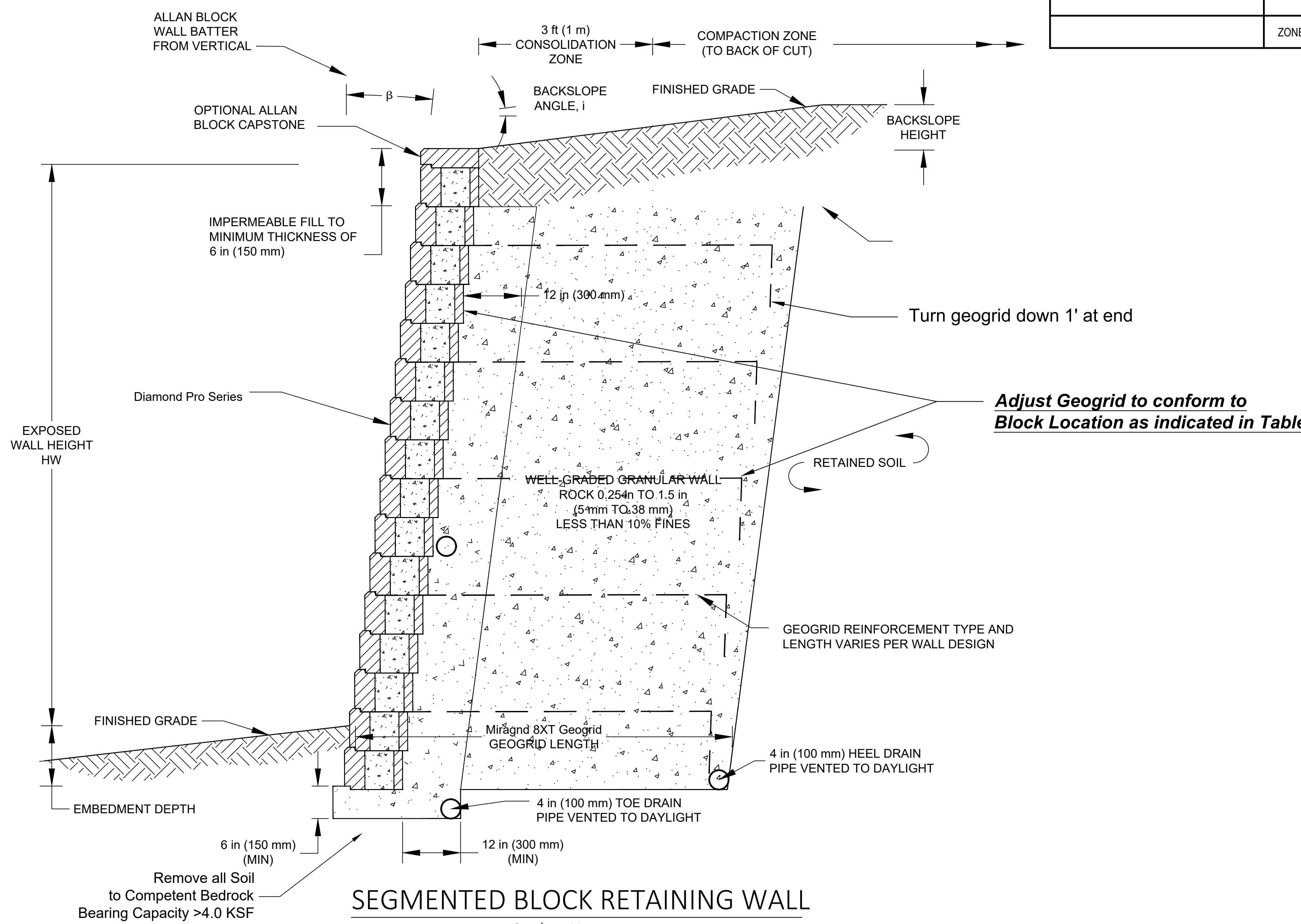
Please feel free to contact our office if you have any questions regarding this matter.

Sincerely,

PLANNING, DESIGN & RESEARCH ENGINEERS, INC.

Jon F. Goff, PE

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



SEGMENTED BLOCK RETAINING WALL

Scale: None

Wall Height HW - (FT)	Block Layer for Grid 1	Geogrid Length for Grid 1- (ft)	Block Layer for Grid 2	Geogrid Length for Grid 2- (ft)	Block Layer for Grid 3	Geogrid Length for Grid 3- (ft)	Block Layer for Grid 4	Geogrid Length for Grid 4- (ft)	Block Layer for Grid 5	Geogrid Length for Grid 5- (ft)	Block Layer for Grid 6	Geogrid Length for Grid 6- (ft)	Block Layer for Grid 7	Geogrid Length for Grid 7- (ft)
0' to 4'	2	4'-0"	5	4'-0"	Not Required	Not Required	Not Required	Not required	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required
4' to 6'	2	4'-0"	5	4'-0"	8	4'-0"	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required
6' to 8'	2	5'-6"	5	5'-6"	8	5'-6"	11	5'-6"	Not required	Not required	Not required	Not required	Not required	Not required
8' to 10'	2	6'-0"	5	6'-0"	8	6'-0"	11	6'-0"	14	6'-0"	Not required	Not Required	Not Required	Not Required
10' to 12'	2	8'-0"	5	8'-0"	8	8'-0"	11	8'-0"	14	8'-0"	17	8'-0"	Not Required	Not Required
12' to 14'	2	8'-6"	5	8'-6"	8	8'-6"	11	8'-6"	14	8'-6"	17	8'-6"	17	8'-6"

Know what's below. Call before you dig.

PLANNING DESIGN & RESEARCH ENGINEERS, INC.
2000 LINDELL AVENUE
NASHVILLE, TENNESSEE 37203
(615) 298-2065

5421, 5425 & 5429 FRANKLIN PIKE
OAKHILL, TENNESSEE

SEGMENTED BLOCK RETAINING WALL

1.	ORIGINAL SUBMITTAL	02-06-2023

SIZE	FSCM NO.	DWG NO.	REV
SCALE	BUILDING PERMIT No.	SHEET	

5421 FRANKLIN PIKE
OAKHILL, TENNESSEE

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5425 franklin pik

Segmental Retaining Wall with Geogrids

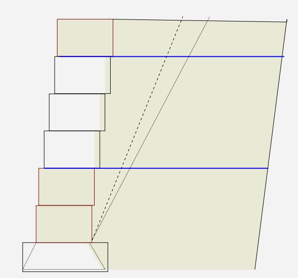
Code: NCMA 3rd

Criteria

Wall height (retained height)	4.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	4.00 ft
Base Sliding Force (w/o Seismic)	186.88 lb
Base Resisting Force (w/o Seismic)	1,650.64 lb
Base Sliding (w/o Seismic) FS	8.83
Overturning Moment (w/o Seismic)	249.18 ft lb
Resisting Moment (w/o Seismic)	3,822.69 ft lb
Overturning (w/o Seismic) FS	15.34
Applied Bearing Pressure (w/o Seismic)	381.23 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	10.49
Eccentricity of Vert. Force (w/o Seismic)	0.16 ft
Effective Base Width (w/o Seismic)	4.33 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	8.83	OK	
Overturning	2.00	15.34	OK	
Bearing	2.00	10.49	OK	
Internal Sliding	1.50	37.69	OK	
Tensile Overstress	1.50	44.08	OK	
Pullout	1.50	24.09	OK	
Connection	1.50	9.74	OK	

PDR Engineers, Inc.
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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
2	3.33	1.67	0.67	15.9	0.0	0.0	15.9	3,927.0	2,485.4	15.9	246.84	156.23
1	1.33	2.33	2.67	89.1	0.0	0.0	89.1	3,927.0	2,485.4	89.1	44.08	27.90

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
2	1,152.3	72.43	0.00	672.1	42.25	42.25	5.2	479.51	5.2	479.51
1	2,145.7	24.09	0.00	867.5	9.74	9.74	83.1	37.69	83.1	37.69

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065   Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5425 franklin
Title **5421 Franklin Pike, Oakhill, Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 6'

Date: 6 FEB 2023

This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5425 franklin pik

Segmental Retaining Wall with Geogrids

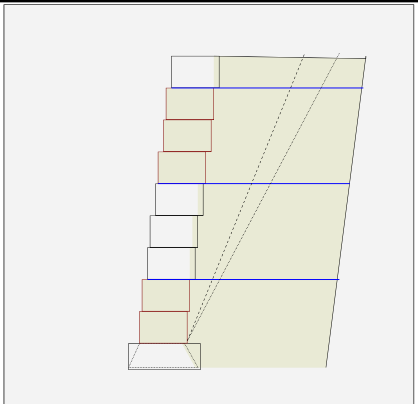
Code: NCMA 3rd

Criteria

Wall height (retained height)	6.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

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Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	4.00 ft
Base Sliding Force (w/o Seismic)	420.49 lb
Base Resisting Force (w/o Seismic)	2,543.95 lb
Base Sliding (w/o Seismic) FS	6.05
Overturning Moment (w/o Seismic)	840.98 ft lb
Resisting Moment (w/o Seismic)	6,326.79 ft lb
Overturning (w/o Seismic) FS	7.52
Applied Bearing Pressure (w/o Seismic)	589.86 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	6.78
Eccentricity of Vert. Force (w/o Seismic)	0.16 ft
Effective Base Width (w/o Seismic)	4.31 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.05	OK	
Overturning	2.00	7.52	OK	
Bearing	2.00	6.78	OK	
Internal Sliding	1.50	14.96	OK	
Tensile Overstress	1.50	25.19	OK	
Pullout	1.50	14.98	OK	
Connection	1.50	6.82	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
3	5.33	1.67	0.67	15.9	0.0	0.0	15.9	3,927.0	2,485.4	15.9	246.84	156.23
2	3.33	2.00	2.67	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55
1	1.33	2.33	4.67	155.9	0.0	0.0	155.9	3,927.0	2,485.4	155.9	25.19	15.94

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
3	238.4	14.98	0.00	672.1	42.25	42.25	5.2	479.51	5.2	479.51
2	1,728.5	22.64	0.00	867.5	11.36	11.36	83.1	37.69	83.1	37.69
1	3,218.6	20.64	0.00	1,062.8	6.82	6.82	254.4	14.96	254.4	14.96

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5425 franklin
Title **5421 Franklin Pike, Oakhill, Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 8'

Date: 6 FEB 2023

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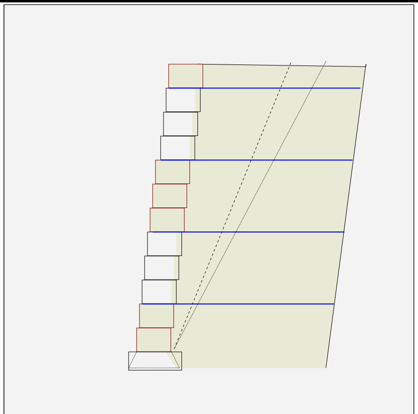
Segmental Retaining Wall with Geogrids

Code: NCMA 3rd



Criteria

Wall height (retained height)	8.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	5.40 ft
Base Sliding Force (w/o Seismic)	747.53 lb
Base Resisting Force (w/o Seismic)	4,938.58 lb
Base Sliding (w/o Seismic) FS	6.61
Overturning Moment (w/o Seismic)	1,993.42 ft lb
Resisting Moment (w/o Seismic)	16,531.32 ft lb
Overturning (w/o Seismic) FS	8.29
Applied Bearing Pressure (w/o Seismic)	838.83 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	4.77
Eccentricity of Vert. Force (w/o Seismic)	0.24 ft
Effective Base Width (w/o Seismic)	5.89 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.61	OK	
Overturning	2.00	8.29	OK	
Bearing	2.00	4.77	OK	
Internal Sliding	1.50	10.45	OK	
Tensile Overstress	1.50	17.63	OK	
Pullout	1.50	31.04	OK	
Connection	1.50	5.65	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
4	7.33	1.67	0.67	15.9	0.0	0.0	15.9	3,927.0	2,485.4	15.9	246.84	156.23
3	5.33	2.00	2.67	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55
2	3.33	2.00	4.67	133.6	0.0	0.0	133.6	3,927.0	2,485.4	133.6	29.39	18.60
1	1.33	2.33	6.67	222.7	0.0	0.0	222.7	3,927.0	2,485.4	222.7	17.63	11.16

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
4	951.8	59.83	0.00	672.1	42.25	42.25	5.2	497.04	5.2	497.04
3	2,938.6	38.48	0.00	867.5	11.36	11.36	83.1	42.07	83.1	42.07
2	4,925.5	36.86	0.00	1,062.8	7.95	7.95	254.4	17.47	254.4	17.47
1	6,912.3	31.04	0.00	1,258.2	5.65	5.65	519.1	10.45	519.1	10.45

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5425 franklin
Title 5421 Franklin Pike, Oakhill, Tn
Dsgnr: Jon F. Goff, P.E.
Description....
0' to 10'

Date: 6 FEB 2023

This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5425 franklin pik

Segmental Retaining Wall with Geogrids

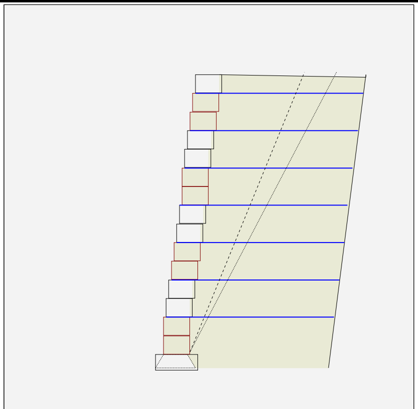
Code: NCMA 3rd

Criteria

Wall height (retained height)	10.00	ft
Backfill slope	Level	
Backfill angle	0.0	deg
Embedment	0.5	ft

Soil data

External Soil, Phi_e	33	deg
External soil density (In situ)	120	pcf
Internal Soil, Phi_i	45	deg
Internal soil density	130	pcf
Wall Soil Friction Angle	30	deg
K_a(Horiz)	0.12	


Thumbnail

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Dead load	0	psf
Live load	0	psf
Seismic Factor, A	0.00	
d_seismic	0.00	in

Segmental block data

Vendor selection	Anchor Retaining Wall				
Vendor ESR	ICC ESR-1959[		Valid through	07/01/18	
Block selection type	Diamond Pro Straight Face				
Block height	8.00	in	alpha(u_1)	83.00	lb
Block depth	12.00	in	tan(lambda_u1)	2.04	
Offset per block	1.00	in	Max_1	2485.00	lb
Batter angle	7.13	deg	alpha(u_2)	2299.00	lb
Wall weight	74.00	psf	tan(lambda_u2)	0.19	
			Max_2	3043.00	lb

Stability

Base length	6.00	ft
Base Sliding Force (w/o Seismic)	1,168.02	lb
Base Resisting Force (w/o Seismic)	7,066.53	lb
Base Sliding (w/o Seismic) FS	6.05	
Overturning Moment (w/o Seismic)	3,893.41	ft lb
Resisting Moment (w/o Seismic)	26,926.91	ft lb
Overturning (w/o Seismic) FS	6.92	
Applied Bearing Pressure (w/o Seismic)	1,083.98	psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00	psf
Bearing (w/o Seismic) FS	3.69	
Eccentricity of Vert. Force (w/o Seismic)	0.26	ft
Effective Base Width (w/o Seismic)	6.52	ft

Geogrid material

Vendor Selection	Mirafi Geogrid				
Geogrid type	Miragrid 8XT				
LTDS	3,927.00	lb/ft			
Ci	0.90				
RF_CR	1.58				
alpha_u	2,283.00	lb			
tan(lambda_u)	0.19				
Max	3,017.00	lb			
alpha_cs1	607.00	lb	alpha_cs2	1,786.00	lb
tan(lambda_cs1)	1.32		tan(lambda_cs2)	0.14	
Max_1	1,928.00	lb	Max_2	2,354.00	lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.05	OK	
Overturning	2.00	6.92	OK	
Bearing	2.00	3.69	OK	
Internal Sliding	1.50	7.92	OK	
Tensile Overstress	1.50	15.82	OK	
Pullout	1.50	8.67	OK	
Connection	1.50	5.86	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
7	9.33	1.33	0.67	12.7	0.0	0.0	12.7	3,927.0	2,485.4	12.7	308.56	195.29
6	8.00	1.33	2.00	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
5	6.67	1.33	3.33	63.6	0.0	0.0	63.6	3,927.0	2,485.4	63.6	61.71	39.06
4	5.33	1.33	4.67	89.1	0.0	0.0	89.1	3,927.0	2,485.4	89.1	44.08	27.90
3	4.00	1.33	6.00	114.5	0.0	0.0	114.5	3,927.0	2,485.4	114.5	34.28	21.70
2	2.67	1.33	7.33	140.0	0.0	0.0	140.0	3,927.0	2,485.4	140.0	28.05	17.75
1	1.33	2.00	8.67	248.2	0.0	0.0	248.2	3,927.0	2,485.4	248.2	15.82	10.01

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
7	110.3	8.67	0.00	672.1	52.81	52.81	5.2	504.56	5.2	504.56
6	1,766.0	46.25	0.00	802.4	21.01	21.01	46.7	70.70	46.7	70.70
5	3,421.6	53.77	0.00	932.6	14.66	14.66	129.8	30.84	129.8	30.84
4	5,077.3	56.99	0.00	1,062.8	11.93	11.93	254.4	18.54	254.4	18.54
3	6,733.0	58.78	0.00	1,193.1	10.42	10.42	420.5	12.95	420.5	12.95
2	8,388.7	59.92	0.00	1,323.3	9.45	9.45	628.1	9.85	628.1	9.85
1	10,044.3	40.47	0.00	1,453.6	5.86	5.86	877.3	7.92	877.3	7.92

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065   Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5425 franklin

Title **5421 Franklin Pike, Oakhill, Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 12'

Page : 1
Date: 6 FEB 2023

This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5425 franklin pik

RetainPro (c) 1987-2019, Build 11.20.03.31
License : KW-06051727
License To : PDR ENGINEERS, INC.

Segmental Retaining Wall with Geogrids

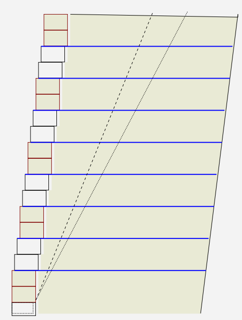
Code: NCMA 3rd

Criteria

Wall height (retained height)	12.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	8.00 ft
Base Sliding Force (w/o Seismic)	1,681.95 lb
Base Resisting Force (w/o Seismic)	11,735.80 lb
Base Sliding (w/o Seismic) FS	6.98
Overturning Moment (w/o Seismic)	6,727.81 ft lb
Resisting Moment (w/o Seismic)	58,349.34 ft lb
Overturning (w/o Seismic) FS	8.67
Applied Bearing Pressure (w/o Seismic)	1,334.03 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	3.00
Eccentricity of Vert. Force (w/o Seismic)	0.40 ft
Effective Base Width (w/o Seismic)	8.80 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.98	OK	
Overturning	2.00	8.67	OK	
Bearing	2.00	3.00	OK	
Internal Sliding	1.50	7.67	OK	
Tensile Overstress	1.50	12.86	OK	
Pullout	1.50	57.85	OK	
Connection	1.50	5.40	OK	

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
8	10.67	2.00	1.33	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
7	9.33	1.33	2.67	50.9	0.0	0.0	50.9	3,927.0	2,485.4	50.9	77.14	48.82
6	8.00	1.33	4.00	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55
5	6.67	1.33	5.33	101.8	0.0	0.0	101.8	3,927.0	2,485.4	101.8	38.57	24.41
4	5.33	1.33	6.67	127.3	0.0	0.0	127.3	3,927.0	2,485.4	127.3	30.86	19.53
3	4.00	1.33	8.00	152.7	0.0	0.0	152.7	3,927.0	2,485.4	152.7	25.71	16.27
2	2.67	1.33	9.33	178.2	0.0	0.0	178.2	3,927.0	2,485.4	178.2	22.04	13.95
1	1.33	2.00	10.67	305.4	0.0	0.0	305.4	3,927.0	2,485.4	305.4	12.86	8.14

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
8	3,761.5	98.52	0.00	737.2	19.31	19.31	20.8	155.04	20.8	155.04
7	5,748.3	112.92	0.00	867.5	17.04	17.04	83.1	50.21	83.1	50.21
6	7,735.1	101.30	0.00	997.7	13.07	13.07	186.9	27.49	186.9	27.49
5	9,722.0	95.49	0.00	1,128.0	11.08	11.08	332.2	18.42	332.2	18.42
4	11,708.8	92.00	0.00	1,258.2	9.89	9.89	519.1	13.71	519.1	13.71
3	13,695.6	89.68	0.00	1,388.4	9.09	9.09	747.5	10.87	747.5	10.87
2	15,682.4	88.02	0.00	1,518.7	8.52	8.52	1,017.5	9.00	1,017.5	9.00
1	17,669.2	57.85	0.00	1,648.9	5.40	5.40	1,328.9	7.67	1,328.9	7.67

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

Project Name/Number : 5425 franklin
Title 5421 Franklin Pike, Oakhill, Tn
Dsgnr: Jon F. Goff, P.E.
Description....
0' to 14'

Page : 1
Date: 6 FEB 2023

PDR Engineers, Inc.
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email: jgoff@pdre.net

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Segmental Retaining Wall with Geogrids

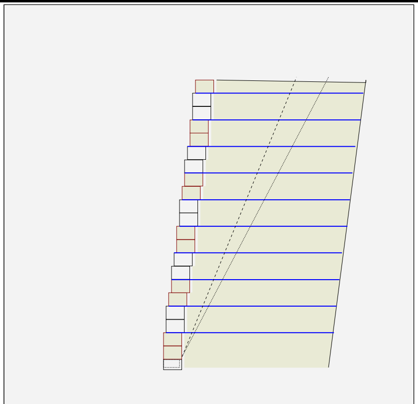
Code: NCMA 3rd

Criteria

Wall height (retained height)	14.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	8.40 ft
Base Sliding Force (w/o Seismic)	2,289.32 lb
Base Resisting Force (w/o Seismic)	14,578.40 lb
Base Sliding (w/o Seismic) FS	6.37
Overturning Moment (w/o Seismic)	10,683.51 ft lb
Resisting Moment (w/o Seismic)	77,764.03 ft lb
Overturning (w/o Seismic) FS	7.28
Applied Bearing Pressure (w/o Seismic)	1,584.14 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	2.53
Eccentricity of Vert. Force (w/o Seismic)	0.40 ft
Effective Base Width (w/o Seismic)	9.20 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.37	OK	
Overturning	2.00	7.28	OK	
Bearing	2.00	2.53	OK	
Internal Sliding	1.50	6.55	OK	
Tensile Overstress	1.50	10.83	OK	
Pullout	1.50	60.44	OK	
Connection	1.50	5.08	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
10	13.33	1.33	0.67	12.7	0.0	0.0	12.7	3,927.0	2,485.4	12.7	308.56	195.29
9	12.00	1.33	2.00	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
8	10.67	1.33	3.33	63.6	0.0	0.0	63.6	3,927.0	2,485.4	63.6	61.71	39.06
7	9.33	1.33	4.67	89.1	0.0	0.0	89.1	3,927.0	2,485.4	89.1	44.08	27.90
6	8.00	1.33	6.00	114.5	0.0	0.0	114.5	3,927.0	2,485.4	114.5	34.28	21.70
5	6.67	1.33	7.33	140.0	0.0	0.0	140.0	3,927.0	2,485.4	140.0	28.05	17.75
4	5.33	1.33	8.67	165.5	0.0	0.0	165.5	3,927.0	2,485.4	165.5	23.74	15.02
3	4.00	1.33	10.00	190.9	0.0	0.0	190.9	3,927.0	2,485.4	190.9	20.57	13.02
2	2.67	1.33	11.33	216.4	0.0	0.0	216.4	3,927.0	2,485.4	216.4	18.15	11.49
1	1.33	2.00	12.67	362.7	0.0	0.0	362.7	3,927.0	2,485.4	362.7	10.83	6.85

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
10	1,063.0	83.52	0.00	672.1	52.81	52.81	5.2	534.61	5.2	534.61
9	3,380.9	88.55	0.00	802.4	21.01	21.01	46.7	80.72	46.7	80.72
8	5,698.8	89.56	0.00	932.6	14.66	14.66	129.8	36.85	129.8	36.85
7	8,016.8	89.99	0.00	1,062.8	11.93	11.93	254.4	22.83	254.4	22.83
6	10,334.7	90.23	0.00	1,193.1	10.42	10.42	420.5	16.29	420.5	16.29
5	12,652.7	90.38	0.00	1,323.3	9.45	9.45	628.1	12.59	628.1	12.59
4	14,970.6	90.48	0.00	1,453.6	8.79	8.79	877.3	10.23	877.3	10.23
3	17,288.6	90.56	0.00	1,583.8	8.30	8.30	1,168.0	8.62	1,168.0	8.62
2	19,606.5	90.62	0.00	1,714.0	7.92	7.92	1,500.3	7.44	1,500.3	7.44
1	21,924.5	60.44	0.00	1,844.3	5.08	5.08	1,874.0	6.55	1,874.0	6.55

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

PDR Engineers, Inc.
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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

5425 FRANKLIN PIKE
OAKHILL, TENNESSEE

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5425 franklin
Title **5425 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 4'

Date: 6 FEB 2023

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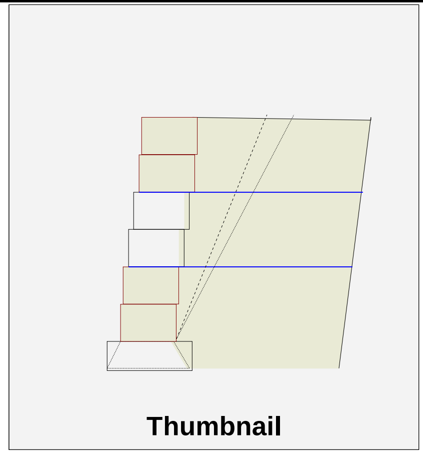
Segmental Retaining Wall with Geogrids

Code: NCMA 3rd



Criteria

Wall height (retained height)	4.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	4.00 ft
Base Sliding Force (w/o Seismic)	186.88 lb
Base Resisting Force (w/o Seismic)	1,650.64 lb
Base Sliding (w/o Seismic) FS	8.83
Overturning Moment (w/o Seismic)	249.18 ft lb
Resisting Moment (w/o Seismic)	3,822.69 ft lb
Overturning (w/o Seismic) FS	15.34
Applied Bearing Pressure (w/o Seismic)	381.23 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	10.49
Eccentricity of Vert. Force (w/o Seismic)	0.16 ft
Effective Base Width (w/o Seismic)	4.33 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	8.83	OK	
Overturning	2.00	15.34	OK	
Bearing	2.00	10.49	OK	
Internal Sliding	1.50	37.69	OK	
Tensile Overstress	1.50	51.43	OK	
Pullout	1.50	28.10	OK	
Connection	1.50	11.36	OK	

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
2	2.67	2.00	1.33	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
1	1.33	2.00	2.67	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
2	1,483.5	38.85	0.00	737.2	19.31	19.31	20.8	129.99	20.8	129.99
1	2,145.7	28.10	0.00	867.5	11.36	11.36	83.1	37.69	83.1	37.69

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

Project Name/Number : 5425 franklin

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Title **5425 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 6'

Date: 6 FEB 2023

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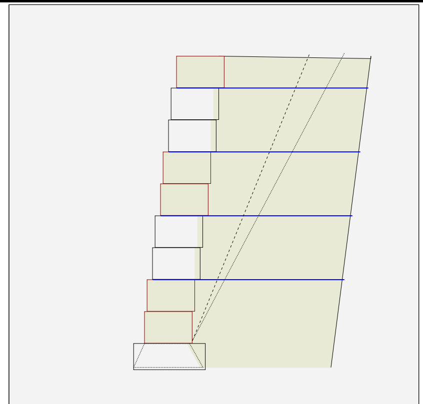
Segmental Retaining Wall with Geogrids

Code: NCMA 3rd



Thumbnail

Criteria

Wall height (retained height)	6.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	4.00 ft
Base Sliding Force (w/o Seismic)	420.49 lb
Base Resisting Force (w/o Seismic)	2,543.95 lb
Base Sliding (w/o Seismic) FS	6.05
Overturning Moment (w/o Seismic)	840.98 ft lb
Resisting Moment (w/o Seismic)	6,326.79 ft lb
Overturning (w/o Seismic) FS	7.52
Applied Bearing Pressure (w/o Seismic)	589.86 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	6.78
Eccentricity of Vert. Force (w/o Seismic)	0.16 ft
Effective Base Width (w/o Seismic)	4.31 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.05	OK	
Overturning	2.00	7.52	OK	
Bearing	2.00	6.78	OK	
Internal Sliding	1.50	14.96	OK	
Tensile Overstress	1.50	29.39	OK	
Pullout	1.50	18.73	OK	
Connection	1.50	7.95	OK	

PDR Engineers, Inc.
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Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
4	5.33	1.33	0.67	12.7	0.0	0.0	12.7	3,927.0	2,485.4	12.7	308.56	195.29
3	4.00	1.33	2.00	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
2	2.67	1.33	3.33	63.6	0.0	0.0	63.6	3,927.0	2,485.4	63.6	61.71	39.06
1	1.33	2.00	4.67	133.6	0.0	0.0	133.6	3,927.0	2,485.4	133.6	29.39	18.60

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
4	238.4	18.73	0.00	672.1	52.81	52.81	5.2	479.51	5.2	479.51
3	1,231.8	32.26	0.00	802.4	21.01	21.01	46.7	62.35	46.7	62.35
2	2,225.2	34.97	0.00	932.6	14.66	14.66	129.8	25.83	129.8	25.83
1	3,218.6	24.09	0.00	1,062.8	7.95	7.95	254.4	14.96	254.4	14.96

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065   Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5425 franklin
Title **5425 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 8'

Date: 6 FEB 2023

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Segmental Retaining Wall with Geogrids

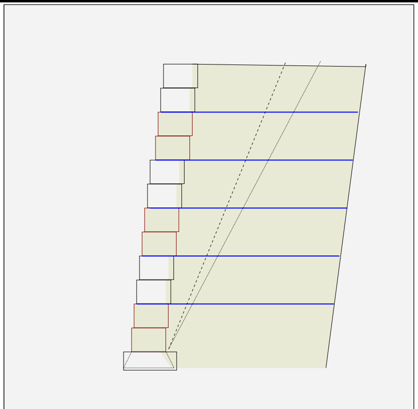
Code: NCMA 3rd

Criteria

Wall height (retained height)	8.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	5.50 ft
Base Sliding Force (w/o Seismic)	747.53 lb
Base Resisting Force (w/o Seismic)	5,042.58 lb
Base Sliding (w/o Seismic) FS	6.75
Overturning Moment (w/o Seismic)	1,993.42 ft lb
Resisting Moment (w/o Seismic)	17,130.05 ft lb
Overturning (w/o Seismic) FS	8.59
Applied Bearing Pressure (w/o Seismic)	839.94 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	4.76
Eccentricity of Vert. Force (w/o Seismic)	0.25 ft
Effective Base Width (w/o Seismic)	6.00 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.75	OK	
Overturning	2.00	8.59	OK	
Bearing	2.00	4.76	OK	
Internal Sliding	1.50	10.58	OK	
Tensile Overstress	1.50	20.57	OK	
Pullout	1.50	37.19	OK	
Connection	1.50	6.59	OK	

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
5	6.67	2.00	1.33	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
4	5.33	1.33	2.67	50.9	0.0	0.0	50.9	3,927.0	2,485.4	50.9	77.14	48.82
3	4.00	1.33	4.00	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55
2	2.67	1.33	5.33	101.8	0.0	0.0	101.8	3,927.0	2,485.4	101.8	38.57	24.41
1	1.33	2.00	6.67	190.9	0.0	0.0	190.9	3,927.0	2,485.4	190.9	20.57	13.02

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
5	1,801.3	47.18	0.00	737.2	19.31	19.31	20.8	139.38	20.8	139.38
4	3,125.8	61.40	0.00	867.5	17.04	17.04	83.1	42.39	83.1	42.39
3	4,450.4	58.28	0.00	997.7	13.07	13.07	186.9	22.27	186.9	22.27
2	5,774.9	56.72	0.00	1,128.0	11.08	11.08	332.2	14.50	332.2	14.50
1	7,099.5	37.19	0.00	1,258.2	6.59	6.59	519.1	10.58	519.1	10.58

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

Project Name/Number : 5425 franklin

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Title **5425 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 10'

Page : 1
Date: 6 FEB 2023

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Segmental Retaining Wall with Geogrids

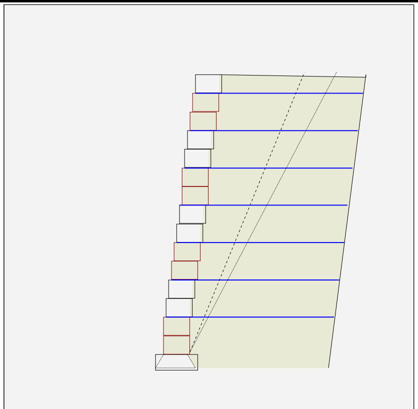
Code: NCMA 3rd

Criteria

Wall height (retained height)	10.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	6.00 ft
Base Sliding Force (w/o Seismic)	1,168.02 lb
Base Resisting Force (w/o Seismic)	7,066.53 lb
Base Sliding (w/o Seismic) FS	6.05
Overturning Moment (w/o Seismic)	3,893.41 ft lb
Resisting Moment (w/o Seismic)	26,926.91 ft lb
Overturning (w/o Seismic) FS	6.92
Applied Bearing Pressure (w/o Seismic)	1,083.98 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	3.69
Eccentricity of Vert. Force (w/o Seismic)	0.26 ft
Effective Base Width (w/o Seismic)	6.52 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.05	OK	
Overturning	2.00	6.92	OK	
Bearing	2.00	3.69	OK	
Internal Sliding	1.50	7.92	OK	
Tensile Overstress	1.50	15.82	OK	
Pullout	1.50	8.67	OK	
Connection	1.50	5.86	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
7	9.33	1.33	0.67	12.7	0.0	0.0	12.7	3,927.0	2,485.4	12.7	308.56	195.29
6	8.00	1.33	2.00	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
5	6.67	1.33	3.33	63.6	0.0	0.0	63.6	3,927.0	2,485.4	63.6	61.71	39.06
4	5.33	1.33	4.67	89.1	0.0	0.0	89.1	3,927.0	2,485.4	89.1	44.08	27.90
3	4.00	1.33	6.00	114.5	0.0	0.0	114.5	3,927.0	2,485.4	114.5	34.28	21.70
2	2.67	1.33	7.33	140.0	0.0	0.0	140.0	3,927.0	2,485.4	140.0	28.05	17.75
1	1.33	2.00	8.67	248.2	0.0	0.0	248.2	3,927.0	2,485.4	248.2	15.82	10.01

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
7	110.3	8.67	0.00	672.1	52.81	52.81	5.2	504.56	5.2	504.56
6	1,766.0	46.25	0.00	802.4	21.01	21.01	46.7	70.70	46.7	70.70
5	3,421.6	53.77	0.00	932.6	14.66	14.66	129.8	30.84	129.8	30.84
4	5,077.3	56.99	0.00	1,062.8	11.93	11.93	254.4	18.54	254.4	18.54
3	6,733.0	58.78	0.00	1,193.1	10.42	10.42	420.5	12.95	420.5	12.95
2	8,388.7	59.92	0.00	1,323.3	9.45	9.45	628.1	9.85	628.1	9.85
1	10,044.3	40.47	0.00	1,453.6	5.86	5.86	877.3	7.92	877.3	7.92

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

Project Name/Number : 5425 franklin

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Title **5425 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 12'

Date: 6 FEB 2023

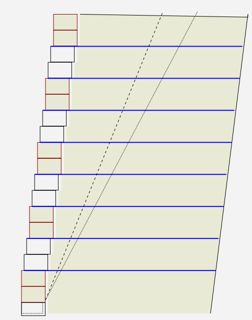
This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5425 franklin pik

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Criteria

Wall height (retained height)	12.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft



Thumbnail

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	8.00 ft
Base Sliding Force (w/o Seismic)	1,681.95 lb
Base Resisting Force (w/o Seismic)	11,735.80 lb
Base Sliding (w/o Seismic) FS	6.98
Overturning Moment (w/o Seismic)	6,727.81 ft lb
Resisting Moment (w/o Seismic)	58,349.34 ft lb
Overturning (w/o Seismic) FS	8.67
Applied Bearing Pressure (w/o Seismic)	1,334.03 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	3.00
Eccentricity of Vert. Force (w/o Seismic)	0.40 ft
Effective Base Width (w/o Seismic)	8.80 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.98	OK	
Overturning	2.00	8.67	OK	
Bearing	2.00	3.00	OK	
Internal Sliding	1.50	7.67	OK	
Tensile Overstress	1.50	12.86	OK	
Pullout	1.50	57.85	OK	
Connection	1.50	5.40	OK	

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
8	10.67	2.00	1.33	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
7	9.33	1.33	2.67	50.9	0.0	0.0	50.9	3,927.0	2,485.4	50.9	77.14	48.82
6	8.00	1.33	4.00	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55
5	6.67	1.33	5.33	101.8	0.0	0.0	101.8	3,927.0	2,485.4	101.8	38.57	24.41
4	5.33	1.33	6.67	127.3	0.0	0.0	127.3	3,927.0	2,485.4	127.3	30.86	19.53
3	4.00	1.33	8.00	152.7	0.0	0.0	152.7	3,927.0	2,485.4	152.7	25.71	16.27
2	2.67	1.33	9.33	178.2	0.0	0.0	178.2	3,927.0	2,485.4	178.2	22.04	13.95
1	1.33	2.00	10.67	305.4	0.0	0.0	305.4	3,927.0	2,485.4	305.4	12.86	8.14

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
8	3,761.5	98.52	0.00	737.2	19.31	19.31	20.8	155.04	20.8	155.04
7	5,748.3	112.92	0.00	867.5	17.04	17.04	83.1	50.21	83.1	50.21
6	7,735.1	101.30	0.00	997.7	13.07	13.07	186.9	27.49	186.9	27.49
5	9,722.0	95.49	0.00	1,128.0	11.08	11.08	332.2	18.42	332.2	18.42
4	11,708.8	92.00	0.00	1,258.2	9.89	9.89	519.1	13.71	519.1	13.71
3	13,695.6	89.68	0.00	1,388.4	9.09	9.09	747.5	10.87	747.5	10.87
2	15,682.4	88.02	0.00	1,518.7	8.52	8.52	1,017.5	9.00	1,017.5	9.00
1	17,669.2	57.85	0.00	1,648.9	5.40	5.40	1,328.9	7.67	1,328.9	7.67

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5425 franklin
Title **5425 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 14'

Date: 6 FEB 2023

This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5425 franklin pik

Segmental Retaining Wall with Geogrids

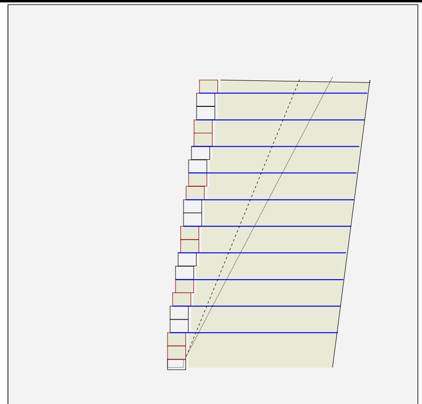
Code: NCMA 3rd

Criteria

Wall height (retained height)	14.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

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Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Stability

Base length	8.40 ft
Base Sliding Force (w/o Seismic)	2,289.32 lb
Base Resisting Force (w/o Seismic)	14,578.40 lb
Base Sliding (w/o Seismic) FS	6.37
Overturning Moment (w/o Seismic)	10,683.51 ft lb
Resisting Moment (w/o Seismic)	77,764.03 ft lb
Overturning (w/o Seismic) FS	7.28
Applied Bearing Pressure (w/o Seismic)	1,584.14 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	2.53
Eccentricity of Vert. Force (w/o Seismic)	0.40 ft
Effective Base Width (w/o Seismic)	9.20 ft

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.37	OK	
Overturning	2.00	7.28	OK	
Bearing	2.00	2.53	OK	
Internal Sliding	1.50	6.55	OK	
Tensile Overstress	1.50	10.83	OK	
Pullout	1.50	60.44	OK	
Connection	1.50	5.08	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
10	13.33	1.33	0.67	12.7	0.0	0.0	12.7	3,927.0	2,485.4	12.7	308.56	195.29
9	12.00	1.33	2.00	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
8	10.67	1.33	3.33	63.6	0.0	0.0	63.6	3,927.0	2,485.4	63.6	61.71	39.06
7	9.33	1.33	4.67	89.1	0.0	0.0	89.1	3,927.0	2,485.4	89.1	44.08	27.90
6	8.00	1.33	6.00	114.5	0.0	0.0	114.5	3,927.0	2,485.4	114.5	34.28	21.70
5	6.67	1.33	7.33	140.0	0.0	0.0	140.0	3,927.0	2,485.4	140.0	28.05	17.75
4	5.33	1.33	8.67	165.5	0.0	0.0	165.5	3,927.0	2,485.4	165.5	23.74	15.02
3	4.00	1.33	10.00	190.9	0.0	0.0	190.9	3,927.0	2,485.4	190.9	20.57	13.02
2	2.67	1.33	11.33	216.4	0.0	0.0	216.4	3,927.0	2,485.4	216.4	18.15	11.49
1	1.33	2.00	12.67	362.7	0.0	0.0	362.7	3,927.0	2,485.4	362.7	10.83	6.85

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
10	1,063.0	83.52	0.00	672.1	52.81	52.81	5.2	534.61	5.2	534.61
9	3,380.9	88.55	0.00	802.4	21.01	21.01	46.7	80.72	46.7	80.72
8	5,698.8	89.56	0.00	932.6	14.66	14.66	129.8	36.85	129.8	36.85
7	8,016.8	89.99	0.00	1,062.8	11.93	11.93	254.4	22.83	254.4	22.83
6	10,334.7	90.23	0.00	1,193.1	10.42	10.42	420.5	16.29	420.5	16.29
5	12,652.7	90.38	0.00	1,323.3	9.45	9.45	628.1	12.59	628.1	12.59
4	14,970.6	90.48	0.00	1,453.6	8.79	8.79	877.3	10.23	877.3	10.23
3	17,288.6	90.56	0.00	1,583.8	8.30	8.30	1,168.0	8.62	1,168.0	8.62
2	19,606.5	90.62	0.00	1,714.0	7.92	7.92	1,500.3	7.44	1,500.3	7.44
1	21,924.5	60.44	0.00	1,844.3	5.08	5.08	1,874.0	6.55	1,874.0	6.55

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

PDR Engineers, Inc.
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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

5429 FRANKLIN PIKE
OAKHILL, TENNESSEE

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5429 franklin
Title **5429 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 4'

Page : 1
Date: 6 FEB 2023

This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5429 franklin pik

Segmental Retaining Wall with Geogrids

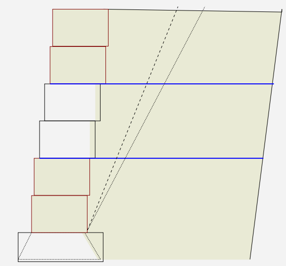
Code: NCMA 3rd

Criteria

Wall height (retained height)	4.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

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Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	4.00 ft
Base Sliding Force (w/o Seismic)	186.88 lb
Base Resisting Force (w/o Seismic)	1,650.64 lb
Base Sliding (w/o Seismic) FS	8.83
Overturning Moment (w/o Seismic)	249.18 ft lb
Resisting Moment (w/o Seismic)	3,822.69 ft lb
Overturning (w/o Seismic) FS	15.34
Applied Bearing Pressure (w/o Seismic)	381.23 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	10.49
Eccentricity of Vert. Force (w/o Seismic)	0.16 ft
Effective Base Width (w/o Seismic)	4.33 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	8.83	OK	
Overturning	2.00	15.34	OK	
Bearing	2.00	10.49	OK	
Internal Sliding	1.50	37.69	OK	
Tensile Overstress	1.50	51.43	OK	
Pullout	1.50	28.10	OK	
Connection	1.50	11.36	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
2	2.67	2.00	1.33	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
1	1.33	2.00	2.67	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
2	1,483.5	38.85	0.00	737.2	19.31	19.31	20.8	129.99	20.8	129.99
1	2,145.7	28.10	0.00	867.5	11.36	11.36	83.1	37.69	83.1	37.69

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

PDR Engineers, Inc.
2000 Lindell Avenue
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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5429 franklin
Title **5429 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 6'

Date: 6 FEB 2023

This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5429 franklin pik

Segmental Retaining Wall with Geogrids

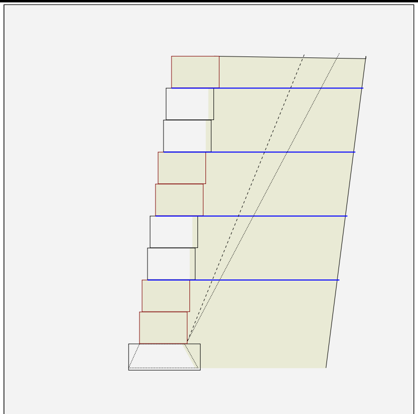
Code: NCMA 3rd

Criteria

Wall height (retained height)	6.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



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Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	4.00 ft
Base Sliding Force (w/o Seismic)	420.49 lb
Base Resisting Force (w/o Seismic)	2,543.95 lb
Base Sliding (w/o Seismic) FS	6.05
Overturning Moment (w/o Seismic)	840.98 ft lb
Resisting Moment (w/o Seismic)	6,326.79 ft lb
Overturning (w/o Seismic) FS	7.52
Applied Bearing Pressure (w/o Seismic)	589.86 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	6.78
Eccentricity of Vert. Force (w/o Seismic)	0.16 ft
Effective Base Width (w/o Seismic)	4.31 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.05	OK	
Overturning	2.00	7.52	OK	
Bearing	2.00	6.78	OK	
Internal Sliding	1.50	14.96	OK	
Tensile Overstress	1.50	29.39	OK	
Pullout	1.50	18.73	OK	
Connection	1.50	7.95	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
4	5.33	1.33	0.67	12.7	0.0	0.0	12.7	3,927.0	2,485.4	12.7	308.56	195.29
3	4.00	1.33	2.00	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
2	2.67	1.33	3.33	63.6	0.0	0.0	63.6	3,927.0	2,485.4	63.6	61.71	39.06
1	1.33	2.00	4.67	133.6	0.0	0.0	133.6	3,927.0	2,485.4	133.6	29.39	18.60

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
4	238.4	18.73	0.00	672.1	52.81	52.81	5.2	479.51	5.2	479.51
3	1,231.8	32.26	0.00	802.4	21.01	21.01	46.7	62.35	46.7	62.35
2	2,225.2	34.97	0.00	932.6	14.66	14.66	129.8	25.83	129.8	25.83
1	3,218.6	24.09	0.00	1,062.8	7.95	7.95	254.4	14.96	254.4	14.96

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5429 franklin
Title **5429 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 8'

Date: 6 FEB 2023

This Wall in File: \\pdr-server\z drive\urban development group\5425 franklin pike\5429 franklin pik

Segmental Retaining Wall with Geogrids

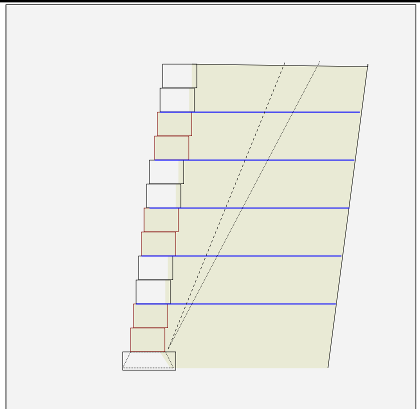
Code: NCMA 3rd

Criteria

Wall height (retained height)	8.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	5.60 ft
Base Sliding Force (w/o Seismic)	747.53 lb
Base Resisting Force (w/o Seismic)	5,146.58 lb
Base Sliding (w/o Seismic) FS	6.88
Overturning Moment (w/o Seismic)	1,993.42 ft lb
Resisting Moment (w/o Seismic)	17,739.17 ft lb
Overturning (w/o Seismic) FS	8.90
Applied Bearing Pressure (w/o Seismic)	841.09 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	4.76
Eccentricity of Vert. Force (w/o Seismic)	0.26 ft
Effective Base Width (w/o Seismic)	6.12 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.88	OK	
Overturning	2.00	8.90	OK	
Bearing	2.00	4.76	OK	
Internal Sliding	1.50	10.70	OK	
Tensile Overstress	1.50	20.57	OK	
Pullout	1.50	38.17	OK	
Connection	1.50	6.59	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
5	6.67	2.00	1.33	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
4	5.33	1.33	2.67	50.9	0.0	0.0	50.9	3,927.0	2,485.4	50.9	77.14	48.82
3	4.00	1.33	4.00	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55
2	2.67	1.33	5.33	101.8	0.0	0.0	101.8	3,927.0	2,485.4	101.8	38.57	24.41
1	1.33	2.00	6.67	190.9	0.0	0.0	190.9	3,927.0	2,485.4	190.9	20.57	13.02

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
5	1,988.5	52.08	0.00	737.2	19.31	19.31	20.8	140.01	20.8	140.01
4	3,313.0	65.08	0.00	867.5	17.04	17.04	83.1	42.70	83.1	42.70
3	4,637.6	60.73	0.00	997.7	13.07	13.07	186.9	22.48	186.9	22.48
2	5,962.1	58.56	0.00	1,128.0	11.08	11.08	332.2	14.66	332.2	14.66
1	7,286.7	38.17	0.00	1,258.2	6.59	6.59	519.1	10.70	519.1	10.70

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

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DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065   Cell 615-308-2511
email: jgoff@pdre.net

Project Name/Number : 5429 franklin
Title **5429 Franklin Pike, Oak Hill Tn**
Dsgnr: **Jon F. Goff, P.E.**
Description....
0' to 10'

Date: 6 FEB 2023

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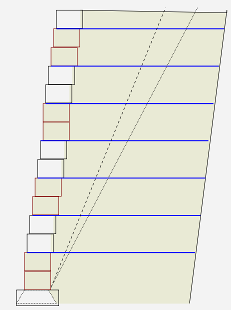
Segmental Retaining Wall with Geogrids

Code: NCMA 3rd


Thumbnail

Criteria

Wall height (retained height)	10.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	6.00 ft
Base Sliding Force (w/o Seismic)	1,168.02 lb
Base Resisting Force (w/o Seismic)	7,066.53 lb
Base Sliding (w/o Seismic) FS	6.05
Overturning Moment (w/o Seismic)	3,893.41 ft lb
Resisting Moment (w/o Seismic)	26,926.91 ft lb
Overturning (w/o Seismic) FS	6.92
Applied Bearing Pressure (w/o Seismic)	1,083.98 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	3.69
Eccentricity of Vert. Force (w/o Seismic)	0.26 ft
Effective Base Width (w/o Seismic)	6.52 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.05	OK	
Overturning	2.00	6.92	OK	
Bearing	2.00	3.69	OK	
Internal Sliding	1.50	7.92	OK	
Tensile Overstress	1.50	15.82	OK	
Pullout	1.50	8.67	OK	
Connection	1.50	5.86	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
7	9.33	1.33	0.67	12.7	0.0	0.0	12.7	3,927.0	2,485.4	12.7	308.56	195.29
6	8.00	1.33	2.00	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
5	6.67	1.33	3.33	63.6	0.0	0.0	63.6	3,927.0	2,485.4	63.6	61.71	39.06
4	5.33	1.33	4.67	89.1	0.0	0.0	89.1	3,927.0	2,485.4	89.1	44.08	27.90
3	4.00	1.33	6.00	114.5	0.0	0.0	114.5	3,927.0	2,485.4	114.5	34.28	21.70
2	2.67	1.33	7.33	140.0	0.0	0.0	140.0	3,927.0	2,485.4	140.0	28.05	17.75
1	1.33	2.00	8.67	248.2	0.0	0.0	248.2	3,927.0	2,485.4	248.2	15.82	10.01

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
7	110.3	8.67	0.00	672.1	52.81	52.81	5.2	504.56	5.2	504.56
6	1,766.0	46.25	0.00	802.4	21.01	21.01	46.7	70.70	46.7	70.70
5	3,421.6	53.77	0.00	932.6	14.66	14.66	129.8	30.84	129.8	30.84
4	5,077.3	56.99	0.00	1,062.8	11.93	11.93	254.4	18.54	254.4	18.54
3	6,733.0	58.78	0.00	1,193.1	10.42	10.42	420.5	12.95	420.5	12.95
2	8,388.7	59.92	0.00	1,323.3	9.45	9.45	628.1	9.85	628.1	9.85
1	10,044.3	40.47	0.00	1,453.6	5.86	5.86	877.3	7.92	877.3	7.92

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

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Segmental Retaining Wall with Geogrids

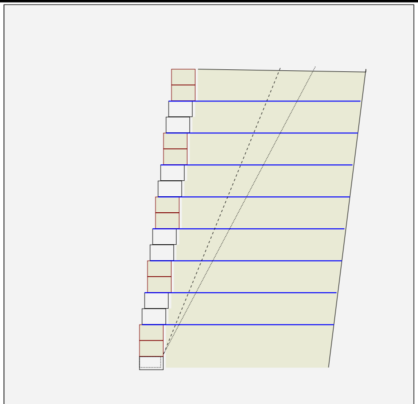
Code: NCMA 3rd

Criteria

Wall height (retained height)	12.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12



Thumbnail

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	8.00 ft
Base Sliding Force (w/o Seismic)	1,681.95 lb
Base Resisting Force (w/o Seismic)	11,735.80 lb
Base Sliding (w/o Seismic) FS	6.98
Overturning Moment (w/o Seismic)	6,727.81 ft lb
Resisting Moment (w/o Seismic)	58,349.34 ft lb
Overturning (w/o Seismic) FS	8.67
Applied Bearing Pressure (w/o Seismic)	1,334.03 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	3.00
Eccentricity of Vert. Force (w/o Seismic)	0.40 ft
Effective Base Width (w/o Seismic)	8.80 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.98	OK	
Overturning	2.00	8.67	OK	
Bearing	2.00	3.00	OK	
Internal Sliding	1.50	7.67	OK	
Tensile Overstress	1.50	12.86	OK	
Pullout	1.50	57.85	OK	
Connection	1.50	5.40	OK	

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Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
8	10.67	2.00	1.33	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
7	9.33	1.33	2.67	50.9	0.0	0.0	50.9	3,927.0	2,485.4	50.9	77.14	48.82
6	8.00	1.33	4.00	76.4	0.0	0.0	76.4	3,927.0	2,485.4	76.4	51.43	32.55
5	6.67	1.33	5.33	101.8	0.0	0.0	101.8	3,927.0	2,485.4	101.8	38.57	24.41
4	5.33	1.33	6.67	127.3	0.0	0.0	127.3	3,927.0	2,485.4	127.3	30.86	19.53
3	4.00	1.33	8.00	152.7	0.0	0.0	152.7	3,927.0	2,485.4	152.7	25.71	16.27
2	2.67	1.33	9.33	178.2	0.0	0.0	178.2	3,927.0	2,485.4	178.2	22.04	13.95
1	1.33	2.00	10.67	305.4	0.0	0.0	305.4	3,927.0	2,485.4	305.4	12.86	8.14

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
8	3,761.5	98.52	0.00	737.2	19.31	19.31	20.8	155.04	20.8	155.04
7	5,748.3	112.92	0.00	867.5	17.04	17.04	83.1	50.21	83.1	50.21
6	7,735.1	101.30	0.00	997.7	13.07	13.07	186.9	27.49	186.9	27.49
5	9,722.0	95.49	0.00	1,128.0	11.08	11.08	332.2	18.42	332.2	18.42
4	11,708.8	92.00	0.00	1,258.2	9.89	9.89	519.1	13.71	519.1	13.71
3	13,695.6	89.68	0.00	1,388.4	9.09	9.09	747.5	10.87	747.5	10.87
2	15,682.4	88.02	0.00	1,518.7	8.52	8.52	1,017.5	9.00	1,017.5	9.00
1	17,669.2	57.85	0.00	1,648.9	5.40	5.40	1,328.9	7.67	1,328.9	7.67

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

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Segmental Retaining Wall with Geogrids

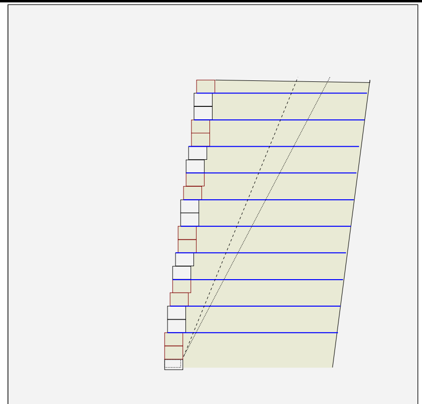
Code: NCMA 3rd

Criteria

Wall height (retained height)	14.00 ft
Backfill slope	Level
Backfill angle	0.0 deg
Embedment	0.5 ft

Soil data

External Soil, Phi_e	33 deg
External soil density (In situ)	120 pcf
Internal Soil, Phi_i	45 deg
Internal soil density	130 pcf
Wall Soil Friction Angle	30 deg
K_a(Horiz)	0.12


Thumbnail

Loading

Dead load	0 psf
Live load	0 psf
Seismic Factor, A	0.00
d_seismic	0.00 in

Stability

Base length	8.60 ft
Base Sliding Force (w/o Seismic)	2,289.32 lb
Base Resisting Force (w/o Seismic)	14,942.40 lb
Base Sliding (w/o Seismic) FS	6.53
Overturning Moment (w/o Seismic)	10,683.51 ft lb
Resisting Moment (w/o Seismic)	81,201.44 ft lb
Overturning (w/o Seismic) FS	7.60
Applied Bearing Pressure (w/o Seismic)	1,583.11 psf
Allowable Bearing Pressure (w/o Seismic)	4,000.00 psf
Bearing (w/o Seismic) FS	2.53
Eccentricity of Vert. Force (w/o Seismic)	0.42 ft
Effective Base Width (w/o Seismic)	9.44 ft

Segmental block data

Vendor selection	Anchor Retaining Wall		
Vendor ESR	ICC ESR-1959[	Valid through	07/01/18
Block selection type	Diamond Pro Straight Face		
Block height	8.00 in	alpha(u_1)	83.00 lb
Block depth	12.00 in	tan(lambda_u1)	2.04
Offset per block	1.00 in	Max_1	2485.00 lb
Batter angle	7.13 deg	alpha(u_2)	2299.00 lb
Wall weight	74.00 psf	tan(lambda_u2)	0.19
		Max_2	3043.00 lb

Geogrid material

Vendor Selection	Mirafi Geogrid		
Geogrid type	Miragrid 8XT		
LTDS	3,927.00 lb/ft		
Ci	0.90		
RF_CR	1.58		
alpha_u	2,283.00 lb		
tan(lambda_u)	0.19		
Max	3,017.00 lb		
alpha_cs1	607.00 lb	alpha_cs2	1,786.00 lb
tan(lambda_cs1)	1.32	tan(lambda_cs2)	0.14
Max_1	1,928.00 lb	Max_2	2,354.00 lb

Factors of Safety

Failure Mode	Static Condition Min Acceptable	Actual	Status	Acceptable
Base Sliding	1.50	6.53	OK	
Overturning	2.00	7.60	OK	
Bearing	2.00	2.53	OK	
Internal Sliding	1.50	6.69	OK	
Tensile Overstress	1.50	10.83	OK	
Pullout	1.50	62.25	OK	
Connection	1.50	5.08	OK	

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

Wall Analysis Table:

Layer	Height ft	Trib Height	Depth to Midpoint	Tension From Surcharge Soil	DL	LL	Static Total Fg	LTDS	LTDS (Seismic)	Total Tension (W/seismic), Fi	FS Tensile Overstress (Static)	w/Seismic)
10	13.33	1.33	0.67	12.7	0.0	0.0	12.7	3,927.0	2,485.4	12.7	308.56	195.29
9	12.00	1.33	2.00	38.2	0.0	0.0	38.2	3,927.0	2,485.4	38.2	102.85	65.10
8	10.67	1.33	3.33	63.6	0.0	0.0	63.6	3,927.0	2,485.4	63.6	61.71	39.06
7	9.33	1.33	4.67	89.1	0.0	0.0	89.1	3,927.0	2,485.4	89.1	44.08	27.90
6	8.00	1.33	6.00	114.5	0.0	0.0	114.5	3,927.0	2,485.4	114.5	34.28	21.70
5	6.67	1.33	7.33	140.0	0.0	0.0	140.0	3,927.0	2,485.4	140.0	28.05	17.75
4	5.33	1.33	8.67	165.5	0.0	0.0	165.5	3,927.0	2,485.4	165.5	23.74	15.02
3	4.00	1.33	10.00	190.9	0.0	0.0	190.9	3,927.0	2,485.4	190.9	20.57	13.02
2	2.67	1.33	11.33	216.4	0.0	0.0	216.4	3,927.0	2,485.4	216.4	18.15	11.49
1	1.33	2.00	12.67	362.7	0.0	0.0	362.7	3,927.0	2,485.4	362.7	10.83	6.85

Wall Analysis Table Continued:

Layer	Pullout Strength	FS Pullout (Static)	(Seismic)	Connection Strength	FS Conn (Static)	(Seismic)	Internal Sliding Force (Static)	FS Internal Sliding (Static)	Internal Sliding Force (Seismic)	FS Internal Sliding (Seismic)
10	1,718.2	135.00	0.00	672.1	52.81	52.81	5.2	537.11	5.2	537.11
9	4,036.1	105.71	0.00	802.4	21.01	21.01	46.7	81.55	46.7	81.55
8	6,354.0	99.85	0.00	932.6	14.66	14.66	129.8	37.35	129.8	37.35
7	8,672.0	97.34	0.00	1,062.8	11.93	11.93	254.4	23.19	254.4	23.19
6	10,989.9	95.95	0.00	1,193.1	10.42	10.42	420.5	16.57	420.5	16.57
5	13,307.9	95.06	0.00	1,323.3	9.45	9.45	628.1	12.81	628.1	12.81
4	15,625.8	94.44	0.00	1,453.6	8.79	8.79	877.3	10.42	877.3	10.42
3	17,943.8	93.99	0.00	1,583.8	8.30	8.30	1,168.0	8.78	1,168.0	8.78
2	20,261.7	93.65	0.00	1,714.0	7.92	7.92	1,500.3	7.59	1,500.3	7.59
1	22,579.7	62.25	0.00	1,844.3	5.08	5.08	1,874.0	6.69	1,874.0	6.69

ASSUMPTIONS AND CRITERIA USED

1. References used include *Design Manual for Segmental Retaining Walls*, *3rd Edition*, by NCMA.
2. Blocks are all same size and uniform offsets (batter) for full wall height.
3. Coulomb earth pressure theory used for earth pressures and failure plane angle.
4. Refer to geotechnical report for backfill material, compaction, and other design data and recommendations.
5. Cap blocks if used are above the retained height and are neglected in this design.
6. Geogrid LTDS and connection values for block vendors obtained from ICC Evaluation Service (ES Legacy Reports) or as provided by vendors. Since these may change or be updated, verification of values is recommended.
7. Block sizes obtained from vendors' literature and may vary with locality.
8. Geogrid layers are equally spaced vertically, all same length, and laid horizontally.
9. Average weight of block and cell infill assumed to be 120 pcf.
10. See vendor web sites (on input screen) for more information and specifications.
11. Vendor specifications or project specifications, whichever is most restrictive, to be followed for construction procedures.
12. Add notes and details for proper drainage.
13. See *User's Manual* Design Example #10 for methodology and sample verification calculations.
14. Final design responsibility is with the project Engineer-of-Record.

PDR Engineers, Inc.
2000 Lindell Avenue
Nashville, Tennessee
Office 615-298-2065 Cell 615-308-2511
email: jgoff@pdre.net

Segmental Retaining Wall with Geogrids

Code: NCMA 3rd

DESIGNER NOTES:

Segmented Block Wall
Diamond Pro Stone Cut with Mirafi Geogrid - Miragrid 8XT

Access Easement

Being a tract of land in Nashville, Davidson County, Tennessee, said tract being a portion of Lots 3 & 4 of the First Revision of Deer Run Subdivision, as of record in Book 9700, Page 825, Register's Office for Davidson County, Tennessee and being more particularly described as follows:

Commencing from an iron rod on the western right- of- way Franklin Pike (R.O.W. varies) said iron rod being the southeastern corner of said Lot 4, having a Tennessee State Plane Bearing with a Northing of 625082.24 and an Easting of 1738669.63, North 55 degrees 40 minutes 47 seconds a distance of 56.83 feet to point of beginning;

Thence from point of beginning, along the common line of Lots 4 & 5 of said First Revision of Deer Run Subdivision, North 55 degrees 40 minutes 47 seconds West a distance of 26.11 feet to a point;

Thence from said point, a new arc, with an Arc Radius of 188.50 feet and an Arc Length of 34.56 feet, with a Chord Bearing North 46 degrees 56 minutes 17 seconds East a distance of 34.51 feet;

Thence North 41 degrees 41 minutes 07 seconds East a distance of 151.92 feet;

Thence an arc with an Arc Radius of 288.50 feet and an Arc Length of 105.88 feet, with a Chord Bearing North 31 degrees 10 minutes 19 seconds East a distance of 105.28 feet;

Thence an arc with an Arc Radius of 411.13 feet and an Arc Length of 22.72 feet, with a Chord Bearing North 22 degrees 14 minutes 29 seconds East a distance of 22.71 feet;

Thence an arc with an Arc Radius of 1209.50 feet and an Arc Length of 138.28 feet, with a Chord Bearing South 38 degrees 45 minutes 38 seconds West a distance of 138.21 feet to a point on the common line of said Lots 4 & 5;

Thence North 54 degrees 31 minutes 11 seconds West a distance of 25.17 feet;

Thence an arc with an Arc Radius of 1184.50 feet and an Arc Length of 138.30 feet, with a Chord Bearing North 38 degrees 49 minutes 48 seconds East a distance of 138.22 feet;

Thence an arc with an Arc Radius of 1184.50 feet and an Arc Length of 58.68 feet, with a Chord Bearing North 34 degrees 03 minutes 57 seconds East a distance of 58.68 feet;

Thence North 36 degrees 02 minutes 40 seconds East a distance of 60.62 feet to a point on the common line of said Lot 3 and Lot 193 on the Addition to Section One Oak Hill Estates as of record in PB 4300, Page 23, Register's Office for Davidson County, Tennessee;

Thence along said common line, South 75 degrees 36 minutes 31 seconds East a distance of 59.45 feet to the western right-of-way of Franklin Pike (variable ROW);

Thence along said right-of-way, an Arc Radius of 1966.67 feet and an Arc Length of 81.59 feet, with a Chord Bearing South 18 degrees 57 minutes 32 seconds West a distance of 81.59 feet;

Thence a new line, North 70 degrees 13 minutes 28 seconds West a distance of 36.46 feet;

Thence an arc with an Arc Radius of 386.13 feet and an Arc Length of 48.04 feet, with a Chord Bearing South 27 degrees 23 minutes 19 seconds West a distance of 48.01 feet;

Thence an arc with an Arc Radius of 386.13 feet and an Arc Length of 21.34 feet, with a Chord Bearing South 22 degrees 14 minutes 29 seconds West a distance of 21.33 feet;

Thence an arc with an Arc Radius of 313.50 feet and an Arc Length of 115.05 feet, with a Chord Bearing South 31 degrees 10 minutes 19 seconds West a distance of 114.41 feet;

Thence South 41 degrees 41 minutes 07 seconds West a distance of 151.92 feet;

Thence an arc with an Arc Radius of 213.50 feet and an Arc Length of 31.13 feet, with a Chord Bearing South 45 degrees 51 minutes 46 seconds West a distance of 31.10 feet to the point of beginning, said easement containing 19,064 square feet more or less based on the boundary survey performed by Clint Elliott Survey; Jason Garrett RLS# 2861.

10’ Sanitary Sewer Easement

Being a tract of land in Nashville, Davidson County, Tennessee, said tract being a portion of Lot 4 of the First Revision of Deer Run Subdivision, as of record in Book 9700, Page 825, Register’s Office for Davidson County, Tennessee and being more particularly described as follows;

Commencing from an iron rod on the western right- of- way Franklin Pike (R.O.W. varies) said iron rod being the southeastern corner of said Lot 4, having a Tennessee State Plane Bearing with a Northing of 625082.24 and an Easting of 1738669.63, North 55 degrees 40 minutes 47 seconds a distance of 101.66 feet to point of beginning.

Thence from point of beginning, along the common line of Lots 4 & 5 of said First Revision of Deer Run Subdivision, North 55 degrees 40 minutes 47 seconds West a distance of 10.63 feet to a point;

Thence from said point, a new line North 14 degrees 26 minutes 43 seconds East a distance of 24.13 feet;

Thence North 64 degrees 13 minutes 20 seconds West a distance of 35.46 feet;

Thence North 20 degrees 26 minutes 27 seconds West a distance of 19.09 feet;

Thence North 32 degrees 09 minutes 35 seconds East a distance of 56.68 feet;

Thence North 25 degrees 22 minutes 48 seconds West a distance of 1.20 feet;

Thence North 27 degrees 17 minutes 06 seconds West a distance of 23.12 feet;

Thence North 46 degrees 17 minutes 55 seconds West a distance of 77.18 feet;

Thence North 44 degrees 57 minutes 33 seconds West a distance of 43.82 feet;

Thence North 18 degrees 49 minutes 37 seconds West a distance of 21.92 feet;

Thence North 46 degrees 53 minutes 56 seconds West a distance of 50.28 feet;

Thence North 05 degrees 50 minutes 32 seconds East a distance of 36.55 feet;

Thence North 54 degrees 29 minutes 35 seconds West a distance of 35.30 feet;

Thence North 14 degrees 19 minutes 01 seconds East a distance of 10.73 feet to a point on the common line of said Lots 3 & 4;

Thence with said common line South 54 degrees 29 minutes 35 seconds East a distance of 44.99 feet;

Thence with a new line South 05 degrees 50 minutes 32 seconds West a distance of 37.41 feet;

Thence South 46 degrees 53 minutes 56 seconds East a distance of 47.82 feet;

Thence South 18 degrees 49 minutes 37 seconds East a distance of 22.10 feet;

Thence South 44 degrees 57 minutes 33 seconds East a distance of 41.38 feet;

Thence South 46 degrees 17 minutes 55 seconds East a distance of 78.74 feet;

Thence South 27 degrees 17 minutes 06 seconds East a distance of 24.97 feet;

Thence South 25 degrees 22 minutes 48 seconds East a distance of 6.85 feet;

Thence South 32 degrees 09 minutes 35 seconds West a distance of 57.23 feet;

Thence South 20 degrees 26 minutes 27 seconds East a distance of 10.13 feet;

Thence South 64 degrees 13 minutes 20 seconds East a distance of 39.64 feet;

Thence South 14 degrees 26 minutes 43 seconds West a distance of 35.94 feet to the point of beginning, said easement containing 4,360 square feet more or less based on the boundary survey performed by Clint Elliott Survey; Jason Garrett RLS# 2861