PRELIMINARY DETERMINATION

PERMIT MODIFICATION

Green Valley Services, LLC.
P.O. Box 170034
Birmingham, Alabama 35217

Green Valley Services, LLC. Landfill
Permit No. 37-35

April 25, 2025

LaBella Associates, on behalf of Green Valley Services, LLC, has applied to the Alabama Department of Environmental Management (ADEM) to modify the Solid Waste Disposal Facility Permit for the Green Valley Services, LLC Landfill (Permit. No. 37-35). The modification includes expanding the permitted disposal area from 9.3 acres to 16.81 acres. In addition, the permittee has requested variances from ADEM Admin. Code Rules 335-13-4-.23(1)(c) and 335-13-4-.20(2)(c)2. The variances will allow the working face and final slopes to increase to 33.3 percent (3 to 1). All other permit conditions will remain unchanged.

The Green Valley Services, LLC Landfill is described as being located in the Southeast ¼ of the Northeast ¼ of Section 33, Township 16 South, Range 2 West in Jefferson County, Alabama.

The Land Division has determined that the permit modification meets the applicable requirements of ADEM's Administrative Code Division 13 regulations

Technical Contact:

Hunter Baker
Solid Waste Engineering Section
Land Division

Alabama Department of Environmental Management

SOLID WASTE DISPOSAL FACILITY *PERMIT*

PERMITTEE:	**Green Valley Services, LLC.**
FACILITY NAME:	**Green Valley Services, LLC. Landfill**
FACILITY LOCATION:	**The Southeast ¼ of the Northeast ¼ of Section 33, Township 16 South, Range 2 West in Jefferson County. The permitted facility consists of 30.37 with a disposal area of 16.81 acres.**
PERMIT NUMBER:	**37-35**
PERMIT TYPE:	**Construction and Demolition**
WASTE APPROVED FOR DISPOSAL:	**Nonputrescible and nonhazardous construction and demolition waste, tires, and rubbish as defined by Rule 335-13-1-.03.**
APPROVED WASTE VOLUME:	**Maximum Average Daily Volume of 300 tons per day**
APPROVED SERVICE AREA:	**Jefferson County, Alabama**

In accordance with and subject to the provisions of the Solid Wastes & Recyclable Materials Management Act, as amended, Code of Alabama 1975, S 22-27-1 to 22-27-27 ("SWRMMA"), the Alabama Environmental Management Act, as amended, Code of Alabama 1975, S 22-22A-1 to 22-22A-15, and rules and regulations adopted thereunder, and subject further to the conditions set forth in this permit, the Permittee is hereby authorized to dispose of the above-described solid wastes at the above-described facility location.

ISSUANCE DATE:	**November 10, 2020**
EFFECTIVE DATE:	**November 10, 2020**
MODIFICATION DATE:	**?????**
EXPIRATION DATE:	**November 9, 2030**

_____

Alabama Department of Environmental Management

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
SOLID WASTE PERMIT

Permittee:	Green Valley Services, LLC. P.O. Box 1700304 Birmingham, Alabama 35217
Landfill Name:	Green Valley Services, LLC. Landfill
Landfill Location:	The Southeast ¼ of the Northeast ¼ of Section 33, Township 16 South, Range 2 West in Jefferson County
Permit Number:	37-35
Landfill Type:	Construction and Demolition

Pursuant to the Solid Wastes & Recyclable Materials Management Act, Code of Alabama 1975, §§ 22-27-1, *et seq*., as amended, and attendant regulations promulgated thereunder by the Alabama Department of Environmental Management (ADEM), this permit is issued to Green Valley Services, LLC. (hereinafter called the Permittee), to operate a solid waste disposal facility, known as the Green Valley Services, LLC. Landfill.

The Permittee must comply with all terms and conditions of this permit. This permit consists of the conditions set forth herein (including those in any attachments), and the applicable regulations contained in Chapters 335-13-1 through 335-13-16 of the ADEM Administrative Code (hereinafter referred to as the "ADEM Admin. Code"). Rules cited are set forth in this document for the purpose of Permittee reference. Any Rule that is cited incorrectly in this document does not constitute grounds for noncompliance on the part of the Permittee. Applicable ADEM Administrative Codes are those that are in effect on the date of issuance of this permit or any revisions approved after permit issuance.

This permit is based on the information submitted to the Department on March 25, 2020 for permit renewal, and on July 24, 2024 for permit modification, as amended, and is known as the Permit Application (hereby incorporated by reference and hereinafter referred to as the Application). Any inaccuracies found in this information could lead to the termination or modification of this permit and potential enforcement action. The Permittee must inform ADEM of any deviation from or changes in the information in the Application that would affect the Permittee's ability to comply with the applicable ADEM Admin. Code or permit conditions.

This permit is effective as of **November 10, 2020**, as modified on **?????,** and shall remain in effect until **November 9, 2030**, unless suspended or revoked.

_____ _____

Alabama Department of Environmental Management Date Signed

SECTION I. STANDARD CONDITIONS

A. Effect of Permit

The Permittee is allowed to dispose of nonhazardous solid waste in accordance with the conditions of this permit and ADEM Admin. Code 335-13. Issuance of this permit does not convey property rights of any sort or any exclusive privilege, nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local laws or regulations. Except for actions brought under Code of Alabama 1975, §§ 22-27-1, *et seq*., as amended, compliance with the conditions of this permit shall be deemed to be in compliance with applicable requirements in effect as of the date of issuance of this permit and any future revisions.

B. Permit Actions

This permit may be suspended, revoked or modified for cause. The filing of a request for a permit modification or the notification of planned changes or anticipated noncompliance on the part of the Permittee, and the suspension or revocation does not stay the applicability or enforceability of any permit condition.

C. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

D. Definitions

For the purpose of this permit, terms used herein shall have the same meaning as those in ADEM Admin. Code 335-13, unless this permit specifically provides otherwise; where terms are not otherwise defined, the meaning associated with such terms shall be as defined by a standard dictionary reference or the generally accepted scientific or industrial meaning of the term.

1. "EPA" for purposes of this permit means the United States Environmental Protection Agency.

2. "Permit Application" for the purposes of this permit, means all permit application forms, design plans, operational plans, closure plans, technical data, reports, specifications, plats, geological and hydrological reports, and other materials which are submitted to the Department in pursuit of a solid waste disposal permit.

E. Duties and Requirements

1. Duty to Comply

The Permittee must comply with all conditions of this permit except to the extent and for the duration such noncompliance is authorized by a variance granted by the Department. Any permit noncompliance, other than noncompliance authorized by a variance, constitutes a violation of Code of Alabama 1975, §§ 22-27-1 *et seq*., as amended, and is grounds for enforcement action, permit suspension, revocation, modification, and/or denial of a permit renewal application.

2. Duty to Reapply

If the Permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must apply for and obtain a new permit. The renewal application must be submitted to the Department at least 180 days before this permit expires.

3. Permit Expiration

This permit and all conditions therein will remain in effect beyond the permit's expiration date if the Permittee has submitted a timely, complete application as required by Section I.E.2., and, through no fault of the Permittee, the Department has not made a final decision regarding the renewal application.

4. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of this permit.

5. Duty to Mitigate

In the event of noncompliance with this permit, the Permittee shall take all reasonable steps to minimize releases to the environment, and shall carry out such measures as are reasonable to prevent significant adverse impacts on human health or the environment.

6. Proper Operation and Maintenance

The Permittee shall at all times properly operate and maintain all facilities and systems of control (and related appurtenances) that are installed or used by the Permittee to achieve compliance with the conditions of this permit.

7. Duty to Provide Information

If requested, the Permittee shall furnish to ADEM, within a reasonable time, any information that ADEM may reasonably need to determine whether cause exists for denying, suspending, revoking, or modifying this permit, or to determine compliance with this permit. If requested, the Permittee shall also furnish the Department with copies of records kept as a requirement of this permit.

8. Inspection and Entry

Upon presentation of credentials and other documents as may be required by law, the Permittee shall allow the employees of the Department or their authorized representative to:

a. Enter at reasonable times the Permittee's premises where the regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit.

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit.

c. Inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit.

d. Sample or monitor, at reasonable times, any substances or parameters at any location for the purposes of assuring permit compliance or as otherwise authorized by Code of Alabama 1975, §§ 22-27-1 *et seq*.

9. Monitoring, Corrective Actions, and Records

a. Samples and measurements taken for the purpose of monitoring or corrective action shall be representative of the monitored activity. The methods used to obtain representative samples to be analyzed must be the appropriate method from ADEM Admin. Code 335-13-4 or the methods as specified in the Application attached hereto and incorporated by reference. Laboratory methods must be those specified in Standard Methods for the Examination of Water and Wastewater (American Public Health Association, latest edition), Methods for Chemical

Analysis of Water and Wastes (EPA-600/4-79-020), Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA Publication SW-846, latest edition), other appropriate EPA methods, or as specified in the Application. All field tests must be conducted using approved EPA test kits and procedures.

b. The Permittee shall retain records, at the location specified in Section I.I., of all monitoring, or corrective action information, including all calibration and maintenance records, copies of all reports and records required by this permit, and records of all data used to complete the application for this permit for a period of at least three years from the date of the sample, measurement, report or record or for periods elsewhere specified in this permit. These periods may be extended by the request of the Department at any time and are automatically extended during the course of any unresolved enforcement action regarding this facility.

c. Records of monitoring and corrective action information shall include.

i. The exact place, date, and time of sampling or measurement.

ii. The individual(s) and company who performed the sampling or measurements.

iii. The date(s) analyses were performed.

iv. The individual(s) and company who performed the analyses.

v. The analytical techniques or methods used.

vi. The results of such analyses.

d. The Permittee shall submit all monitoring and corrective action results at the interval specified elsewhere in this permit.

10. Reporting Planned Changes

The Permittee shall notify the Department, in the form of a request for permit modification, at least 90 days prior to any change in the permitted service area, increase in the waste received, or change in the design or operating procedure as described in this permit, including any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

11. Transfer of Permit

This permit may be transferred to a new owner or operator. All requests for transfer of permits shall be in writing and shall be submitted on forms provided by the Department. Before transferring ownership or operation of the facility during its operating life, the Permittee shall notify the new owner or operator in writing of the requirements of this permit.

12. Certification of Construction

The Permittee may not commence disposal of waste in any new cell or phase until the Permittee has submitted to the Department, by certified mail or hand delivery, a letter signed by both the Permittee and a professional engineer stating that the facility has been constructed in compliance with the permit.

The Department must inspect the constructed cells or phases before the owner or operator can commence waste disposal unless the Permittee is notified that the Department will waive the inspection.

13. Compliance Schedules

Reports of compliance or noncompliance with or any progress reports on interim and final requirements contained in any compliance schedule required and approved by the Department shall be submitted no later than 14 days following each schedule date.

14. Other Noncompliance

The Permittee shall report all instances of noncompliance with the permit at the time monitoring reports are submitted.

15. Other Information

If the Permittee becomes aware that information required by the Application was not submitted or was incorrect in the Application or in any report to the Department, the Permittee shall promptly submit such facts or information. In addition, upon request, the Permittee shall furnish to the Department, within a reasonable time, information related to compliance with the permit.

F. Design and Operation of Facility

The Permittee shall maintain and operate the facility to minimize the possibility of a fire, explosion, or any unplanned sudden or nonsudden release of contaminants (including leachate and explosive gases) to air, soil, groundwater, or surface water, which could threaten human health or the environment.

G. Inspection Requirements

1. The Permittee shall comply with all requirements of ADEM Admin. Code 335-13.

2. The Permittee shall conduct random inspections of incoming loads.

3. Records of all inspections shall be included in the operating record.

H. Recordkeeping and Reporting

1. The Permittee shall maintain a written operating record at the location specified in Section I.I. The operating record shall include:

   a. Documentation of inspections and maintenance activities.

   b. Daily Volume reports.

   c. Personnel training documents and records.

   d. Groundwater monitoring records if required.

   e. Explosive gas monitoring records if required.

   f. Copies of this Permit and the Application.

   g. Copies of all variances granted by the Department, including copies of all approvals of special operating conditions.

2. Quarterly Volume Report

Beginning with the effective date of this permit, the Permittee shall submit, within thirty (30) days after the end of each calendar quarter, a report summarizing the daily waste receipts for the previous (just ended) quarter. Copies of the quarterly reports shall be maintained in the operating record.

3. Monitoring and Corrective Action Reports

The Permittee shall submit reports on all monitoring and corrective activities conducted pursuant to the requirements of this permit, including, but not limited to, groundwater, surface water, explosive gas and leachate monitoring. Groundwater monitoring is not required at this time, but if it is determined that monitoring is necessary, the Permittee shall conduct monitoring and submit reports as directed by the Department. Likewise, if necessary, explosive gas monitoring must be conducted and reports submitted as directed by the Department. Copies of the groundwater and explosive gas monitoring reports shall be maintained in the operating record.

4. Availability, Retention, and Disposition of Records

a. All records, including plans, required under this permit or ADEM Admin. Code 335-13 must be furnished upon request, and made available at reasonable times for inspection by any officer, employee, or representative of the Department.

b. All records, including plans, required under this permit or ADEM Admin. Code 335-13 shall be retained by the Permittee for a period of at least three years. The retention period for all records is extended automatically during the course of any unresolved enforcement action regarding the facility, or as requested by the Department.

c. A copy of records of waste disposal locations and quantities must be submitted to the Department and local land authority upon closure of the facility.

I. Documents to be Maintained by the Permittee

The Permittee shall maintain, at the Green Valley Services, LLC. Landfill facility, the following documents and amendments, revisions and modifications to these documents until an engineer certifies closure.

1. Operating record.

2. Closure Plan.

J. Mailing Location

All reports, notifications, or other submissions which are required by this permit should be sent via signed mail (i.e. certified mail, express mail delivery service, etc.) or hand delivered to:

Mailing Address.
Chief, Solid Waste Branch, Land Division
Alabama Department of Environmental Management
P.O. Box 301463
Montgomery, AL 36130-1463

Physical Address.
Chief, Solid Waste Branch, Land Division
Alabama Department of Environmental Management
1400 Coliseum Blvd.
Montgomery, Alabama 36110-2400

K. Signatory Requirement

All applications, reports or information required by this permit, or otherwise submitted to the Department, shall be signed and certified by the owner as follows:

1. If an individual, by the applicant.

2. If a city, county, or other municipality or governmental entity, by the ranking elected official, or by a duly authorized representative of that person.

3. If a corporation, organization, or other legal entity, by a principal executive officer, of at least the level of Vice President, or by a duly authorized representative of that person.

L. Confidential Information

The Permittee may claim information submitted as confidential pursuant to ADEM Admin. Code 335-1-1-.06.

M. State Laws and Regulations

Nothing in this permit shall be construed to preclude the initiation of any legal action or to relieve the Permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation.

SECTION II. GENERAL OPERATING CONDITIONS

A. Operation of Facility

The Permittee shall operate and maintain the disposal facility consistent with the Application, this permit, and ADEM Admin. Code 335-13.

B. Open Burning

The Permittee shall not allow open burning without prior written approval from the Department and other appropriate agencies. A burn request should be submitted in writing to the Department outlining why that burn request should be granted. This request should include, but not be limited to, specifically what areas will be utilized, types of waste to be burned, the projected starting and completion dates for the project, and the projected days and hours of operation. The approval, if granted, shall be included in the operating record.

C. Prevention of Unauthorized Disposal

The Permittee shall follow the approved procedures for the detecting and preventing the disposal of free liquids, regulated hazardous waste, PCB's, and medical waste at the facility.

D. Unauthorized Discharge

The Permittee shall operate the disposal facility in such a manner that there will be no water pollution or unauthorized discharge. Any discharge from the disposal facility or practice thereof may require a National Pollutant Discharge Elimination System permit under the Alabama Water Pollution Control Act.

E. Industrial Waste Disposal

The Permittee shall not dispose of industrial process waste at this landfill. Only those wastes shown in Section III.B. are allowed for disposal in this landfill.

F. Boundary Markers

The Permittee shall ensure that the facility is identified with a sufficient number of permanent boundary markers that are at least visible from one marker to the next.

G. Certified Operator

The Permittee shall be required to have an operator certified by the Department on-site during hours of operation, in accordance with the requirements of ADEM Admin. Code 335-13-12.

SECTION III. SPECIFIC REQUIREMENTS FOR C/D LANDFILLS

A. Waste Identification and Management

1. Subject to the terms of this permit, the Permittee may accept for disposal the nonhazardous solid wastes listed in III.B. Disposal of any other wastes is prohibited, except waste granted a temporary or one time waiver by the Director.

2. The total permitted area for the Green Valley Services Landfill is approximately 30.37 acres with a disposal area of 16.81 acres.

3. The maximum average daily volume of waste disposed at the facility shall not exceed 300 tons/day. Should the average daily volume exceed this value by 20% or 100 tons/day, whichever is less, for two (2) consecutive quarters, the permittee shall be required to modify the permit in accordance with ADEM Admin. Code 335-13-5-.06(2)(b)2. The average daily volume shall be computed as specified by ADEM Admin. Code 335-13-4-.23(2)(f).

B. Waste Streams

The Permittee may accept for disposal nonputrescible and nonhazardous construction and demolition waste, tires, and rubbish as defined by ADEM Admin. Code 335-13-1-.03.

C. Service Area:

The Permittee is allowed to receive waste for disposal from Jefferson County, Alabama.

D. Waste Placement, Compaction, and Cover

All waste shall be confined to an area as small as possible within a single working face and placed onto an appropriate slope not to exceed 3 to 1 (See Section VIII.1.). All waste shall be spread in layers two feet or less in thickness and thoroughly compacted weekly with adequate landfill equipment prior to placing additional layers of waste or placing the weekly cover. A minimum of six inches of compacted earth or other alternative cover material approved by the Department shall be added at the conclusion of each week's operation unless a variance is granted in Section VIII.

E. Security

The Permittee shall provide artificial and/or natural barriers, which prevent entry of unauthorized vehicular traffic to the facility.

F. All Weather Access Roads

The Permittee shall provide an all-weather access road to the dumping face that is wide enough to allow passage of collection vehicles.

G. Adverse Weather Disposal

The Permittee shall provide for disposal activities in adverse weather conditions.

H. Personnel

The Permittee shall maintain adequate personnel to ensure continued and smooth operation of the facility.

I. Environmental Monitoring and Treatment Structures

The Permittee shall provide protection and proper maintenance of environmental monitoring and treatment structures.

J. Vector Control

The Permittee shall provide for vector control as required by ADEM Admin. Code 335-13.

K. Bulk or Noncontainerized Liquid Waste

The Permittee shall not dispose of bulk or noncontainerized liquid waste, or containers capable of holding liquids, unless the conditions of ADEM Admin. Code 335-13-4-.23(1)(j) are met.

L. Empty Containers

Empty containers larger than 10 gallons in size must be rendered unsuitable for holding liquids prior to disposal in the landfill unless otherwise approved by the Department.

M. Other Requirements

The Department may enhance or reduce any requirements for operating and maintaining the landfill as deemed necessary by the Land Division.

N. Other Permits

The Permittee shall operate the landfill according to this and any other applicable permits.

O. Scavenging and Salvaging Operations

The Permittee shall prevent scavenging and salvaging operations, except as part of a controlled recycling effort. Any recycling operation must be in accordance with plans submitted and approved by the Department.

P. Signs

If the landfill is available to the public or commercial haulers, the Permittee shall provide a sign outlining instructions for use of the site. The sign shall be posted and have the information required by ADEM Admin. Code 335-13-4-.23(1)(f).

Q. Litter Control

The Permittee shall control litter.

R. Fire Control

The Permittee shall provide fire control measures.

SECTION IV. GROUNDWATER MONITORING REQUIREMENTS:

Groundwater monitoring is not required at this landfill provided that the waste stream is in accordance with Section III.B. Should any waste be disposed other than the waste streams indicated in Section III.B., the Department may require that groundwater-monitoring wells be installed.

SECTION V. GAS MONITORING REQUIREMENTS

The permittee shall monitor for explosive gases in accordance with ADEM Admin. Code 335-13-4-.16.

SECTION VI. SURFACE WATER MANAGEMENT

The Permittee shall construct and maintain run-on and run-off control structures to control the discharge of pollutants in stormwater. Any discharges from drainage control structures shall be permitted through a discharge permit issued by the ADEM Water Division.

SECTION VII. CLOSURE AND POST-CLOSURE REQUIREMENTS

The Permittee shall close the landfill and perform post-closure care of the landfill in accordance with ADEM Admin. Code 335-13.

A. Final Cover

The Permittee shall grade final soil cover such that surface water does not pond over the permitted area as specified in the Application. The Permittee has been granted a variance for 3 to 1 slopes for the final cover system (See Section VIII.2.). All other requirements for the final cover system shall comply with ADEM Admin. Code 335-13.

B. Vegetative Cover

The Permittee shall establish a vegetative or other appropriate cover, as approved by the Department, within 90 days after completion of final grading requirements in the Application. Preparation of a vegetative cover shall include, but not be limited to, the placement of seed, fertilizer, mulch, and water.

C. Notice of Intent

The Permittee shall place in the operating record and notify the Department of their intent to close the landfill prior to beginning closure.

D. Completion of Closure Activities

The Permittee must complete closure activities of each landfill unit in accordance with the Closure Plan within 180 days of the last known receipt of waste.

E. Certification of Closure

Following closure of each unit, the Permittee must submit to the Department a certification, signed by an engineer, verifying the closure has been completed according to the Closure Plan.

F. Post-Closure Care Period

Post-closure care activities shall be conducted after closure of each unit throughout the life of this permit and continuing for a period of thirty (30) years following closure of the facility. The Department may shorten or

extend the post-closure care period applicable to the solid waste disposal facility. The Permittee shall reapply in order to fulfill the post-closure care requirements of this permit.

G. Post-Closure Maintenance

The Permittee shall provide post closure maintenance of the facility to include regularly scheduled inspections. This shall include maintenance of the cover, vegetation, monitoring devices and pollution control equipment and correction of other deficiencies that may be observed by ADEM. Monitoring requirements shall continue throughout the post closure period as determined by the Department unless all waste is removed and no unpermitted discharge to waters of the State have occurred.

H. Post-Closure Use of Property

The Permittee shall ensure that post closure use of the property never be allowed to disturb the integrity of the final cover, liner, or any other component of the containment system. This shall preclude the growing of deep-rooted vegetation on the closed area.

I. Certification of Post-Closure

Following post-closure of each unit, the Permittee must submit to the Department a certification, signed by an engineer, verifying the post-closure has been completed according to the Post-Closure Plan.

J. Notice in Deed to Property

The Permittee shall record a notation onto the land deed containing the property utilized for disposal within 90 days after permit expiration, revocation or when closure requirements are achieved as determined by the Department as stated in the Application. This notation shall state that the land has been used as a solid waste disposal facility, the name of the Permittee, type of disposal activity, location of the disposal facility and beginning and closure dates of the disposal activity.

K. Recording Instrument

The Permittee shall submit a certified copy of the recording instrument to the Department within 120 days after permit expiration, revocation, or as directed by the Department as described in the Application.

L. Removal of Waste

If the Permittee, or any other person(s), wishes to remove waste, waste residues, or any liner or contaminated soils, the owner must request and receive prior approval from the Department.

SECTION VIII. VARIANCES

1. The Permittee is granted a variance from ADEM Admin. Code 335-13-4-.23(1)(c) requiring 4 to 1 operating slopes. The Permittee shall be allowed 3 to 1 operating slopes (See Section III.D.).

2. The Permittee is granted a variance from ADEM Admin. Code 335-13-4-.20(2)(c)2. requiring 4 to 1 slopes for the final cover system. The Permittee shall be allowed 3 to 1 slopes for the final cover system (See Section VII.A.).

Any variance granted by the Department may be terminated by the Department whenever the Department finds, after notice and opportunity for hearing, that the petitioner is in violation of any requirement, condition, schedule, limitation or any other provision of the variance, or that operation under the variance does not meet the minimum requirements established by state and federal laws and regulations or is unreasonably threatening the public health.

Permit Application

LaBella
Powered by partnership.

July 23, 2024

Received
JUL 24 2024
Land Division

Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2059

Attention: Mr. Hunter Baker
Solid Waste Branch
Land Division

RE: Application for the Modification of
Solid Waste Disposal Permit for
Green Valley Services Landfill
ADEM Permit No.: 37-35
Tarrant, Alabama
LaBella Project No.: 2233518

Dear Mr. Baker:

On behalf of Green Valley Services, LLC, Labella Associates, D.P.C. (LaBella) is submitting the enclosed request for modification to Solid Waste Disposal Permit 37-35 issued to Green Valley Services, LLC. This submittal includes the Permit Application (ADEM Form 439) and the Design Report prepared for the permit modification of an existing construction/demolition-inert landfill unit (C/DLF).

The requested modification specifically addresses a proposed new cell within the southern portion of the previously permitted landfill boundary.

LaBella and Green Valley Services, LLC appreciate your consideration in this matter. If you have any questions concerning this submittal or require any additional information, please contact me at wcooch@labellapc.com or office at (205) 985-4874.

Respectfully submitted,
LaBella Associates, DPC

William W. Cooch, P.G.
Principal Geologist

enclosures

cc: Clinton Harris – Green Valley Services, LLC

PERMIT APPLICATION
SOLID WASTE DISPOSAL FACILITY
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
(Submit in Triplicate)

1. **Facility type:**
   - _____ **Municipal Solid Waste Landfill (MSWLF)**
   - _____ **Industrial Landfill (ILF)**
   - X **Construction and Demolition Landfill (C/DLF)**
   - _____ **CCR Landfill (CCRLF)**
   - _____ **CCR Surface Impoundment (CCRSI)**
   - _____ **Other (explain)**_____

2. **Facility Name** Green Valley Services, LLC Landfill

3. **Applicant/Permittee:**

   Name: Green Valley Services, LLC

   Address: 3660 Eddings Place
   Birmingham, Alabama 35217

   Telephone: (205) 632 - 0359

   If applicant/permittee is a Corporation, please list officers:

   Clinton Harris

4. **Location: (include county highway map or USGS map)**

   Township 16 South **Range** 2 West
   Section 33 **County** Jefferson

5. **Land Owner:**

   Name: Green Valley Services, LLC

   Address: 3417 Davey Allison Boulevard
   Hueytown Alabama 35023

   Telephone: (205) 632 - 0359

   (Attach copy of agreement from landowner if applicable.)

6. **Contact Person:**

Name Clinton Harris

Position or Affiliation President

Address: 3417 Davey Allison Boulevard
Hueytown, Alabama 35023

Telephone: (205) 632 - 0359

7. **Size of Facility:** 30.37 **Acres**

Size of Disposal Area(s): 16.812 **Acres**

8. **Identify proposed service area or specific industry that waste will be received from:**

Jefferson County, Alabama

9. **Proposed maximum average daily volume to be received at landfill (choose one):**

300 **Tons/Day** _____ **Cubic Yards/Day**

10. **List all waste streams to be accepted at the facility (i.e., household solid waste, wood boiler ash, tires, trees, limbs, stumps, etc.):**

Non-putrescible and non-hazardous construction and demolition waste, tires, and rubbish as defined by Rule 335-13-1-.03

SIGNATURE (Responsible official of permit applicant):

Clinton Harris **TITLE:** President

DATE: 7-23-24

(please print or type name)

Prepared For:
Green Valley Services, LLC
3417 Davey Allison Boulevard
Hueytown, Alabama 35023

Prepared By:
LaBella Associates, D.P.C.
528 Mineral Trace
Hoover, Alabama 35244

LaBella
Powered by partnership.

Green Valley Landfill Southern Expansion
Jefferson County, Alabama

Design Report

JUNE 2024
LABELLA PROJECT 2233518

GREEN VALLEY LANDFILL
DESIGN REPORT

TABLE OF CONTENTS

ATTACHMENTS

I. GENERAL

This design report has been prepared for the permit modification of an existing construction/demolition-inert landfill unit (C/DLF), operated by Green Valley Services, LLC under the name Green Valley Landfill. The landfill provides waste disposal services for Jefferson County, Alabama.

The Green Valley Landfill is located in Jefferson County, specifically in the Southeast ¼ of the Northeast ¼ of Section 33, Township 16 South, Range 2 West. The permitted acreage of the facility is approximately 30.4 acres in total. The proposed southern expansion waste disposal area has a footprint of approximately 15.20 acres, and is anticipated to provide an additional gross volume of approximately 200,000 cubic yards at final grades. The service area of the facility is proposed to be Jefferson County, Alabama. Wastes approved for disposal at the subject facility are non-hazardous, non-putrescible, inert solid wastes, and rubbish including paper, glass, plastic, cloth, wood, construction debris, leaves, grass clippings, tree limbs, tires and other similar wastes as specified in the facility Permit.

A. GENERAL SITE PLANS

The following are included as part of the permit design plans:

1. Existing Conditions Plan

   The Existing Conditions plan (Drawing No. 01) shows site conditions prior to development of the landfill area.

2. Base Grading Plan

   The Base Grading Plan (Drawing No. 02) shows the proposed landfill base grades.

3. Final Grading Plan

   The Final Grading Plan (Drawing No. 03) shows the proposed landfill final grades, after installation of the final closure cap.

4. Sections

   The Sections are provided (Drawing Nos. 04 through 06) to show perpendicular and transverse cross-sections of the proposed landfill.

5. Post-Development Erosion and Sediment Control Plan

The Post-Development Erosion and Sediment Control Plan (Drawing No. 07) shows the erosion and sediment controls following closure of the proposed landfill area.

6. Details

The Details (Drawing No. 08 & 09) show the project details for the landfill and erosion and sediment controls.

DRAWING #	TITLE
T	Title Sheet
L	Legend and Notes
01	Existing Conditions
02	Base Grading Plan
03	Final Grading Plan
04	Sections
05	Sections
06	Sections
07	Post-Development Erosion and Sediment Control Plan
08	Details
09	Details
10	Adjacent Property Owners

B. GENERAL FACILITY INFORMATION

I. *Facility Information:*

Green Valley Landfill
3360 Eddings Place
Birmingham, AL 35217

II. *Owner Information:*

Green Valley Services, LLC
3360 Eddings Place
Birmingham, AL 35217
205-623-0359

Principal Contact:
Clinton Harris, President
Green Valley Services, LLC
205-632-0359

III. Facility Site Location Information

A. Location Description:

The location of the facility is shown on the Existing Conditions plan (Drawing No. 01).

SITE LIFE AND CAPACITY:

The total volume of the proposed expansion to the landfill is approximately 200,000 cubic yards. The estimated life expectancy added to the landfill from the proposed expansion is 1.7 years, based on an incoming average waste stream of 200 tons per day (with no growth), and average waste compaction of 1,000 pounds per cubic yard (lbs/CY). Deviations from the assumptions noted will affect the number of years accordingly. The average daily intake rate is used to calculate site life and should not be construed as a limit on the facility's daily intake.

FACILITY DESIGN:

1. Floodplain

The facility is not located in a 100-year floodplain.

2. Site Access

Access to the existing landfill is limited to Eddings Place. This access route will not change. The gate will be closed and locked during all non-operating hours to prevent entry and illegal disposal of wastes. The other site borders are heavily wooded and are not accessible. Access to the disposal area is through the existing entrance and across the existing scales.

A Gate Attendant will be stationed at the landfill entrance to monitoring incoming wastes and maintain records of landfill use.

Access to the landfill working face will be off of the permanent access road by use of temporary ramps. A ramp will be necessary for each lift of each phase. These temporary ramps will be located by the landfill operator and constructed in accordance to the permit specifications for the permanent road to maintain all weather traffic.

3. Shelter

Basic sanitary facilities and a weatherproof personnel shelter with heating, lighting and communication will be utilized from the existing facility.

C. PLANS AND DISCUSSION

Initial site preparation consists of installing necessary erosion and sediment control measures, clearing and grubbing of project area, and construction of the access road and base grades.

Construction shall be in accordance with the facility construction specifications. Survey reference points have been provided for construction control. All construction will be located from these reference points. If the points are lost or destroyed or require relocation, new points will be established by professionally qualified personnel. Field measurements will also be performed by qualified personnel.

Any unforeseen subsurface or latent physical conditions that differ from the plans will be reported to the Owner and Engineer. Such unforeseen or differing conditions may warrant further investigations and testing to ensure compliance with the landfill construction design.

Copies of all specifications, drawings, addenda, modifications, and shop drawings, will be kept at the site. Any changes made during construction will be noted on the records and will be made available to the Engineer and Owner. Revised records will be delivered to the Engineer upon completion of the work.

Photographs should be used to document progression of the work in conjunction with the as-built records.

A surveyor licensed in the State of Alabama will perform construction layout and survey control for the proposed disposal unit. A record of significant construction activities will be kept and any unforeseen subsurface or latent physical conditions will be reported and documented.

III. LANDFILL UNIT DESIGN

A. LANDFILL FOUNDATION

1. Design Description

The landfill foundation will consist of undisturbed soil. Based on laboratory analysis performed on native soil, undisturbed soils at base grades will be used as landfill subgrade foundation material. This material consists of clayey gravel (GC) and silty gravel (GM). Where areas of fill are required to achieve base grade, all fill shall be placed in eight (8") loose lifts and compacted 95% of maximum dry density per ASTM D698, Standard Proctor.

2. Settlement Potential

The potential for settlement in the cell foundation is minimal due to the quality of the native soil encountered at base grade. Immediate settlement was assumed to occur instantaneously and with an average uniform load from the edge of the disposal unit to the center. The amount of maximum settlement that is expected to occur as a result of the static load of the waste and cover at final grade of the C&D fill has been estimated to be a maximum of 6.45 ft, see Attachment 1.

3. Bearing Capacity and Stability

The bearing capacity of the native soils beneath the landfill was calculated using a conservative maximum waste thickness of 78-ft. The applied stress was then calculated to be 3.0 tons per square foot (tsf) including liner and final cover system soil components. Dynamic vehicle loading will be negligible compared to 3.0 tsf. The bearing capacity of the native soil has been determined to be 411 tsf. With the maximum load of 3.0 tsf, the Factor of Safety is 137.

The resulting FS indicates that the native soil has an adequate safety factor against bearing capacity failure for the conditions analyzed. For landfills, traditional bearing capacity does not normally govern the design of the landfill with respect to stability. This is due, in part, to the large size of the landfill footprint (relative to the soil depth). However, other related shear stress issues will have an impact and need to be evaluated. This includes primarily slope stability through the waste and in some cases, the subgrade materials. The slope stability of the overall waste mass and perimeter berms, the interim waste slopes, the protective cover veneer, and the final cover veneer are addressed in Attachment 1 along with a bearing capacity evaluation.

4. Bottom Heave or Blow-out

Conditions necessary for blowout are not present at this site. The base grade of the landfill will be a minimum of five (5) feet above the groundwater elevation, and the proposed landfill will be surrounded by an earthen berm. Therefore, excessive hydrostatic pressure is not expected to develop within the landfill to cause blowout.

B. RUN-ON CONTROL SYSTEM

The proposed landfill area has been designed to prevent run-on from a 24-hour, 25-year- storm from entering the active disposal area. A series of temporary diversion

berms and drainage ditches will be in place prior to the construction of the landfill area, to collect and divert stormwater to the sediment basins.

C. RUN-OFF CONTROL SYSTEM

The run-off control system consists of storm water conveyance channels, diversion berms, slope drains, and two sediment basins. Layout and details of the stormwater conveyance channels, diversion berms, and slope drains are included on Drawing No. 07. Calculations used in sizing of these structures are included in Attachment IV of the Closure Plan.

1. Design Volume

Calculations were performed for the Erosion and Sediment Control Plan to determine the total run-off peak flow rates expected to result from the 25 year, 24-hour storm event. The minimum design volumes required by the Alabama Erosion and Sediment Control Handbook in proposed erosion and sediment control devices are provided along with supporting calculations in Attachment IV of the Closure Plan.

2. Design and Performance

The run-off control system is designed for all storm water conveyance channels, diversion berms, and downslope drains to convey run-off. Supporting calculations are provided in Attachment IV of the Closure Plan.

IV. CONSTRUCTION SPECIFICATIONS

The Construction Specifications are previously approved and contain all construction requirements for this permit.

V. CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL

The Construction Quality Assurance (CQA) Plan is previously approved and contains all construction quality control and quality assurance procedures and responsibilities.

END OF DESIGN REPORT

ATTACHMENT 1

CALCULATIONS

LaBella
Powered by partnership.

Project:	Green Valley Landfill So. Expansion		
Project Number:	2233518 Phase 02		
Calculated By:	HAK	Date:	7/11/24
Revised By:		Date:	
Checked By:		Date:	
Subject:	Global Stability		
Sheet:	1 of 6		

GLOBAL STATIC AND SEISMIC SLOPE STABILITY

OBJECTIVE

The objective of this calculation is to analyze the stability of the Green Valley Landfill So. Expansion at final grade conditions. This analysis will determine an acceptable soil to waste friction envelope that will yield deep-seated translational and rotational factors of safety exceeding 1.5 for static conditions and 1.0 for seismic conditions. Final grades represent worst case for stability because interim grades are designed with flatter slopes, and lower waste depths.

This analysis includes:

Attachment A – Cross Section Location
Cross Section Profile
Attachment B – SLIDE v. 9.017 Slope Stability Software Analysis Output Data

METHOD

Cross Section – Final Grade Slopes

A cross-section through the proposed final grades configuration that included the maximum crest height and sloping landfill base grade was considered. The cross section (Section A-A) and profile has a maximum elevation of approximately 742 feet with a waste thickness of approximately 78 feet at the point of maximum elevation. Since global stability is being analyzed, the cover system soils were modeled as one soil unit.

LANDFILL DESIGN

The landfill system design consists of the following (from top to bottom):

- Cover System (2 ft)
- Waste (78 ft thickness)
- Subgrade

STATIC STABILITY ANALYSIS

The software program used to calculate slope stability FS within this analysis is entitled, "SLIDE" version 9.017, compiled by Rocscience, Inc. of Toronto, ON, Canada. The program uses limit equilibrium techniques to determine a minimum Factor of Safety (FS) for each given input cross-section slope. SLIDE will calculate a minimum FS for both rotational and non-circular, translational failure surfaces within the cross-section under both static and seismic conditions based upon slope geometry, a phreatic surface, and the shear strength parameters of waste and soils.

Block Search with Janbu's Method

The Block Search method is a technique used within SLIDE to locate the most critical non-circular failure surface within each cross-section. This method was used for both static and seismic conditions. The Block search method was used in conjunction with the Simplified Janbu Method as

it does not incorporate moment equilibrium and is therefore appropriate for ***translational*** soil movement.

Characteristics of Block Search/Janbu's Method include:

- The ability to single out a confined zone that may represent a potentially weak layer;
- Generating passive and active portions or "blocks" of the failure surface at angles that are randomly generated within a specified range;
- Applicable to any shape of failure surface;
- Satisfies both vertical force and moment equilibrium for each slice and overall horizontal force equilibrium for the entire wedge;
- Considers all interslice shear forces to be horizontal (no interslice shear force);

Bishop's Simplified Method

Bishop's simplified method is a limit equilibrium technique used within this analysis by SLIDE to locate the most critical ***rotational*** failure surface within the cross-section.

Characteristics of Bishop's Method include:

- Dividing failure mass into a number of slices;
- Satisfies vertical force equilibrium for each slice and overall moment equilibrium about the center of the rotational failure surface;
- Specifically applicable to rotational failure surfaces;
- Considers all interslice shear forces to be horizontal (no interslice shear forces).

Janbu's Method

The Simplified Janbu Method was also used for analyzing the most critical ***rotational*** failure surface for each cross section, considering static and seismic conditions. This approach uses the method of slices to determine the stability of the slide mass. The simplified procedure assumes that there are no inter-slice shear forces. Janbu's method satisfies vertical force equilibrium for each slice, as well as overall horizontal force equilibrium for the entire slide mass.

Shear Strength Parameters

The shear strength of the base liner within this stability analysis is represented by the most critical contact interface along the landfill floor and sideslopes defining the weakest material and plane within the landfill base liner.

The shear strength parameters utilized in the analysis were used so that the resulting factor of safety of at least 1.5 for static conditions and 1.0 for seismic conditions were obtained.

LANDFILL DESIGN

SOIL & WASTE PARAMETERS

Cover and Fill Soil Strength

γ: Moist Unit weight of constructed soil layers = 128 pcf

γs: Saturated Unit weight of constructed soil layers = 130 pcf
c': Cohesion = 0 psf
Φ': Friction angle = 34 degrees

Waste Strength Parameters
The shear strength values for construction and demolition waste were estimated to be:

γ: Moist Unit weight of waste = 75 pcf
γs: Saturated Unit weight waste = 80 pcf
c': Cohesion = 0 psf
Φ': Friction angle = 35 degrees

The shear strength values for waste were taken from the Ohio State EPA publication Geotechnical and Stability Analysis for Ohio Waste Containment Facilities, 2004.

Foundation Soil "Rock" Strength
γ: Moist Unit weight of foundation = 128 pcf
γs: Saturated Unit weight of foundation = 130 pcf
c': Cohesion = 100 psf
Φ': Friction angle = 34 degrees

The friction angle used is a conservative value a based upon NAVFAC Design Manual 7.2, 1986, which lists the following friction angles for gravel:

USCS GROUP	SOIL TYPE	FRICTION ANGLE
GC	Clayey Gravel	28
GM	Silty Gravel	34

SEISMIC STABILITY ANALYSIS

The shear wave acceleration is modeled within the stability analysis by inputting a coefficient, (Cs) that is some fraction of gravity. The peak acceleration for the site is estimated to be 0.12 g which is taken from the "Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years (site: hazards.atcouncil.org)" published by the U.S.G.S and included in ASCE 7-10 in 2016.

The peak acceleration at the base (approximately 0.12 g, from USGS Map) was adjusted to reflect the peak acceleration at the crest of the landfill using Figure 8-11 adopted from Singh and Sun (1995). Accordingly, the peak acceleration at the crest is estimated to be 0.17 g.

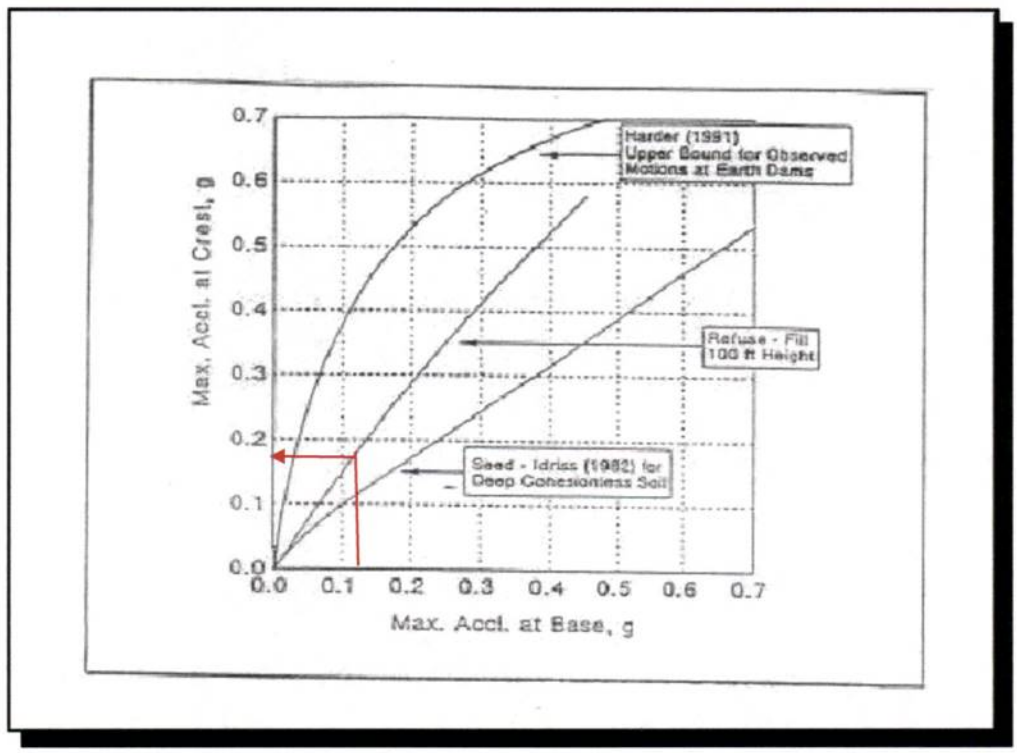


Figure 8-11 Approximate relationship between maximum accelerations at the base and crest for various ground conditions. Singh and Sun,1995, Figure 3.

The modified peak horizontal ground acceleration was used directly as the seismic coefficient in the SLIDE slope stability program.

SLOPE STABILITY RESULTS

Factors of safety (FS) were calculated for the final slope condition for the new landfill expansion. The SLIDE software package calculated FS, expressing the ratio of resisting to driving forces, for each failure surface considering static conditions. Attachment B contains the SLIDE slope stability software output data.

The most critical failure surface for the cross section was then evaluated under seismic conditions.

RESULTS & OUTPUT

Factors of safety (FS) were calculated for the final slope condition for the C&D landfill. The SLIDE software package calculated FS, expressing the ratio of resisting to driving forces, for each failure surface considering static and seismic conditions. The SLIDE slope stability software output data are attached. The geometry of the critical failure planes are shown in attachment B. Below is a summary of the analysis files and results.

	Failure Type	Static/Seismic	FS
Cross Section	Translational	Static	**2.92**
	Rotational	Static	**1.77**
	Translational	Seismic	**1.73**
	Rotational	Seismic	**1.25**

CONCLUSIONS

Considering rotational and translational failure surfaces, it was the rotational surfaces that produced the lowest FS for each case. Factors of Safety calculated within this stability analysis comply with industry accepted standards. All ***deep-seated*** translational and rotational analyses provided a static and seismic factor of safety greater than 1.5 and 1.0, respectfully. **In conclusion, the proposed Green Valley Landfill So. Expansion will be structurally stable under static and seismic conditions.**

rocscience

Green Valley Slide
Green Valley Landfill So. Expansion
Date Created: 5/23/2024, 9:21:26 AM
Software Version: 9.034

Table of Contents

Slide2 Analysis Information

Green Valley Slide

Project Summary

File Name:	Green Valley Slide.slmd
Slide2 Modeler Version:	9.034
Project Title:	Green Valley Landfill So. Expansion
Date Created:	5/23/2024, 9:21:26 AM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Group 1	Scenario 1 - Static Circular	Bishop Simplified: 1.772260 Janbu Simplified: 1.682460	00h:00m:00.977s
	Scenario 2 - Static Sliding	Bishop Simplified: 2.920590 Janbu Simplified: 2.689160	00h:00m:00.526s
	Scenario 3 - Seismic Circular	Bishop Simplified: 1.253220 Janbu Simplified: 1.166970	00h:00m:01.54s
	Scenario 4 - Seismic Sliding	Bishop Simplified: 1.883410 Janbu Simplified: 1.729110	00h:00m:00.441s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Left to Right

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	None

Surface Options

Group 1 - Scenario 1 - Static Circular

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	5
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Group 1 - Scenario 2 - Static Sliding

Surface Type:	Non-Circular Block Search
Number of Surfaces:	5000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Disabled
Optimize Surfaces:	Disabled
Left Projection Angle (Start Angle) [deg]:	135
Left Projection Angle (End Angle) [deg]:	135
Right Projection Angle (Start Angle) [deg]:	45
Right Projection Angle (End Angle) [deg]:	45
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	6
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Group 1 - Scenario 3 - Seismic Circular

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	5
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Group 1 - Scenario 4 - Seismic Sliding

Surface Type:	Non-Circular Block Search
Number of Surfaces:	5000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Disabled
Optimize Surfaces:	Disabled
Left Projection Angle (Start Angle) [deg]:	135
Left Projection Angle (End Angle) [deg]:	135
Right Projection Angle (Start Angle) [deg]:	45
Right Projection Angle (End Angle) [deg]:	45
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	6
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Group 1 - Scenario 3 - Seismic Circular

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.17

All other Scenarios

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	128 lbs/ft3
Cohesion	0 psf
Phi	34 °
Water Surface	Assigned per scenario
Hu Type	Custom
Hu	1
Specify alternate strength type above water surface	No

Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	75 lbs/ft3
Cohesion	0 psf
Phi	35 °
Water Surface	Assigned per scenario
Hu Type	Custom
Hu	1
Specify alternate strength type above water surface	No

Foundation	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	128 lbs/ft3
Cohesion	100 psf
Phi	34 °
Water Surface	Assigned per scenario
Hu Type	Custom
Hu	1
Specify alternate strength type above water surface	No

Materials In Use

Material	Scenario 1 - Static Circular	Scenario 2 - Static Sliding	Scenario 3 - Seismic Circular	Scenario 4 - Seismic Sliding
Cover	✓	✓	✓	✓
Waste	✓	✓	✓	✓
Foundation	✓	✓	✓	✓

Global Minimums

Group 1 - Scenario 1 - Static Circular

Method: bishop simplified

FS	1.772260
Center:	770.361, 727.970
Radius:	80.034
Left Slip Surface Endpoint:	708.656, 677.000
Right Slip Surface Endpoint:	766.987, 648.007
Resisting Moment:	2.77704e+06 lb-ft
Driving Moment:	1.56695e+06 lb-ft
Total Slice Area:	351.867 ft2
Surface Horizontal Width:	58.3317 ft
Surface Average Height:	6.03216 ft

Method: janbu simplified

FS	1.682460
Center:	761.831, 709.200
Radius:	61.420
Left Slip Surface Endpoint:	709.528, 677.000
Right Slip Surface Endpoint:	767.029, 648.000
Resisting Horizontal Force:	36147 lb
Driving Horizontal Force:	21484.7 lb
Total Slice Area:	432.868 ft2
Surface Horizontal Width:	57.5011 ft
Surface Average Height:	7.52799 ft

Group 1 - Scenario 2 - Static Sliding

Method: bishop simplified

FS	2.920590
Axis Location:	632.068, 903.072
Left Slip Surface Endpoint:	473.654, 740.879
Right Slip Surface Endpoint:	666.775, 679.024
Resisting Moment:	8.70962e+07 lb-ft
Driving Moment:	2.98215e+07 lb-ft
Total Slice Area:	6168.9 ft2
Surface Horizontal Width:	193.121 ft
Surface Average Height:	31.9433 ft

Method: janbu simplified

FS	2.689160
Axis Location:	632.379, 901.013
Left Slip Surface Endpoint:	475.290, 740.706
Right Slip Surface Endpoint:	666.370, 679.158
Resisting Horizontal Force:	318863 lb
Driving Horizontal Force:	118574 lb
Total Slice Area:	6053.83 ft2
Surface Horizontal Width:	191.081 ft
Surface Average Height:	31.6821 ft

Group 1 - Scenario 3 - Seismic Circular

Method: bishop simplified

FS	1.253220
Center:	769.033, 726.666
Radius:	78.686
Left Slip Surface Endpoint:	708.001, 677.000
Right Slip Surface Endpoint:	766.989, 648.006
Resisting Moment:	2.71862e+06 lb-ft
Driving Moment:	2.1693e+06 lb-ft
Total Slice Area:	375.966 ft2
Surface Horizontal Width:	58.9881 ft
Surface Average Height:	6.37359 ft

Method: janbu simplified

FS	1.166970
Center:	768.960, 700.832
Radius:	66.673
Left Slip Surface Endpoint:	706.692, 677.000
Right Slip Surface Endpoint:	800.955, 642.337
Left Slope Intercept:	706.692 677.000
Right Slope Intercept:	800.955 644.000
Resisting Horizontal Force:	87707.9 lb
Driving Horizontal Force:	75158.4 lb
Total Slice Area:	1370.36 ft2
Surface Horizontal Width:	94.2628 ft
Surface Average Height:	14.5377 ft

Group 1 - Scenario 4 - Seismic Sliding

Method: bishop simplified

FS	1.883410
Axis Location:	630.341, 908.949
Left Slip Surface Endpoint:	468.402, 741.431
Right Slip Surface Endpoint:	667.191, 678.887
Resisting Moment:	9.18708e+07 lb-ft
Driving Moment:	4.87789e+07 lb-ft
Total Slice Area:	6538.57 ft2
Surface Horizontal Width:	198.79 ft
Surface Average Height:	32.8919 ft

Method: janbu simplified

FS	1.729110
Axis Location:	630.341, 908.949
Left Slip Surface Endpoint:	468.402, 741.431
Right Slip Surface Endpoint:	667.191, 678.887
Resisting Horizontal Force:	336739 lb
Driving Horizontal Force:	194747 lb
Total Slice Area:	6538.57 ft2
Surface Horizontal Width:	198.79 ft
Surface Average Height:	32.8919 ft

Global Minimum Coordinates

Group 1 - Scenario 2 - Static Sliding

Method: bishop simplified

X	Y
473.654	740.879
551.994	662.539
647	661
662.688	677.158
665.964	678.235
666.775	679.024

Method: janbu simplified

X	Y
475.29	740.706
553.482	662.514
647	661
662.688	677.158
665.195	677.982
666.37	679.158

Group 1 - Scenario 4 - Seismic Sliding

Method: bishop simplified

X	Y
468.402	741.431
547.217	662.616
647	661
662.688	677.158
665.964	678.235
666.54	678.235
667.191	678.887

Method: janbu simplified

X	Y
468.402	741.431
547.217	662.616
647	661
662.688	677.158
665.964	678.235
666.54	678.235
667.191	678.887

Discharge Sections

Entity Information

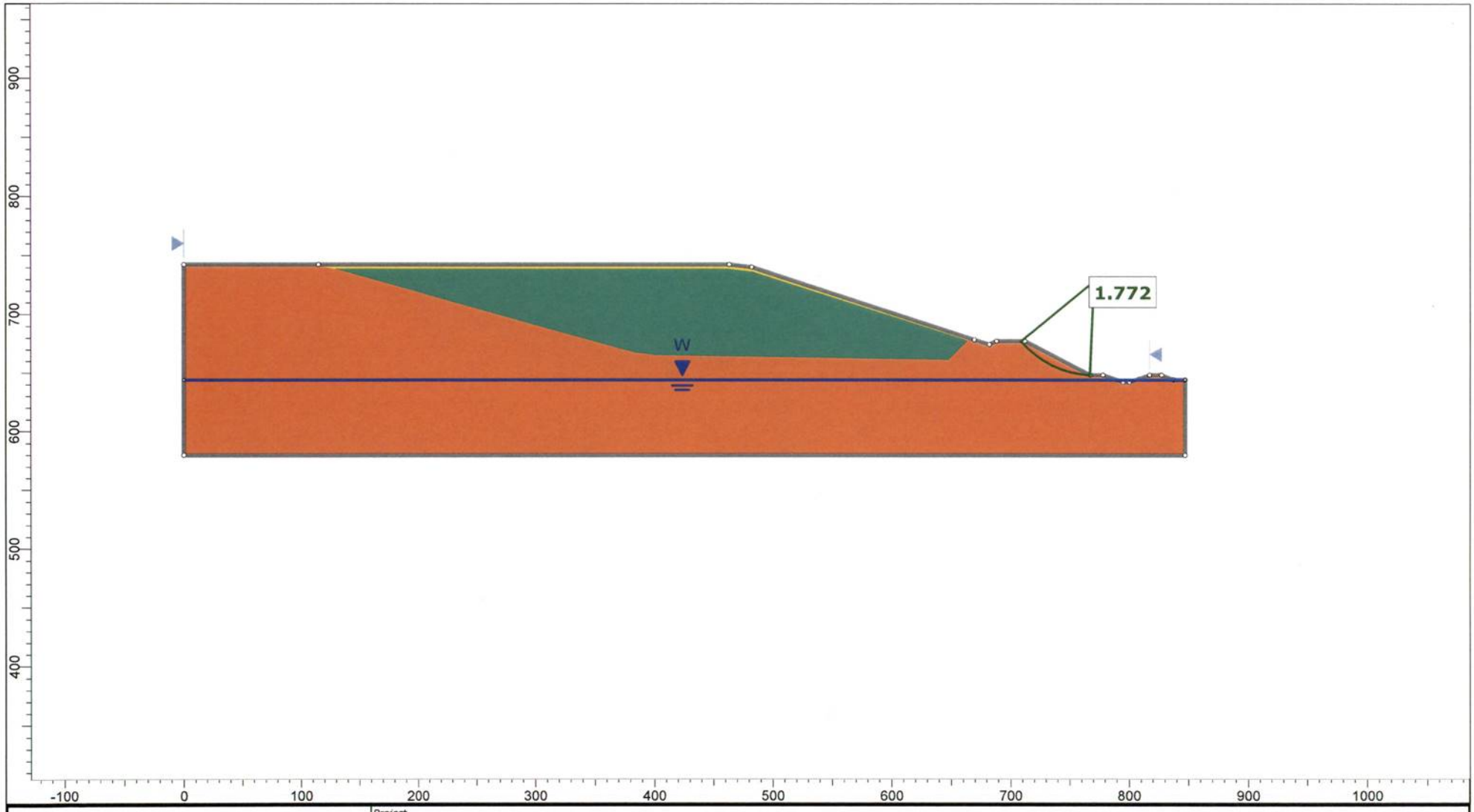
Group 1

Shared Entities

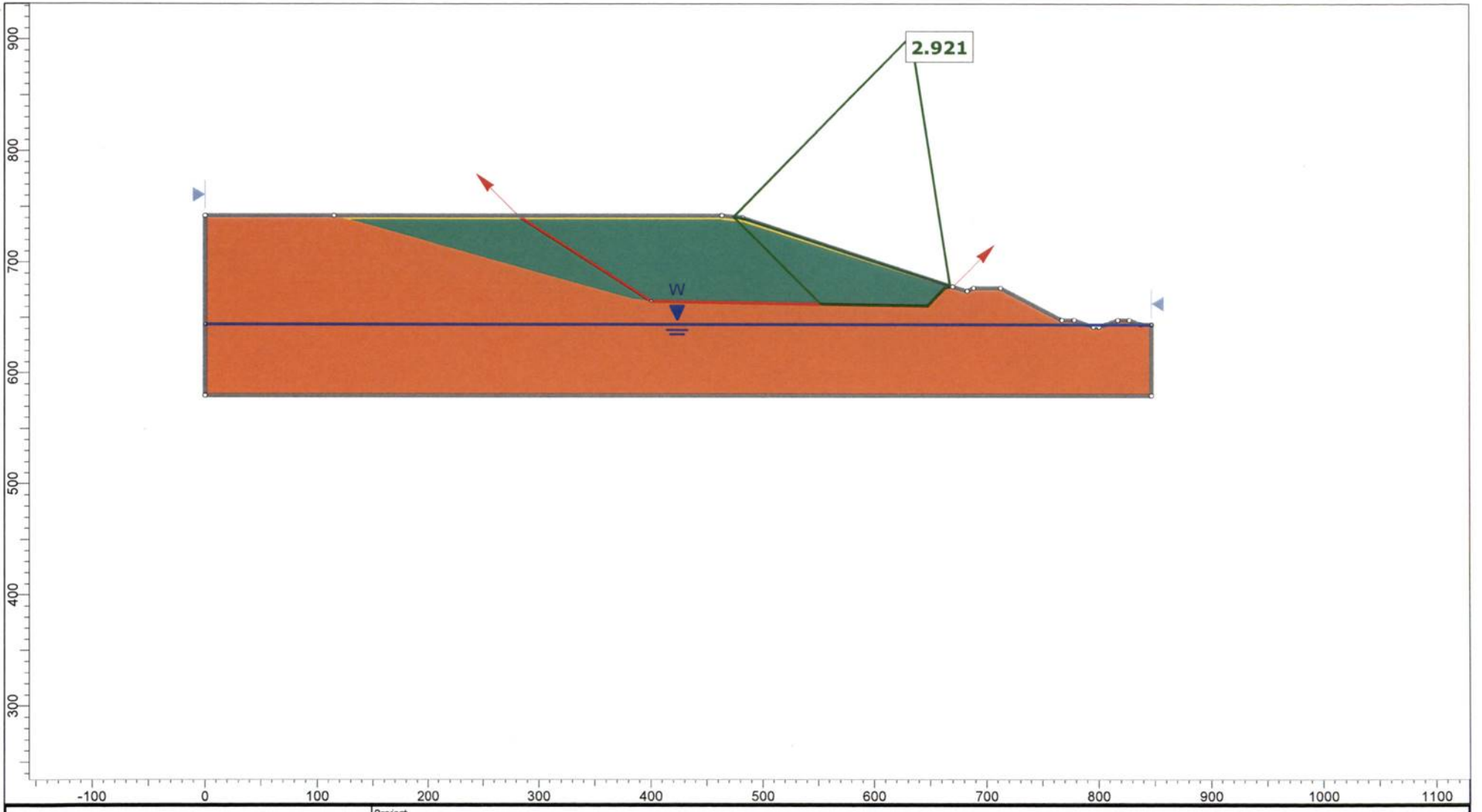
Type	Coordinates (x,y)
External Boundary	847, 580 847, 644 837, 644 827, 648 817, 648 800, 642 795, 642 778, 648 767, 648 712, 677 688, 677 682, 674 669.166, 678.235 482, 740 463, 742 115, 742 0, 742 0, 580
Material Boundary	115, 742 123.438, 740 124.648, 739.713 126.351, 739.309 127.981, 738.923 130.082, 738.425 385, 667 400, 665 647, 661 662.688, 677.158 663.841, 677.537 663.863, 677.544 665.091, 677.948 665.964, 678.235 667.166, 678.235 669.166, 678.235
Material Boundary	130.082, 738.425 462.378, 738.425 481.436, 736.25 663.841, 677.537

Scenario-based Entities

Type	Coordinates (x,y)	Scenario 1 - Static Circular	Scenario 2 - Static Sliding	Scenario 3 - Seismic Circular	Scenario 4 - Seismic Sliding
Water Table	0, 644 847, 644	Assigned to: Cover Waste Foundation	Assigned to: Cover Waste Foundation	Assigned to: Cover Waste Foundation	Assigned to: Cover Waste Foundation
Block Search Polyline	281.406, 742 400, 665 647, 661 662.688, 677.158 665.964, 678.235 669.166, 678.235				
Block Search Polyline	281.406, 742 400, 665 647, 661 662.688, 677.158 665.964, 678.235 669.166, 678.235				



rocscience	Project	Green Valley Landfill So. Expansion	
	Group	Group 1	Scenario: Scenario 1 - Static Circular
	Drawn By		Company
SLIDEINTERPRET 9.034	Date	5/23/2024, 9:21:26 AM	File Name: Green Valley Slide.slmd



rocscience	Project	Green Valley Landfill So. Expansion	
	Group	Group 1	Scenario: Scenario 2 - Static Sliding
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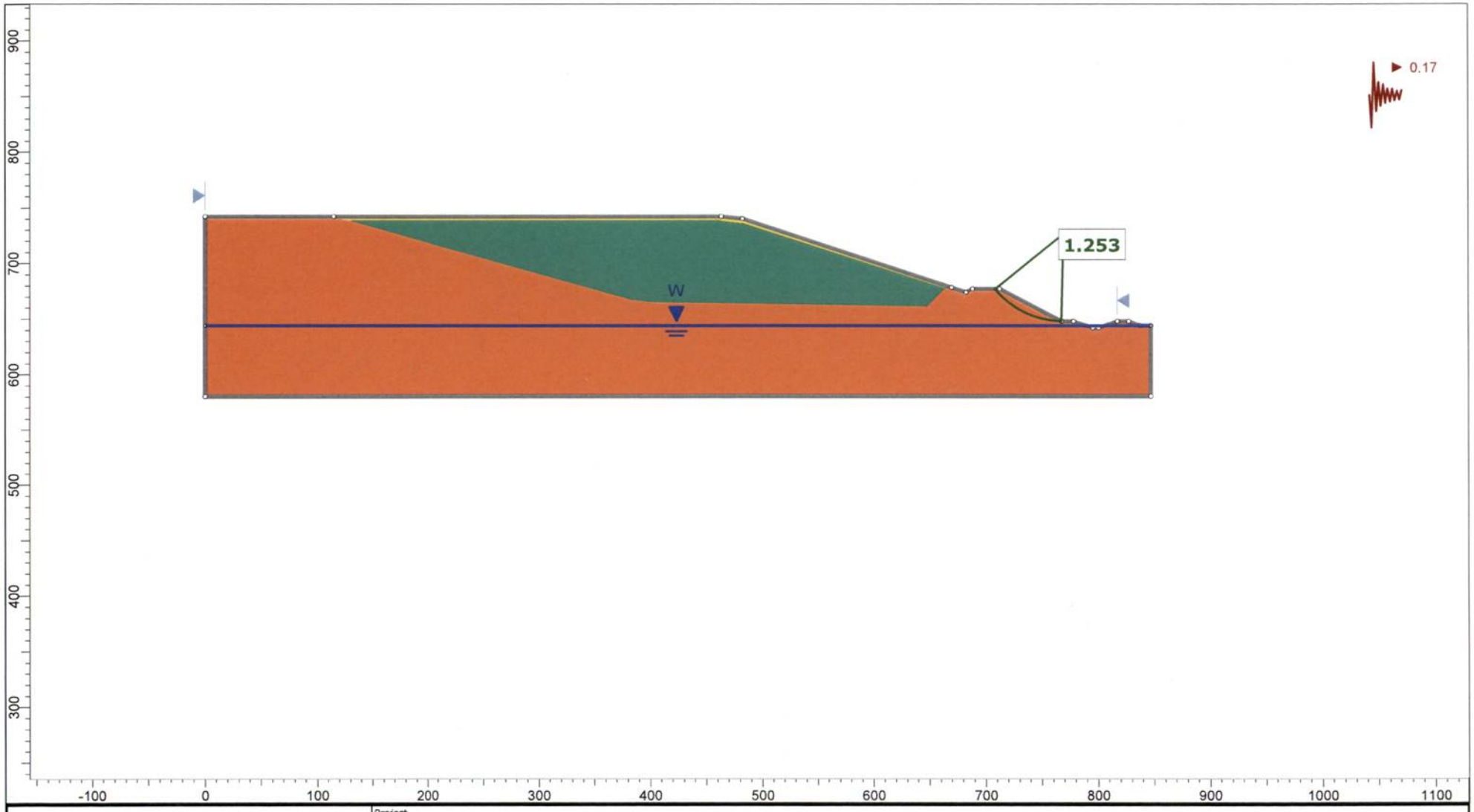

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SLIDEINTERPRET 9.034

Project	Green Valley Landfill So. Expansion		
Group	Group 1	Scenario	Scenario 3 - Seismic Circular
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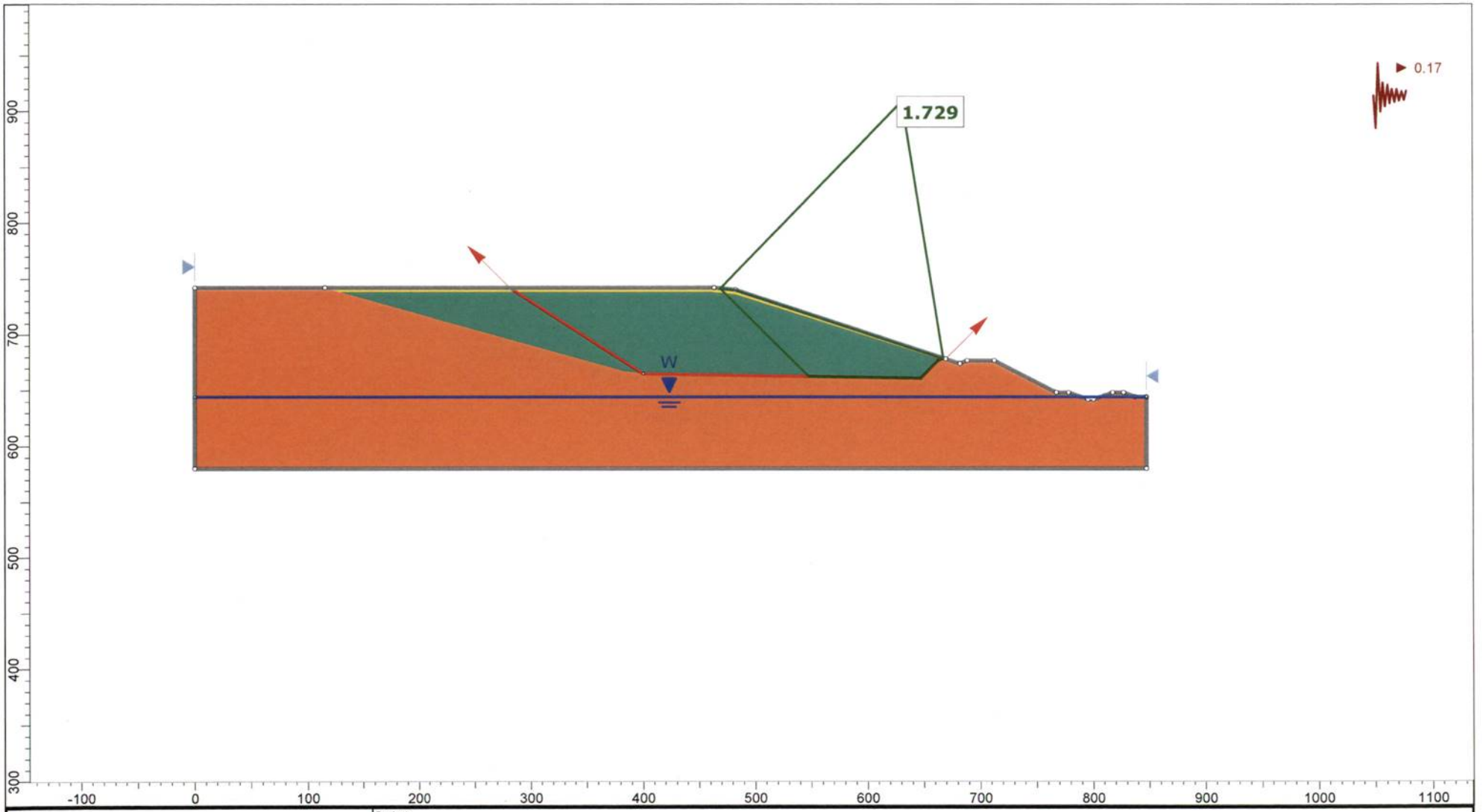
Date	5/23/2024, 9:21:26 AM	File Name	Green Valley Slide.slmd



rocscience	Project	Green Valley Landfill So. Expansion	
	Group	Group 1	Scenario: Scenario 4 - Seismic Sliding
	Drawn By		Company
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BEARING CAPACITY

OBJECTIVE

To determine the bearing capacity of the subgrade material beneath the proposed base liner of the Green Valley Landfill So. Expansion.

METHOD

The surface beneath the landfill base liner must be able to bear the weight of the landfill without enduring shear failure or excessive settlement that, in turn, may cause damage and eventual failure of the landfill base liner. The calculations are based on the Vesic Bearing Capacity Equation.

For conservatism, bearing capacity calculations are performed considering a waste thickness of 78 feet, with an average unit weight of 75 pounds per cubic foot (pcf).

The internal friction angle of the foundation soils is assumed to be 34 degrees for the purpose of this calculation. This is conservative in that the strength used represents a total stress analysis, assuming that the landfill is built quickly relative to the ability of the foundation soils to dissipate excess pore pressures resulting from the loading, when in reality, the opposite can be expected to happen. An additional conservative assumption is that the foundation soil has no cohesion.

A factor of safety (FS) is calculated, comparing the total anticipated applied load to the estimated ultimate load that the foundation soils can support.

SUMMARY TABLE

Component	Thickness (ft)	Cohesion (psf)	Internal Friction Angle (degrees)	Unit Weight (pcf)
Foundation Soils	—	0	34	128
Solid Waste	78*	0	35	75
Vesic Bearing Capacity Factors**	—	Nc = 42.16	Nq = 29.44	$N\gamma$ = 41.06

* Use a conservative maximum waste vertical height of 78 feet.
**Vesic Bearing Capacity Factors were taken from Table 4 below.

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BEARING CAPACITY CALCULATION

The overburden pressures developed by the base liner components are negligible and are not considered in this calculation. The width, B, and the length, L, from the point with the thickest waste mass within the landfill footprint are used for this analysis. The excavation at the thickest waste point in the landfill is approximately 10 feet beneath the existing surface. The friction angle, 34 degrees, is assumed. A vertical pressure and a horizontal base are assumed; therefore, the following equation does not include the inclination, ground, and base factors.

$q_{ult} = cN_c S_c d_c + qN_q S_q d_q + 0.5\gamma B N_\gamma S_\gamma d_\gamma$ (Vesic Equation)

Where:

q_{ult} = ultimate bearing capacity of the subgrade material, (psf).

c = cohesion (conservatively assumed to be 0 psf for the analysis)

γ = unit weight of the foundation soil = 128 pcf.

B = width of the rectangular foundation = 385-feet.

L = length of the rectangular foundation = 630-feet.

D_f = depth of embedment for a footing in a std. bearing capacity analysis = 10-feet.

$q = \gamma D_f$, soil pressure around footing, not applicable for surface footings.

N_c, N_q, N_γ = bearing capacity factors which are a function of the foundation soil's internal angle of friction, use a ϕ of 34° and see Summary Table to obtain factors:

$N_c = 42.16$, $N_q = 29.44$, $N_\gamma = 41.06$

S_c, S_q, S_γ = Shape Factors for use in the Vesic bearing capacity equation,

$S_c = 1 + (N_q / N_c) \times (B/L) = 1.43$

$S_q = 1 + (B/L)\tan\phi = 1.41$

$S_\gamma = 1 - 0.4(B/L) = 0.76$

d_c, d_q, d_γ = Depth Factors for use in the Vesic bearing capacity equation,

$d_c = 1 + 0.4\ (D/B)$, for $D/B <= 1$, = 1.010

$d_q = 1 + 2\tan\phi(1-\sin\phi)^2(D/B)$ = 1.007

$d_\gamma = 1$

$$q_{ult} = cN_c S_c d_c + qN_q S_q d_q + 0.5\gamma B N_\gamma S_\gamma d_\gamma$$

q_{ult}=0+[(128 * 10) * 29.44 * 1.41 * 1.007]+[0.5 * 128 * 385 * 41.06 * 0.76 * 1]

q_{ult} = 53,579 psf + 764,409 psf = 817,988 psf or 409 tsf

The total applied load from the maximum waste thickness is:

q = (unit weight of waste)(maximum waste thickness) + (unit weight of final cover system)(final cover system thickness) + (operating equipment)

q = (75 pcf * 78 ft)$_{\text{Waste}}$ + (128 pcf * 2.0 ft)$_{\text{Final Cover}}$ + 679.1 psf$_{\text{Operating Equipment}}$

q = 6,785 psf or 3.4 tsf

Bearing Capacity Factor of Safety, FS

$$FS = \frac{q\ ultimate}{q} = 409/3.4 = \mathbf{121}$$

CONCLUSION

The bearing capacity of the in situ soils beneath the landfill was calculated using a conservative maximum waste thickness of **78**-ft. The applied stress was then calculated to be **3.4** tons per square foot (tsf) including the worst case for loading and final cover system soil components. The bearing capacity of the underlying foundation soils was estimated to be **409** tsf.

The resulting FS of **121** indicates that the in situ soil has an adequate factor of safety against bearing capacity failure for the conditions analyzed.

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REFERENCES

1) Terzaghi & Peck, **"Soil Mechanics in Engineering Practice",** John Wiley and Sons, 1967.

2) Das, Braja, M., **"Principles of Geotechnical Engineering",** PWS Publishers, 1985.

3) Vesic, Aleksander S., **"Analysis of Ultimate Loads of Shallow Foundations"**, Journal of the Soil Mechanics and Foundations Division, January 1973.

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Bearing Capacity Factors
(Excerpt Taken From Reference 3, Table 4)

Table 4.—Bearing Capacity Factors

ϕ (1)	N_c (2)	N_q (3)	N_γ (4)	N_q/N_c (5)	$\tan\phi$ (6)
0	5.14	1.00	0.00	0.20	0.00
1	5.38	1.09	0.07	0.20	0.02
2	5.63	1.20	0.15	0.21	0.03
3	5.90	1.31	0.24	0.22	0.05
4	6.19	1.43	0.34	0.23	0.07
5	6.49	1.57	0.45	0.24	0.09
6	6.81	1.72	0.57	0.25	0.11
7	7.16	1.88	0.71	0.26	0.12
8	7.53	2.06	0.86	0.27	0.14
9	7.92	2.25	1.03	0.28	0.16
10	8.35	2.47	1.22	0.30	0.18
11	8.80	2.71	1.44	0.31	0.19
12	9.28	2.97	1.69	0.32	0.21
13	9.81	3.26	1.97	0.33	0.23
14	10.37	3.59	2.29	0.35	0.25
15	10.98	3.94	2.65	0.36	0.27
16	11.63	4.34	3.06	0.37	0.29
17	12.34	4.77	3.53	0.39	0.31
18	13.10	5.26	4.07	0.40	0.32
19	13.93	5.80	4.68	0.42	0.34
20	14.83	6.40	5.39	0.43	0.36
21	15.82	7.07	6.20	0.45	0.38
22	16.88	7.82	7.13	0.46	0.40
23	18.05	8.66	8.20	0.48	0.42
24	19.32	9.60	9.44	0.50	0.45
25	20.72	10.66	10.88	0.51	0.47
26	22.25	11.85	12.54	0.53	0.49
27	23.94	13.20	14.47	0.55	0.51
28	25.80	14.72	16.72	0.57	0.53
29	27.86	16.44	19.34	0.59	0.55
30	30.14	18.40	22.40	0.61	0.58
31	32.67	20.63	25.99	0.63	0.60
32	35.49	23.18	30.22	0.65	0.62
33	38.64	26.09	35.19	0.68	0.65
34	42.16	29.44	41.06	0.70	0.67
35	46.12	33.30	48.03	0.72	0.70
36	50.59	37.75	56.31	0.75	0.73
37	55.63	42.92	66.19	0.77	0.75
38	61.35	48.93	78.03	0.80	0.78
39	67.87	55.96	92.25	0.82	0.81
40	75.31	64.20	109.41	0.85	0.84
41	83.86	73.90	130.22	0.88	0.87
42	93.71	85.38	155.55	0.91	0.90

Table 4.—*Continued*

(1)	(2)	(3)	(4)	(5)	(6)
43	105.11	99.02	186.54	0.94	0.93
44	118.37	115.31	224.64	0.97	0.97
45	133.88	134.88	271.76	1.01	1.00
46	152.10	158.51	330.35	1.04	1.04
47	173.64	187.21	403.67	1.08	1.07
48	199.26	222.31	496.01	1.12	1.11
49	229.93	265.51	613.16	1.15	1.15
50	266.89	319.07	762.89	1.20	1.19

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DETERMINATION OF LOW NORMAL LOAD INTERFACE STRENGTH FOR THE FINAL COVER SYSTEM

OBJECTIVE

Calculate the shear strength that will provide a static, unsaturated veneer slope stability Factor of Safety (FS) $\geq$ 1.5 with respect to the landfill cover soils failing along the final cover side slopes. The calculation will also consider dyanamic, unsaturated veneer slope stability under the condition of moving equipment placing and spreading protective cover material on the side slope.

METHOD

The analytical method used to calculate the veneer slope stability FS is taken from a report prepared by the Geosynthetic Research Institute (GRI), Drexel University:

1) Te-Yang Soong and Robert M. Koerner; "*Cover Soil Slope Stability Involving Geosynthetic Interfaces*"; Geosynthetic Research Institute (GRI) Report #18; December 9, 1996.

GRI Report #18 is used to consider the presence of equipment on top of the soil cover layer and provides a FS based on the most critical interface shear strength of final cover components. The FS is calculated by dividing the protective cover material along the side slope into two blocks:

1) an active wedge of protective cover material along the length of the side slope; and,
2) a passive wedge of protective cover material at the toe of the side slope.

A freebody diagram is then drawn identifying the forces on each wedge, and static equilibrium equations are resolved in terms of vertical and horizontal components. Expressions are derived that quantify the magnitude of both the passive and active interwedge forces. Subsequently, the interwedge force equations are set equal to each other and arranged in the form of a quadratic equation that can be solved to calculate a FS.

This calculation analyzes the longest length of the final cover side slope. Figure 1 illustrates the proposed geometry of the final cover side slope and the freebody of the forces acting along the side slope.

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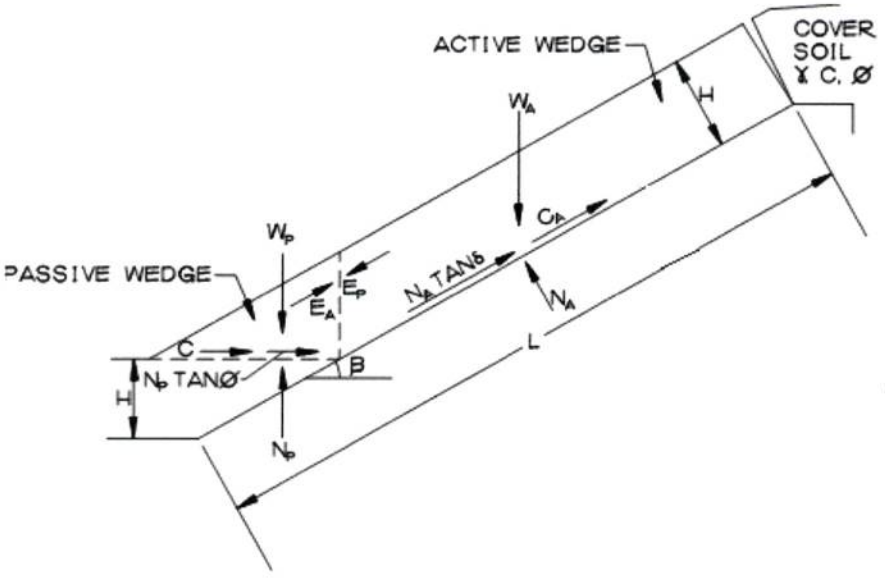

Figure 1, Slope Geometry & Free Body Diagram

Slope Dimensions	
Maximum Length of Cover Side Slope	216 feet
Cover Side Slope Orientation	4H:1V or 14.04 degrees

This veneer slope stability FS calculation is prepared proposing the following assumptions:

- The presence of moving equipment (dynamic loading) along the protective cover side slope is analyzed as presented by GRI Report #18.
- The shear strength component of adhesion developed between material layers is ignored.
- Tensile strength of the geosynthetic materials contributing to the veneer slope stability FS is ignored.
- The protective cover material provides a buttress at the toe of the slope, *i.e.* the passive soil wedge.
- For conservatism, the cohesive strength of the proposed protective cover material was ignored.
- All calculations utilize a 1-foot unit width of side slope.

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LANDFILL COVER

The Landfill Cover System is outlined below, from top to bottom:

- 6-inch thick Vegetative Support Layer (Topsoil);
- 18-inch thick protective soil layer.

PROTECTIVE COVER MATERIAL PARAMETERS

Unit weight: γ_{Total} = 128 pcf;

Cohesion: c = 0 psf; and,
Internal angle of friction: ϕ_i = 34 degrees (conservative).

REQUIRED SHEAR STRENGTH PARAMETERS

The calculation presented within GRI Report #18 will be used to determine the shear strength parameter (contact interface friction angle, $\delta_{interface\ friction}$) that corresponds to a FS $\geq$ 1.5 under drained conditions for all interfaces. The input variables of final cover side slope length, protective coverthickness, and LGP equipment will be held constant while the contact interface friction angle, $\delta_{interface\ friction,}$ is varied, until a FS of $\geq$ 1.5 is achieved. Cohesion values of 0 psf will be assumed.

The calculated $\delta_{interface\ friction}$ that corresponds to the FS $\geq$ 1.5 represents laboratory data where a straight line is drawn from the origin through the first data point (*i.e.* c = 0 psf) that corresponds to the lowest normal load within the given data set. The lowest normal load models the shear strength of protective cover material under relatively light normal loads that are anticipated to be initially encountered in the field during placement of the material. The proposed critical contact interface will undergo ASTM D-5321-92 Direct Shear Testing, and will be required to meet the minimum calculated contact interface friction angle corresponding to the first normal load.

The resulting contact interface friction angles will be included with other minimum shear strength parameters specified within the Construction Quality Assurance (CQA) Plan and/or specifications.

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VARIABLES DEFINED

W_A = Total weight of the active wedge;
W_P = Total weight of the passive wedge;
N_A = Effective force normal to the failure plane of the active wedge;
N_P = Effective force normal to the failure plane of the passive wedge;
γ = Unit weight of the protective cover material;
h = Thickness of the protective cover material;
L = Length of slope measured along the slope;
β = Soil slope angle beneath the cap section;
ϕ = Internal angle of friction within the protective cover soil;
δ = Interface friction angle between the most critical surface to soil interface;
C_a = Adhesive force between the components lying along the most critical interface of the active wedge;
c_a = The adhesion developed between the components lying along the most critical interface of the active wedge;
C = Cohesive force along the failure plane of the passive wedge;
c = cohesion of the protective cover soil;
E_A = Interwedge force acting on the active wedge from the passive wedge;
E_P = Interwedge force acting on the passive wedge from the active wedge; and
FS = Factor of safety against protective cover soil sliding down the slope.

Additional assumptions include:

- The presence of an equipment load along the landfill cover side slope, equipment pushes material from toe towards the crest;
- The shear strength component of adhesion between the landfill cover material and the in-place waste does not exist; and,
- Calculations consider that the 24-inch thick soil protective cover layer is entirely in-place along the length of landfill cover side slope, approximately 216 feet.

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CALCULATIONS

It is proposed that a Low Ground Pressure (LGP) bulldozer will be used to place protective cover material across the side slope. The pressure exerted upon the top of the landfill cover layer by a bulldozer is modeled as illustrated in Figure 2.

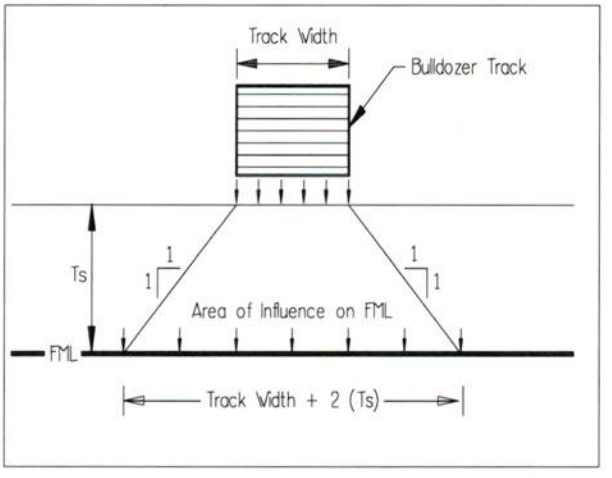

Figure 2, Stress Distribution of the LGP Bulldozer

The following typical LGP Bulldozer equipment specifications are used within the GRI Report #18.

- 2 tracks
- Track length = 9.4 feet
- Track width = 3.0 feet
- Operating weight = 38,300 lbs
- One Track Contact area = 28.2 ft^2
- One Track Contact pressure = 19,150 lbs / 28.2 ft^2 = 679.1 psf

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Subsequently, the forces illustrated in Figure 1 are resolved below to produce a veneer slope stability FS. The equations presented are taken from pages 13 and 14 of GRI Report #18.

$$W_a = \gamma\, h^2 \left[\frac{L}{h} - \frac{1}{\sin\beta} - \frac{\tan\beta}{2} \right]$$

$$N_a = W_a \cos\beta$$

$$C_a = c_a \left[L - \frac{h}{\sin\beta} \right]$$

Balancing the forces in the vertical direction, the following formulation results:

$$E_A \sin\beta = W_A - N_A \cos\beta - \frac{N_A \tan\delta + C_a}{FS} \sin\beta$$

The interwedge force acting on the active wedge is:

$$E_A = \frac{FS \cdot (W_A - N_A \cos\beta) - (N_A \tan\delta + C_a)\sin\beta}{\sin\beta\, FS}$$

The passive wedge is considered in a similar manner:

$$W_p = \frac{\gamma\, h^2}{\sin 2\beta}$$

$$N_p = W_p + E_p \sin\beta$$

$$C = \frac{c\, h}{\sin\beta}$$

Balancing the forces in the horizontal direction produces:

$$E_p \cos\beta = \frac{C + N_p \tan\phi}{FS}$$

The interwedge force acting on the passive wedge is:

$$E_p = \frac{C + W_p \tan\phi}{\cos\beta\,(FS) - \sin\beta \tan\phi}$$

$$a(FS)^2 + b(FS) + c = 0$$

Setting $E_A = E_p$ the equation can be arranged in the form of the quadratic equation, where the coefficients a, b and c are equal to the following expressions:

$$a = (W_A - N_A \cos\beta)\cos\beta$$

$$b = -\left[(W_A - N_A \cos\beta)\sin\beta \tan\phi + (N_A \tan\delta + C_a)\sin\beta\cos\beta + \sin\beta(C + W_p \tan\phi)\right]$$

$$c = (N_A \tan\delta + C_a)\sin^2\beta \tan\phi$$

The quadratic equation is then used to calculate the FS:

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

For the ease of calculations the above quadratic equation was input into a spreadsheet format to produce a FS corresponding to a given set of input parameters. A copy of the spreadsheet calculations displaying the results is included in Attachment A.

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CONCLUSIONS

Utilizing a contact interface shear strength friction angle of 26 degrees (conservative) within GRI Report #18 resulted in a veneer slope stability FS equal to 2.01 while the equipment is static. This is the critical interface friction angle for the final cover interface. While the equipment is placing the final cover materials, a veneer slope stability FS equal to 1.86 was calculated.

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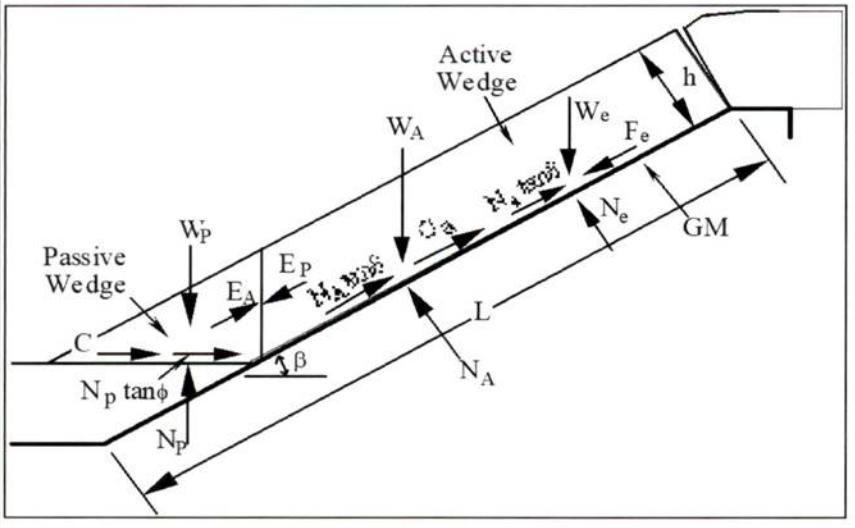
Attachment A

Spreadsheet Calculation

GREEN VALLEY LANDFILL SO. EXPANSION

Placement of the 24-inch thick Landfill Cover
across the 4:1 (H:V) Sideslopes



Calculation of FS

Active Wedge:

Wa=	*53121.5*	*lb*
Na=	*51534.6*	*lb*

Passive Wedge:

Wp=	*1087.7*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*13944.5*
b=	*-30283*
c=	*4587.5*

FS= 2.01

thickness of protective cover soil = h =	2.00	ft			
pro. cov. mat. slope angle beneath the geocomposite = β =	14.04	°	*= 0.25*	*(rad.)*	
finished protective cover material slope angle = ω =	14.04	°	*= 0.25*	*(rad.)*	
length of slope measured along the slope = L =	216.0	ft			
unit weight of the protective cover soil = γ =	128.0	lb/ft^3			
friction angle of the protective cover soil = ϕ =	34.0	°	*0.59*	*(rad.)*	
cohesion of the protective cover soil = c =	0.0	lb/ft^2	=	*C= 0*	*lb*
critical interface friction angle = δ =	26.0	°	*0.45*	*(rad.)*	
adhesion = ca =	0.0	lb/ft^2		*Ca= 0*	*lb*

thickness of the protective cover soil = h =	2.00	ft		
equipment ground pressure (= wt. of equipment/(2wb)) = q =	679.1	lb/ft^2	*b/h=*	*1.5*
length of each equipment track = w =	9.4	ft	*We=qwl=*	*6128.2*
width of each equipment track = b =	3.0	ft	*Ne=Wecos β =*	*5945.1*
influence factor* at geocomposite interface = I =	0.96		*Fe=We(a/g)=*	*0.0*
acceleration/deceleration of the bulldozer = a =	0.00	g		

*Influence Factor Default Values

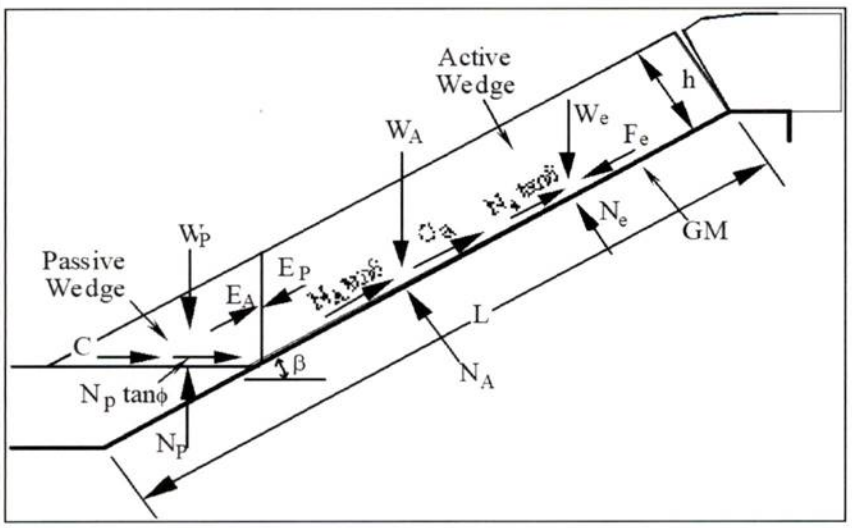
Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
[2] 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
[3] 1000 mm	0.95	0.75	0.30

Note: numbers in boxes are input values

numbers in Italics are calculated values

GREEN VALLEY LANDFILL SO. EXPANSION

Placement of the 24-inch thick Landfill Cover
across the 4:1 (H:V) Sideslopes with the incorporation of Equipment Loads



Calculation of FS

Active Wedge:

Wa= 53121.5 *lb*

Na= 51534.6 *lb*

Passive Wedge:

Wp= 1087.7 *lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= 15074.1

b= -30474

c= 4587.5

FS= 1.858

thickness of protective cover soil = h =	2.00	ft			
pro. cov. mat. slope angle beneath the geocomposite = β =	14.04	°	*= 0.25*	*(rad.)*	
finished protective cover material slope angle = ω =	14.04	°	*= 0.25*	*(rad.)*	
length of slope measured along the slope = L =	216.0	ft			
unit weight of the protective cover soil = γ =	128.0	lb/ft^3			
friction angle of the protective cover soil = ϕ =	34.0	°	*= 0.59*	*(rad.)*	
cohesion of the protective cover soil = c =	0.0	lb/ft^2		*C= 0*	*lb*
critical interface friction angle = δ =	26.0	°	*= 0.45*	*(rad.)*	
adhesion = ca =	0.0	lb/ft^2		*Ca= 0*	*lb*

thickness of the protective cover soil = h =	2.00	ft	*b/h=*	*1.5*
equipment ground pressure (= wt. of equipment/(2wb)) = q =	679.1	lb/ft^2	*We=qwl=*	*6128.2*
length of each equipment track = w =	9.4	ft	*Ne=Wecos β =*	*5945.1*
width of each equipment track = b =	3.0	ft	*Fe=We(a/g)=*	*1164.4*
influence factor* at geocomposite interface = I =	0.96			
acceleration/deceleration of the bulldozer = a =	0.19	g		

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
[2] 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
[3] 1000 mm	0.95	0.75	0.30

Note: numbers in boxes are input values

numbers in Italics are calculated values

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Project Number:	2233518 Phase 02		
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FINAL COVER VENEER STATIC AND SEISMIC SLOPE STABILITY

OBJECTIVE

The objective of this calculation is to perform a seismic slope stability analysis for the final cover system of the landfill.

METHOD

A spreadsheet taken from a report prepared by the Geosynthetic Research Institute (GRI), Drexel University, entitled "Cover Soil Stability Involving Geosynthetic Interfaces", by Te-Yang Soong and Robert M. Koerner is utilized to perform the calculation. This method analyzes the situation where a uniform layer of cover soil lies along a finite length of landfill side slope.

The seismic coefficient used within the stability analysis was obtained from the "Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years (site: hazards.atcouncil.org)" published by the U.S.G.S and included in ASCE 7-10 in 2016 and Figure 9-9 of the "Geotechnical and Stability Analyses for Ohio Waste Containment Facilities" September 14, 2002, which is included here. As suggested, the factor of safety for seismic stability worst-case slope and most critical interface must be greater than or equal to 1.0. The factor of safety for the static conditions must be greater than or equal to 1.5.

VARIABLES DEFINED

The shear strength envelope of the most critical interface in the final cover system was defined in the "Final Cover Veneer Slope Stability" calculation included with this Amendment.

The seismic coefficient, Cs, is defined as follows:

Cs = Seismic Coefficient, or the yield acceleration, Ky, which is expressed as a percentage of g, (acceleration due to gravity)

The seismic coefficient is multiplied by the weight of the active and passive blocks to produce a horizontal force resulting from the seismic acceleration. (F = ma)

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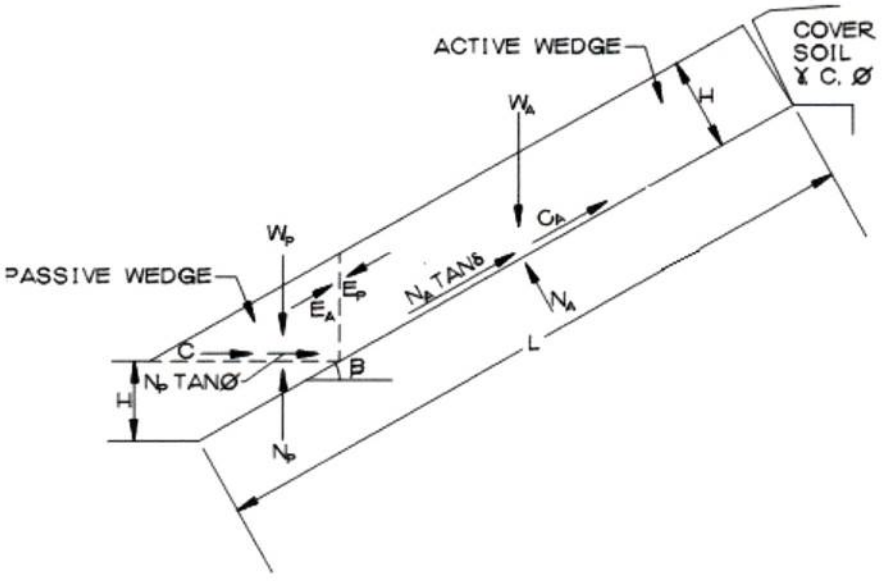

Figure 1, Side Slope Geometry & Free Body Diagram

Slope Dimensions	
Maximum Slope Length	216 feet
Slope Orientation	4H:1V or 14.04 degrees

The final cover system along the landfill side slope is outlined below, from top to bottom:

- 6-inch thick vegetative support (Topsoil) layer;
- 18-inch thick protective cover layer;
- Intermediate Cover

W_A = Total weight of the active wedge;
W_P = Total weight of the passive wedge;
N_A = Effective force normal to the failure plane of the active wedge;
N_P = Effective force normal to the failure plane of the passive wedge;
γ = Unit weight of the cover soil;
h = Thickness of the cover soil;
L = Length of slope measured along the soil cover;
β = Soil slope angle beneath the soil cover;
ϕ = Internal angle of friction within the cover soil;
δ = Interface friction angle between the most critical interface;

C_a = Adhesive force between the components lying along the most critical geosynthetic interface of the active wedge;
c_a = The adhesion developed between the components lying along the most critical geosynthetic interface of the active wedge;
C = Cohesive force along the failure plane of the passive wedge;
c = cohesion of the cover soil;
E_A = Interwedge force acting on the active wedge from the passive wedge;
E_P = Interwedge force acting on the passive wedge from the active wedge;
FS = Factor of safety against cover soil sliding down the slope; and
C_s = Seismic coefficient in percent of gravity. The resulting acceleration at the crest of the landfill is based on the design bedrock acceleration.

Additional Material Properties

Assumed unit weight of the final cover soil: γ_S = 128 pcf

The final cover soils were modeled as one layer with a thickness of 2.0 feet and assigned the average values for cohesion and friction angle.

Internal angle of friction = 34°

Equations Used

The forces illustrated in Figure 1 are resolved below to produce a FS:

$$W_a = \gamma h^2 \left[\frac{L}{h} - \frac{1}{\sin\beta} - \frac{\tan\beta}{2} \right]$$

$$N_a = W_a \cos\beta$$

$$C_a = c_a \left[L - \frac{h}{\sin\beta} \right]$$

Balancing the forces in the horizontal direction, the following formulation results:

$$E_A \cos\beta + \frac{N_A \tan\delta + C_a}{FS} \cos\beta = C_S W_A + N_A \sin\beta$$

The interwedge force acting on the active wedge is:

$$E_A = \frac{FS \cdot (C_S W_A + N_A \sin\beta) - (N_A \tan\delta + C_a)\cos\beta}{FS \cos\beta}$$

The passive wedge can be considered in a similar manner:

$$W_p = \frac{\gamma h^2}{\sin 2\beta}$$

$$N_p = W_p + E_p \sin\beta$$

$$C = \frac{c\,h}{\sin\ \beta}$$

Balancing the forces in the horizontal direction produces:

$$E_p \cos\beta + C_S W_P = \frac{C + N_p \tan\phi}{FS}$$

The interwedge force acting on the passive wedge is:

$$E_p = \frac{C + W_p \tan\phi - C_S W_P (FS)}{\cos\beta\,(FS) - \sin\beta \tan\phi}$$

Setting $E_A = E_p$, the equation can be arranged in the form of the following quadratic equation:

$$a(FS)^2 + b(FS) + c = 0$$

Where the coefficients a, b and c are equal to the following expressions:

$$a = (C_S W_A + N_A \sin\beta)\cos\beta + C_S W_p \cos\beta$$

$$b = -\left[(C_S W_A + N_A \sin\beta)\sin\beta \tan\phi + (N_A \tan\delta + C_a)\cos^2\beta + \cos\beta(C + W_p \tan\phi)\right]$$

$$c = (N_A \tan\delta + C_a)\sin\beta\cos\beta\tan\phi$$

The quadratic equation is then used to calculate the FS:

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

For the ease of calculation the above quadratic equation was input into a spreadsheet format to produce a FS corresponding to a given set of input parameters. A copy of the spreadsheet calculations displaying the results is included in Attachment A.

Seismic Analysis

The shear wave acceleration is modeled within the stability analysis by inputting a coefficient, (Cs) that is some fraction of gravity. The peak acceleration for the site is estimated to be 0.12 g which is taken from the "Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years (site: hazards.atcouncil.org)" published by the U.S.G.S and included in ASCE 7-10 in 2016. Since this analysis is for the final cover system, the acceleration at the crest of the landfill will be considered.

When plotting this value onto Singh and Sun's 1995 figure below for the relationship between maximum horizontal seismic acceleration at the base and crest of 150 feet of refuse, the maximum horizontal seismic acceleration at the crest of the landfill can be expected to be 0.17 g.

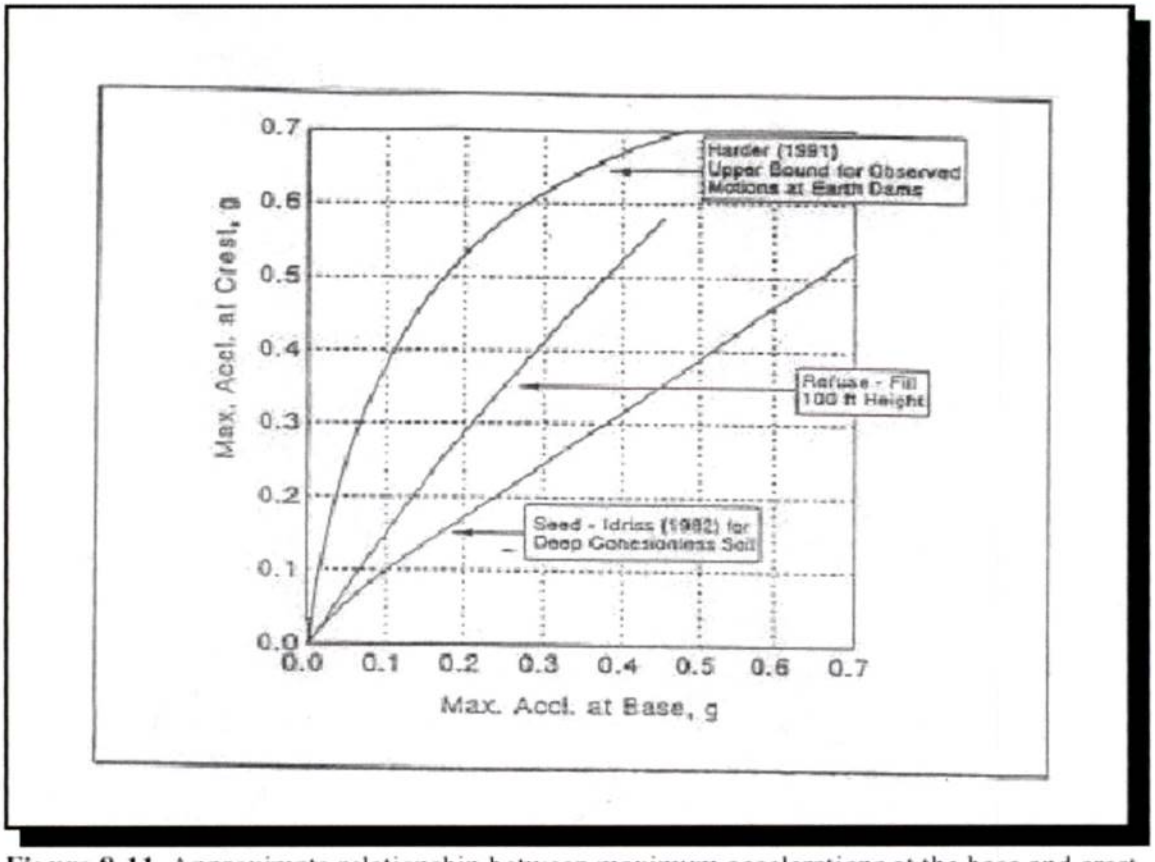

Figure 8-11 Approximate relationship between maximum accelerations at the base and crest for various ground conditions. Singh and Sun,1995, Figure 3.

The parameters used in the seismic analysis are stated below:

h = Thickness of cover soil = 2.0 ft
L = Length of slope measured along the geomembrane = 216 ft
γ = Unit weight of the cover soil = 128.0 lb/ft^3
δ = Critical interface friction angle = 26 degrees (conservative)
c_a = Adhesion of cover soil = 0.0 lb/ft^2 (conservative)
D = Thickness of cover soil along the bottom of the slope = 2.0 ft
ϕ = Friction angle of the cover soil layer = 34 degrees (conservative)
c = Cohesion of cover soil = 0 lb/ft^2

CALCULATIONS

The spreadsheet printout of the seismic stability analysis considering yield acceleration is included in Attachment A.

RESULTS

The results of the static stability analyses to determine the yield acceleration is presented below:

FS = 2.01

The results of the seismic stability analyses to determine the yield acceleration is presented below:

C_s = 0.17 g, FS = 1.16.

Therefore, the final cover system should be stable during static conditions and seismic activity.

REFERENCES

1. Soong, Te-Yang and Koerner, R.M., (1996) "Cover Soil Slope Stability Involving Geosynthetic Interfaces", Geosynthetic Research Institute, Drexel University, GRI Report #18

2. Ohio EPA, (September 14, 2002), "Geotechnical and Stability Analyses for Ohio Waste Containment Facilities".

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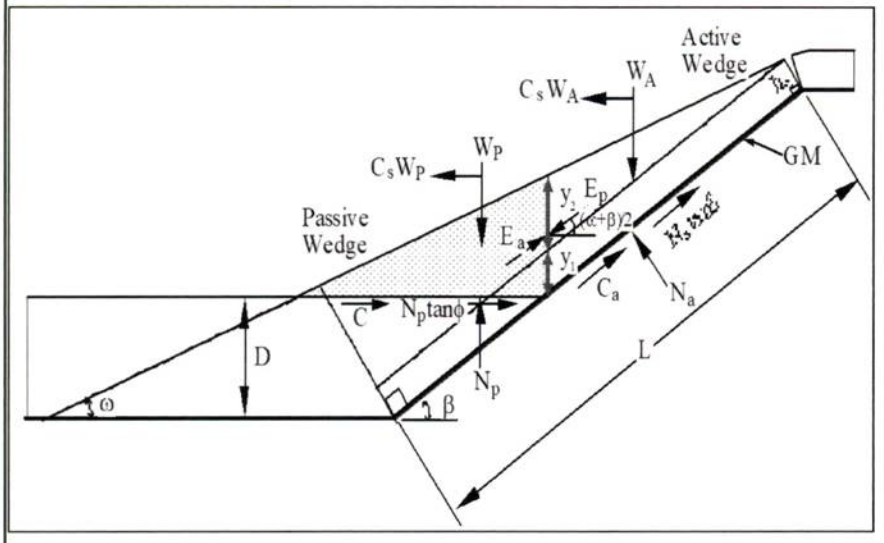
ATTACHMENT A

LANDFILL COVER SYSTEM
STABILITY ANALYSIS
COMPUTER SPREADSHEET RESULT

GREEN VALLEY LANDFILL SO. EXPANSION

Uniform and/or Tapered Cover Soil with Consideration of Static Forces



Calculation of FS

Active Wedge:

Wa=	*53121.5*	*lb*
Na=	*51534.6*	*lb*
Ca=	*0.0*	*lb*

Passive Wedge:

Wp=	*1087.7*	*lb*
C=	*0.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*12128.8*
b=	*-26413.3363*
c=	*3990.1*

FS= 2.01

(Note: for uniform cover soil thickness the input value of $\omega = \beta$)

thickness of cover soil at top (crest) of the slope = hc =	2.00	ft	
thickness of cover soil along the bottom of the site = D =	2.00	ft	
soil slope angle beneath the cover = β =	14.04	°	= *0.25 (rad.)*
finished cover soil slope angle = ω =	14.04	°	= *0.25 (rad.)*
length of slope measured along the geomembrane = L =	216.0	ft	

y2=	*0.00*	*(ft)*
y1=	*2.06*	*(ft)*
$(\omega+\beta)/2$=	*0.245*	*(rad.)*
(=	*14.0*	*°)*

unit weight of the cover soil = γ =	128.0	lb/ft^3	
friction angle of the cover soil = ϕ =	34.0	°	= *0.59 (rad.)*
cohesion of the cover soil = c =	0.0	lb/ft^2	
critical interface friction angle = δ =	26.0	°	= *0.45 (rad.)*
adhesion between cover soil and geocomposite = ca =	0.0	lb/ft^2	

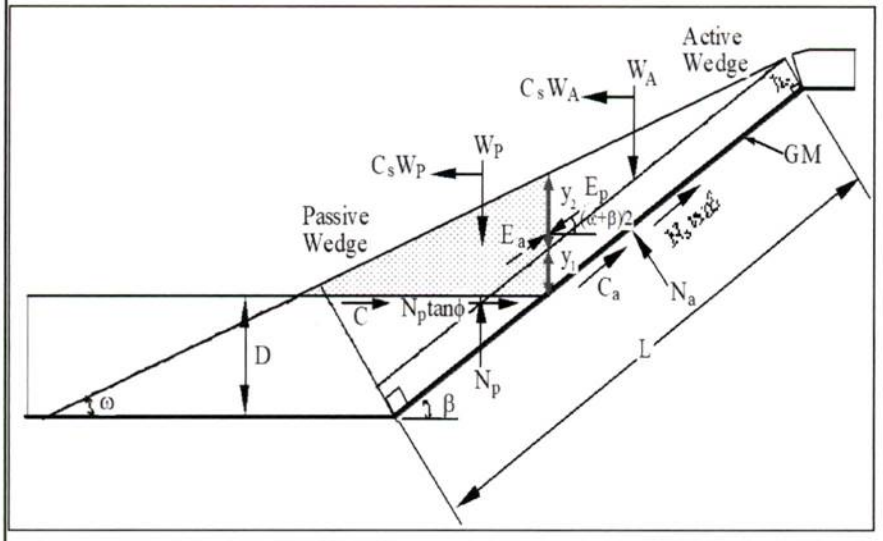
seismic coefficient = Cs = 0.000 g

Note: numbers in boxes are input values

numbers in Italics are calculated values

GREEN VALLEY LANDFILL SO. EXPANSION

Uniform and/or Tapered Cover Soil with Consideration of Seismic Forces



Calculation of FS

Active Wedge:

Wa=	*53121.5*	*lb*
Na=	*51534.6*	*lb*
Ca=	*0.0*	*lb*

Passive Wedge:

Wp=	*1087.7*	*lb*
C=	*0.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*21069.0*
b=	*-27891.0671*
c=	*3990.1*

FS= 1.16

(Note: for uniform cover soil thickness the input value of $\omega = \beta$)

thickness of cover soil at top (crest) of the slope = hc =	2.00	ft		
thickness of cover soil along the bottom of the site = D =	2.00	ft		
soil slope angle beneath the cover = β =	14.04	°	= *0.25*	*(rad.)*
finished cover soil slope angle = ω =	14.04	°	= *0.25*	*(rad.)*
length of slope measured along the geomembrane = L =	216.0	ft		

y2=	*0.00*	*(ft)*
y1=	*2.06*	*(ft)*
(ω+β)/2=	*0.245*	*(rad.)*
(=	*14.0*	*°)*

unit weight of the cover soil = γ =	128.0	lb/ft^3		
friction angle of the cover soil = ϕ =	34.0	°	= *0.59*	*(rad.)*
cohesion of the cover soil = c =	0.0	lb/ft^2		
critical interface friction angle = δ =	26.0	°	= *0.45*	*(rad.)*
adhesion between cover soil and geocomposite = ca =	0.0	lb/ft^2		

seismic coefficient = Cs = 0.170 g

Note: numbers in boxes are input values

numbers in Italics are calculated values

Green Valley Landfill So. Expansion
Estimated Cell Volumes and Life
Intake rate 200 tons/day

Revised By: HAK Date: 05/16/24

Cell	Area (acres)	Total Volume (cy)*	Liner (cy)	Cap (cy)	Monthly Cover (cy)	Intermediate Cover (cy)	Waste Volume (cy)	Waste** Volume (tons)	Expected Life (yr)
So. Expansion	2.3	200,000	-	7,421	2,000	1,855	188,723	94,362	1.7
Total	2.3	200,000	0.0	7,421	2,000	1,855	188,723	94,362	1.7

** Assumed waste density = 1,000 lbs/cy

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SETTLEMENT

OBJECTIVE

To estimate the bottom and final cover settlement for the Green Valley Landfill Southern Expansion.

ASSUMPTIONS

The following assumptions were made for the calculations:

- The groundwater at or just below the bottom of the existing waste.
- The densities of materials were assumed as follows:
  - Landfill waste – 75 pcf
- The depth of influence used in the settlement calculations was calculated based on a bedrock depth of 31'. This value was obtained from the boring logs information for SB-1 and SB-2, which was the closest available log to each of the points used in this calculation.
- Loading pressure is assumed to be equal to vertical effective stress increase in the base. No consideration for vertical stress distribution was assumed. This is conservative; the vertical stress increase will be less than the loading pressure in reality.
- The soils used for the final cover system were assumed to be equivalent to the locally available foundational soils.

METHOD

A one-dimensional consolidation/compression theory is used to estimate the expected primary and secondary settlement of the waste at critical locations within the proposed landfill. A typical section for the expansion area is shown in the attached Figure 1.

I. CALCULATIONS FOR BASE SETTLEMENT

Placement of the new waste will induce primary and secondary consolidation in the foundational soils. Both primary and secondary settlements will be estimated at different critical locations along the proposed base of the landfill. Differential settlements of the base will be calculated to estimate the maximum induced strain in the base soils.

A. Foundation Settlement Analysis

One-dimensional elastic deformation analysis was used to estimate the primary settlement of the foundation due to vertical expansion using the SPT data found in the boring logs of the boundary probes and monitoring wells.

1. The constrained stiffness moduli of the foundation soils were calculated for the subsurface layers as,

$$E_{oed} = \frac{1-\upsilon}{(1-2\upsilon)(1+\upsilon)} E$$

where E_{oed} = constrained stiffness modulus (1D), E = deformation modulus (3D), and u = Poisson's ratio. E was estimated from SPT N values using the average of two methods corresponding to clayey soils and sandy soils, respectively,

For clayey soils:

Method 1 : $E = 2(1+\upsilon)(0.05)(120N^{0.77})p_a$ (Wroth, et al. 1979)

Method 2 : $E = 19.3N^{0.63}p_a$ (Ohya, et al. 1982)

For sandy soils:

Method 1 : $E = 5Np_a$ (Callanan and Kulhawy, et al. 1979)

Method 2 : $E = 9.08N^{0.66}p_a$ (Ohya, et al. 1982)

where p_a = atmospheric pressure (14.7 psi). u = 0.333 was used in the calculations

2. Using the equation in Step 1, the foundation primary settlement was calculated as follows:

$$\delta_p = \frac{\Delta\sigma}{E_{oed}} Z$$

where Δσ = the change in stress imposed by the vertical expansion, and Z = the thickness of that particular foundation layer.

3. The foundation secondary settlement, δ_s, was calculated based on SPT data as below:

$$\delta_s = 0.02\frac{1.4}{\overline{N}_{60}} Z_1 \, log\left(\frac{t}{1day}\right)$$

where δ_s = settlement due to secondary consolidation;

$\overline{N}_{60}$ = arithmetic mean of the SPT-N values measured within the thickness Z_1;

Z_1 = Zone of influence. In this case, the layer thickness of the foundation layer

t = design life of the structure, in days from the end of construction, t = 30 years = 10,950 days were used.

CALCULATIONS FOR FINAL COVER SETTLEMENT

The final cover settlement is difficult to estimate, as it is difficult to estimate when the primary settlement is complete. However, the differential settlement of the final cover is mainly a maintenance issue and is not as important as that of the base soils. In this case, it was assumed that the final cover settlement includes the primary settlement induced due to the top 20 ft of waste placement and cover soils, in addition to the secondary settlement in the cover soil, waste, and foundation soil. The cover is assumed to be placed at year 10, and the secondary settlements evaluated through year 30. Summaries of calculation results are provided in Attachment 1, Table 1 and Table 2.

A. Foundation Settlement Analysis

1. the foundation primary settlement was calculated as follows:

$$\delta_p = \frac{\Delta\sigma}{E_{oed}} Z$$

where Δσ = the change in stress imposed by the application of cover and the final 20 ft of waste, and Z = the thickness of that particular foundation layer.

2. The secondary settlement of the foundation was calculated based on SPT data as below:

$$\delta_s = 0.02 \frac{1.4}{\overline{N}_{60}} Z_1 \log\left(\frac{t}{1day}\right)$$

where δ_s = settlement due to secondary consolidation;
$\overline{N}_{60}$ = arithmetic mean of the SPT-N values measured within the thickness Z_1;
Z_1 = Zone of influence. In this case, use the layer thickness of the foundation layer
t = design life of the structure, in days from the end of construction, t = 30 years = 10,950 days were used*.

*For the purposes of this calculation, the actual secondary consolidation which will affect the settlement of the final cover will take place after the cover is placed (year 10 to year 30). As secondary consolidation does not occur linearly and the compression index at year 10 could only be estimated, the entire 30 years of secondary consolidation is used in the calculation of differential settlement as a conservative value.

B. Waste Settlement Analysis

1. Primary settlement of waste due to the application of cover was calculated using:

$$\delta_p = H * C_c' * \log\left(\frac{(\sigma'_0 + \Delta\sigma)}{\sigma'_0}\right)$$

where H = initial thickness of waste layer of existing landfill
C_c'=modified primary compression index (typically 0.17-0.36), assumed average Cc' = 0.265
σ'_0 =existing overburden pressure acting at the mid-level of the waste layer
$\Delta\sigma$ = incremental overburden pressure due to application of cover

2. Long term secondary settlement was calculated using:

$$\delta_s = H * C_{\alpha\,\min}' * \log\left(\frac{t_2}{t_1}\right) + H * C_{\alpha\,\max}' * \log\left(\frac{t_4}{t_3}\right)$$

where H = initial thickness of waste layer before settlement
$C_{\alpha\,\min}'$ = modified secondary compression index immediately following primary compression between time t_1 to t_2. A value for $C_{\alpha\,\min}'$ = 0.019 was assumed and this settlement occurs between 1 day (t_1) to 1 month (t_2)
$C_{\alpha\,\max}'$ = modified secondary compression index immediately following the initial secondary compression between time t_3 to t_4. A value for $C_{\alpha\,\max}'$ = 0.125 was assumed and this settlement occurs between 10 years (t_3) to 30 years (t_4)

C. Final Cover Settlement Analysis

1. Long term secondary settlement of the final cover soils was calculated using:

$$\delta_s = 0.02 \frac{1.4}{\overline{N}_{60}} Z_1 \log\left(\frac{t}{1day}\right)$$

where δ_s = settlement due to secondary consolidation;
$\overline{N}_{60}$ = arithmetic mean of the SPT-N values measured within the thickness Z_1;
Z_1 = Zone of influence. In this case, use the layer thickness of the foundation layer
t = design life of the structure, in days from the placement of cover, t = 20 years = 7300 days were used.

The calculated settlement differences for base and final cover proposed landfill expansion areas are minimal.

REFERENCES

1) Randolph, M.F. & Wroth, C.P., **"An Analysis of the Vertical Deformation of Pile Groups"**, 1979.
2) Ohya, S., **"Relationship between N value and SPT and LLT Pressuremeter Results"**, 1982.
3) Callanan, J.F. & Kulhawy, F.H., **"Evaluation of Procedures for Predicting Foundation Uplift Movements"**, 1980.

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ATTACHMENT A
SETTLEMENT TABLES

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Table 1 Summary Base Settlement Analysis

Location	Layer	Top Elevation (ft)	Bottom Elevation (ft)	Layer Thickness (ft)	σ'_o (psf)	$\Delta\sigma$ (psf)	$\delta_{primary}$ (ft)	$\delta_{secondary}$ (ft)	δ_{total} (ft)	δ_{total} (ft)	$\delta_{difference}$ (ft)
1	Cover	741.3	739.3	2							
3+50	Waste	739.3	687	52.3						1.34	
	Ex. Waste	687	670.7	16.3	7,306	1,500	0.35	0.56	0.91		
	Foundation	670.7	639.7	31	1,984	4,179	0.40	0.03	0.43		
2	Cover	740	738	2							0.40
(4+83)	Waste	738	674	64						0.94	
	Ex. Waste	674	666	8	8,492	1,500	0.15	0.27	0.42		
	Foundation	666	635	31	1,984	5,056	0.48	0.03	0.51		
3	Cover	701	699	2							-1.27
(6+00)	Waste	699	685	14						2.21	
	Ex. Waste	685	661	24	2,692	1,500	1.22	0.82	2.05		
	Foundation	661	630	31	1,984	1,306	0.13	0.03	0.16		
4	Cover	658	656	2							2.15
(7+23)	Waste	656	655	1						0.06	
	Ex. Waste	655	655	0	128	1,500	0.00	0.00	0.00		
	Foundation	655	624	31	1,984	331	0.03	0.03	0.06		

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Table 2 Summary Cover and Waste Settlement Analysis

Location	Layer	Top Elevation (ft)	Bottom Elevation (ft)	Layer Thickness (ft)	σ'_o (psf)	$\Delta\sigma$ (psf)	$\delta_{primary}$ (ft)	$\delta_{secondary}$ (ft)	δ_{total} (ft)	δ_{total} (ft)	$\delta_{difference}$ (ft)
1	Cover	741.3	739.3	2	75	1,500		0.18	0.18		
3+50	Waste	739.3	687	52.3	1,961	1,500	3.42	1.80	5.22	6.48	
	Ex. Waste	687	670.7	16.3	7,306	1,500	0.35	0.56	0.91		
	Foundation	670.7	639.7	31	6,163	1,500	0.14	0.03	0.17		
2	Cover	740	738	2	75	1,500		0.18	0.18		0.21
(4+83)	Waste	738	674	64	2,656	1,500	3.30	2.20	5.50	6.27	
	Ex. Waste	674	666	8	8,492	1,500	0.15	0.27	0.42		
	Foundation	666	635	31	7,040	1,500	0.14	0.03	0.17		
3	Cover	701	699	2	75	1,500		0.18	0.18		1.67
(6+00)	Waste	699	685	14	781	1,500	1.73	0.48	2.21	4.60	
	Ex. Waste	685	661	24	2,692	1,500	1.22	0.82	2.05		
	Foundation	661	630	31	3,290	1,500	0.14	0.03	0.17		
4	Cover	658	656	2	75	1,500		0.18	0.18		4.01
(7+23)	Waste	656	655	1	294	1,500	0.21	0.03	0.24	0.59	
	Ex. Waste	655	655	0	128	1,500	0.00	0.00	0.00		
	Foundation	655	624	31	2,315	1,500	0.14	0.03	0.17		

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REVISED UNIVERSAL SOIL LOSS EQUATION

OBJECTIVE:

Determine the maximum soil loss per acre for the Green Valley Landfill So. Expansion. The results will be acceptable if the maximum projected erosion rate should be no more than 3 tons per acre per year.

METHOD:

The Revised Universal Soil Loss Equation (RUSLE) will be utilized to estimate the soil loss from the surface water bench to the toe of slope using the following equation. RUSLE is an empirical equation, which includes several coefficients.

$$E = R * K * T * C * P$$

in which:
E = Computed Soil Loss in tons/acre/year
R = Rainfall Energy Factor (Erosivity Index)
K = Soil Erodibility Factor
T = Topographic Factor
C = Crop Management Factor
P = Conservation Practice Factor

CALCULATION:

The worst case scenario for maximum soil loss will be analyzed for the proposed final cover configuration for an approximately 30-foot height between the surface water diversion berms over a 4H:1V slope with a slope length of 216 feet. The references provided the following information:

Rainfall Energy Factor, R:
From Figure 1 of Reference 4, R equals 350 (see page 7 of 7).

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Soil Erodibility Factor, K:

From Table 3-2A of Reference 2, K equals 0.15 for the site. It is assumed that the cover soil will be sand based on the USDA classification (see page 4 of 7).

Topographic Factor, LS:

LS was found by using slope length (L) and slope gradient (S). The maximum slope length (L) between surface water control structures will be 216 feet which relates to the maximum distance between berms. For the 4H to 1V slopes, the slope gradient (S) is 25%. The LS value was interpolated from Table 4-3 of Reference 1. LS equals 8.10 for the site (see page 4 of 7).

Crop Management Factor, C:

Using Table 10 of Reference 1, and assuming 95 percent grass ground cover with no appreciable canopy, the value of C was determined to be 0.007 for the site (see page 5 of 7).

Conservation Practice Factor, P:

The conservation practice factor (P) is a function of the support practice and the land slope. Since there is no support practice, P equals 1.0, the highest and most conservative value. See Page 6 for additional information (see page 6 of 7).

SOIL LOSS EQUATION
with VEGETATED SLOPES:

$E = 350 * 0.15 * 8.10 * 0.007 * 1$

$E = 2.98$ tons/acre/year

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CONCLUSION:

The maximum erosion rate for the Green Valley Landfill So. Expansion final cover was calculated to be approximately 2.98 tons/acre/year with vegetated slopes. This is an acceptable value, which is equal to or less than the maximum value of 3 tons/acre/year.

REFERENCES

1. Predicting Rainfall Erosion Losses, Agricultural Handbook 537, United States Department of Agriculture.
2. Predicting Soil Erosion by Water: A guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), Agricultural Handbook 703, United States Department of Agriculture.
3. Water Management and Sediment Control for Urbanizing Areas, Soil Conservation Service – USDA.
4. Advanced Design Methods for Selecting Sediment and Erosion BMPs, International Erosion Control Association – 1996.

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K Values for Topsoil
(Taken from Reference 2, Table 3-2A)

Texture of Surface Layer	Estimated K Value
Clay, clay loam, loam, silty clay	0.32
Fine sandy loam, loamy very fine sand, sandy loam	0.24
Loamy fine sand, loamy sand	0.17
Sand	0.15
Silt loam, silty clay loam, very fine sand loam	0.37

LS Topographic Factor Values
(Excerpt Taken From Reference 1, Table 4-3)

Table 4-3: Values for topographic factor, LS, for high ratio of rill to interrill erosion. Such as for freshly prepared construction and other highly disturbed soil conditions with little or no cover (not applicable to thawing soil).

PERCENT SLOPE	SLOPE LENGTH (FEET)											
	<3	6	9	12	15	25	50	75	100	150	200	250
10	0.35	0.37	0.38	0.39	0.40	0.57	0.91	1.20	1.46	1.92	2.34	2.72
12	0.36	0.41	0.45	0.47	0.49	0.71	1.15	1.54	1.88	2.51	3.07	3.60
14	0.38	0.45	0.51	0.55	0.58	0.85	1.40	1.87	2.31	3.09	3.81	4.48
16	0.39	0.49	0.56	0.62	0.67	0.98	1.64	2.21	2.73	3.68	4.56	5.37
20	0.41	0.56	0.67	0.76	0.84	1.24	2.10	2.86	3.57	4.85	6.04	7.16
25	0.45	0.64	0.80	0.93	1.04	1.56	2.67	3.67	4.59	6.30	7.88	9.38
30	0.48	0.72	0.91	1.08	1.24	1.86	3.22	4.44	5.58	7.70	9.67	11.55
40	0.53	0.85	1.13	1.37	1.59	2.41	4.24	5.89	7.44	10.35	13.07	15.67
50	0.58	0.97	1.31	1.62	1.91	2.91	5.16	7.20	9.13	12.75	16.16	19.42

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"C" for permanent pasture, range and idle land [1] (Taken from Reference 1, Table 10)

Vegetal Canopy			Cover That Contacts the Surface					
Type and Height Of Raised Canopy [2]	Canopy Cover [3]	Type [4]	0	20	40	60	80	95-100
Column No.:	2	3	4	5	6	7	8	9
No appreciable		G	.45	.20	.10	.042	.013	.003
Canopy		W	.45	.24	.15	.090	.043	.011
Canopy of tall	25	G	.36	.17	.09	.038	.012	.003
Weeds or short		W	.36	.20	.13	.082	.041	.011
Brush (0.5 m	50	G	.26	.13	.07	.035	.012	.003
fall ht.)		W	.26	.16	.11	.075	.039	.011
	75	G	.17	.10	.06	.031	.011	.003
		W	.17	.12	.09	.067	.038	.011
Appreciable brush	25	G	.40	.18	.09	.040	.013	.003
Or bushes		W	.40	.22	.14	.085	.042	.011
(2 m fall ht.)	50	G	.34	.16	.085	.038	.012	.003
		W	.34	.19	.13	.081	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.077	.041	.011
Trees but no	25	G	.42	.19	.10	.041	.013	.003
Appreciable low		W	.42	.23	.14	.087	.042	.011
Brush (4 m	50	G	.39	.18	.09	.040	.013	.003
Fall ht.)		W	.39	.21	.14	.085	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.083	.041	.011

1 The listed C values assume that the vegetation and mulch are randomly distributed over the entire area.
2 Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33-ft.
3 Portion of total-area surface that would be hidden from view by canopy in a vertical projection, (a bird's-eye view).
4 G: Cover at surface is grass, grass like plants, decaying compacted duff, or litter at least 2 inches deep.
W: Cover at surface is mostly broadleaf herbaceous plant (as weeds with little lateral-root network near the surface) or undecayed residues or both

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"P" Value Table

$$P = P_c P_s$$

or $P = P_t$ (if terraces are present)

Where: P_c = contouring factor

P_s = strip cropping factor (see Table 14 in USLE Handbook)

P_t = terraces factor

	Conservation Practice Factors, P			
Slope, %	Contouring factor, P_c (Max. slope length, m)	Strip cropping factor, P_s (Max width, m)	Graded terraces with grass waterway outlets, P_t	Parallel tile outlet terraces, P_t
1-2	0.6 (120)	0.6	0.12	0.05
3-5	0.5 (90)	0.5	0.10	0.05
6-8	0.5 (60)	0.05	0.10	0.05
9-12	0.6 (35)	0.6	0.12	0.05
13-16	0.7 (25)	0.7	0.14	0.05
17-20	0.8 (18)	0.8	0.16	0.06
21-25	0.9 (15)	0.9	0.16	0.06

Source: USLE Handbook, Tables 13, 14, and 15.

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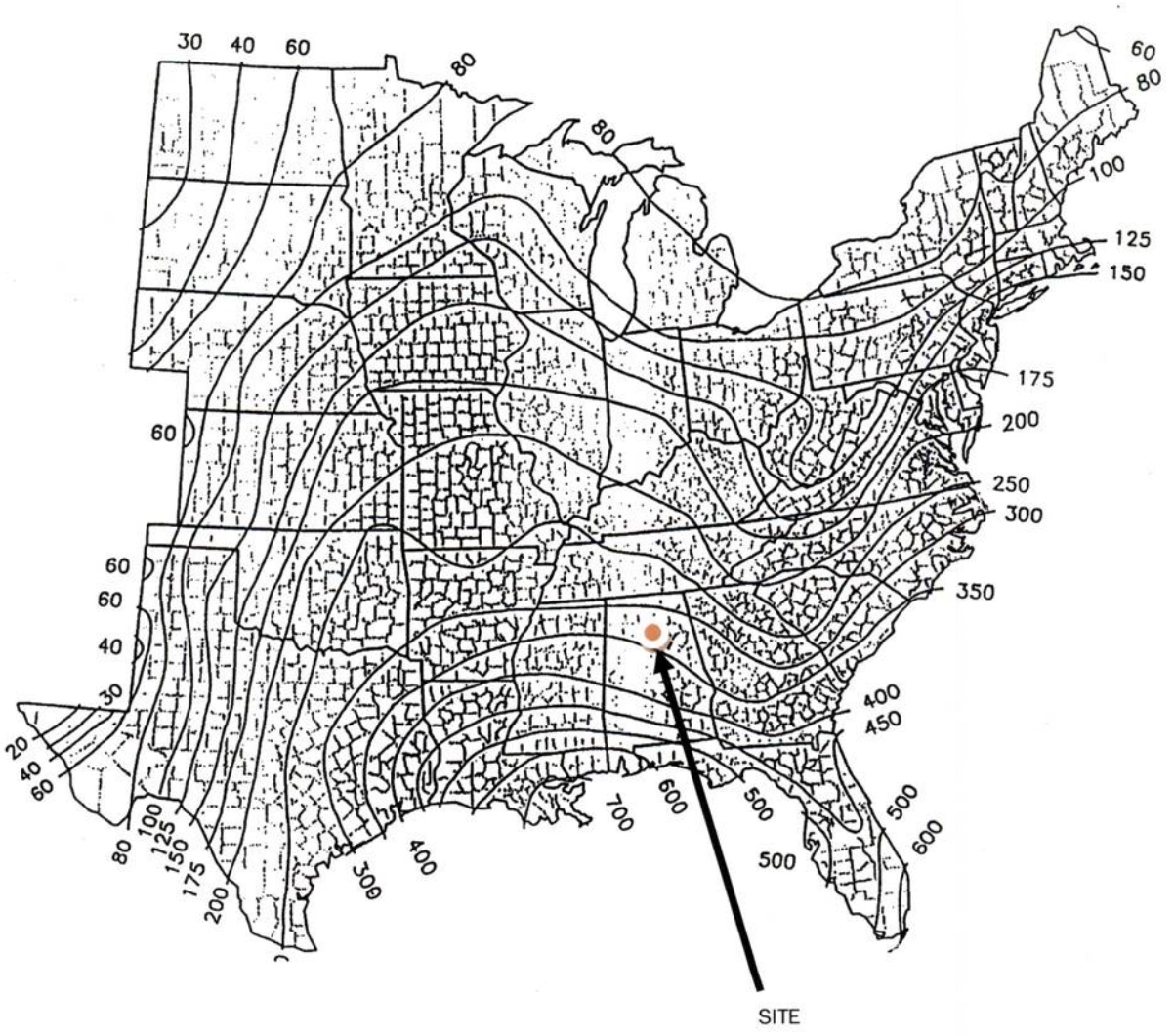
FIGURE 1 – ISOERODENT MAP OF THE EASTERN US (TAKEN FROM REFERENCE 4)



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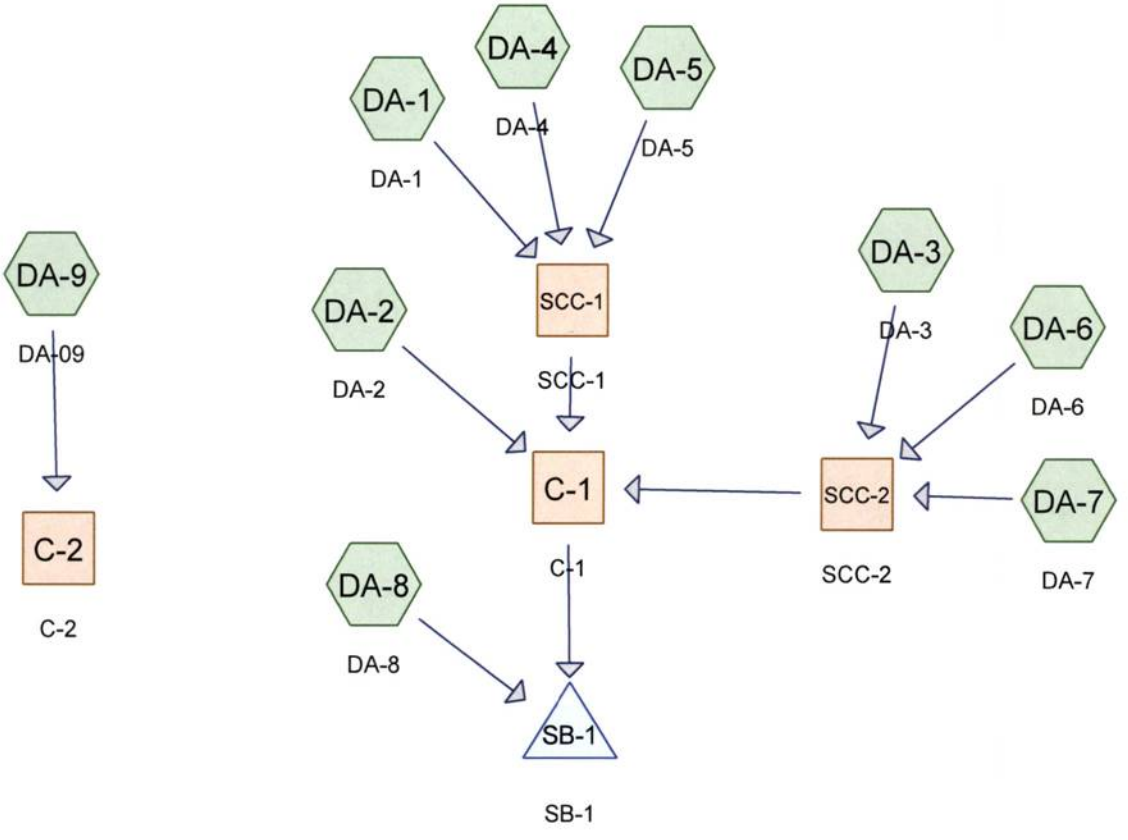


Subcat Reach Pond Link

Routing Diagram for GreenValleyAL_Stormwater
Prepared by Labella Associates, Printed 6/10/2024

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	10Yr	Type II 24-hr		Default	24.00	1	5.82	2
2	25Yr	Type II 24-hr		Default	24.00	1	7.09	2
3	100Yr	Type II 24-hr		Default	24.00	1	9.33	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
33.860	49	50-75% Grass cover, Fair, HSG A (DA-1, DA-2, DA-3, DA-4, DA-5, DA-6, DA-7, DA-8, DA-9)
0.650	96	Gravel surface, HSG A (DA-4, DA-5, DA-6, DA-7, DA-8, DA-9)
34.510	**50**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
34.510	HSG A	DA-1, DA-2, DA-3, DA-4, DA-5, DA-6, DA-7, DA-8, DA-9
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
34.510		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
33.860	0.000	0.000	0.000	0.000	33.860	50-75% Grass cover, Fair	DA-1, DA-2, DA-3, DA-4, DA-5, DA-6, DA-7, DA-8, DA-9
0.650	0.000	0.000	0.000	0.000	0.650	Gravel surface	DA-4, DA-5, DA-6, DA-7, DA-8, DA-9
34.510	**0.000**	**0.000**	**0.000**	**0.000**	**34.510**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	C-1	674.00	648.00	98.0	0.2653	0.012	0.0	24.0	0.0	
2	C-2	666.00	652.00	250.0	0.0560	0.012	0.0	24.0	0.0	
3	SB-1	642.00	640.00	68.0	0.0294	0.013	0.0	24.0	0.0	

Time span=0.00-32.00 hrs, dt=0.05 hrs, 641 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDA-1: DA-1 Runoff Area=1.110 ac 0.00% Impervious Runoff Depth=0.99"
Flow Length=357' Tc=8.5 min CN=49 Runoff=1.46 cfs 0.091 af

SubcatchmentDA-2: DA-2 Runoff Area=0.360 ac 0.00% Impervious Runoff Depth=0.99"
Flow Length=490' Tc=12.6 min CN=49 Runoff=0.39 cfs 0.030 af

SubcatchmentDA-3: DA-3 Runoff Area=1.180 ac 0.00% Impervious Runoff Depth=0.99"
Flow Length=354' Tc=9.2 min CN=49 Runoff=1.50 cfs 0.097 af

SubcatchmentDA-4: DA-4 Runoff Area=0.340 ac 0.00% Impervious Runoff Depth=1.57"
Flow Length=248' Tc=5.0 min CN=57 Runoff=0.93 cfs 0.044 af

SubcatchmentDA-5: DA-5 Runoff Area=0.970 ac 0.00% Impervious Runoff Depth=1.49"
Flow Length=485' Tc=5.0 min CN=56 Runoff=2.50 cfs 0.121 af

SubcatchmentDA-6: DA-6 Runoff Area=0.370 ac 0.00% Impervious Runoff Depth=1.34"
Flow Length=1,898' Tc=5.6 min CN=54 Runoff=0.83 cfs 0.041 af

SubcatchmentDA-7: DA-7 Runoff Area=1.070 ac 0.00% Impervious Runoff Depth=1.49"
Flow Length=535' Tc=5.0 min CN=56 Runoff=2.75 cfs 0.133 af

SubcatchmentDA-8: DA-8 Runoff Area=1.720 ac 0.00% Impervious Runoff Depth=1.27"
Flow Length=327' Tc=9.3 min CN=53 Runoff=3.05 cfs 0.182 af

SubcatchmentDA-9: DA-09 Runoff Area=27.390 ac 0.00% Impervious Runoff Depth=0.99"
Flow Length=1,491' Tc=17.8 min CN=49 Runoff=24.23 cfs 2.255 af

Reach C-1: C-1 Avg. Flow Depth=0.36' Max Vel=23.22 fps Inflow=9.00 cfs 0.557 af
24.0" Round Pipe n=0.012 L=98.0' S=0.2653 '/' Capacity=126.23 cfs Outflow=8.96 cfs 0.557 af

Reach C-2: C-2 Avg. Flow Depth=0.90' Max Vel=17.63 fps Inflow=24.23 cfs 2.255 af
24.0" Round Pipe n=0.012 L=250.0' S=0.0560 '/' Capacity=58.00 cfs Outflow=24.12 cfs 2.255 af

Reach SCC-1: SCC-1 Avg. Flow Depth=0.59' Max Vel=4.14 fps Inflow=4.68 cfs 0.256 af
n=0.030 L=625.0' S=0.0384 '/' Capacity=52.22 cfs Outflow=4.23 cfs 0.256 af

Reach SCC-2: SCC-2 Avg. Flow Depth=0.61' Max Vel=4.01 fps Inflow=4.83 cfs 0.271 af
n=0.030 L=577.0' S=0.0347 '/' Capacity=49.61 cfs Outflow=4.37 cfs 0.271 af

Pond SB-1: SB-1 Peak Elev=645.77' Storage=10,391 cf Inflow=11.86 cfs 0.739 af
Primary=1.50 cfs 0.712 af Secondary=0.00 cfs 0.000 af Outflow=1.50 cfs 0.712 af

Total Runoff Area = 34.510 ac Runoff Volume = 2.994 af Average Runoff Depth = 1.04"
100.00% Pervious = 34.510 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment DA-1: DA-1

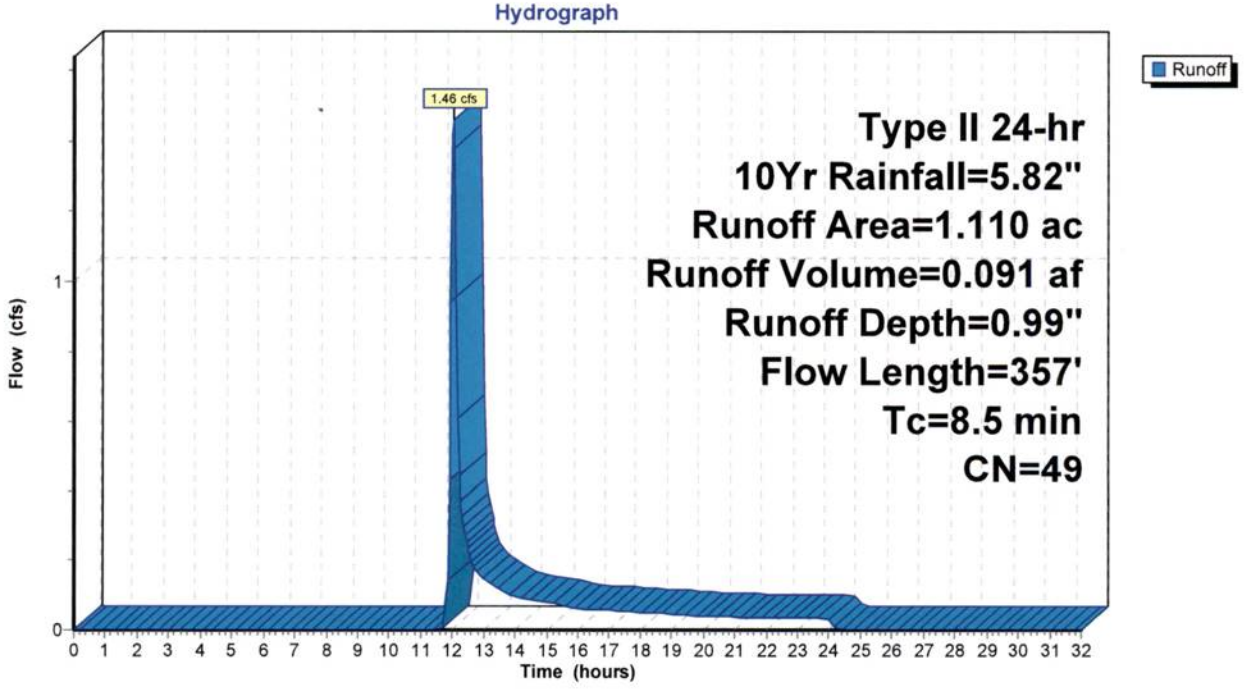
Runoff = 1.46 cfs @ 12.02 hrs, Volume= 0.091 af, Depth= 0.99"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
1.110	49	50-75% Grass cover, Fair, HSG A
1.110		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.1100	0.26		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.1	257	0.0817	2.00		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.5	357	Total			

Subcatchment DA-1: DA-1



Summary for Subcatchment DA-2: DA-2

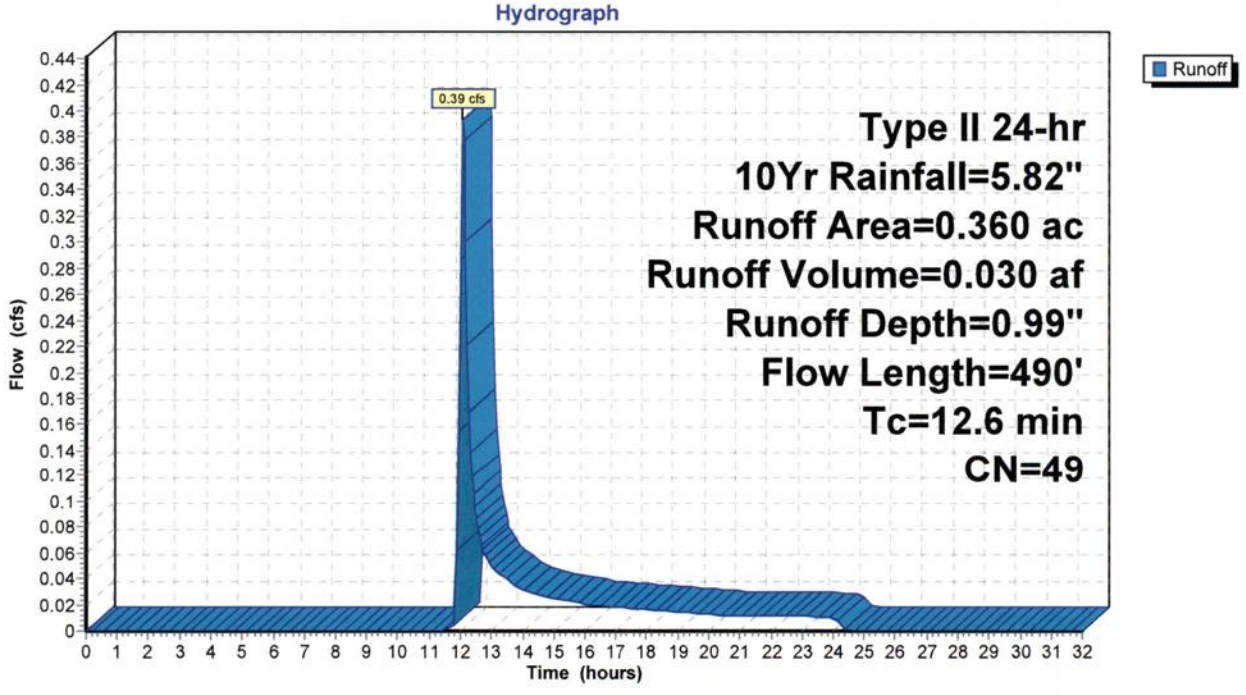
Runoff = 0.39 cfs @ 12.07 hrs, Volume= 0.030 af, Depth= 0.99"
Routed to Reach C-1 : C-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
0.360	49	50-75% Grass cover, Fair, HSG A
0.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	100	0.0436	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
3.4	390	0.0765	1.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.6	490	Total			

Subcatchment DA-2: DA-2



Summary for Subcatchment DA-3: DA-3

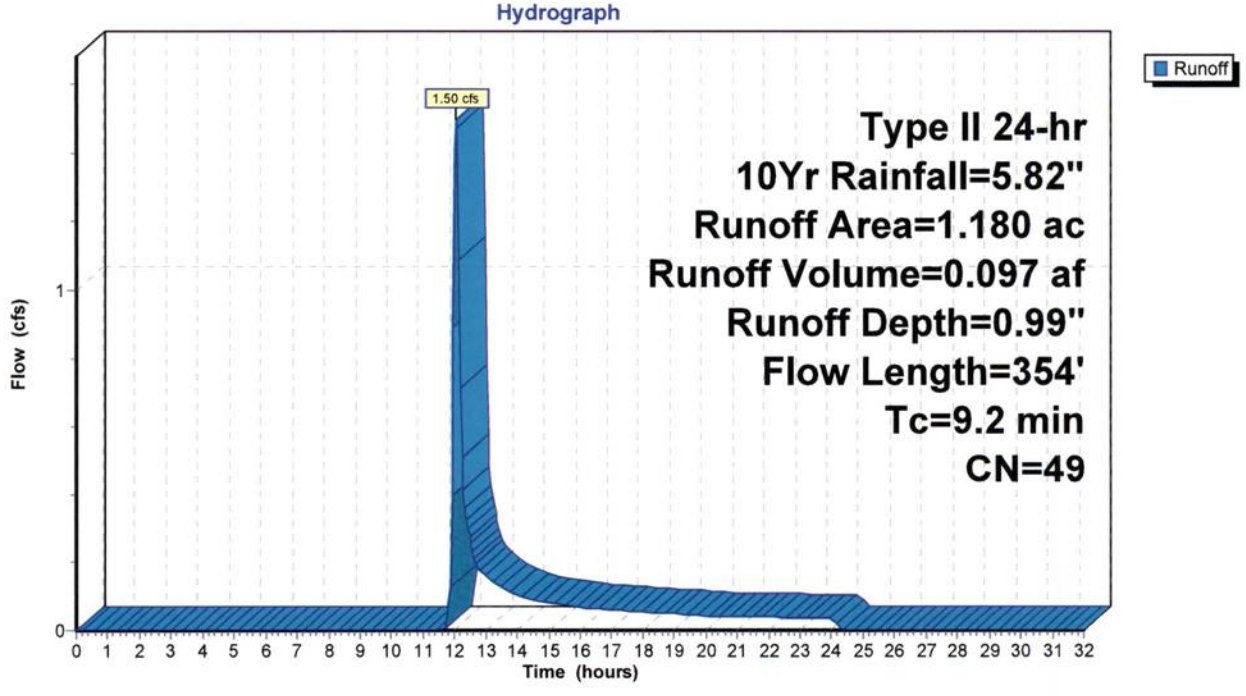
Runoff = 1.50 cfs @ 12.03 hrs, Volume= 0.097 af, Depth= 0.99"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
1.180	49	50-75% Grass cover, Fair, HSG A
1.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0800	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.0	254	0.0946	2.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.2	354	Total			

Subcatchment DA-3: DA-3



Summary for Subcatchment DA-4: DA-4

[49] Hint: Tc<2dt may require smaller dt

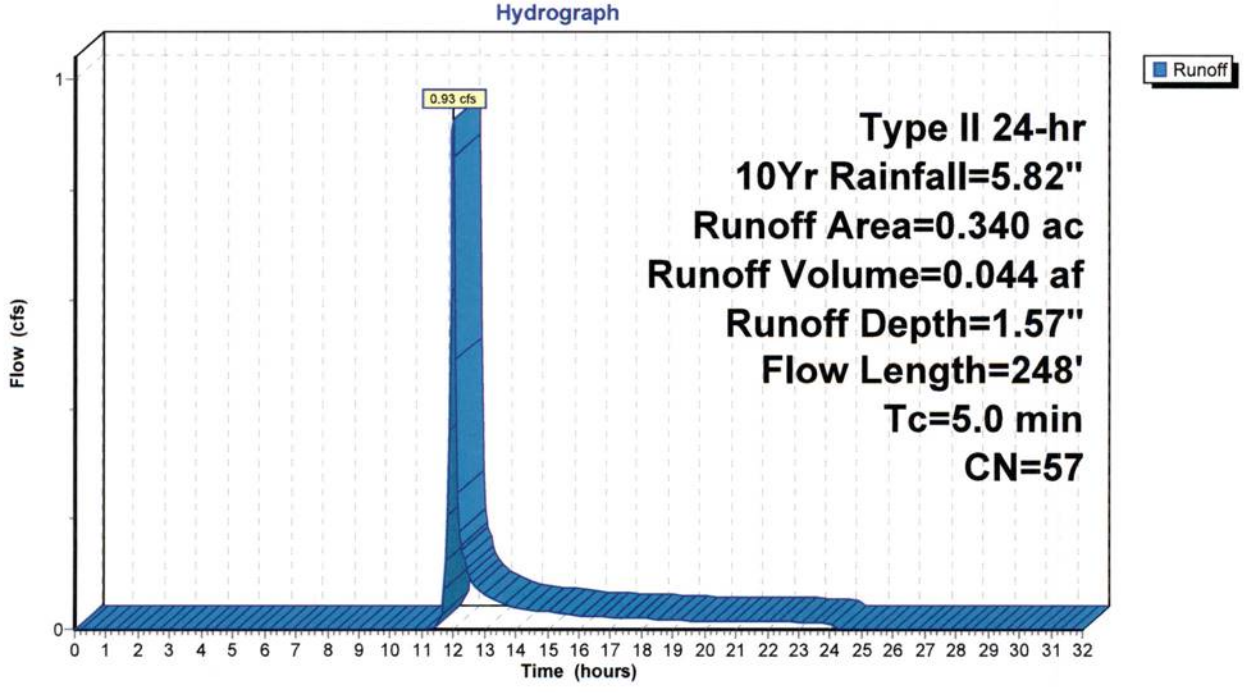
Runoff = 0.93 cfs @ 11.97 hrs, Volume= 0.044 af, Depth= 1.57"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
0.280	49	50-75% Grass cover, Fair, HSG A
0.060	96	Gravel surface, HSG A
0.340	57	Weighted Average
0.340		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	49	0.3160	0.50		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.11"
2.0	199	0.0579	1.68		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.6	248	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-4: DA-4



Summary for Subcatchment DA-5: DA-5

[49] Hint: Tc<2dt may require smaller dt

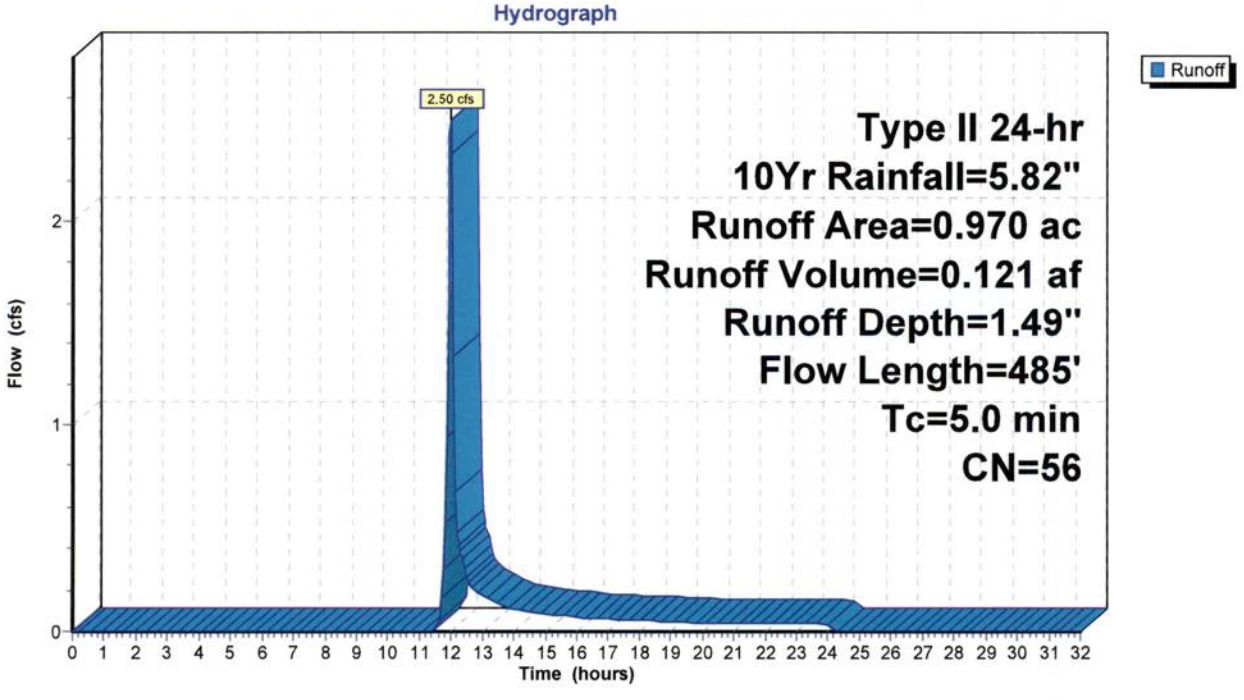
Runoff = 2.50 cfs @ 11.97 hrs, Volume= 0.121 af, Depth= 1.49"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
0.830	49	50-75% Grass cover, Fair, HSG A
0.140	96	Gravel surface, HSG A
0.970	56	Weighted Average
0.970		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	69	0.3300	0.38		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
1.3	416	0.0300	5.22	15.65	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
4.3	485	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-5: DA-5



Summary for Subcatchment DA-6: DA-6

[49] Hint: Tc<2dt may require smaller dt

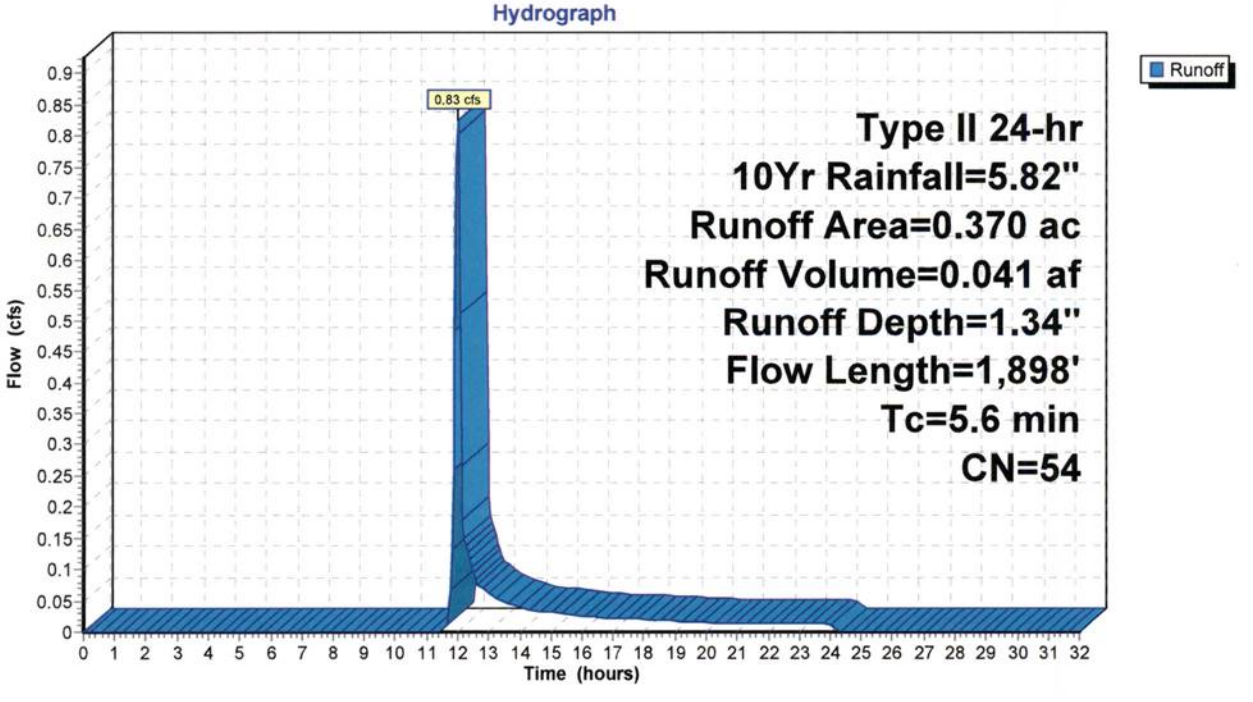
Runoff = 0.83 cfs @ 11.98 hrs, Volume= 0.041 af, Depth= 1.34"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
0.330	49	50-75% Grass cover, Fair, HSG A
0.040	96	Gravel surface, HSG A
0.370	54	Weighted Average
0.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	58	0.2550	0.33		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.7	1,840	0.0247	11.31	475.16	**Trap/Vee/Rect Channel Flow,** Bot.W=5.00' D=3.00' Z= 3.0 '/' Top.W=23.00' n= 0.030
5.6	1,898	Total			

Subcatchment DA-6: DA-6



Summary for Subcatchment DA-7: DA-7

[49] Hint: Tc<2dt may require smaller dt

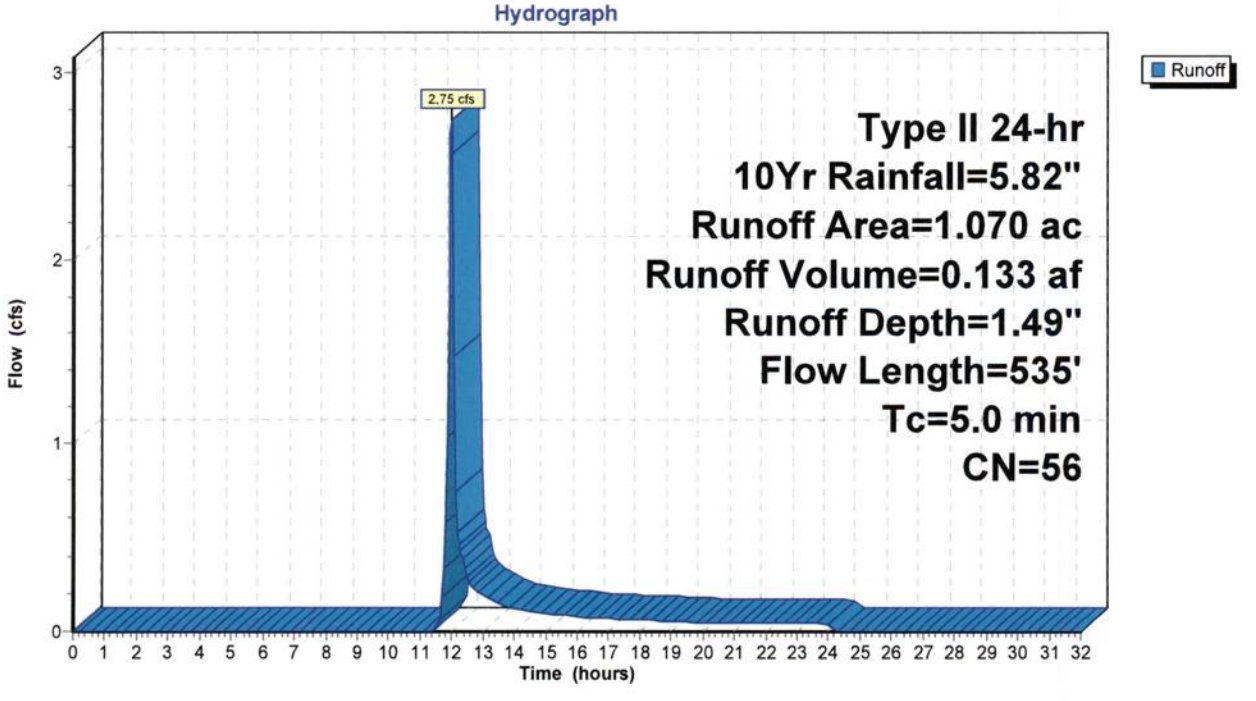
Runoff = 2.75 cfs @ 11.97 hrs, Volume= 0.133 af, Depth= 1.49"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
0.920	49	50-75% Grass cover, Fair, HSG A
0.150	96	Gravel surface, HSG A
1.070	56	Weighted Average
1.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	66	0.3255	0.37		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
1.5	469	0.0300	5.22	15.65	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030
4.5	535	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-7: DA-7



Summary for Subcatchment DA-8: DA-8

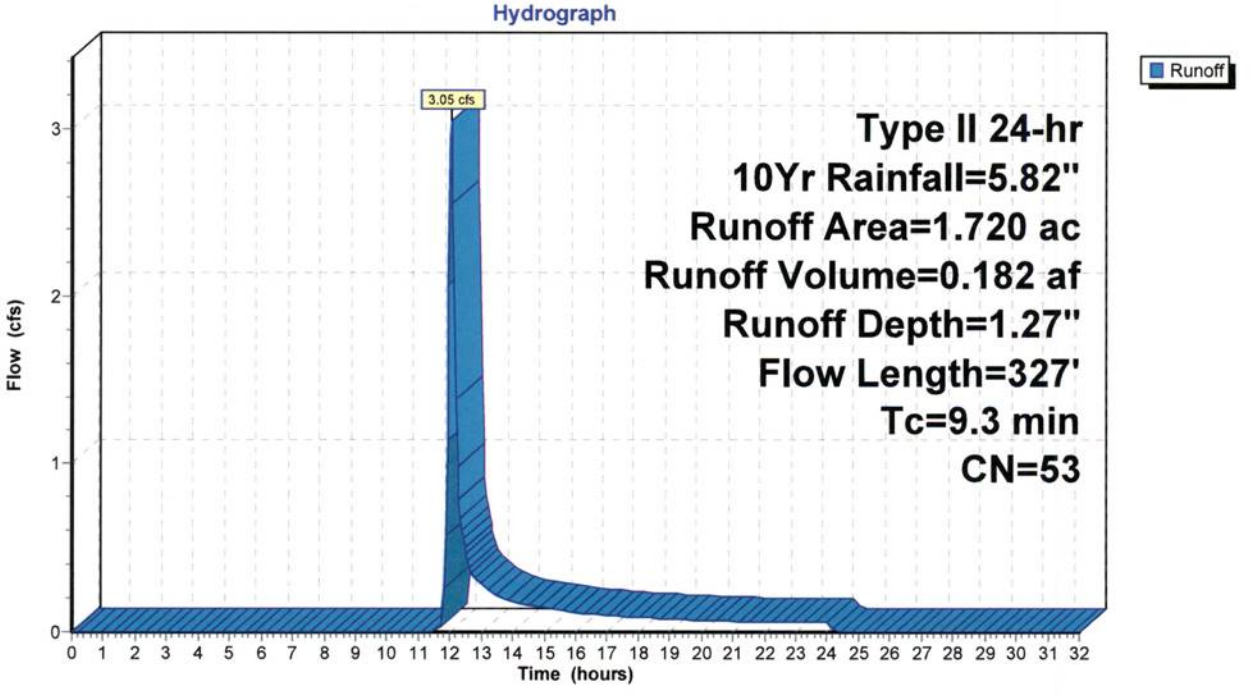
Runoff = 3.05 cfs @ 12.03 hrs, Volume= 0.182 af, Depth= 1.27"
Routed to Pond SB-1 : SB-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
1.570	49	50-75% Grass cover, Fair, HSG A
0.150	96	Gravel surface, HSG A
1.720	53	Weighted Average
1.720		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.0795	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.0	227	0.0729	1.89		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.3	327	Total			

Subcatchment DA-8: DA-8



Summary for Subcatchment DA-9: DA-09

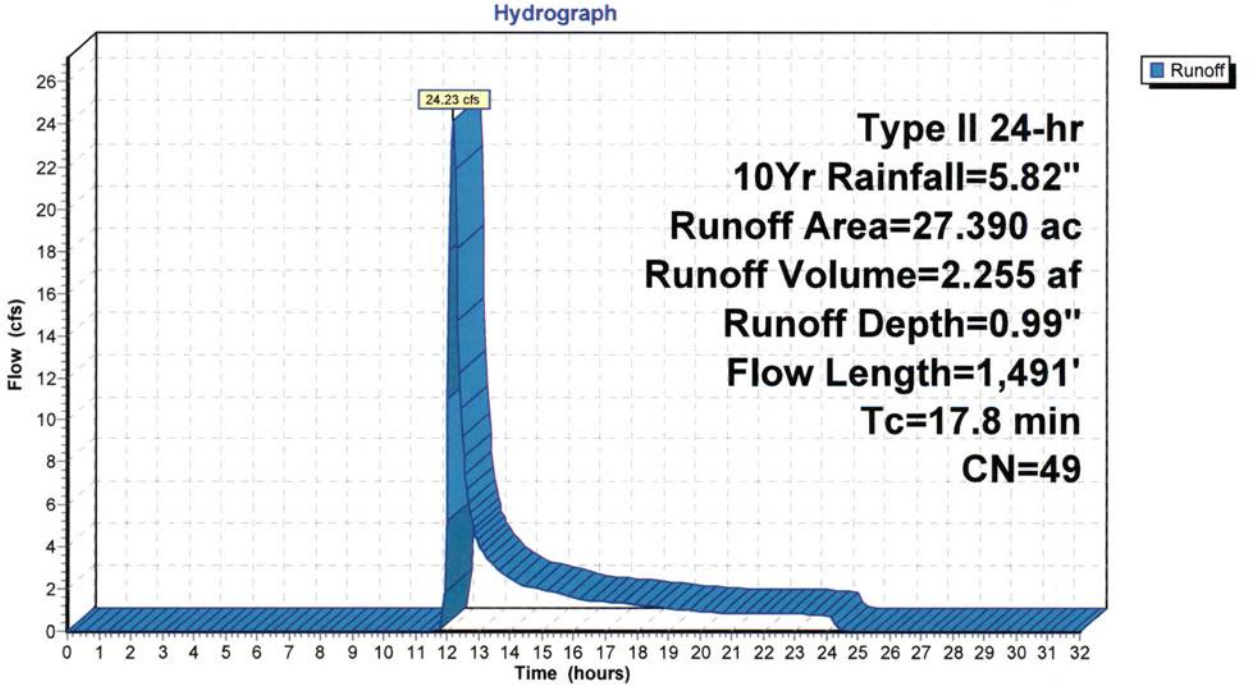
Runoff = 24.23 cfs @ 12.14 hrs, Volume= 2.255 af, Depth= 0.99"
Routed to Reach C-2 : C-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 10Yr Rainfall=5.82"

Area (ac)	CN	Description
27.280	49	50-75% Grass cover, Fair, HSG A
0.110	96	Gravel surface, HSG A
27.390	49	Weighted Average
27.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	100	0.0660	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
10.0	1,391	0.1088	2.31		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.8	1,491	Total			

Subcatchment DA-9: DA-09



Summary for Reach C-1: C-1

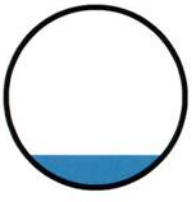
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach SCC-1 outlet invert by 0.36' @ 12.05 hrs
[61] Hint: Exceeded Reach SCC-2 outlet invert by 0.36' @ 12.05 hrs

Inflow Area = 5.400 ac, 0.00% Impervious, Inflow Depth = 1.24" for 10Yr event
Inflow = 9.00 cfs @ 12.06 hrs, Volume= 0.557 af
Outflow = 8.96 cfs @ 12.06 hrs, Volume= 0.557 af, Atten= 0%, Lag= 0.1 min
Routed to Pond SB-1 : SB-1

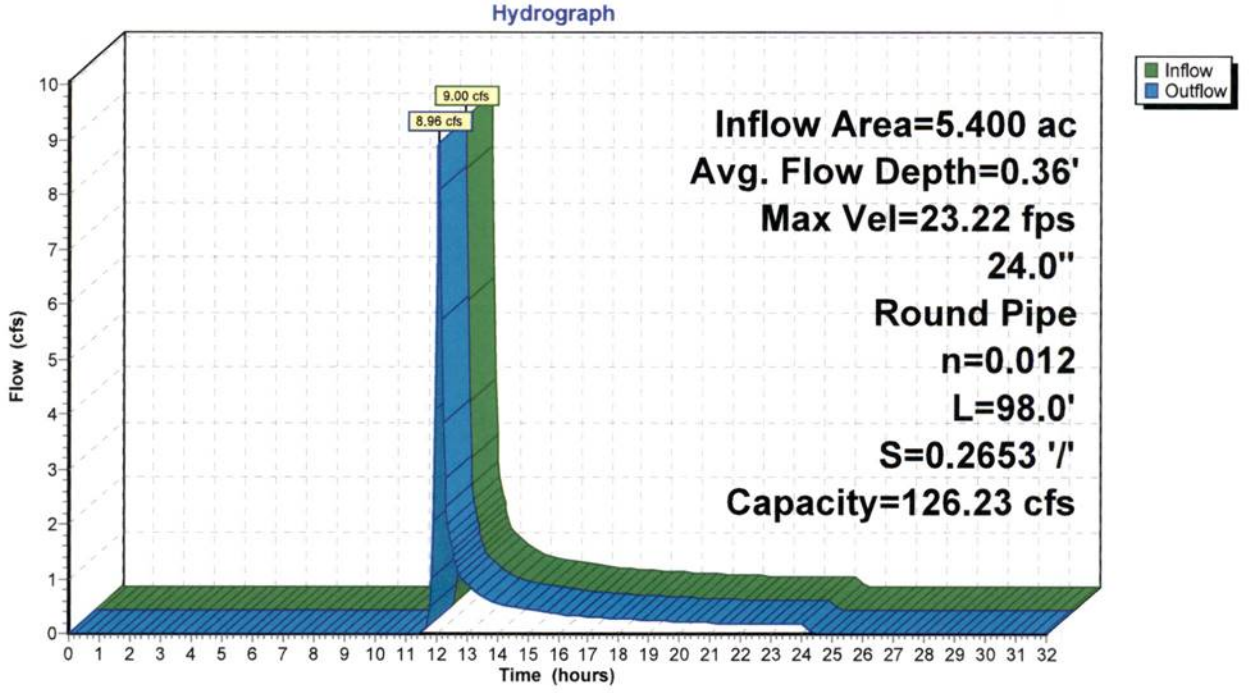
Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 23.22 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 8.45 fps, Avg. Travel Time= 0.2 min

Peak Storage= 38 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.36' , Surface Width= 1.54'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 126.23 cfs

24.0" Round Pipe
n= 0.012
Length= 98.0' Slope= 0.2653 '/'
Inlet Invert= 674.00', Outlet Invert= 648.00'



Reach C-1: C-1


Hydrograph
Inflow
Outflow
9.00 cfs
8.96 cfs
Inflow Area=5.400 ac
Avg. Flow Depth=0.36'
Max Vel=23.22 fps
24.0"
Round Pipe
n=0.012
L=98.0'
S=0.2653 '/'
Capacity=126.23 cfs
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

Summary for Reach C-2: C-2

[52] Hint: Inlet/Outlet conditions not evaluated

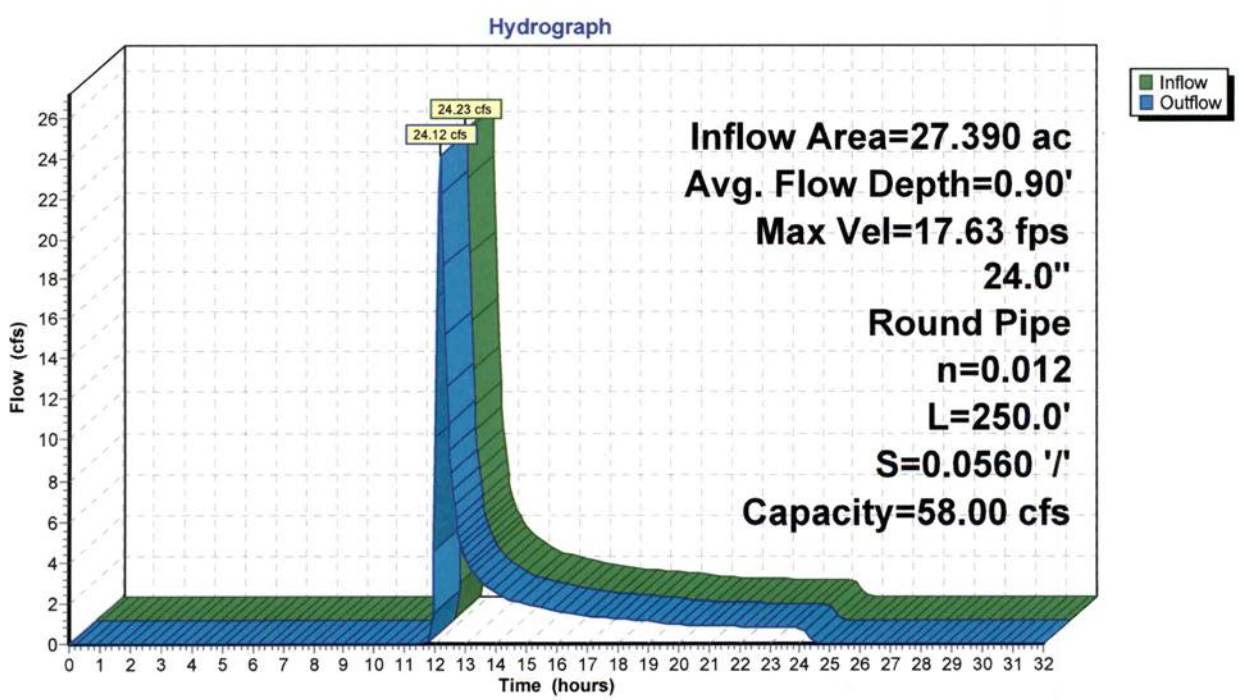
Inflow Area = 27.390 ac, 0.00% Impervious, Inflow Depth = 0.99" for 10Yr event
Inflow = 24.23 cfs @ 12.14 hrs, Volume= 2.255 af
Outflow = 24.12 cfs @ 12.15 hrs, Volume= 2.255 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 17.63 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 7.72 fps, Avg. Travel Time= 0.5 min

Peak Storage= 344 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.90' , Surface Width= 1.99'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 58.00 cfs

24.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 250.0' Slope= 0.0560 '/'
Inlet Invert= 666.00', Outlet Invert= 652.00'

Reach C-2: C-2



Summary for Reach SCC-1: SCC-1

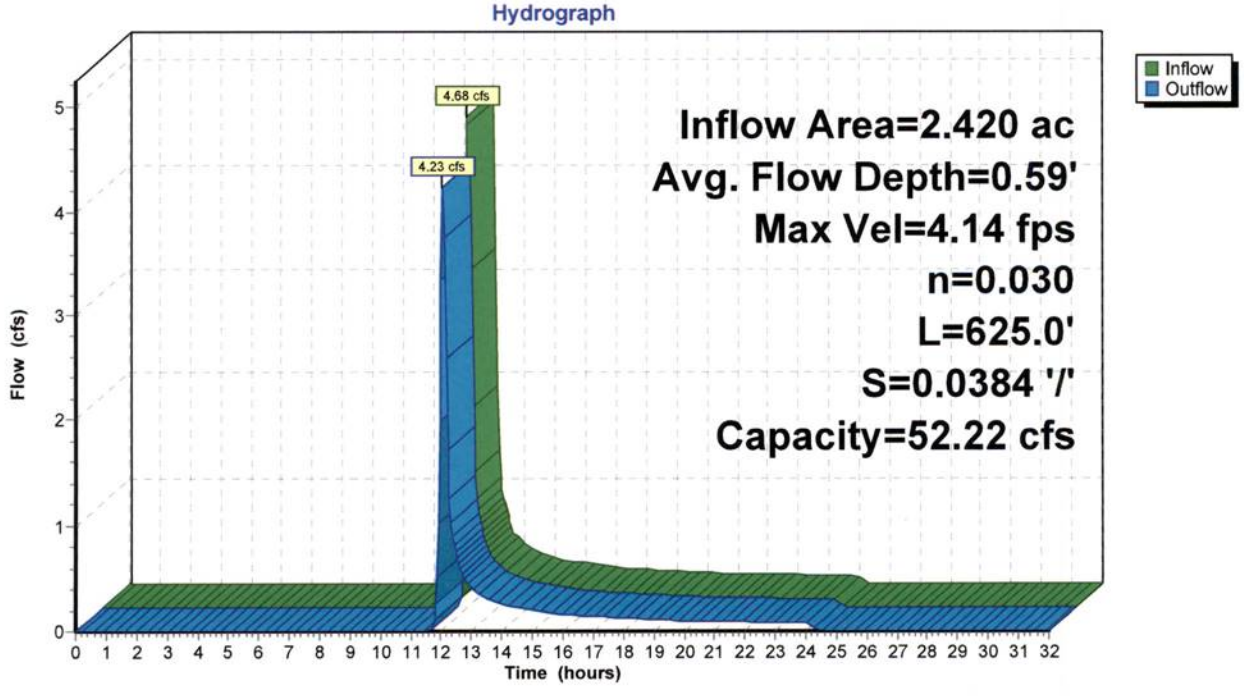
Inflow Area = 2.420 ac, 0.00% Impervious, Inflow Depth = 1.27" for 10Yr event
Inflow = 4.68 cfs @ 11.98 hrs, Volume= 0.256 af
Outflow = 4.23 cfs @ 12.06 hrs, Volume= 0.256 af, Atten= 10%, Lag= 4.4 min
Routed to Reach C-1 : C-1

Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.14 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 1.65 fps, Avg. Travel Time= 6.3 min

Peak Storage= 651 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.59' , Surface Width= 3.54'
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 52.22 cfs

0.00' x 1.50' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 625.0' Slope= 0.0384 '/'
Inlet Invert= 698.00', Outlet Invert= 674.00'

Reach SCC-1: SCC-1



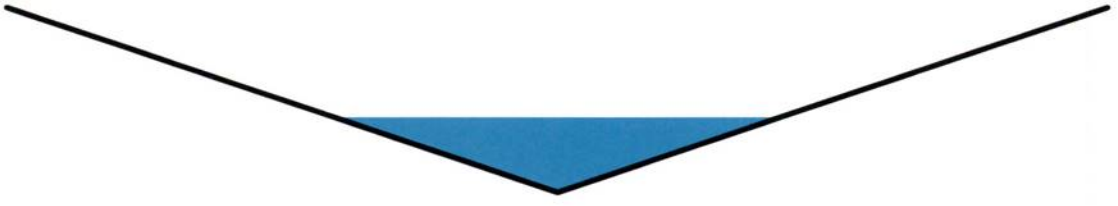
Summary for Reach SCC-2: SCC-2

Inflow Area = 2.620 ac, 0.00% Impervious, Inflow Depth = 1.24" for 10Yr event
Inflow = 4.83 cfs @ 11.99 hrs, Volume= 0.271 af
Outflow = 4.37 cfs @ 12.06 hrs, Volume= 0.271 af, Atten= 9%, Lag= 4.2 min
Routed to Reach C-1 : C-1

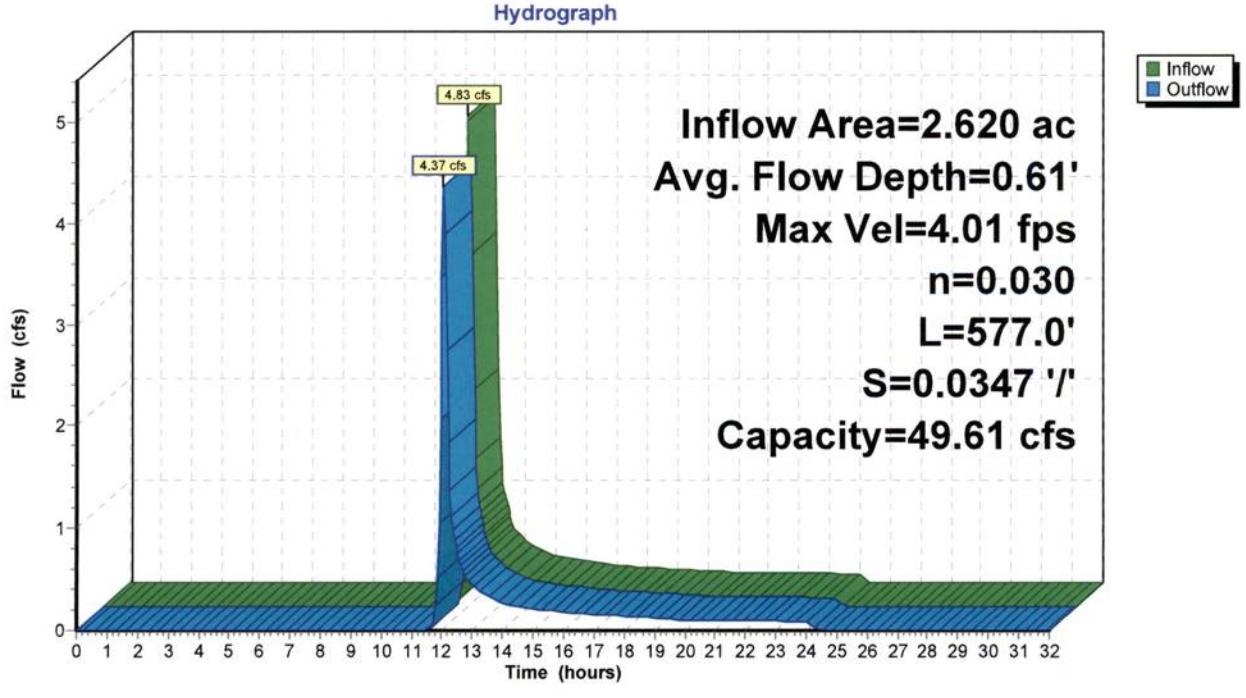
Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.01 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 1.62 fps, Avg. Travel Time= 5.9 min

Peak Storage= 642 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.61' , Surface Width= 3.66'
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 49.61 cfs

0.00' x 1.50' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 577.0' Slope= 0.0347 '/'
Inlet Invert= 694.00', Outlet Invert= 674.00'



Reach SCC-2: SCC-2



Summary for Pond SB-1: SB-1

Inflow Area = 7.120 ac, 0.00% Impervious, Inflow Depth = 1.25" for 10Yr event
Inflow = 11.86 cfs @ 12.05 hrs, Volume= 0.739 af
Outflow = 1.50 cfs @ 12.67 hrs, Volume= 0.712 af, Atten= 87%, Lag= 37.4 min
Primary = 1.50 cfs @ 12.67 hrs, Volume= 0.712 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Peak Elev= 645.77' @ 12.67 hrs Surf.Area= 5,020 sf Storage= 10,391 cf

Plug-Flow detention time= 93.9 min calculated for 0.712 af (96% of inflow)
Center-of-Mass det. time= 73.7 min (963.7 - 890.0)

Volume	Invert	Avail.Storage	Storage Description
#1	642.00'	33,793 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

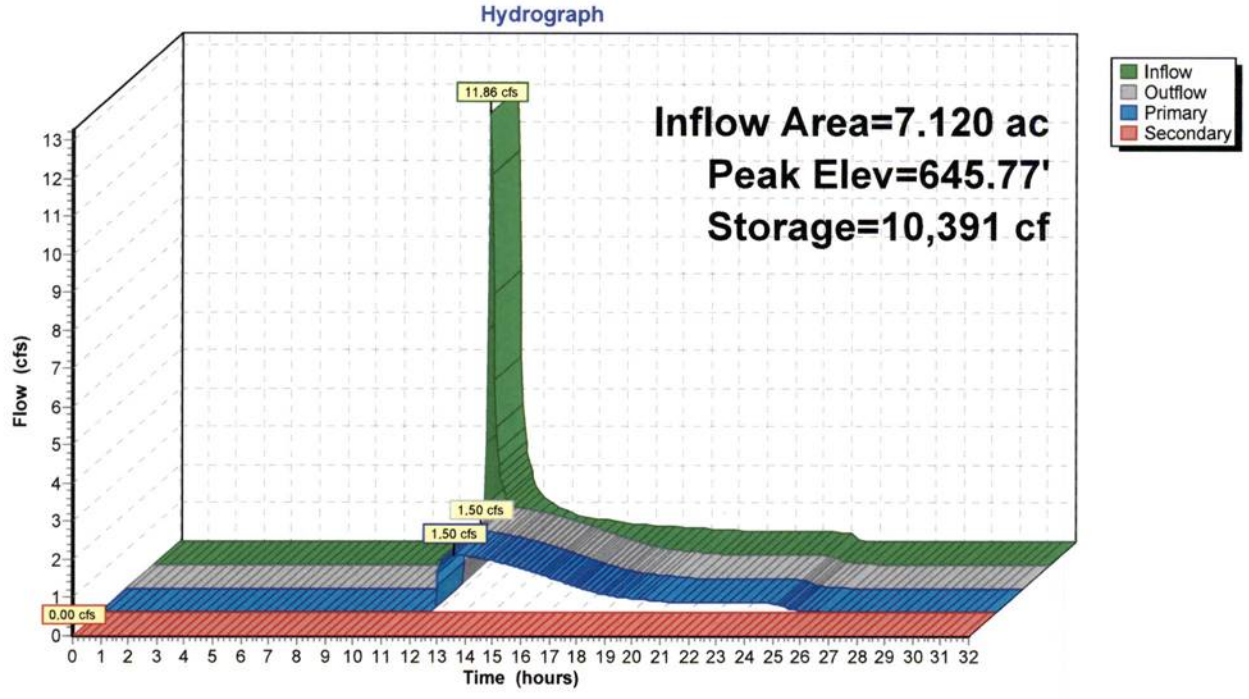
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
642.00	629	0	0
644.00	2,825	3,454	3,454
646.00	5,308	8,133	11,587
648.00	8,076	13,384	24,971
649.00	9,568	8,822	33,793

Device	Routing	Invert	Outlet Devices
#1	Primary	642.00'	**24.0" Round Culvert** L= 68.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 642.00' / 640.00' S= 0.0294 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	643.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	646.00'	**12.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	647.00'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.50 cfs @ 12.67 hrs HW=645.77' (Free Discharge)
└**1=Culvert** (Passes 1.50 cfs of 25.17 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.50 cfs @ 7.64 fps)
  └**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=642.00' (Free Discharge)
└**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond SB-1: SB-1


Hydrograph
Inflow
Outflow
Primary
Secondary
11.86 cfs
1.50 cfs
1.50 cfs
0.00 cfs
Inflow Area=7.120 ac
Peak Elev=645.77'
Storage=10,391 cf
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

Time span=0.00-32.00 hrs, dt=0.05 hrs, 641 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDA-1: DA-1 Runoff Area=1.110 ac 0.00% Impervious Runoff Depth=1.63"
Flow Length=357' Tc=8.5 min CN=49 Runoff=2.67 cfs 0.151 af

SubcatchmentDA-2: DA-2 Runoff Area=0.360 ac 0.00% Impervious Runoff Depth=1.63"
Flow Length=490' Tc=12.6 min CN=49 Runoff=0.73 cfs 0.049 af

SubcatchmentDA-3: DA-3 Runoff Area=1.180 ac 0.00% Impervious Runoff Depth=1.63"
Flow Length=354' Tc=9.2 min CN=49 Runoff=2.75 cfs 0.160 af

SubcatchmentDA-4: DA-4 Runoff Area=0.340 ac 0.00% Impervious Runoff Depth=2.37"
Flow Length=248' Tc=5.0 min CN=57 Runoff=1.44 cfs 0.067 af

SubcatchmentDA-5: DA-5 Runoff Area=0.970 ac 0.00% Impervious Runoff Depth=2.28"
Flow Length=485' Tc=5.0 min CN=56 Runoff=3.92 cfs 0.184 af

SubcatchmentDA-6: DA-6 Runoff Area=0.370 ac 0.00% Impervious Runoff Depth=2.09"
Flow Length=1,898' Tc=5.6 min CN=54 Runoff=1.33 cfs 0.064 af

SubcatchmentDA-7: DA-7 Runoff Area=1.070 ac 0.00% Impervious Runoff Depth=2.28"
Flow Length=535' Tc=5.0 min CN=56 Runoff=4.33 cfs 0.203 af

SubcatchmentDA-8: DA-8 Runoff Area=1.720 ac 0.00% Impervious Runoff Depth=1.99"
Flow Length=327' Tc=9.3 min CN=53 Runoff=5.10 cfs 0.286 af

SubcatchmentDA-9: DA-09 Runoff Area=27.390 ac 0.00% Impervious Runoff Depth=1.63"
Flow Length=1,491' Tc=17.8 min CN=49 Runoff=45.57 cfs 3.714 af

Reach C-1: C-1 Avg. Flow Depth=0.47' Max Vel=27.10 fps Inflow=15.15 cfs 0.878 af
24.0" Round Pipe n=0.012 L=98.0' S=0.2653 '/' Capacity=126.23 cfs Outflow=15.11 cfs 0.878 af

Reach C-2: C-2 Avg. Flow Depth=1.34' Max Vel=20.40 fps Inflow=45.57 cfs 3.714 af
24.0" Round Pipe n=0.012 L=250.0' S=0.0560 '/' Capacity=58.00 cfs Outflow=45.39 cfs 3.714 af

Reach SCC-1: SCC-1 Avg. Flow Depth=0.72' Max Vel=4.73 fps Inflow=7.73 cfs 0.402 af
n=0.030 L=625.0' S=0.0384 '/' Capacity=52.22 cfs Outflow=7.06 cfs 0.402 af

Reach SCC-2: SCC-2 Avg. Flow Depth=0.74' Max Vel=4.60 fps Inflow=8.04 cfs 0.427 af
n=0.030 L=577.0' S=0.0347 '/' Capacity=49.61 cfs Outflow=7.37 cfs 0.427 af

Pond SB-1: SB-1 Peak Elev=646.39' Storage=13,755 cf Inflow=20.02 cfs 1.164 af
Primary=11.05 cfs 1.136 af Secondary=0.00 cfs 0.000 af Outflow=11.05 cfs 1.136 af

Total Runoff Area = 34.510 ac Runoff Volume = 4.877 af Average Runoff Depth = 1.70"
100.00% Pervious = 34.510 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment DA-1: DA-1

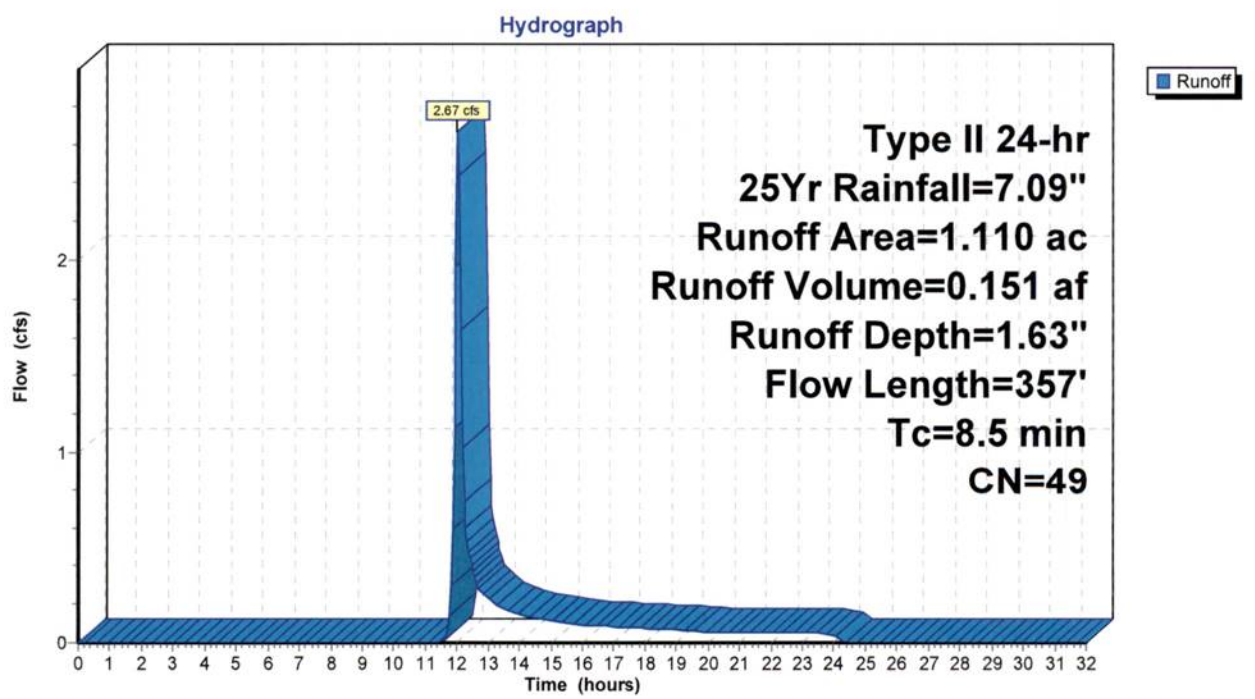
Runoff = 2.67 cfs @ 12.01 hrs, Volume= 0.151 af, Depth= 1.63"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
1.110	49	50-75% Grass cover, Fair, HSG A
1.110		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.1100	0.26		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.1	257	0.0817	2.00		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.5	357	Total			

Subcatchment DA-1: DA-1



Summary for Subcatchment DA-2: DA-2

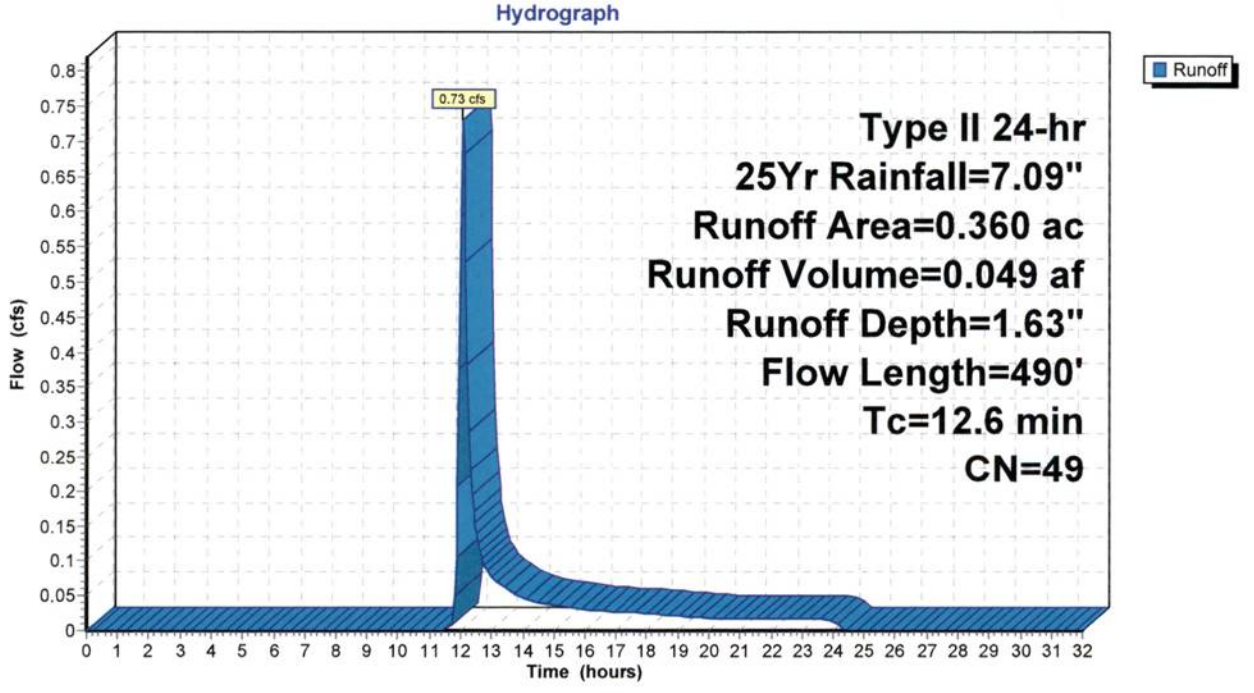
Runoff = 0.73 cfs @ 12.06 hrs, Volume= 0.049 af, Depth= 1.63"
Routed to Reach C-1 : C-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
0.360	49	50-75% Grass cover, Fair, HSG A
0.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	100	0.0436	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
3.4	390	0.0765	1.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.6	490	Total			

Subcatchment DA-2: DA-2



Summary for Subcatchment DA-3: DA-3

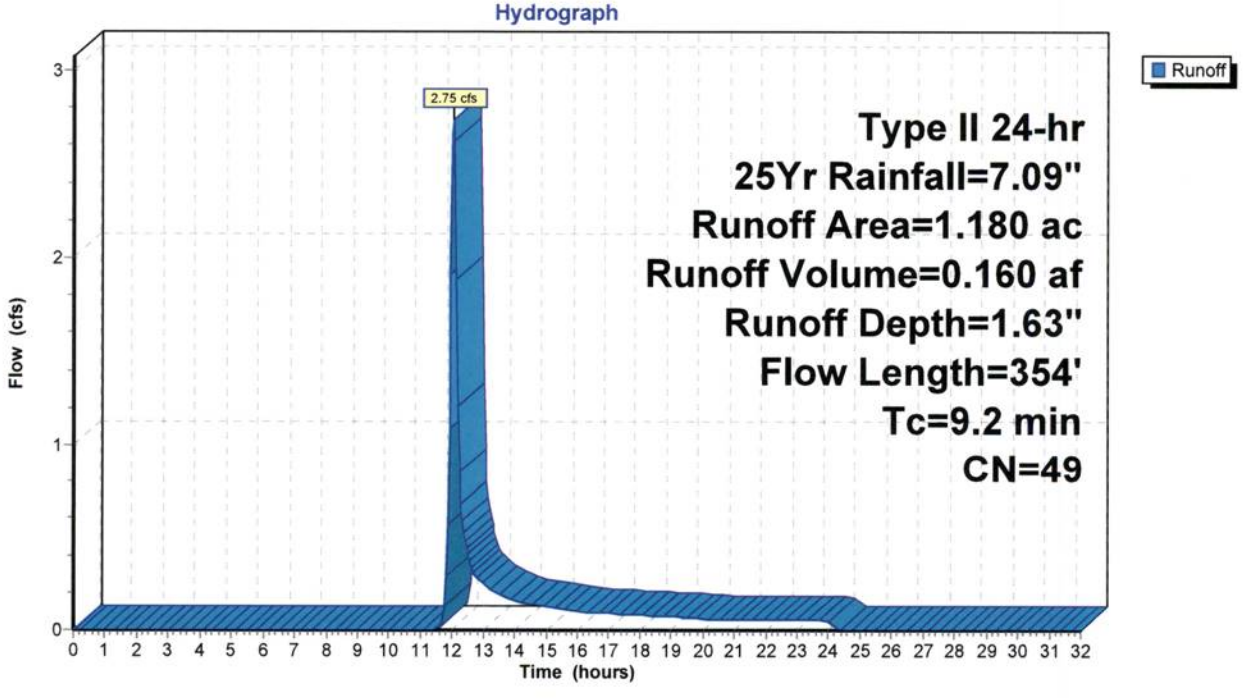
Runoff = 2.75 cfs @ 12.02 hrs, Volume= 0.160 af, Depth= 1.63"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
1.180	49	50-75% Grass cover, Fair, HSG A
1.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0800	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.0	254	0.0946	2.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.2	354	Total			

Subcatchment DA-3: DA-3



Summary for Subcatchment DA-4: DA-4

[49] Hint: Tc<2dt may require smaller dt

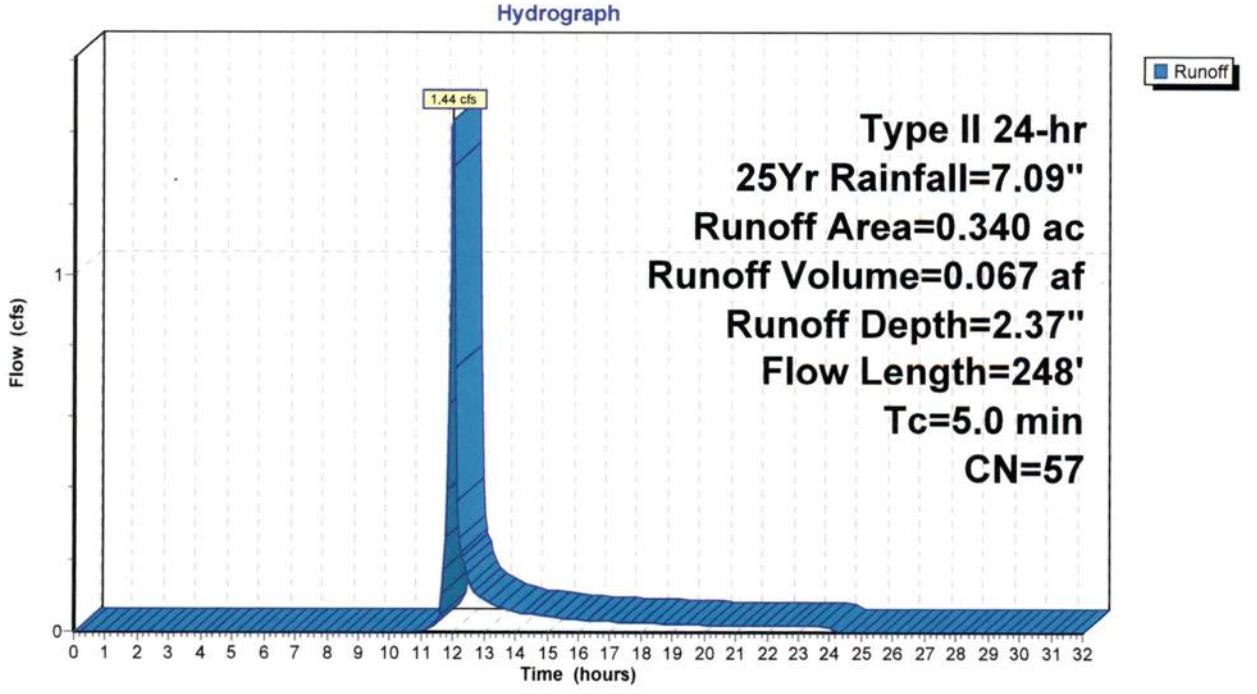
Runoff = 1.44 cfs @ 11.96 hrs, Volume= 0.067 af, Depth= 2.37"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
0.280	49	50-75% Grass cover, Fair, HSG A
0.060	96	Gravel surface, HSG A
0.340	57	Weighted Average
0.340		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	49	0.3160	0.50		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.11"
2.0	199	0.0579	1.68		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.6	248	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-4: DA-4



Summary for Subcatchment DA-5: DA-5

[49] Hint: Tc<2dt may require smaller dt

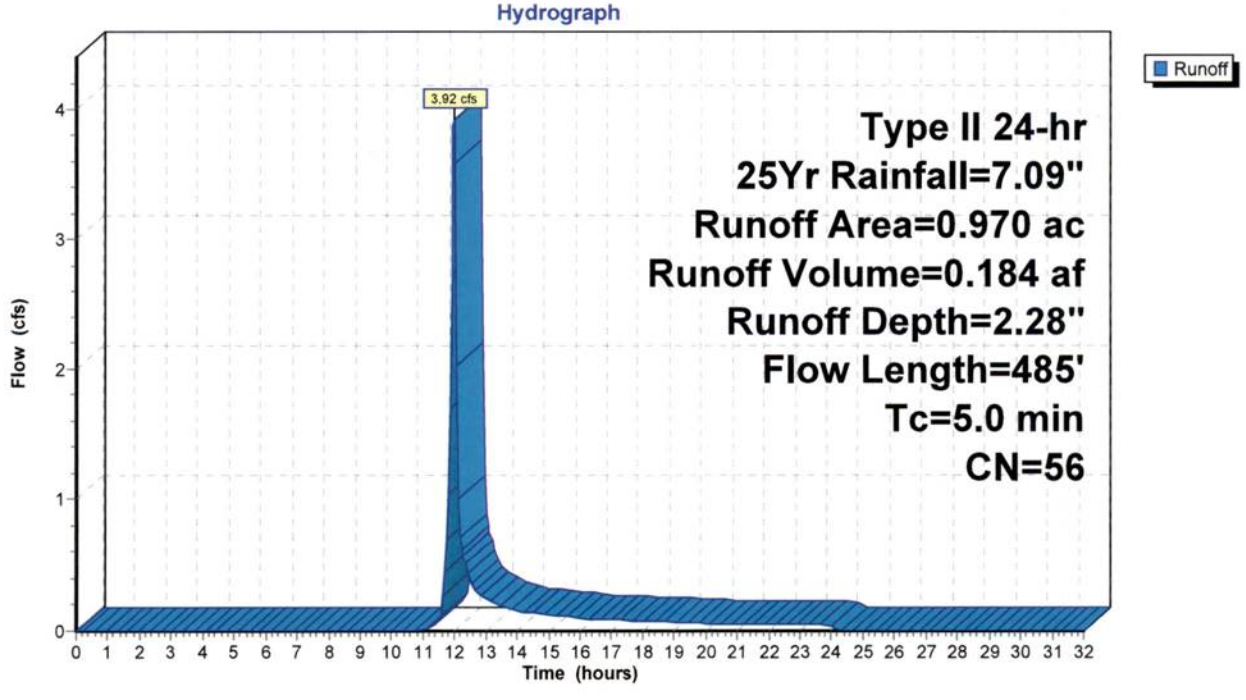
Runoff = 3.92 cfs @ 11.96 hrs, Volume= 0.184 af, Depth= 2.28"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
0.830	49	50-75% Grass cover, Fair, HSG A
0.140	96	Gravel surface, HSG A
0.970	56	Weighted Average
0.970		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	69	0.3300	0.38		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
1.3	416	0.0300	5.22	15.65	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
4.3	485	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-5: DA-5



Summary for Subcatchment DA-6: DA-6

[49] Hint: Tc<2dt may require smaller dt

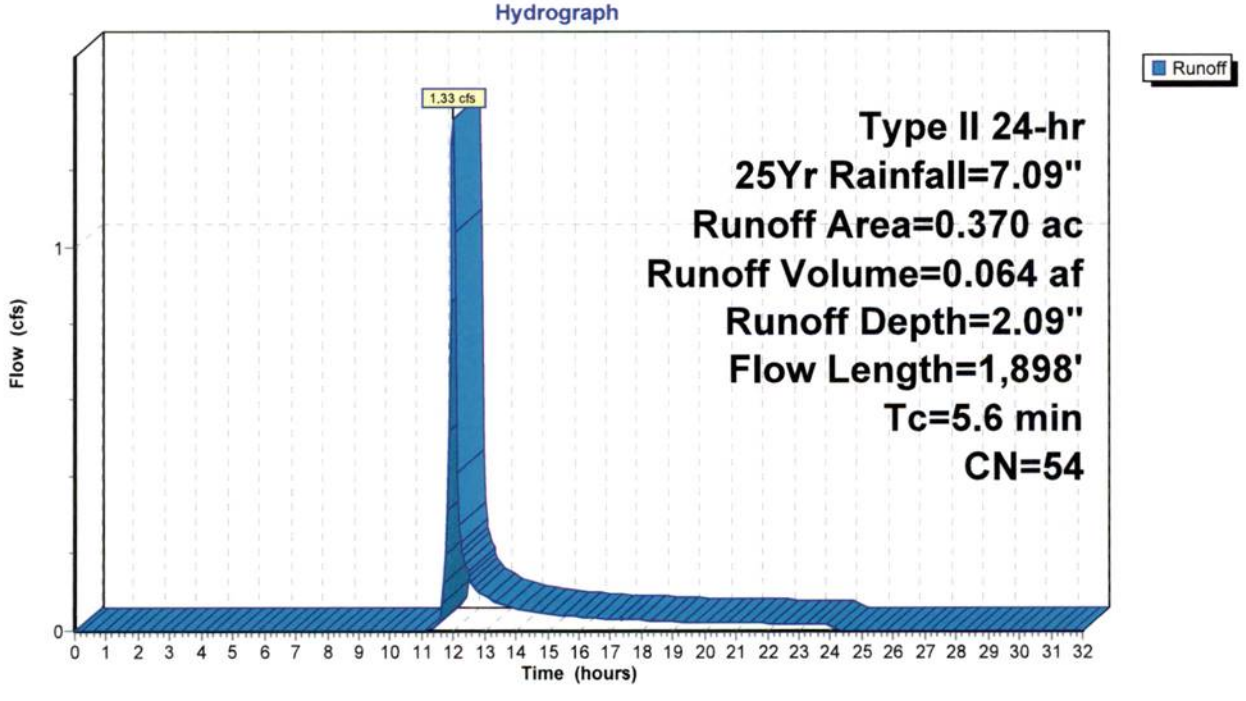
Runoff = 1.33 cfs @ 11.98 hrs, Volume= 0.064 af, Depth= 2.09"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
0.330	49	50-75% Grass cover, Fair, HSG A
0.040	96	Gravel surface, HSG A
0.370	54	Weighted Average
0.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	58	0.2550	0.33		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.7	1,840	0.0247	11.31	475.16	**Trap/Vee/Rect Channel Flow,** Bot.W=5.00' D=3.00' Z= 3.0 '/' Top.W=23.00' n= 0.030
5.6	1,898	Total			

Subcatchment DA-6: DA-6



Summary for Subcatchment DA-7: DA-7

[49] Hint: Tc<2dt may require smaller dt

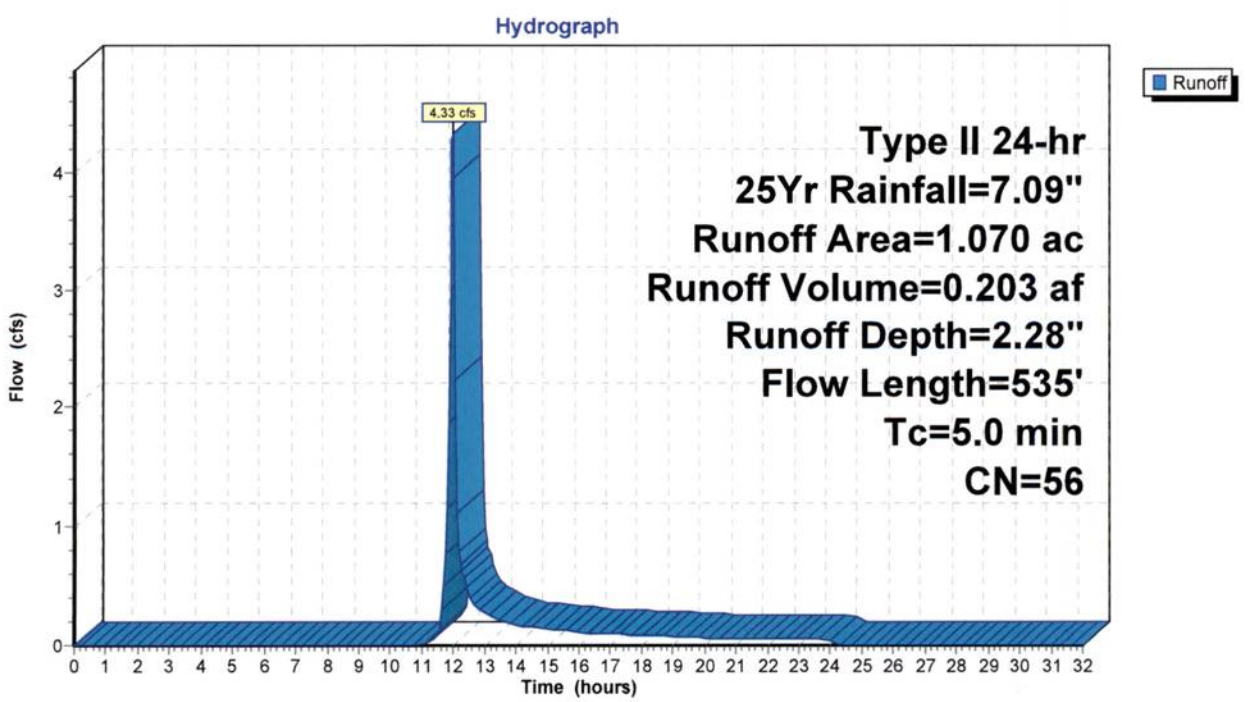
Runoff = 4.33 cfs @ 11.96 hrs, Volume= 0.203 af, Depth= 2.28"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
0.920	49	50-75% Grass cover, Fair, HSG A
0.150	96	Gravel surface, HSG A
1.070	56	Weighted Average
1.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	66	0.3255	0.37		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
1.5	469	0.0300	5.22	15.65	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030
4.5	535	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-7: DA-7



Summary for Subcatchment DA-8: DA-8

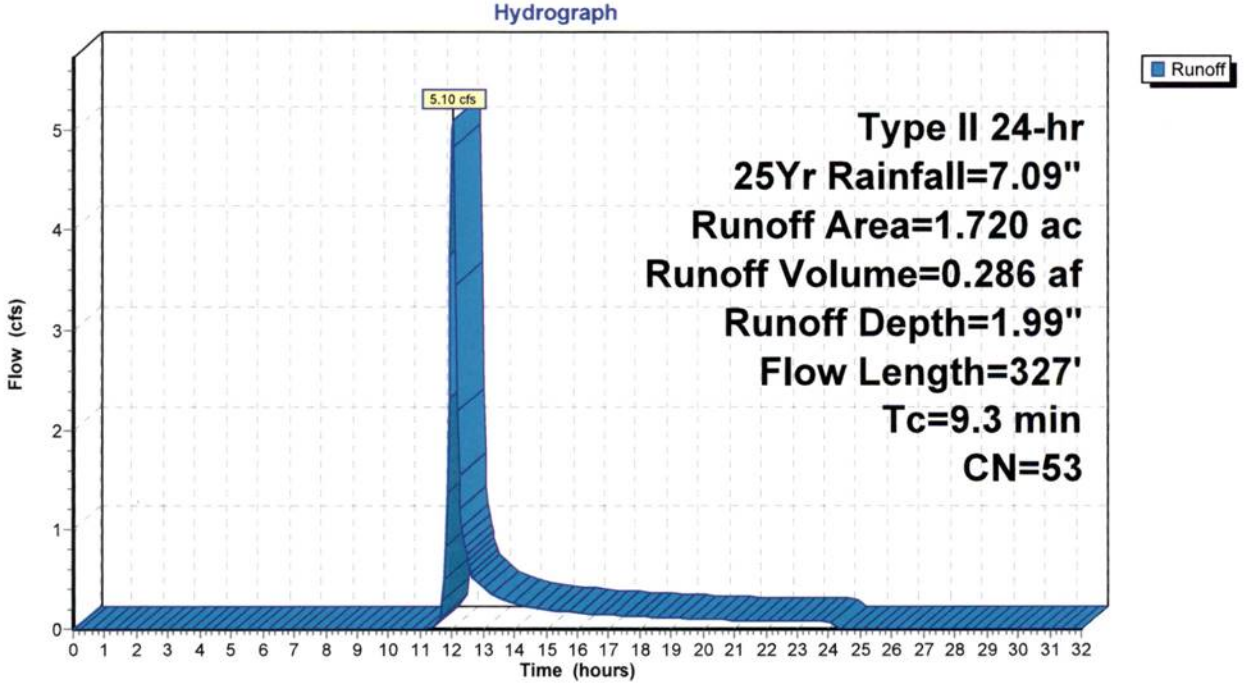
Runoff = 5.10 cfs @ 12.02 hrs, Volume= 0.286 af, Depth= 1.99"
Routed to Pond SB-1 : SB-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
1.570	49	50-75% Grass cover, Fair, HSG A
0.150	96	Gravel surface, HSG A
1.720	53	Weighted Average
1.720		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.0795	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.0	227	0.0729	1.89		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.3	327	Total			

Subcatchment DA-8: DA-8



Summary for Subcatchment DA-9: DA-09

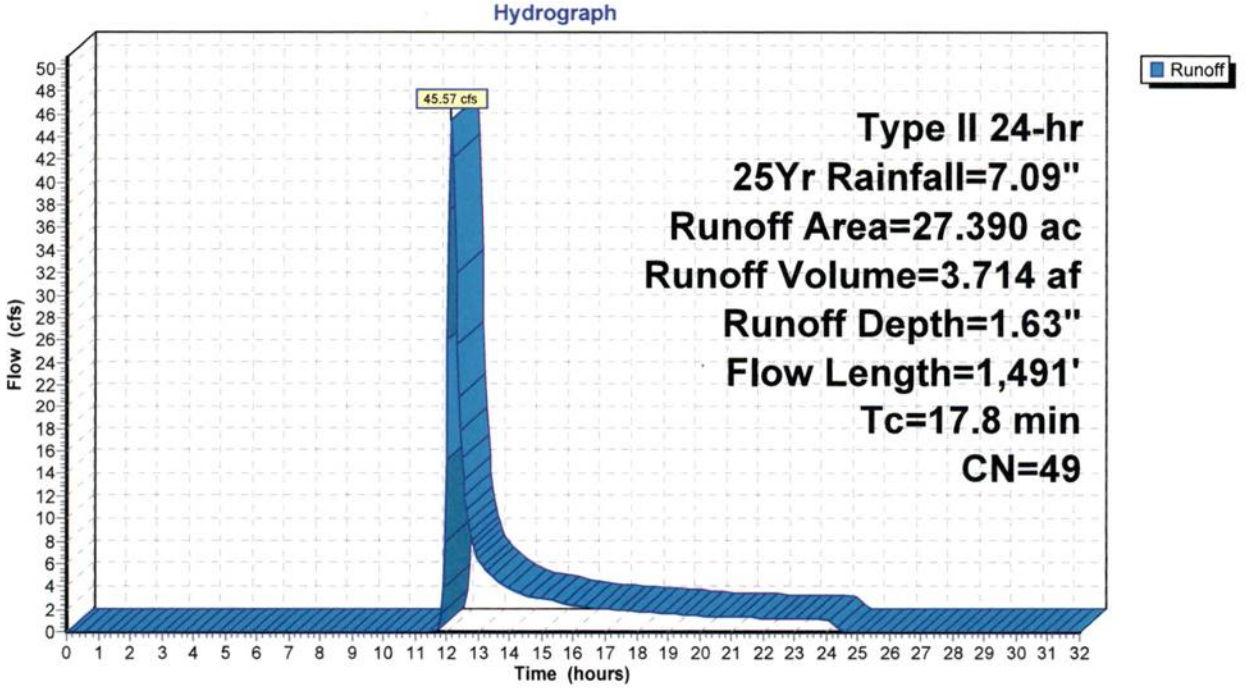
Runoff = 45.57 cfs @ 12.13 hrs, Volume= 3.714 af, Depth= 1.63"
Routed to Reach C-2 : C-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 25Yr Rainfall=7.09"

Area (ac)	CN	Description
27.280	49	50-75% Grass cover, Fair, HSG A
0.110	96	Gravel surface, HSG A
27.390	49	Weighted Average
27.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	100	0.0660	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
10.0	1,391	0.1088	2.31		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.8	1,491	Total			

Subcatchment DA-9: DA-09



Summary for Reach C-1: C-1

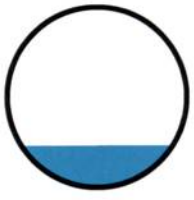
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach SCC-1 outlet invert by 0.47' @ 12.05 hrs
[61] Hint: Exceeded Reach SCC-2 outlet invert by 0.47' @ 12.05 hrs

Inflow Area = 5.400 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25Yr event
Inflow = 15.15 cfs @ 12.05 hrs, Volume= 0.878 af
Outflow = 15.11 cfs @ 12.05 hrs, Volume= 0.878 af, Atten= 0%, Lag= 0.1 min
Routed to Pond SB-1 : SB-1

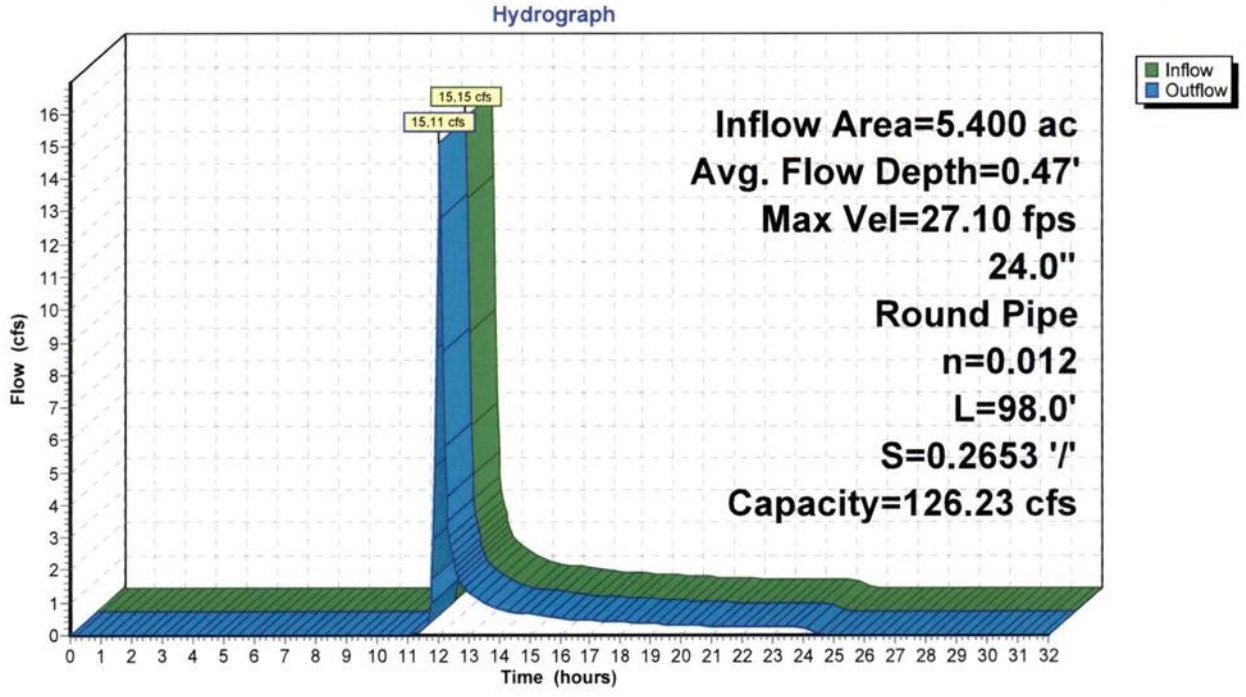
Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 27.10 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 9.32 fps, Avg. Travel Time= 0.2 min

Peak Storage= 55 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.47' , Surface Width= 1.69'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 126.23 cfs

24.0" Round Pipe
n= 0.012
Length= 98.0' Slope= 0.2653 '/'
Inlet Invert= 674.00', Outlet Invert= 648.00'



Reach C-1: C-1


Hydrograph
Inflow
Outflow
15.15 cfs
15.11 cfs
Inflow Area=5.400 ac
Avg. Flow Depth=0.47'
Max Vel=27.10 fps
24.0"
Round Pipe
n=0.012
L=98.0'
S=0.2653 '/'
Capacity=126.23 cfs
Flow (cfs)
Time (hours)

Summary for Reach C-2: C-2

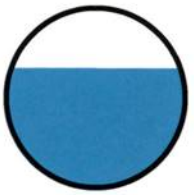
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 27.390 ac, 0.00% Impervious, Inflow Depth = 1.63" for 25Yr event
Inflow = 45.57 cfs @ 12.13 hrs, Volume= 3.714 af
Outflow = 45.39 cfs @ 12.13 hrs, Volume= 3.714 af, Atten= 0%, Lag= 0.5 min

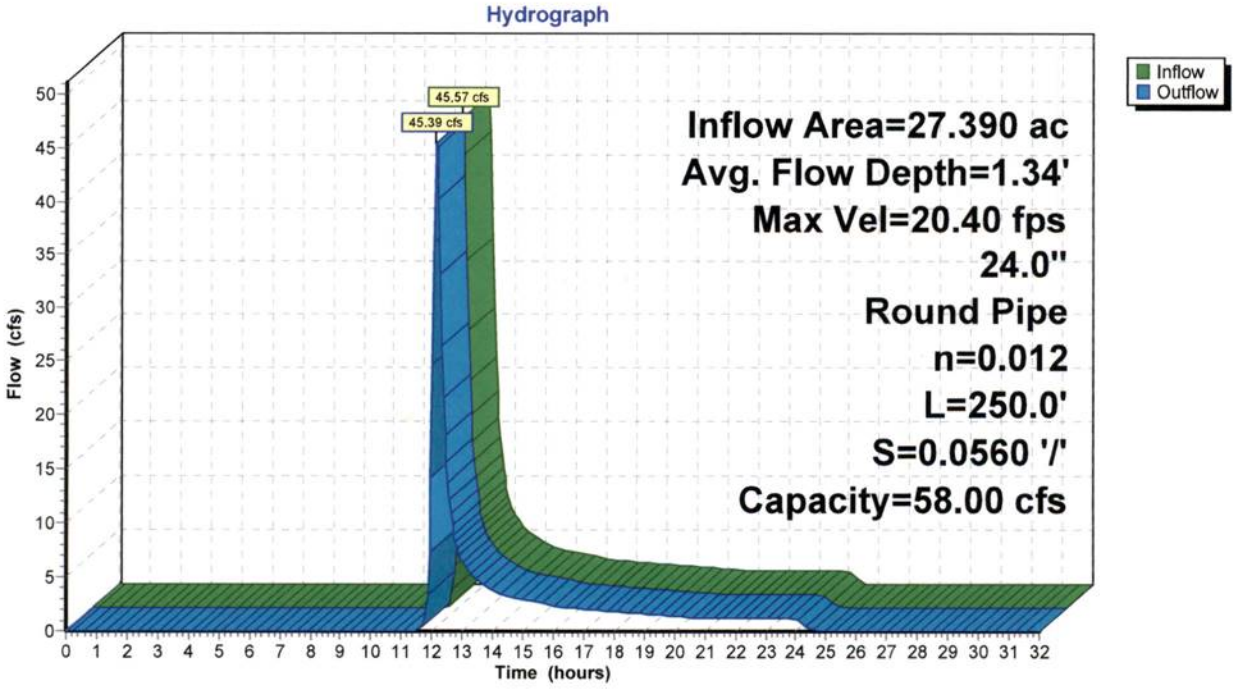
Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 20.40 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 8.72 fps, Avg. Travel Time= 0.5 min

Peak Storage= 558 cf @ 12.13 hrs
Average Depth at Peak Storage= 1.34' , Surface Width= 1.88'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 58.00 cfs

24.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 250.0' Slope= 0.0560 '/'
Inlet Invert= 666.00', Outlet Invert= 652.00'



Reach C-2: C-2



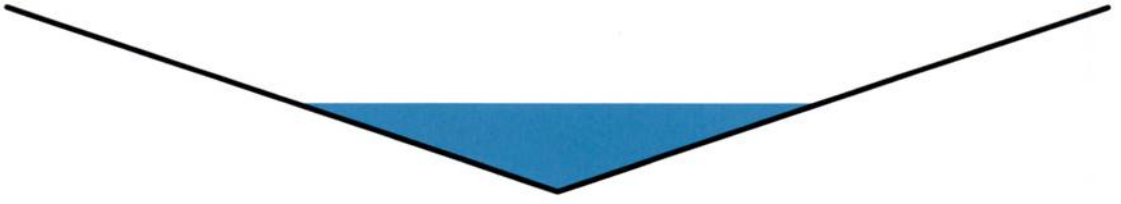
Summary for Reach SCC-1: SCC-1

Inflow Area = 2.420 ac, 0.00% Impervious, Inflow Depth = 1.99" for 25Yr event
Inflow = 7.73 cfs @ 11.98 hrs, Volume= 0.402 af
Outflow = 7.06 cfs @ 12.05 hrs, Volume= 0.402 af, Atten= 9%, Lag= 3.9 min
Routed to Reach C-1 : C-1

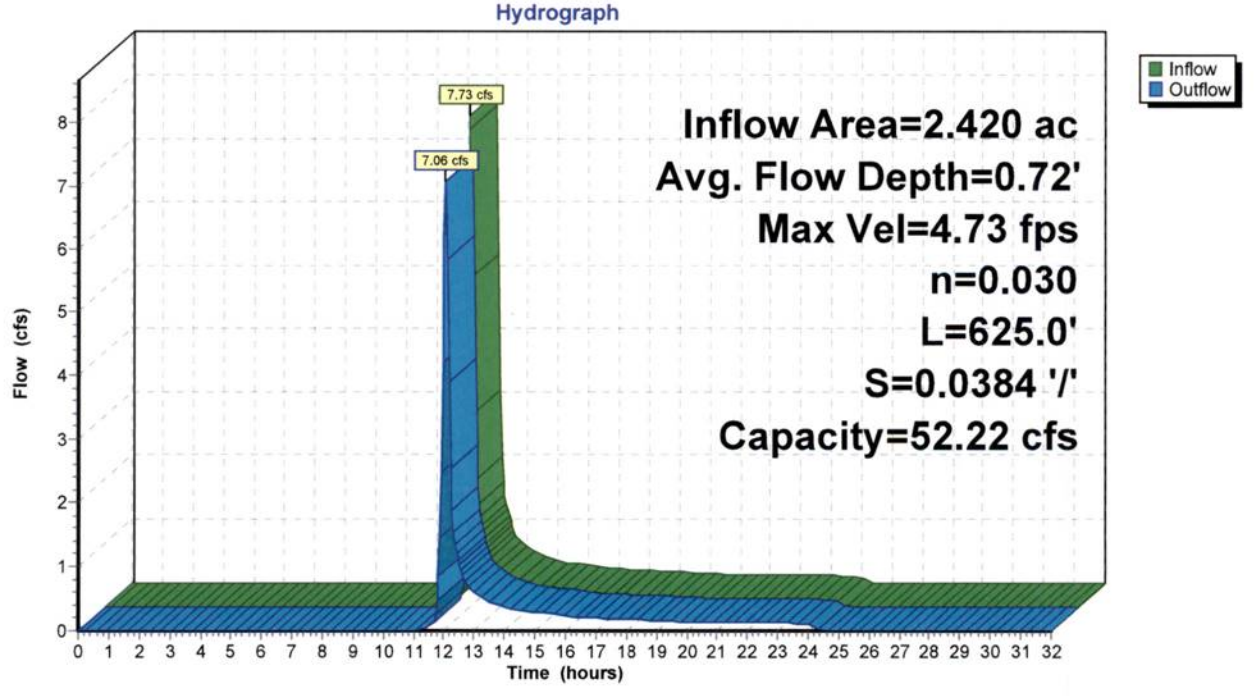
Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.73 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.79 fps, Avg. Travel Time= 5.8 min

Peak Storage= 965 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.72' , Surface Width= 4.31'
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 52.22 cfs

0.00' x 1.50' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 625.0' Slope= 0.0384 '/'
Inlet Invert= 698.00', Outlet Invert= 674.00'



Reach SCC-1: SCC-1



Summary for Reach SCC-2: SCC-2

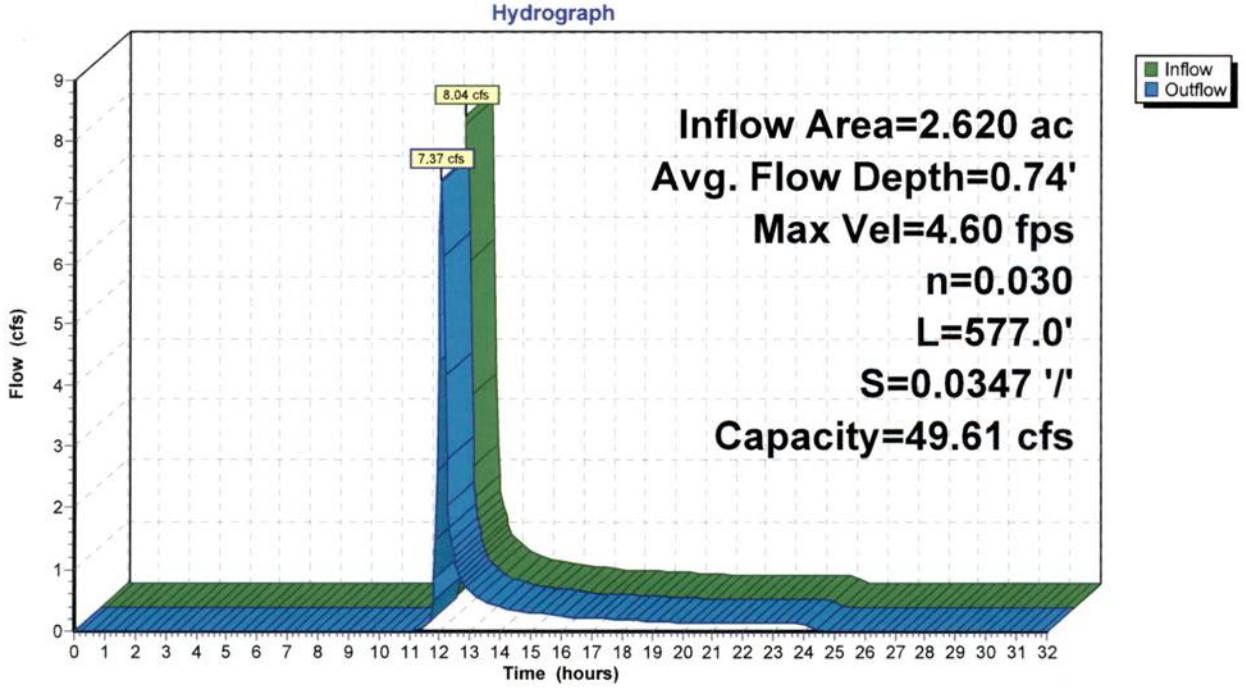
Inflow Area = 2.620 ac, 0.00% Impervious, Inflow Depth = 1.96" for 25Yr event
Inflow = 8.04 cfs @ 11.98 hrs, Volume= 0.427 af
Outflow = 7.37 cfs @ 12.05 hrs, Volume= 0.427 af, Atten= 8%, Lag= 3.7 min
Routed to Reach C-1 : C-1

Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.60 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.75 fps, Avg. Travel Time= 5.5 min

Peak Storage= 957 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.74' , Surface Width= 4.46'
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 49.61 cfs

0.00' x 1.50' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 577.0' Slope= 0.0347 '/'
Inlet Invert= 694.00', Outlet Invert= 674.00'

Reach SCC-2: SCC-2



Summary for Pond SB-1: SB-1

Inflow Area = 7.120 ac, 0.00% Impervious, Inflow Depth = 1.96" for 25Yr event
Inflow = 20.02 cfs @ 12.04 hrs, Volume= 1.164 af
Outflow = 11.05 cfs @ 12.17 hrs, Volume= 1.136 af, Atten= 45%, Lag= 7.5 min
Primary = 11.05 cfs @ 12.17 hrs, Volume= 1.136 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Peak Elev= 646.39' @ 12.17 hrs Surf.Area= 5,846 sf Storage= 13,755 cf

Plug-Flow detention time= 80.1 min calculated for 1.134 af (97% of inflow)
Center-of-Mass det. time= 67.2 min (940.9 - 873.7)

Volume	Invert	Avail.Storage	Storage Description
#1	642.00'	33,793 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

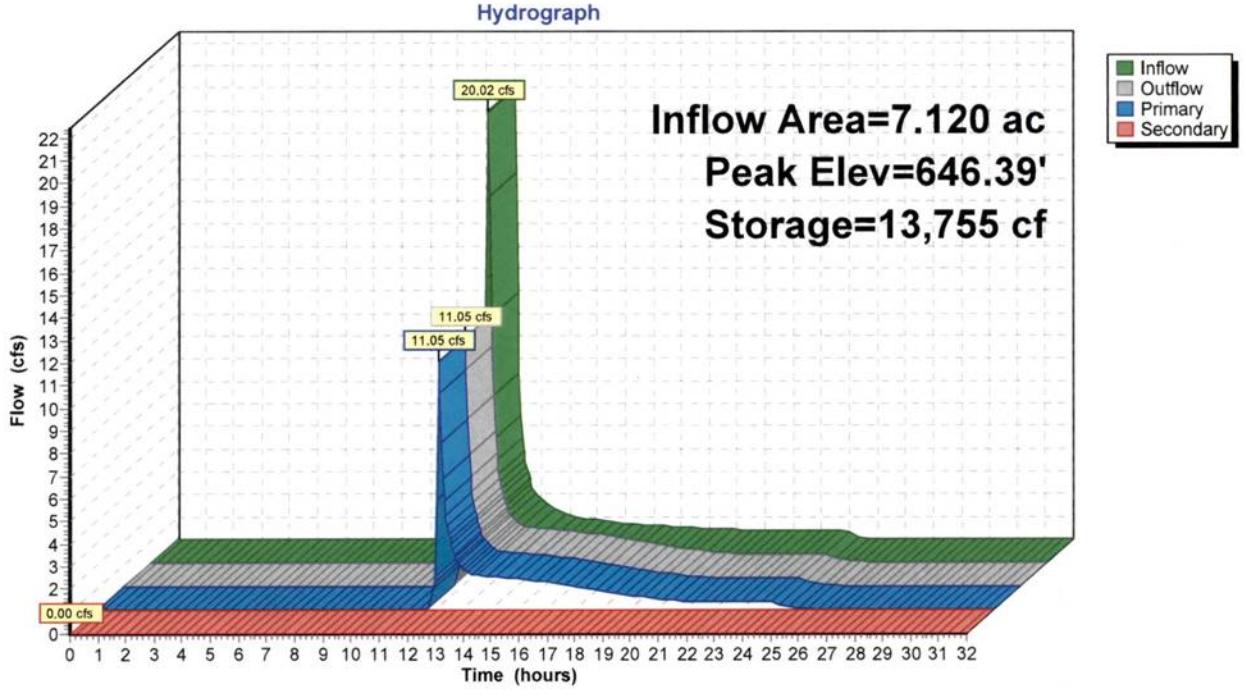
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
642.00	629	0	0
644.00	2,825	3,454	3,454
646.00	5,308	8,133	11,587
648.00	8,076	13,384	24,971
649.00	9,568	8,822	33,793

Device	Routing	Invert	Outlet Devices
#1	Primary	642.00'	**24.0" Round Culvert** L= 68.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 642.00' / 640.00' S= 0.0294 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	643.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	646.00'	**12.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	647.00'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=10.26 cfs @ 12.17 hrs HW=646.36' (Free Discharge)
↑**1=Culvert** (Passes 10.26 cfs of 27.75 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 1.67 cfs @ 8.50 fps)
3=Sharp-Crested Rectangular Weir (Weir Controls 8.59 cfs @ 1.97 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=642.00' (Free Discharge)
↑**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond SB-1: SB-1


Hydrograph
Inflow Area=7.120 ac
Peak Elev=646.39'
Storage=13,755 cf
20.02 cfs
11.05 cfs
11.05 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)

Time span=0.00-32.00 hrs, dt=0.05 hrs, 641 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDA-1: DA-1 Runoff Area=1.110 ac 0.00% Impervious Runoff Depth=2.98"
Flow Length=357' Tc=8.5 min CN=49 Runoff=5.19 cfs 0.275 af

SubcatchmentDA-2: DA-2 Runoff Area=0.360 ac 0.00% Impervious Runoff Depth=2.98"
Flow Length=490' Tc=12.6 min CN=49 Runoff=1.44 cfs 0.089 af

SubcatchmentDA-3: DA-3 Runoff Area=1.180 ac 0.00% Impervious Runoff Depth=2.98"
Flow Length=354' Tc=9.2 min CN=49 Runoff=5.35 cfs 0.293 af

SubcatchmentDA-4: DA-4 Runoff Area=0.340 ac 0.00% Impervious Runoff Depth=3.98"
Flow Length=248' Tc=5.0 min CN=57 Runoff=2.44 cfs 0.113 af

SubcatchmentDA-5: DA-5 Runoff Area=0.970 ac 0.00% Impervious Runoff Depth=3.85"
Flow Length=485' Tc=5.0 min CN=56 Runoff=6.74 cfs 0.312 af

SubcatchmentDA-6: DA-6 Runoff Area=0.370 ac 0.00% Impervious Runoff Depth=3.60"
Flow Length=1,898' Tc=5.6 min CN=54 Runoff=2.33 cfs 0.111 af

SubcatchmentDA-7: DA-7 Runoff Area=1.070 ac 0.00% Impervious Runoff Depth=3.85"
Flow Length=535' Tc=5.0 min CN=56 Runoff=7.43 cfs 0.344 af

SubcatchmentDA-8: DA-8 Runoff Area=1.720 ac 0.00% Impervious Runoff Depth=3.48"
Flow Length=327' Tc=9.3 min CN=53 Runoff=9.22 cfs 0.498 af

SubcatchmentDA-9: DA-09 Runoff Area=27.390 ac 0.00% Impervious Runoff Depth=2.98"
Flow Length=1,491' Tc=17.8 min CN=49 Runoff=91.47 cfs 6.792 af

Reach C-1: C-1 Avg. Flow Depth=0.64' Max Vel=32.05 fps Inflow=27.55 cfs 1.536 af
24.0" Round Pipe n=0.012 L=98.0' S=0.2653 '/' Capacity=126.23 cfs Outflow=27.50 cfs 1.536 af

Reach C-2: C-2 Avg. Flow Depth=2.00' Max Vel=21.04 fps Inflow=91.47 cfs 6.792 af
24.0" Round Pipe n=0.012 L=250.0' S=0.0560 '/' Capacity=58.00 cfs Outflow=58.03 cfs 6.792 af

Reach SCC-1: SCC-1 Avg. Flow Depth=0.90' Max Vel=5.50 fps Inflow=13.84 cfs 0.700 af
n=0.030 L=625.0' S=0.0384 '/' Capacity=52.22 cfs Outflow=12.74 cfs 0.700 af

Reach SCC-2: SCC-2 Avg. Flow Depth=0.93' Max Vel=5.36 fps Inflow=14.50 cfs 0.747 af
n=0.030 L=577.0' S=0.0347 '/' Capacity=49.61 cfs Outflow=13.40 cfs 0.747 af

Pond SB-1: SB-1 Peak Elev=646.95' Storage=17,249 cf Inflow=36.49 cfs 2.035 af
Primary=30.24 cfs 2.007 af Secondary=0.00 cfs 0.000 af Outflow=30.24 cfs 2.007 af

Total Runoff Area = 34.510 ac Runoff Volume = 8.826 af Average Runoff Depth = 3.07"
100.00% Pervious = 34.510 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment DA-1: DA-1

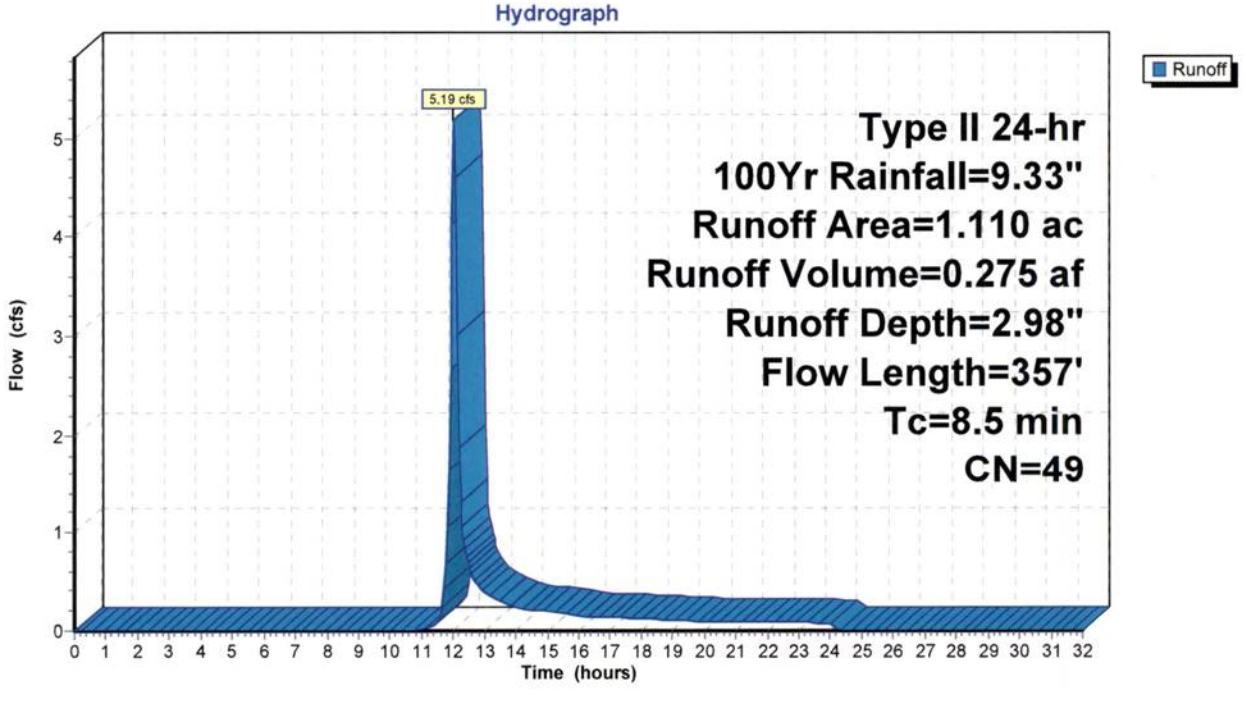
Runoff = 5.19 cfs @ 12.01 hrs, Volume= 0.275 af, Depth= 2.98"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
1.110	49	50-75% Grass cover, Fair, HSG A
1.110		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.1100	0.26		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.1	257	0.0817	2.00		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.5	357	Total			

Subcatchment DA-1: DA-1



Summary for Subcatchment DA-2: DA-2

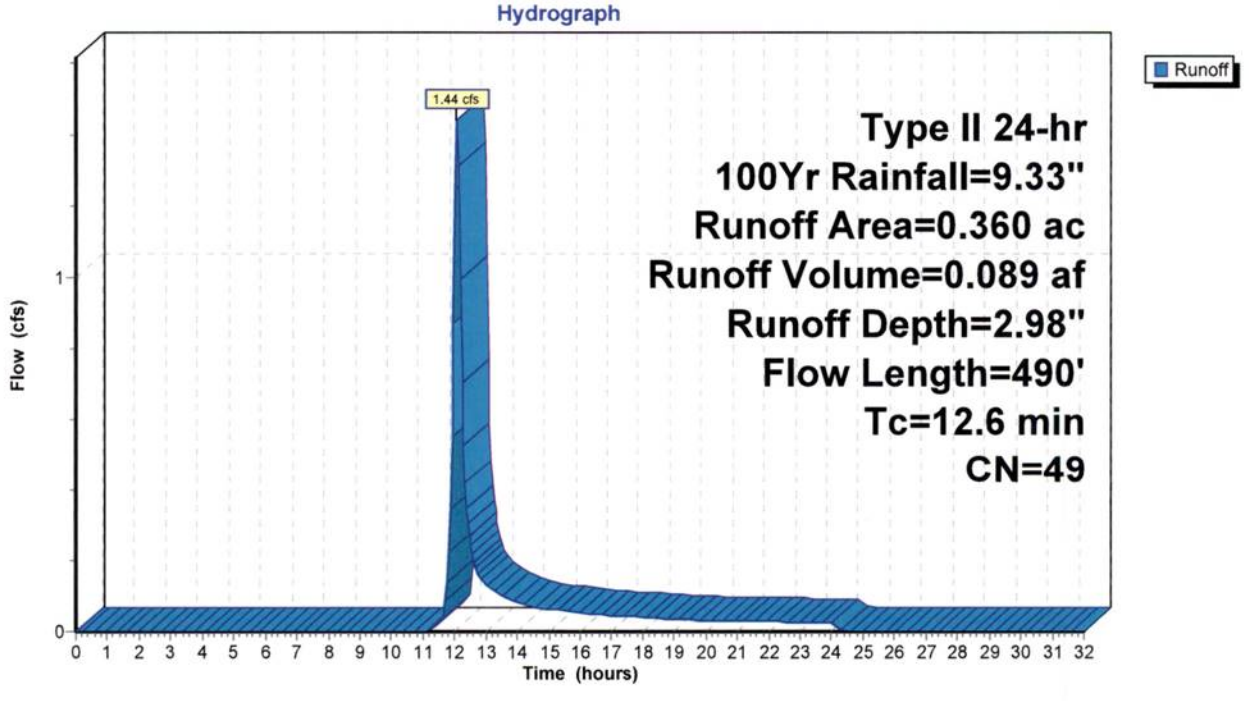
Runoff = 1.44 cfs @ 12.06 hrs, Volume= 0.089 af, Depth= 2.98"
Routed to Reach C-1 : C-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
0.360	49	50-75% Grass cover, Fair, HSG A
0.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	100	0.0436	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
3.4	390	0.0765	1.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.6	490	Total			

Subcatchment DA-2: DA-2



Summary for Subcatchment DA-3: DA-3

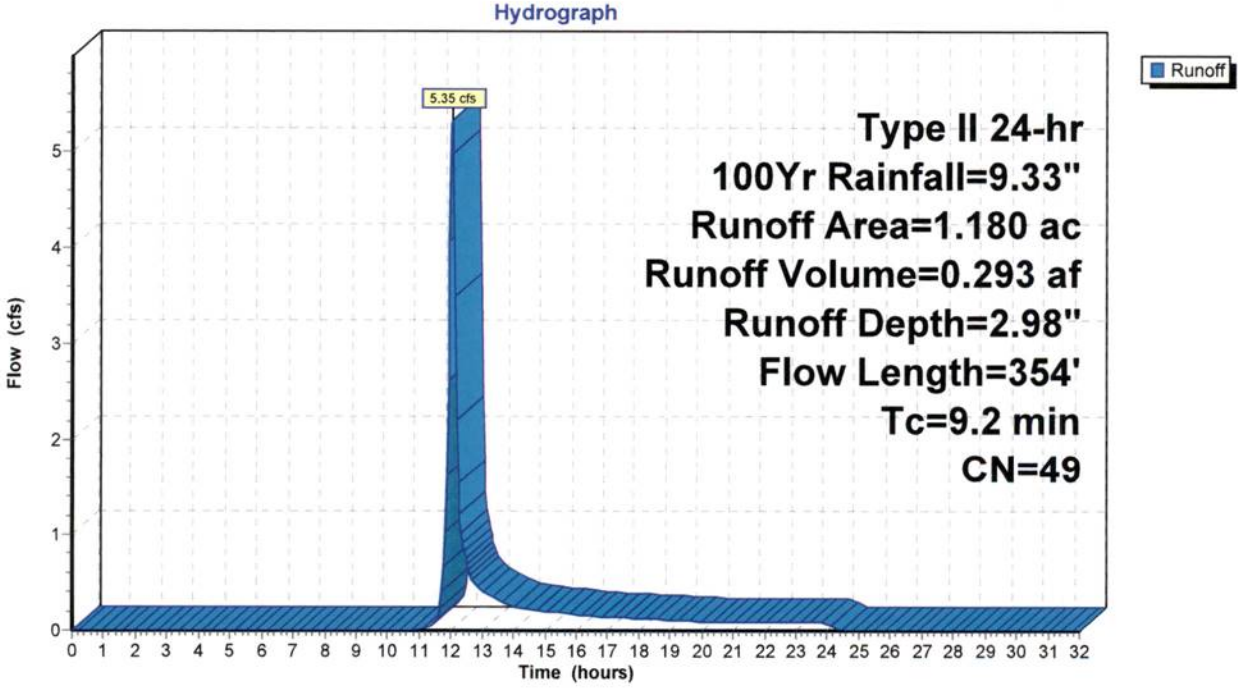
Runoff = 5.35 cfs @ 12.02 hrs, Volume= 0.293 af, Depth= 2.98"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
1.180	49	50-75% Grass cover, Fair, HSG A
1.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0800	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.0	254	0.0946	2.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.2	354	Total			

Subcatchment DA-3: DA-3



Summary for Subcatchment DA-4: DA-4

[49] Hint: Tc<2dt may require smaller dt

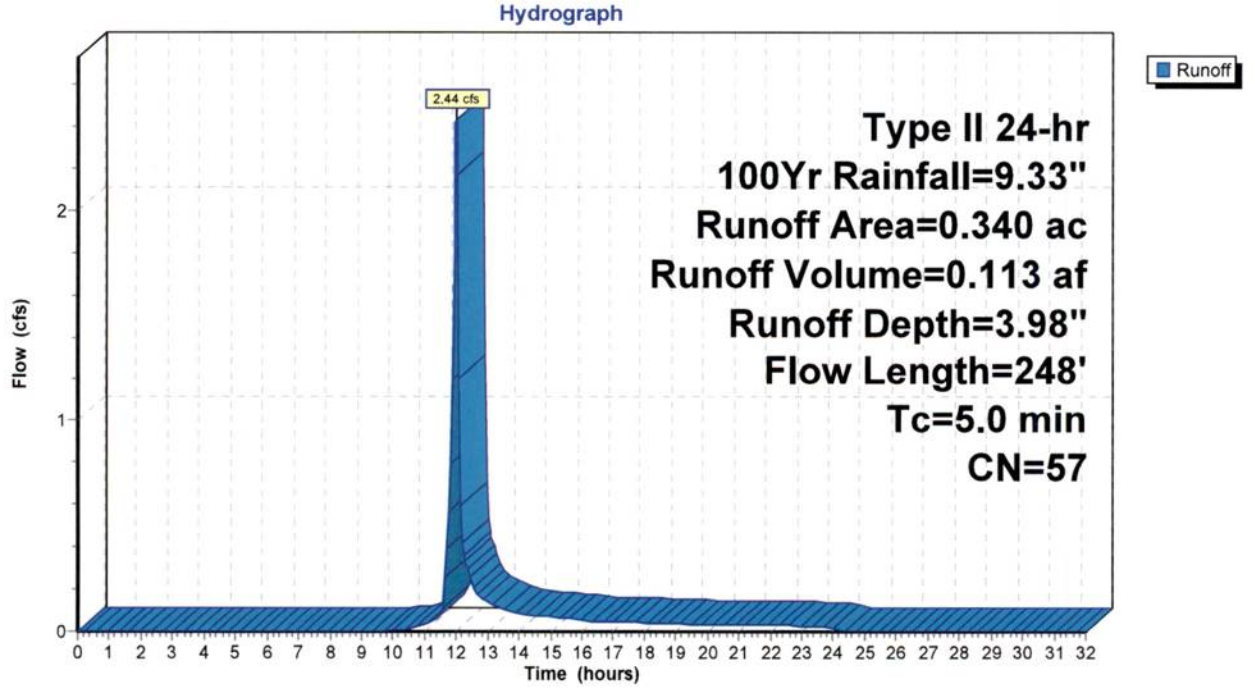
Runoff = 2.44 cfs @ 11.96 hrs, Volume= 0.113 af, Depth= 3.98"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
0.280	49	50-75% Grass cover, Fair, HSG A
0.060	96	Gravel surface, HSG A
0.340	57	Weighted Average
0.340		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	49	0.3160	0.50		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.11"
2.0	199	0.0579	1.68		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.6	248	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-4: DA-4



Summary for Subcatchment DA-5: DA-5

[49] Hint: Tc<2dt may require smaller dt

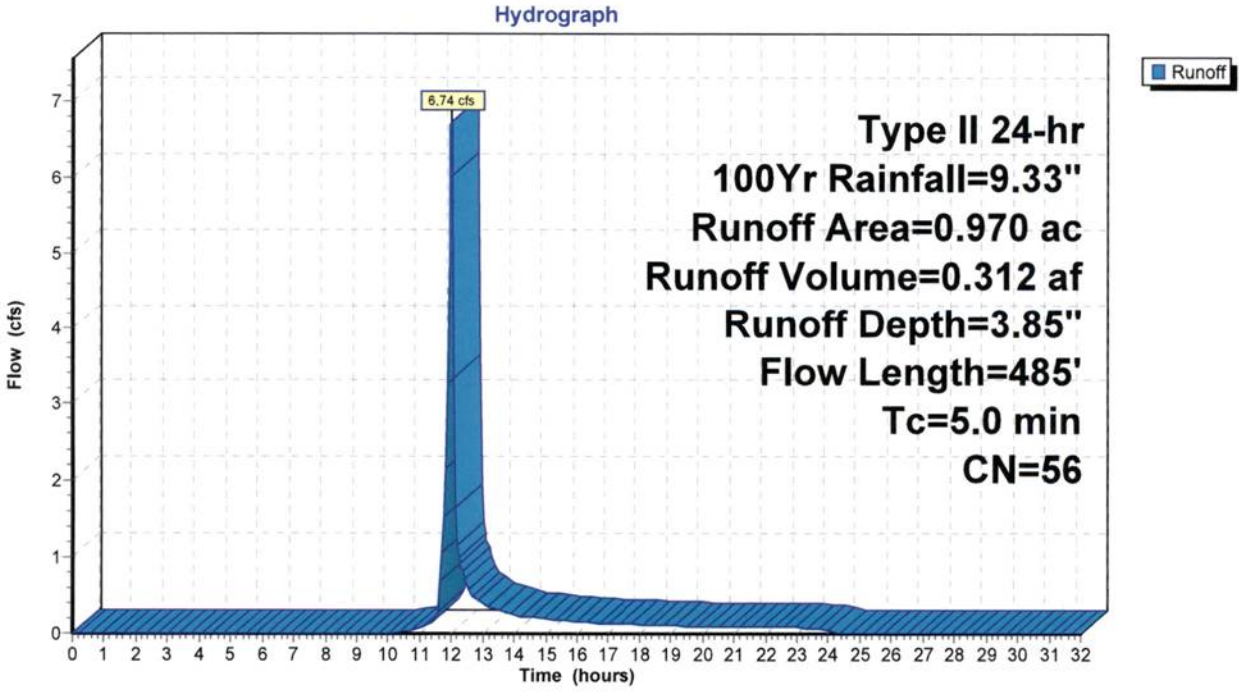
Runoff = 6.74 cfs @ 11.96 hrs, Volume= 0.312 af, Depth= 3.85"
Routed to Reach SCC-1 : SCC-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
0.830	49	50-75% Grass cover, Fair, HSG A
0.140	96	Gravel surface, HSG A
0.970	56	Weighted Average
0.970		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	69	0.3300	0.38		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
1.3	416	0.0300	5.22	15.65	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
4.3	485	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-5: DA-5



Summary for Subcatchment DA-6: DA-6

[49] Hint: Tc<2dt may require smaller dt

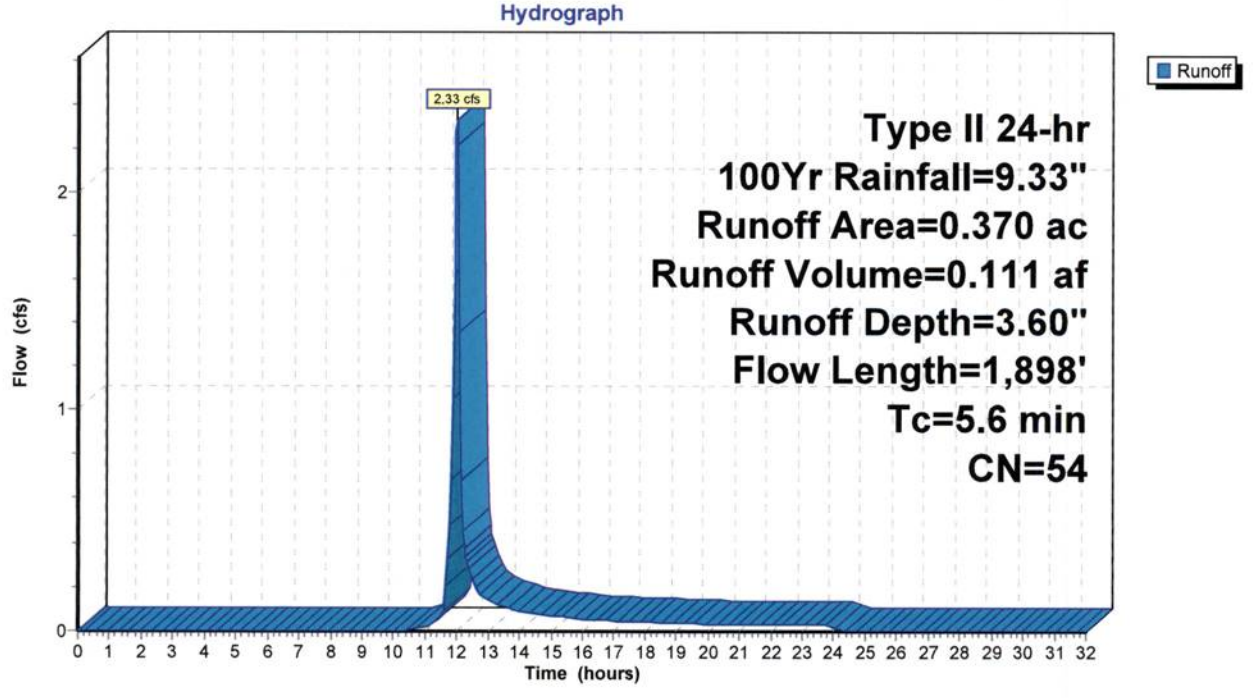
Runoff = 2.33 cfs @ 11.97 hrs, Volume= 0.111 af, Depth= 3.60"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
0.330	49	50-75% Grass cover, Fair, HSG A
0.040	96	Gravel surface, HSG A
0.370	54	Weighted Average
0.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	58	0.2550	0.33		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.7	1,840	0.0247	11.31	475.16	**Trap/Vee/Rect Channel Flow,** Bot.W=5.00' D=3.00' Z= 3.0 '/' Top.W=23.00' n= 0.030
5.6	1,898	Total			

Subcatchment DA-6: DA-6



Summary for Subcatchment DA-7: DA-7

[49] Hint: Tc<2dt may require smaller dt

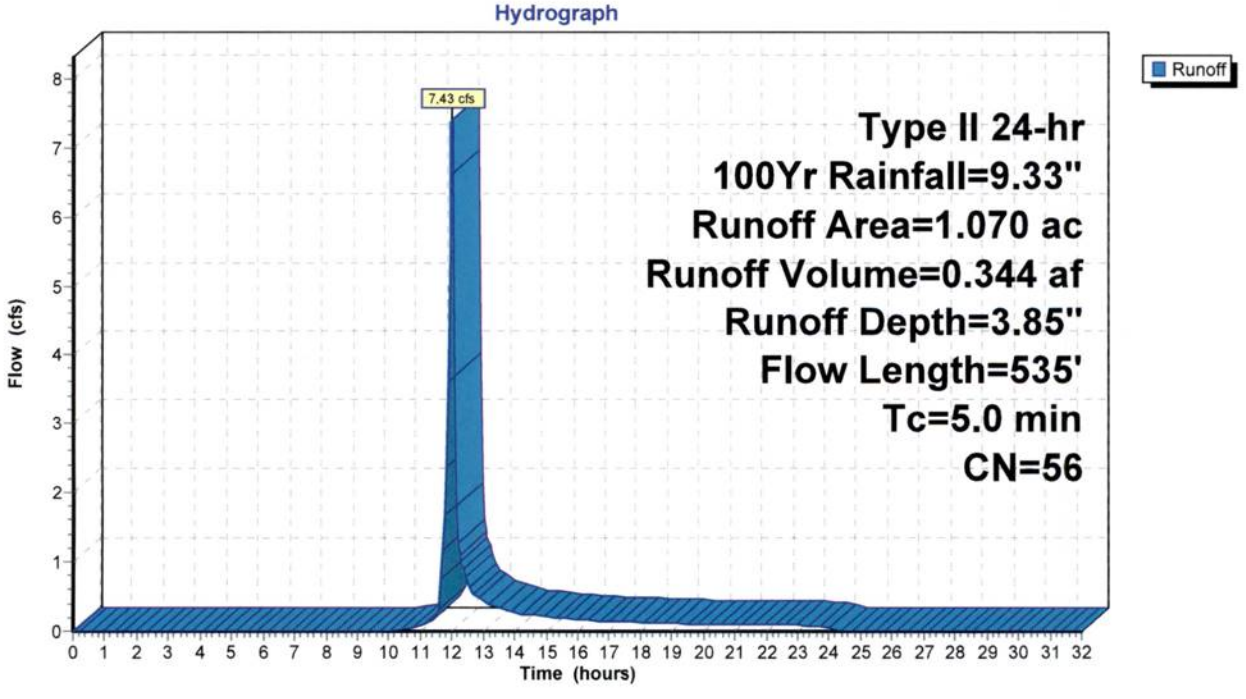
Runoff = 7.43 cfs @ 11.96 hrs, Volume= 0.344 af, Depth= 3.85"
Routed to Reach SCC-2 : SCC-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
0.920	49	50-75% Grass cover, Fair, HSG A
0.150	96	Gravel surface, HSG A
1.070	56	Weighted Average
1.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	66	0.3255	0.37		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
1.5	469	0.0300	5.22	15.65	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030
4.5	535	Total, Increased to minimum Tc = 5.0 min			

Subcatchment DA-7: DA-7



Summary for Subcatchment DA-8: DA-8

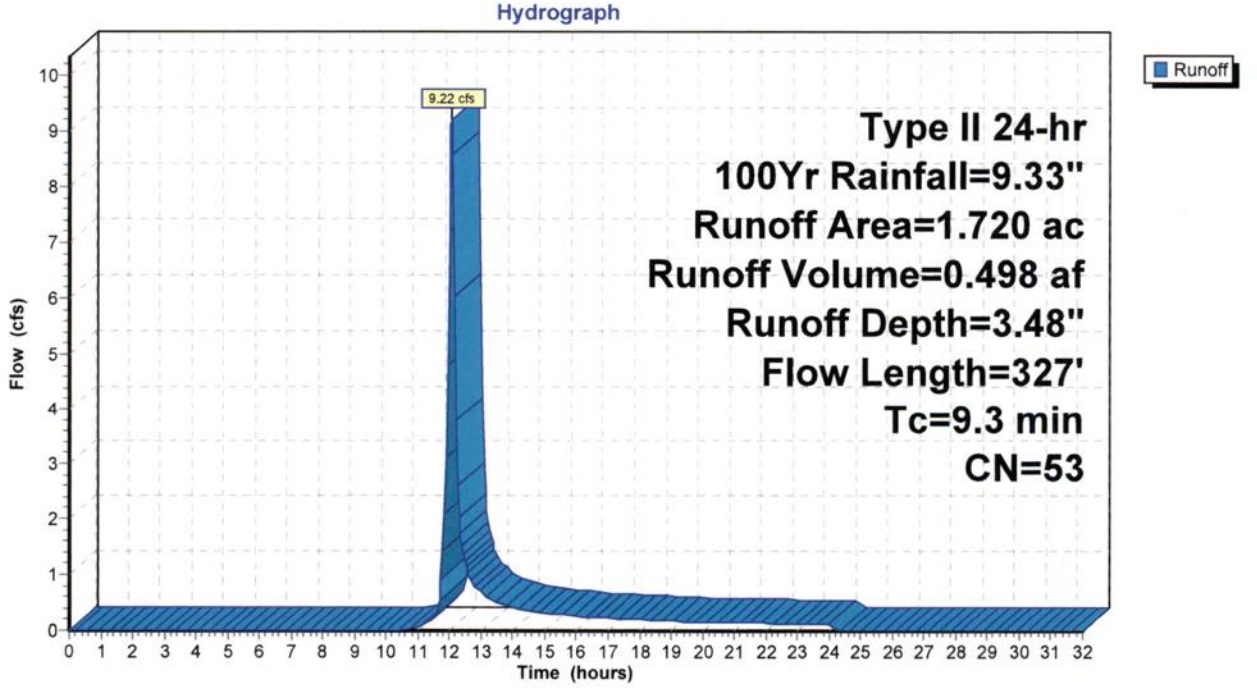
Runoff = 9.22 cfs @ 12.01 hrs, Volume= 0.498 af, Depth= 3.48"
Routed to Pond SB-1 : SB-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
1.570	49	50-75% Grass cover, Fair, HSG A
0.150	96	Gravel surface, HSG A
1.720	53	Weighted Average
1.720		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.0795	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
2.0	227	0.0729	1.89		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.3	327	Total			

Subcatchment DA-8: DA-8



Summary for Subcatchment DA-9: DA-09

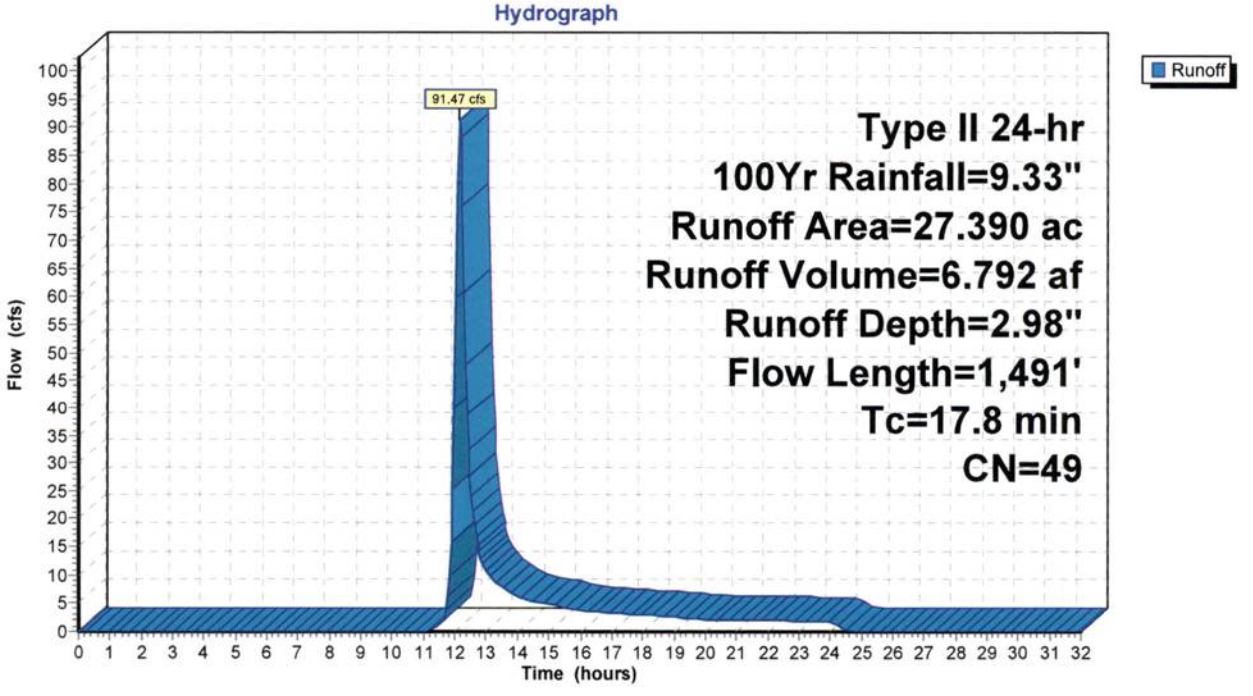
Runoff = 91.47 cfs @ 12.12 hrs, Volume= 6.792 af, Depth= 2.98"
Routed to Reach C-2 : C-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Type II 24-hr 100Yr Rainfall=9.33"

Area (ac)	CN	Description
27.280	49	50-75% Grass cover, Fair, HSG A
0.110	96	Gravel surface, HSG A
27.390	49	Weighted Average
27.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	100	0.0660	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 4.11"
10.0	1,391	0.1088	2.31		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.8	1,491	Total			

Subcatchment DA-9: DA-09



Summary for Reach C-1: C-1

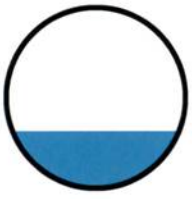
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach SCC-1 outlet invert by 0.63' @ 12.05 hrs
[61] Hint: Exceeded Reach SCC-2 outlet invert by 0.63' @ 12.05 hrs

Inflow Area = 5.400 ac, 0.00% Impervious, Inflow Depth = 3.41" for 100Yr event
Inflow = 27.55 cfs @ 12.03 hrs, Volume= 1.536 af
Outflow = 27.50 cfs @ 12.04 hrs, Volume= 1.536 af, Atten= 0%, Lag= 0.1 min
Routed to Pond SB-1 : SB-1

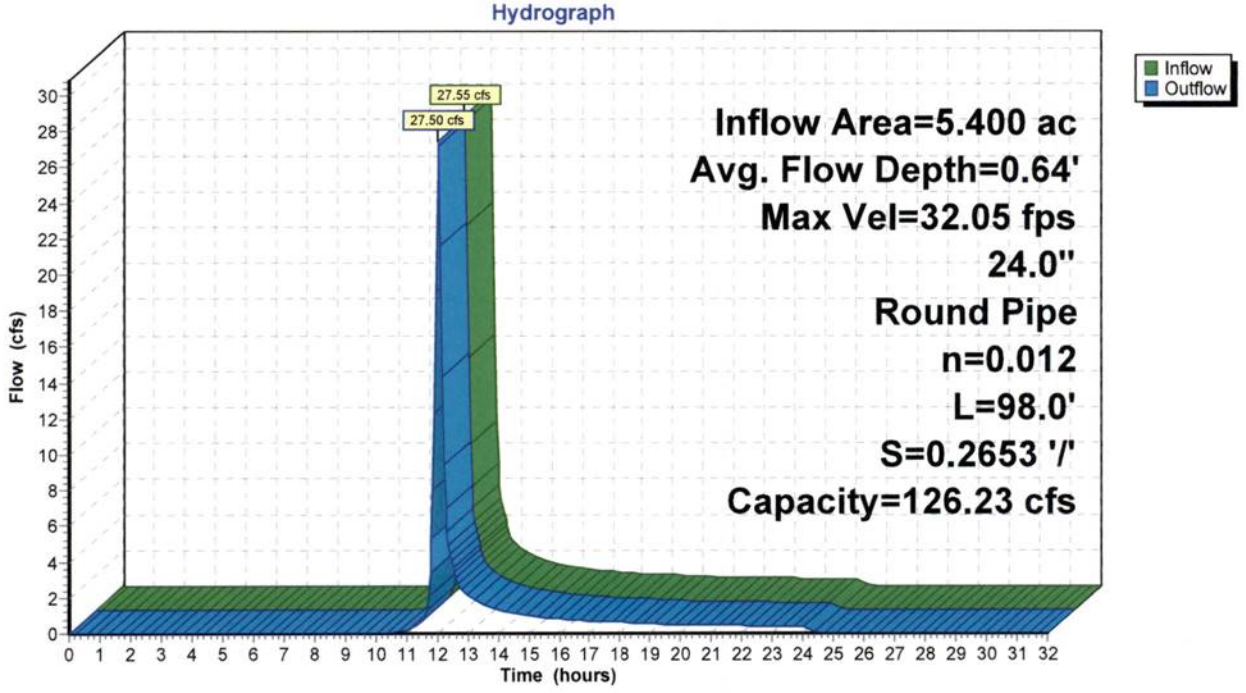
Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 32.05 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 10.44 fps, Avg. Travel Time= 0.2 min

Peak Storage= 84 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.64' , Surface Width= 1.86'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 126.23 cfs

24.0" Round Pipe
n= 0.012
Length= 98.0' Slope= 0.2653 '/'
Inlet Invert= 674.00', Outlet Invert= 648.00'



Reach C-1: C-1


Hydrograph
Inflow
Outflow
27.55 cfs
27.50 cfs
Inflow Area=5.400 ac
Avg. Flow Depth=0.64'
Max Vel=32.05 fps
24.0"
Round Pipe
n=0.012
L=98.0'
S=0.2653 '/'
Capacity=126.23 cfs
Flow (cfs)
Time (hours)

Summary for Reach C-2: C-2

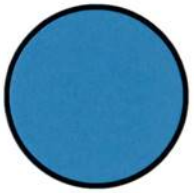
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 158% of Manning's capacity
[76] Warning: Detained 0.438 af (Pond w/culvert advised)

Inflow Area = 27.390 ac, 0.00% Impervious, Inflow Depth = 2.98" for 100Yr event
Inflow = 91.47 cfs @ 12.12 hrs, Volume= 6.792 af
Outflow = 58.03 cfs @ 12.05 hrs, Volume= 6.792 af, Atten= 37%, Lag= 0.0 min

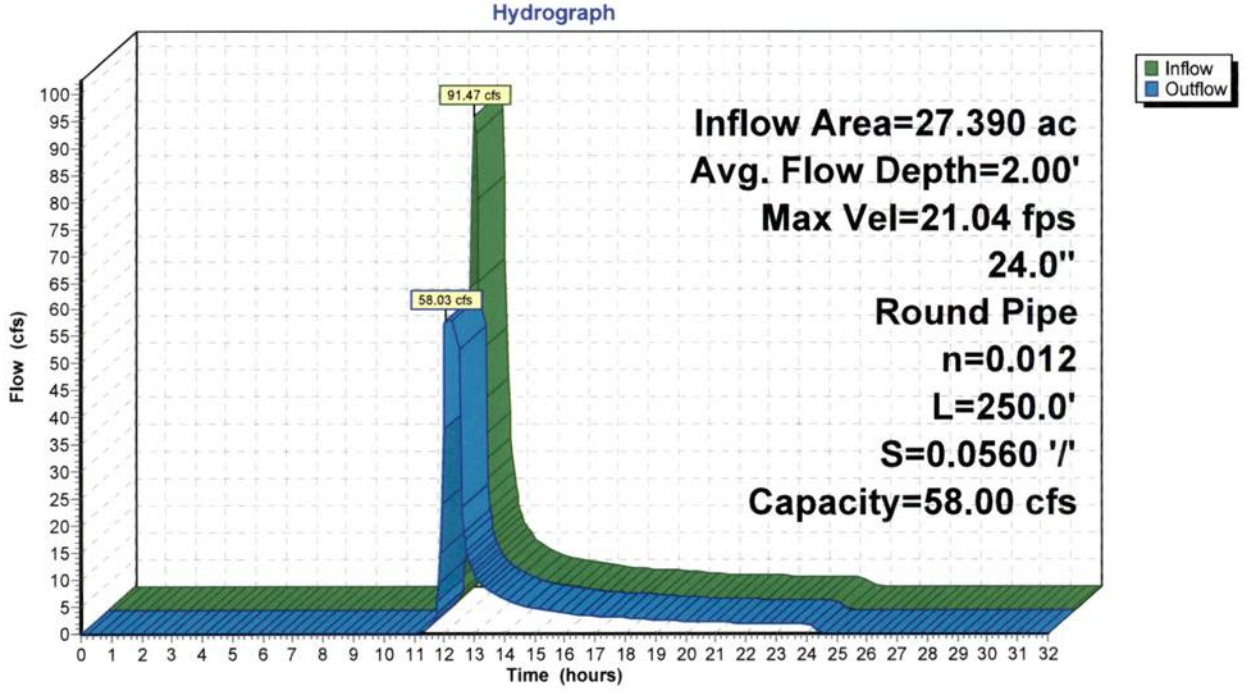
Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 21.04 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 9.83 fps, Avg. Travel Time= 0.4 min

Peak Storage= 785 cf @ 12.05 hrs
Average Depth at Peak Storage= 2.00'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 58.00 cfs

24.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 250.0' Slope= 0.0560 '/'
Inlet Invert= 666.00', Outlet Invert= 652.00'



Reach C-2: C-2


Hydrograph
Inflow
Outflow
91.47 cfs
58.03 cfs
Inflow Area=27.390 ac
Avg. Flow Depth=2.00'
Max Vel=21.04 fps
24.0"
Round Pipe
n=0.012
L=250.0'
S=0.0560 '/'
Capacity=58.00 cfs
Flow (cfs)
Time (hours)

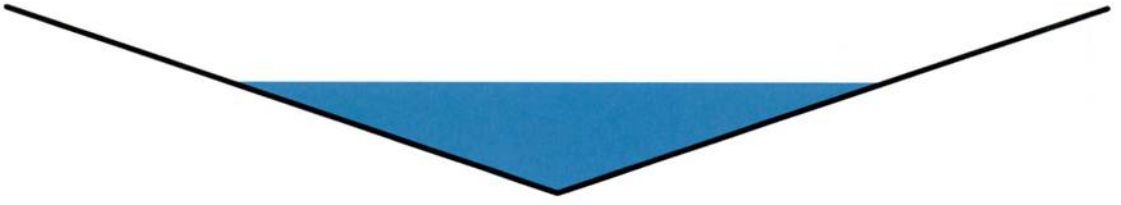
Summary for Reach SCC-1: SCC-1

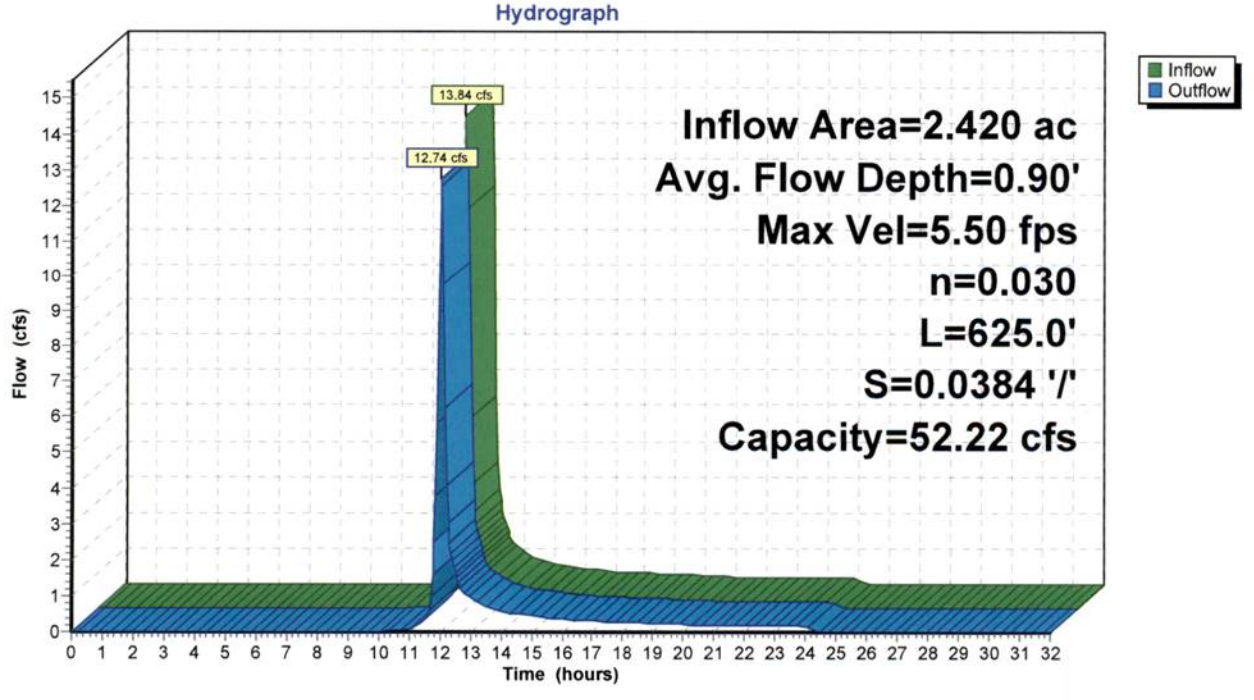
Inflow Area = 2.420 ac, 0.00% Impervious, Inflow Depth = 3.47" for 100Yr event
Inflow = 13.84 cfs @ 11.98 hrs, Volume= 0.700 af
Outflow = 12.74 cfs @ 12.03 hrs, Volume= 0.700 af, Atten= 8%, Lag= 3.4 min
Routed to Reach C-1 : C-1

Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.50 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.96 fps, Avg. Travel Time= 5.3 min

Peak Storage= 1,515 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.90' , Surface Width= 5.39'
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 52.22 cfs

0.00' x 1.50' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 625.0' Slope= 0.0384 '/'
Inlet Invert= 698.00', Outlet Invert= 674.00'





Summary for Reach SCC-2: SCC-2

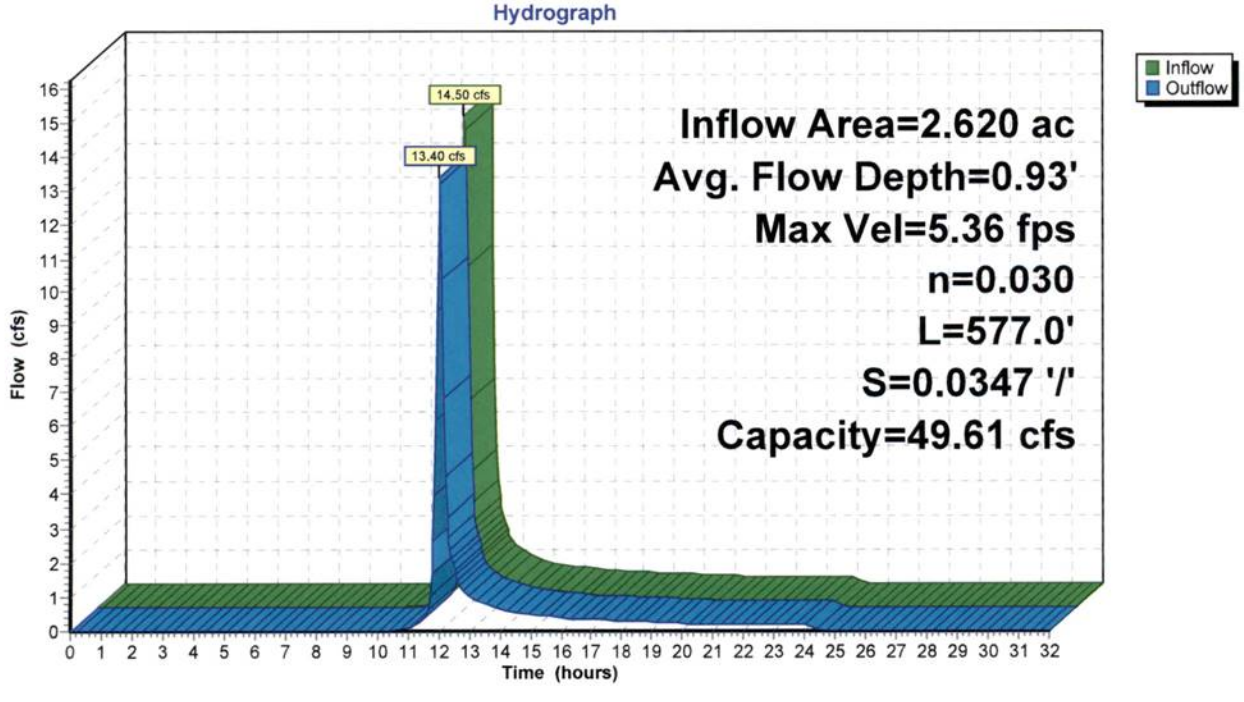
Inflow Area = 2.620 ac, 0.00% Impervious, Inflow Depth = 3.42" for 100Yr event
Inflow = 14.50 cfs @ 11.98 hrs, Volume= 0.747 af
Outflow = 13.40 cfs @ 12.03 hrs, Volume= 0.747 af, Atten= 8%, Lag= 3.2 min
Routed to Reach C-1 : C-1

Routing by Stor-Ind+Trans method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.36 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.93 fps, Avg. Travel Time= 5.0 min

Peak Storage= 1,509 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.93' , Surface Width= 5.60'
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 49.61 cfs

0.00' x 1.50' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 577.0' Slope= 0.0347 '/'
Inlet Invert= 694.00', Outlet Invert= 674.00'

Reach SCC-2: SCC-2



Summary for Pond SB-1: SB-1

Inflow Area = 7.120 ac, 0.00% Impervious, Inflow Depth = 3.43" for 100Yr event
Inflow = 36.49 cfs @ 12.03 hrs, Volume= 2.035 af
Outflow = 30.24 cfs @ 12.08 hrs, Volume= 2.007 af, Atten= 17%, Lag= 2.9 min
Primary = 30.24 cfs @ 12.08 hrs, Volume= 2.007 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.05 hrs
Peak Elev= 646.95' @ 12.09 hrs Surf.Area= 6,622 sf Storage= 17,249 cf

Plug-Flow detention time= 62.8 min calculated for 2.007 af (99% of inflow)
Center-of-Mass det. time= 54.8 min (910.5 - 855.7)

Volume	Invert	Avail.Storage	Storage Description
#1	642.00'	33,793 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

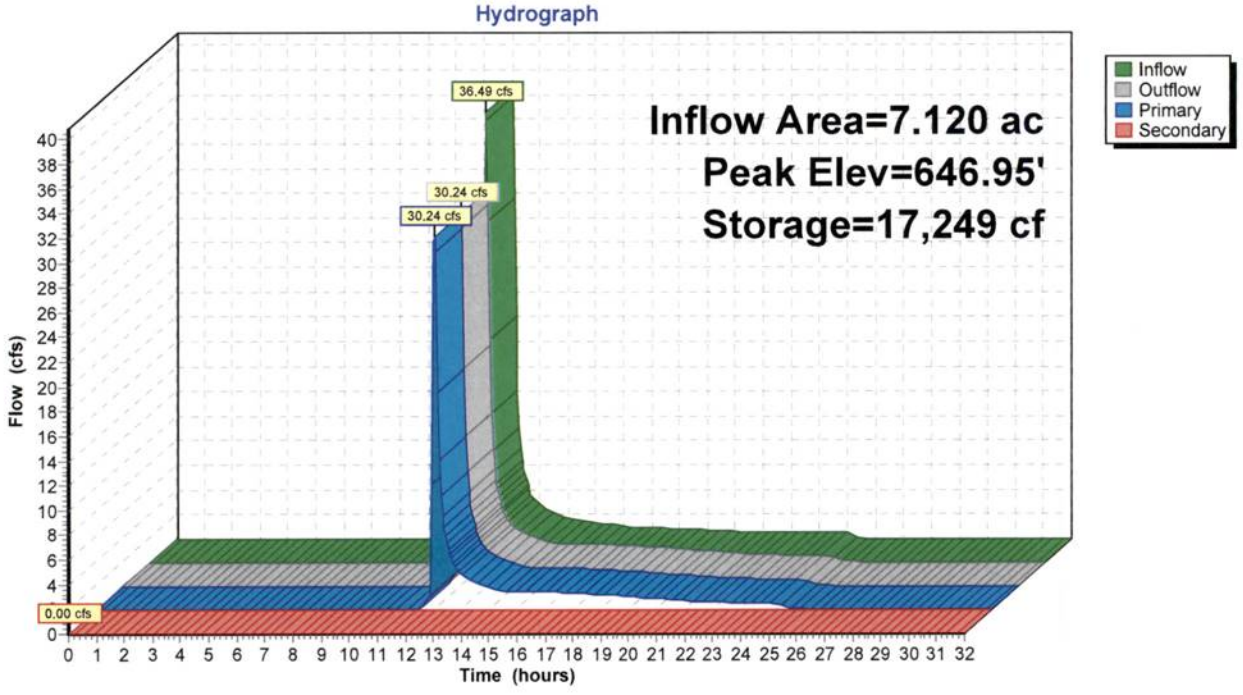
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
642.00	629	0	0
644.00	2,825	3,454	3,454
646.00	5,308	8,133	11,587
648.00	8,076	13,384	24,971
649.00	9,568	8,822	33,793

Device	Routing	Invert	Outlet Devices
#1	Primary	642.00'	**24.0" Round Culvert** L= 68.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 642.00' / 640.00' S= 0.0294 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	643.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	646.00'	**12.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	647.00'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=29.95 cfs @ 12.08 hrs HW=646.92' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 29.95 cfs @ 9.53 fps)
↑—**2=Orifice/Grate** (Passes < 1.81 cfs potential flow)
—**3=Sharp-Crested Rectangular Weir** (Passes < 34.13 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=642.00' (Free Discharge)
↑—**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond SB-1: SB-1


Hydrograph
Inflow
Outflow
Primary
Secondary
36.49 cfs
30.24 cfs
30.24 cfs
0.00 cfs
Inflow Area=7.120 ac
Peak Elev=646.95'
Storage=17,249 cf
Flow (cfs)
Time (hours)

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Job: Green Valley Landfill
Job Number: 2233518
Calculated By: ACC Date: 7/11/2024
Checked By: Date:
Subject: SB Summary
Sheet: 1 of 2

Basin # SB-1 Location: South edge of landfill site
Total Area Draining to basin: 7.12 acres

Basin Volume Design

1. Peak Flow 24-hr event Q_{10} for the Drainage area 11.86 cfs
Peak Flow 24-hr event Q_{25} for the Drainage area 20.02 cfs
(see attached calculations using TR-55 method)

2. Basin Volumes
Minimum required volume = 3600 [cf/acre] * Drainage Area [acre]
3600 [cf/acre] * 7.12 [acre]
25,632 [cf]
Provided total volume = 33,793 [cf] (from AutoCAD)

Sediment cleanout depth = 1 [ft]
Volume above sediment cleanout level = 32,615 [cf]

3. Area of basin
Minimum required surface area = 325 [sf/cfs] * Q_{10} peak inflow [cfs]
325 [sf/cfs] * 11.86 [cfs]
3,855 [sf]

Basin surface area at elevation 646 (top of outlet structure) = 5,308 sf (from AutoCAD)

Length of flow in basin = 102 [ft]
Average Width (@ riser el.) 28 [ft]
Length to Width ratio of basin = L / (Wa) = 3.64

4. Pond discharge capacity

Barrel Diameter = 24 [in]
Barrel Length = 68 [ft]

LaBella
Powered by partnership.

Job:	Green Valley Landfill		
Job Number:	2233518		
Calculated By:	ACC	Date:	7/11/2024
Checked By:		Date:	
Subject:	SB Summary		
Sheet:	2 of 2		

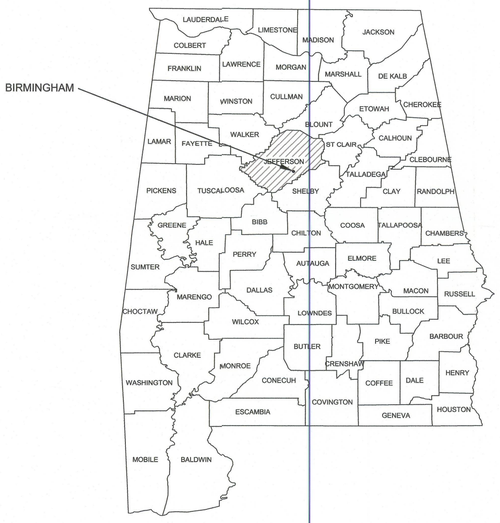
Flow Routing Calculations Attached to Show Suitable Sizing of Pond and Outlet Devices

Predevelopment 10yr storm peak flow	=	27.50 [cfs]
Postdevelopment 10yr storm peak flow	=	1.5 [cfs]
Predevelopment 25yr storm peak flow	=	51.80 [cfs]
Postdevelopment 25yr storm peak flow	=	10.3 [cfs]

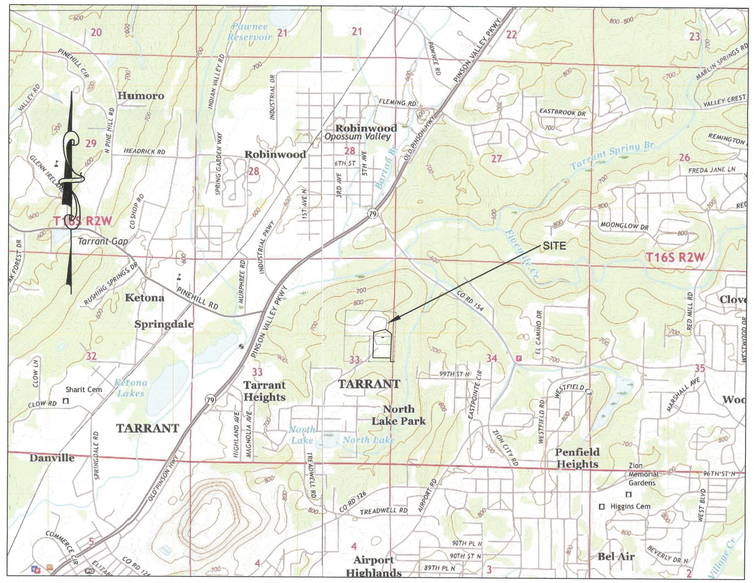
(Post- development flows obtained from outlet pipe of SB-1 flows. See attached output reports)

GREEN VALLEY SERVICES, LLC LANDFILL
PERMIT NUMBER - 37-35
MAJOR PERMIT MODIFICATION

BIRMINGHAM, ALABAMA



ALABAMA
COUNTY LOCATION MAP



VICINITY MAP
SCALE: 1"=2000'

OWNER INFORMATION

PREPARED FOR: GREEN VALLEY SERVICES, LLC
ADDRESS: 3417 DAVEY ALLISON BLVD
HUEYTOWN, ALABAMA 25023
CONTACT: CLINTON HARRIS

PROPERTY INFORMATION

ADDRESS: 3360 EDDINGS PLACE
BIRMINGHAM, ALABAMA 35217
ADEM PERMIT: 37-35

DRAWING INDEX

JULY 2024

LaBella
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(205) 985-4874

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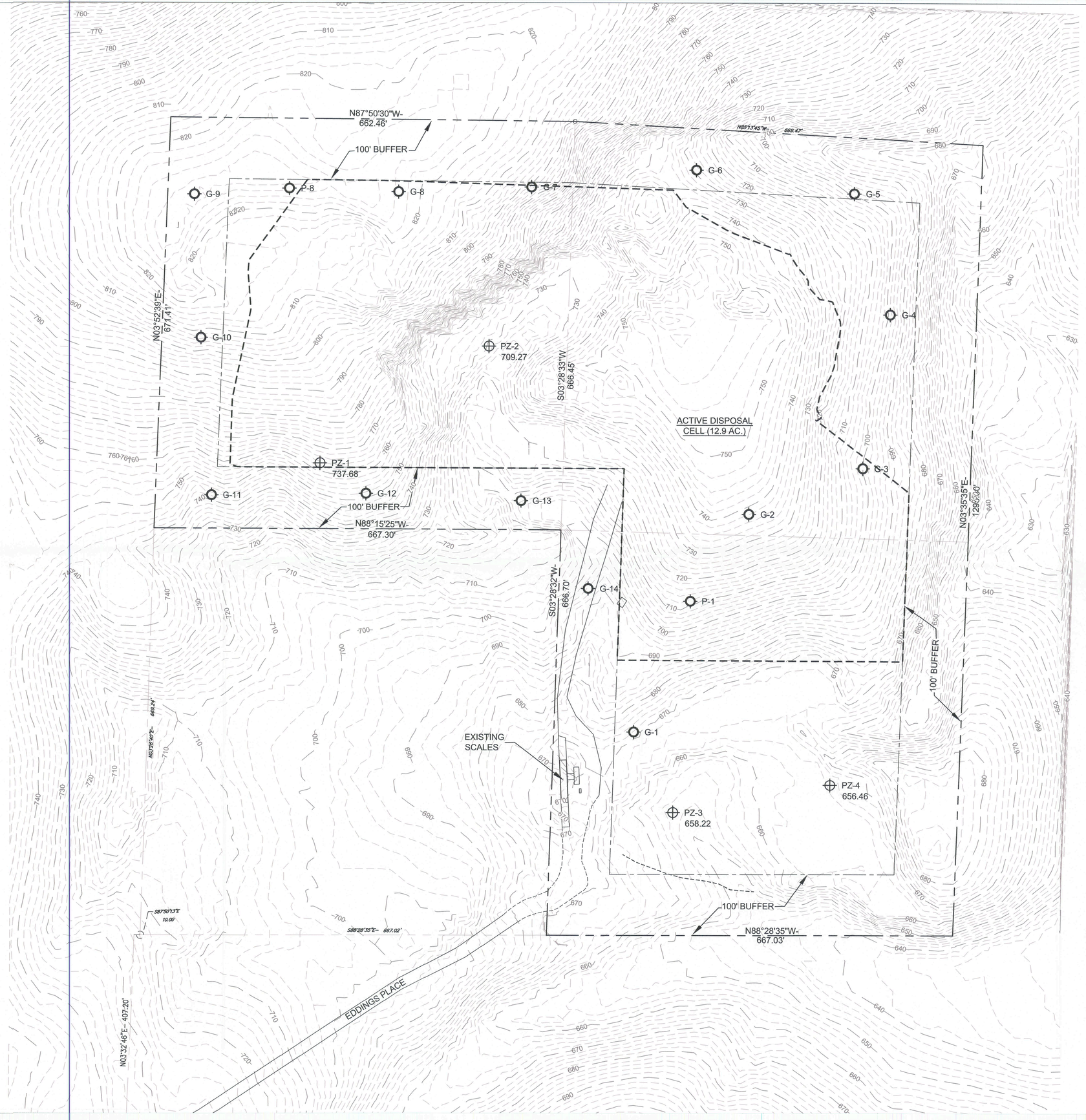
ALABAMA LICENSED No. 37930 PROFESSIONAL ENGINEER 7/15/2024 DARRELL W. THORNOCK

GREEN VALLEY SERVICES, LLC
3417 DAVEY ALLISON BLVD.
HUEYTOWN, ALABAMA 35023

GREEN VALLEY SERVICES, LLC LANDFILL
3360 EDDINGS PLACE
BIRMINGHAM, ALABAMA 35217

NO:	DATE:	DESCRIPTION:
Revisions		

PROJECT NUMBER: 2233518
DRAWN BY: IWW
REVIEWED BY: DWT
ISSUED FOR: PERMITTING
DATE: 07/15/2024
DRAWING NAME: COVER SHEET
DRAWING NUMBER: 00



GRAPHIC SCALE

0 50 100 200

(FEET)

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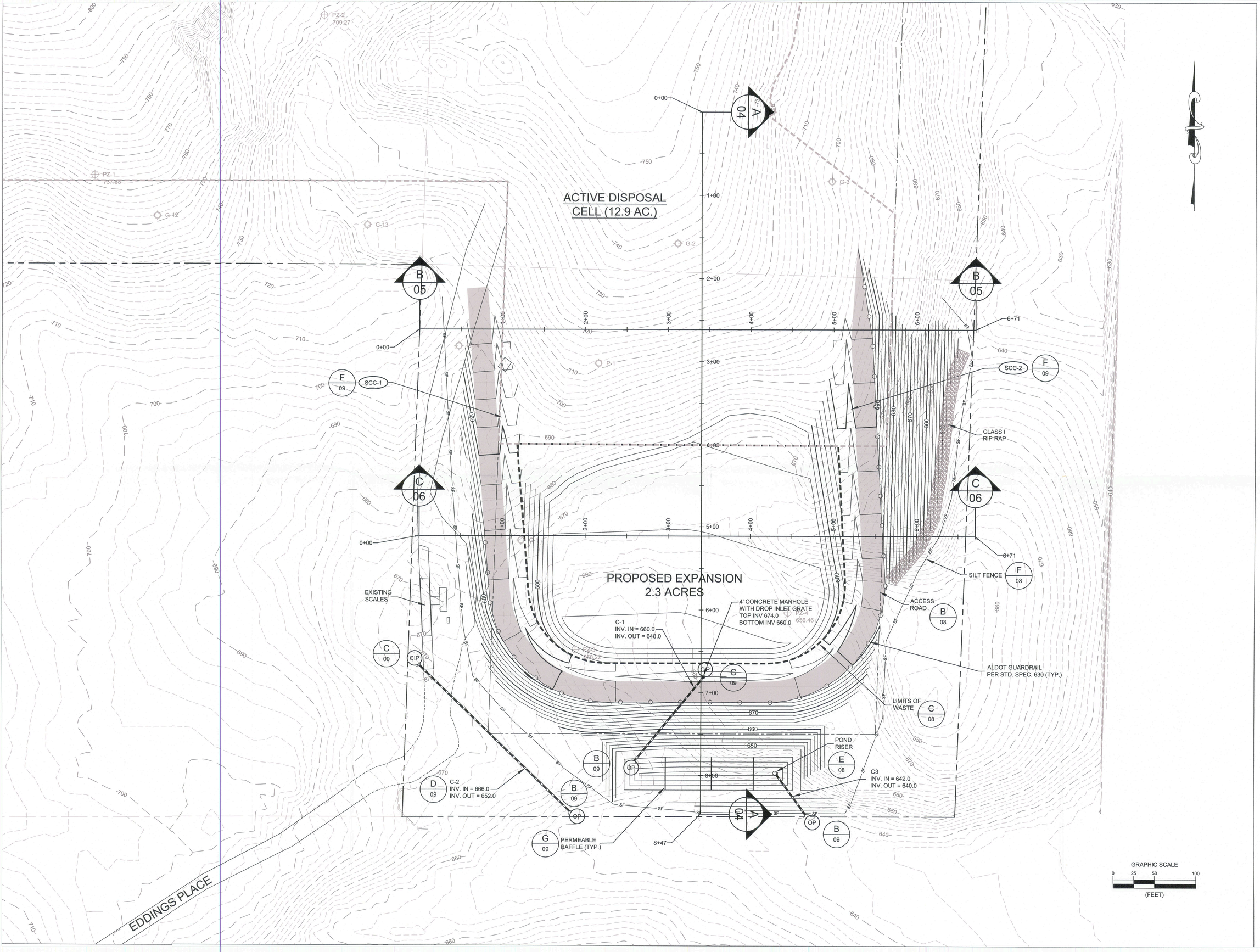
NO:	DATE:	DESCRIPTION:
Revisions		

PROJECT NUMBER: 2233518
DRAWN BY: IWW
REVIEWED BY: DWT
ISSUED FOR: PERMITTING
DATE: 07/15/2024
DRAWING NAME:

EXISTING CONDITIONS

DRAWING NUMBER:

01



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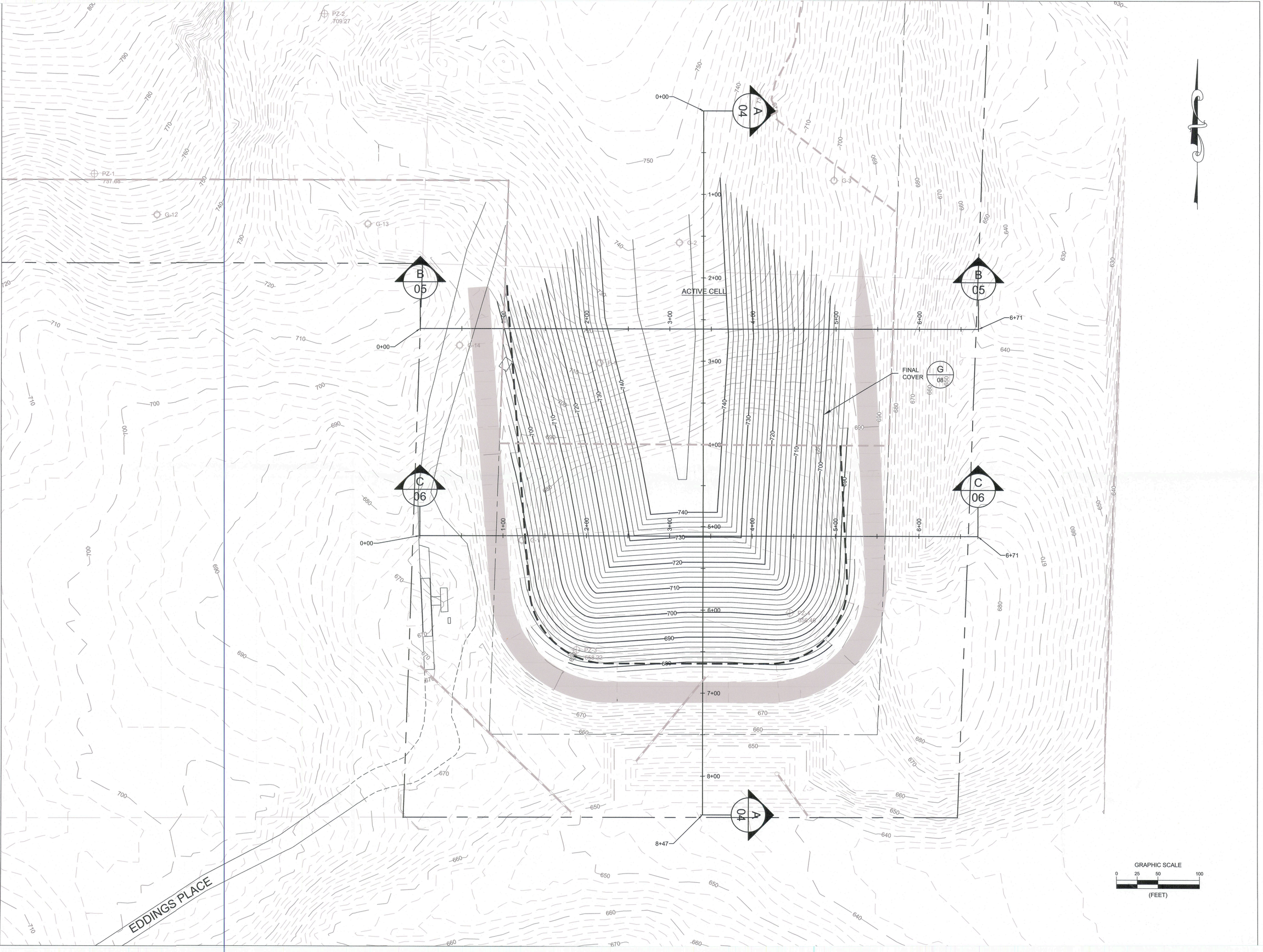
Revisions		

PROJECT NUMBER: 2233518
DRAWN BY: IWW
REVIEWED BY: DWT
ISSUED FOR: PERMITTING
DATE: 07/15/2024
DRAWING NAME:

BASE GRADING PLAN

DRAWING NUMBER:

02



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NO:	DATE:	DESCRIPTION:

Revisions

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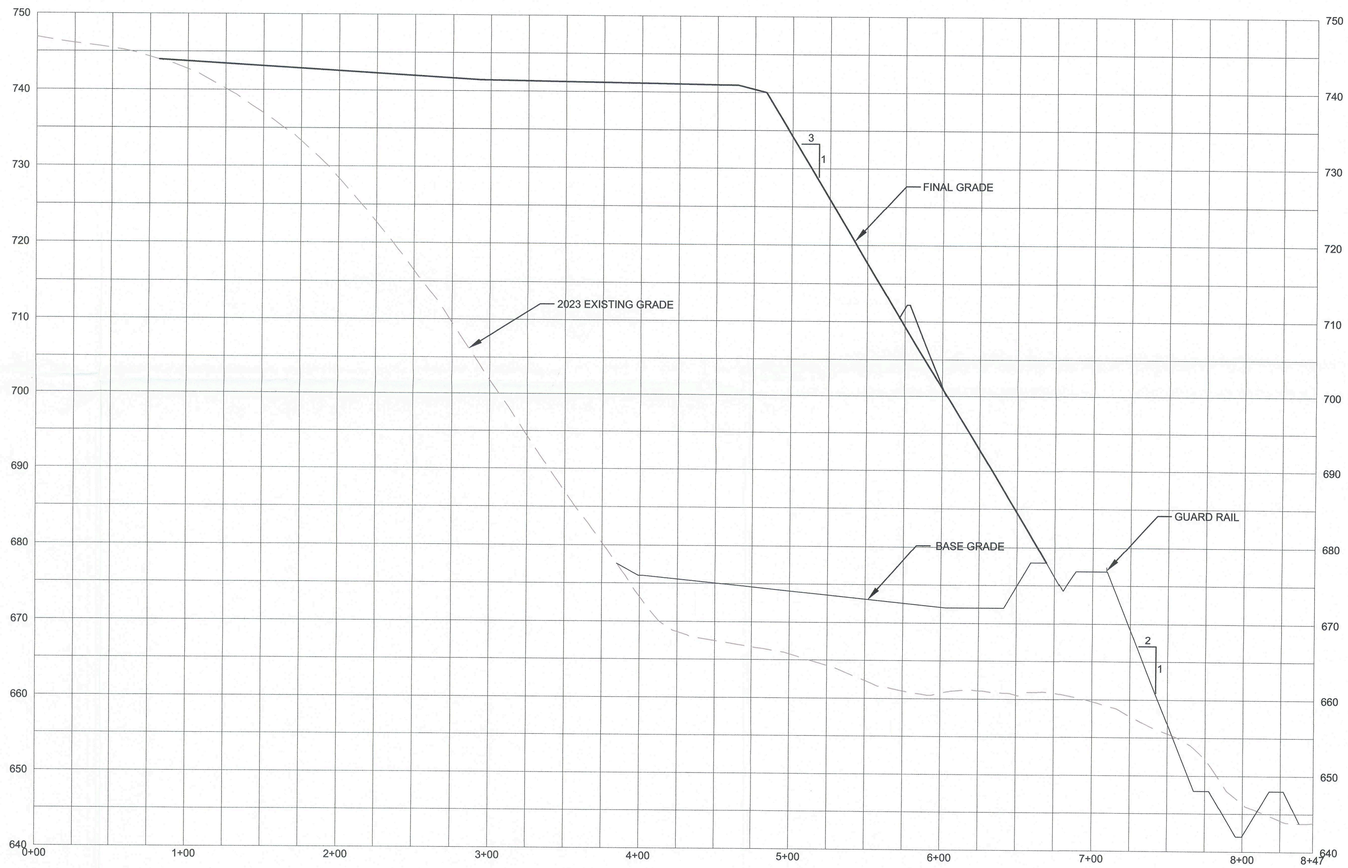
DRAWN BY: IWW
REVIEWED BY: DWT
ISSUED FOR: PERMITTING
DATE: 07/15/2024
DRAWING NAME:

FINAL GRADING PLAN

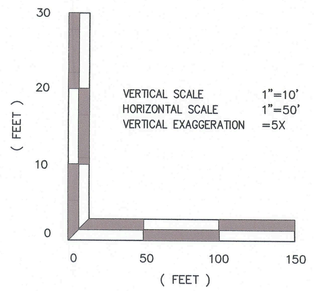
DRAWING NUMBER:

03



SECTION A-A

SCALE



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BIRMINGHAM, ALABAMA 35217

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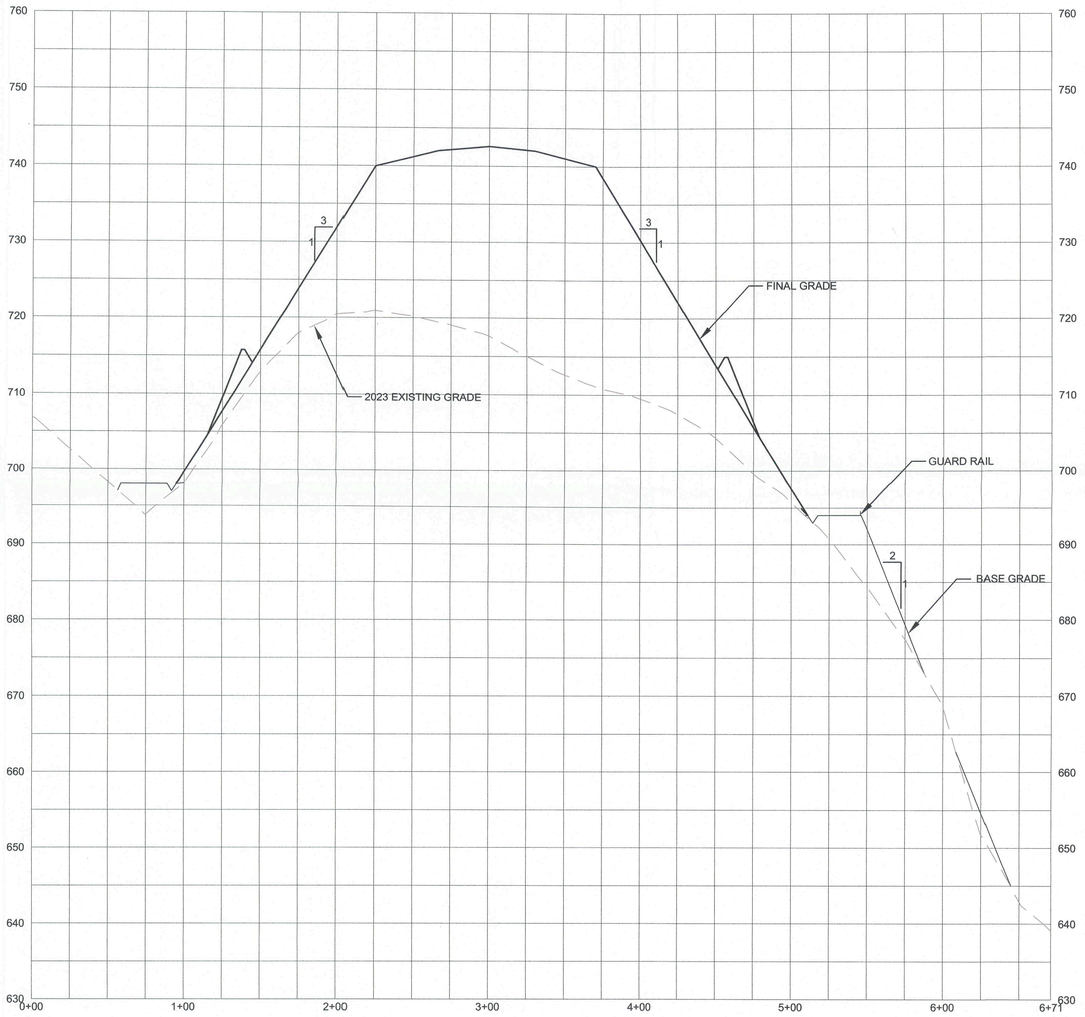
DATE: 07/15/2024
DRAWING NAME:

SECTION

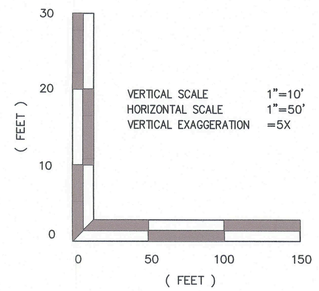
DRAWING NUMBER:

04



SECTION B-B

SCALE



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NO:	DATE:	DESCRIPTION:

Revisions

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ISSUED FOR: PERMITTING

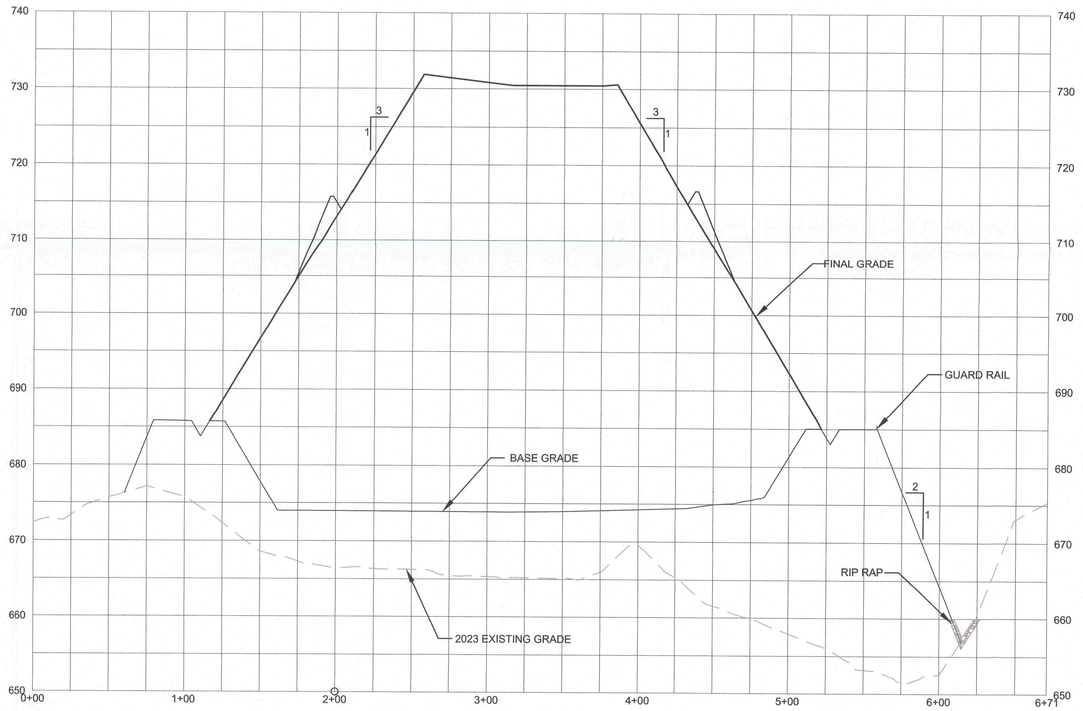
DATE: 07/15/2024

DRAWING NAME:

SECTION

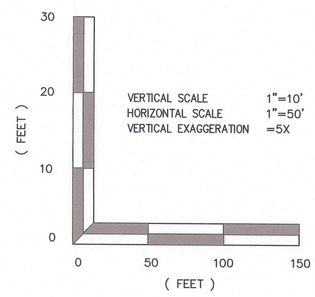
DRAWING NUMBER:

05



SECTION C-C

SCALE



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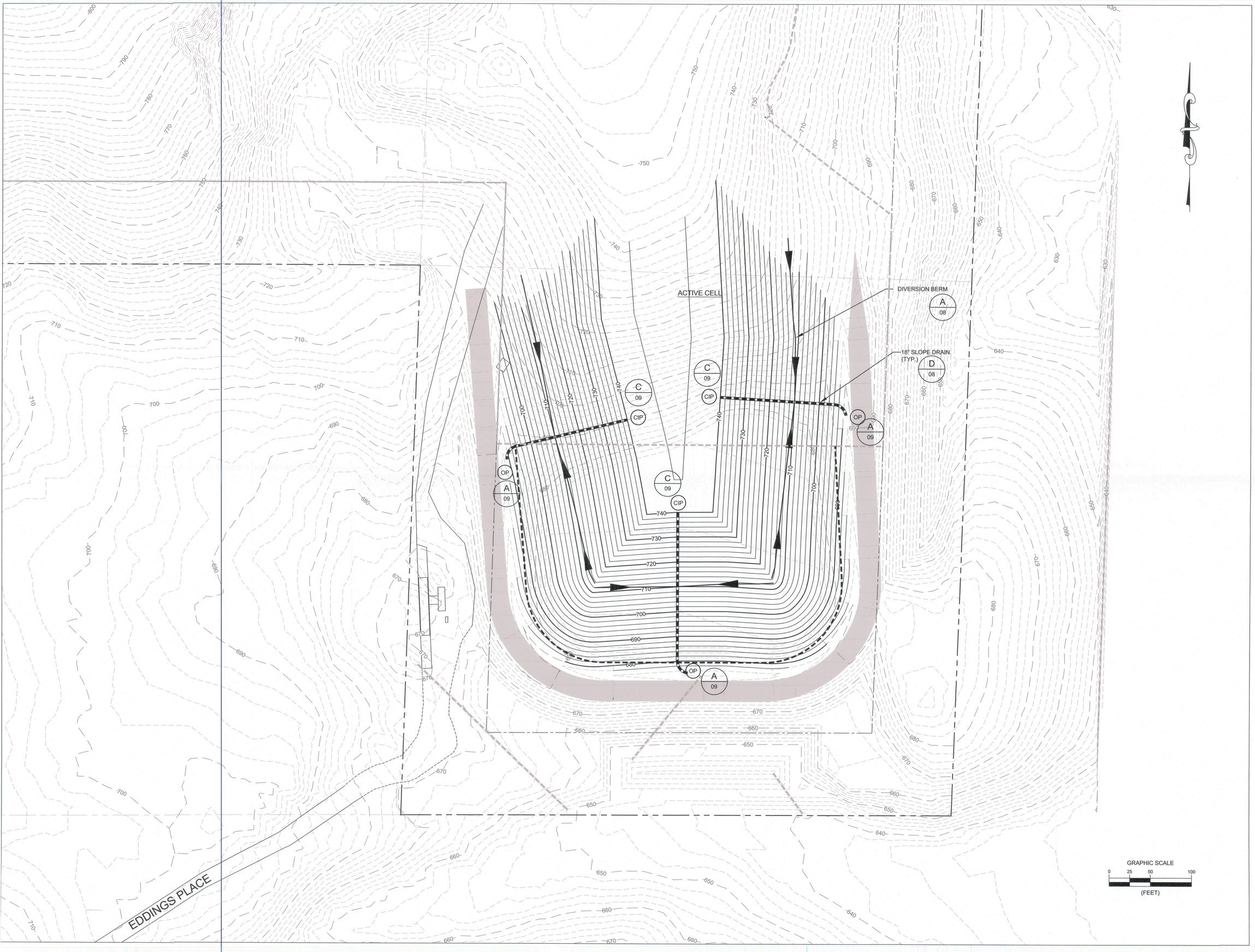
DRAWING NAME:

SECTION

DRAWING NUMBER:

06



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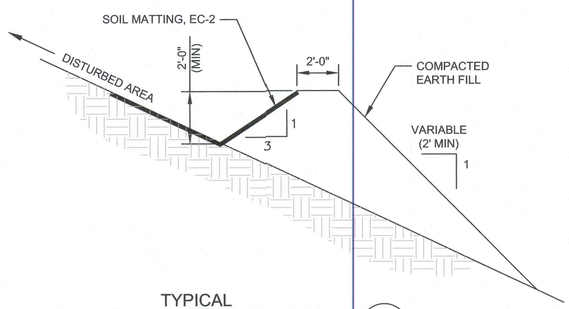
DRAWING NAME:

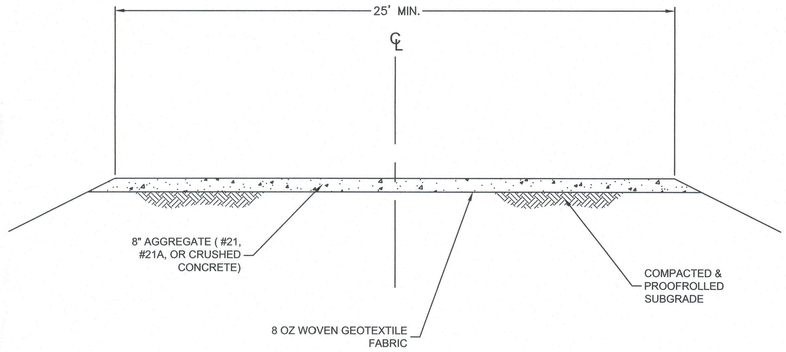
POST-DEVELOPMENT EROSION AND SEDIMENT CONTROL

DRAWING NUMBER:

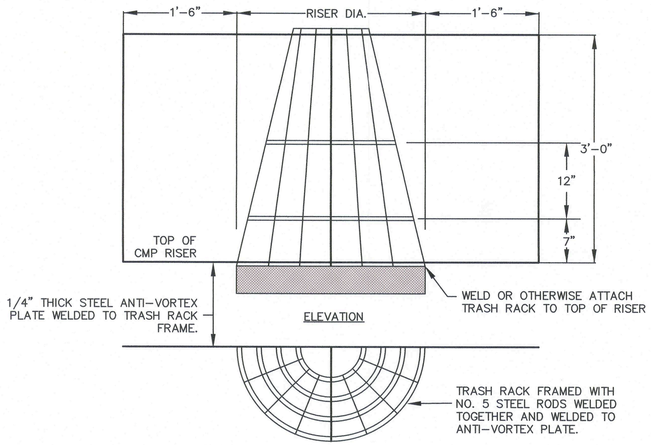
07



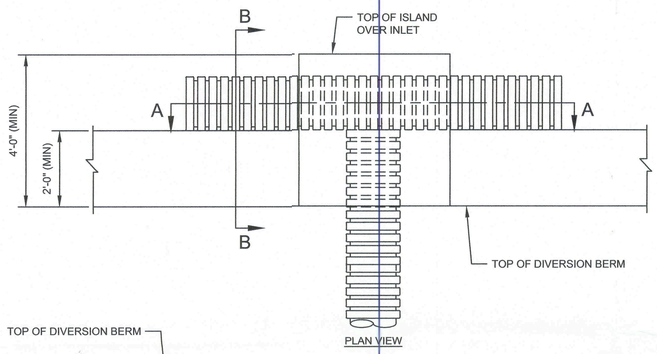
TYPICAL DIVERSION BERM
N.T.S.
A

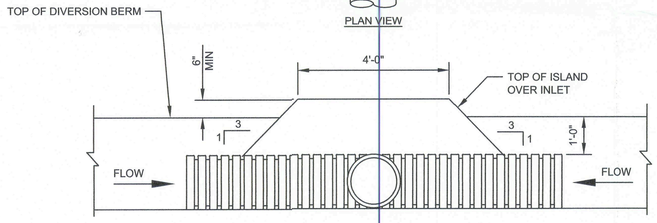


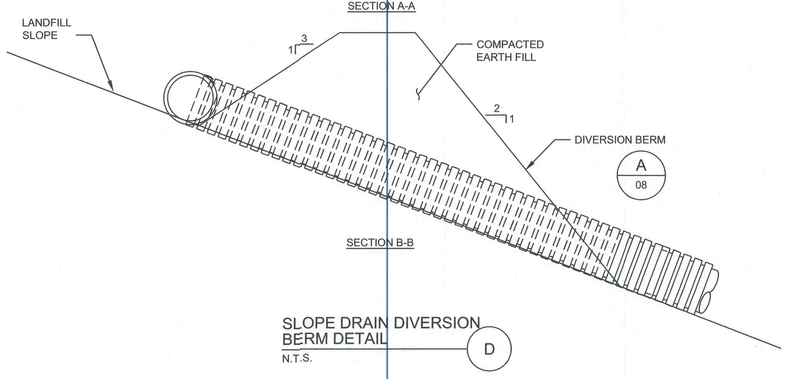
TYPICAL ACCESS ROAD
N.T.S.
B



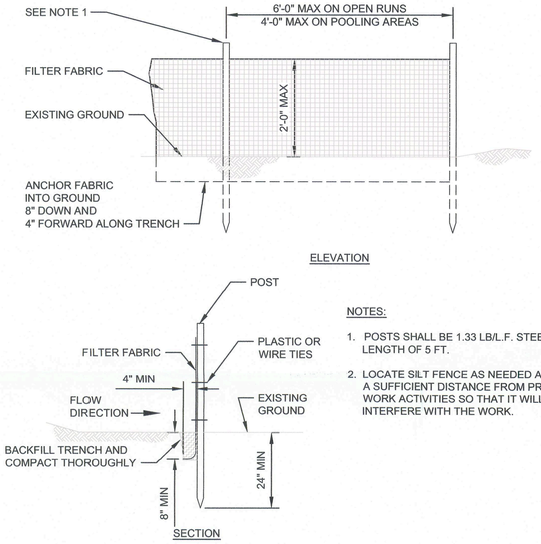
TYPICAL TRASH RACK DETAIL
N.T.S.
E







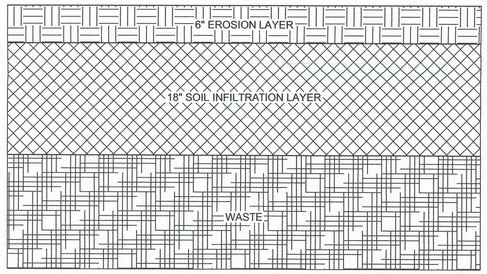
SLOPE DRAIN DIVERSION BERM DETAIL
N.T.S.
D



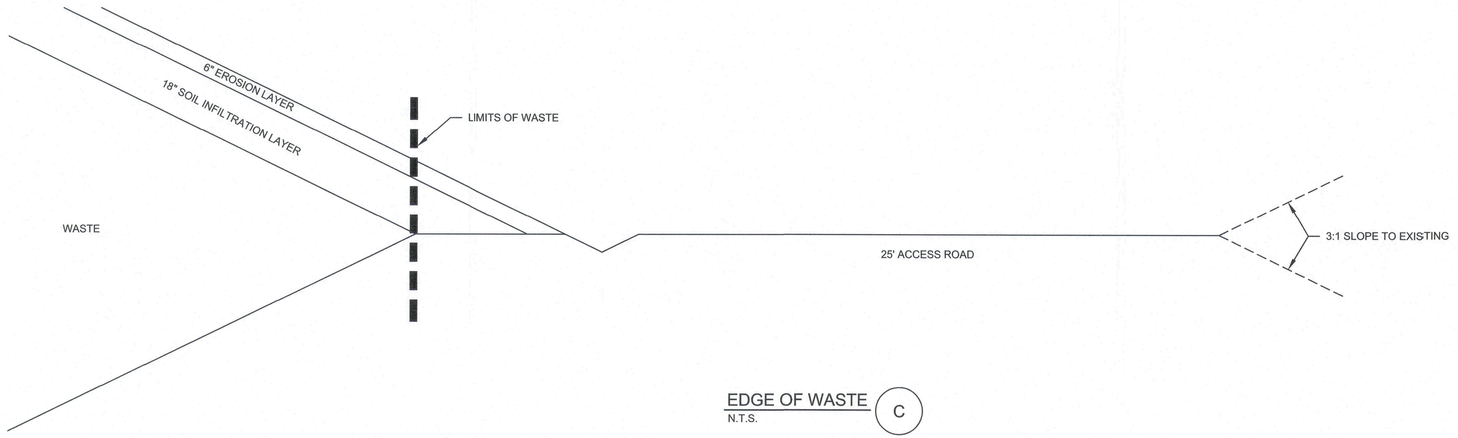
NOTES:

1. POSTS SHALL BE 1.33 LB/L.F. STEEL WITH MIN LENGTH OF 5 FT.
2. LOCATE SILT FENCE AS NEEDED AT A SUFFICIENT DISTANCE FROM PROPOSED WORK ACTIVITIES SO THAT IT WILL NOT INTERFERE WITH THE WORK.

SILT FENCE DETAIL
N.T.S.
F



FINAL COVER
N.T.S.
G



EDGE OF WASTE
N.T.S.
C

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Revisions		

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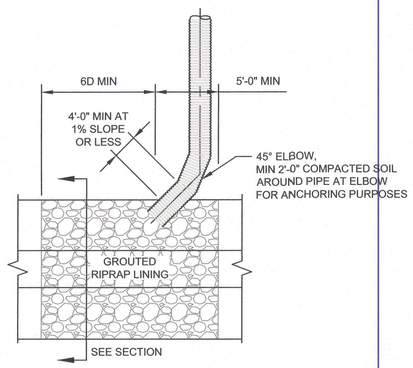
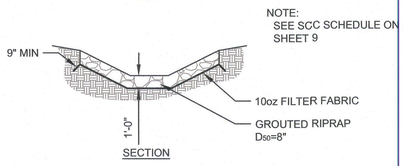
DETAILS

DRAWING NUMBER:

08



PLAN

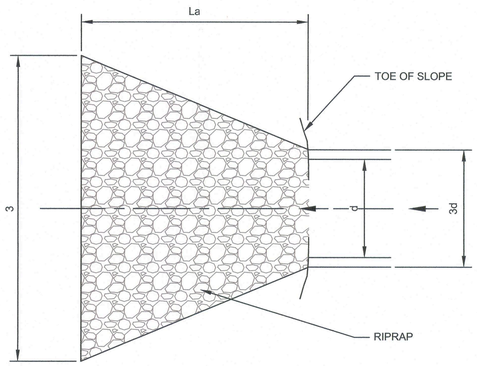


NOTE:
SEE SCC SCHEDULE ON SHEET 9

SECTION

OUTLET PROTECTION DETAIL - TYPE I OP-4 THROUGH OP-6

N.T.S. — A



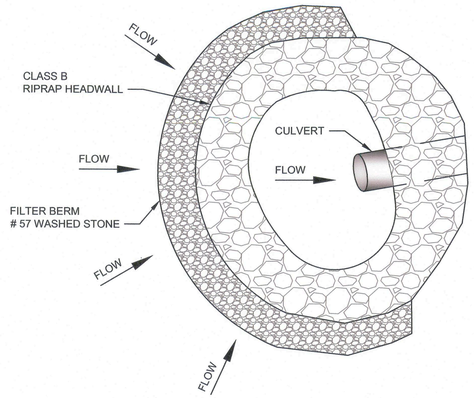
NOTES:

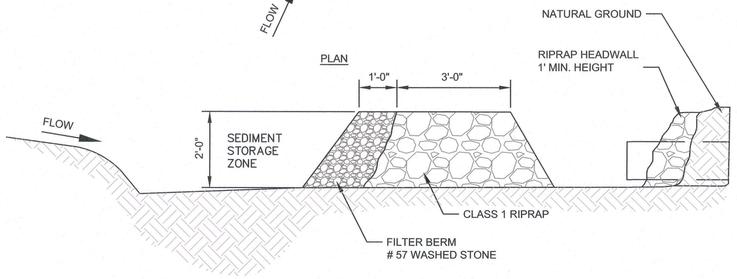
1. INSTALL FILTER FABRIC BETWEEN RIPRAP AND SOIL FOUNDATION.

OUTLET PROTECTION SCHEDULE						
OUTLET NO	La	d	3d	W	d_{50} RIPRAP	THICKNESS (t)
OP-1	12'	24"	6'	14'	6"	14"
OP-2	50'	24"	6'	22'	8"	17"
OP-3	10'	24"	6'	12'	6"	14"

OUTLET PROTECTION DETAIL - TYPE II OP-1 THROUGH OP-3

N.T.S. — B

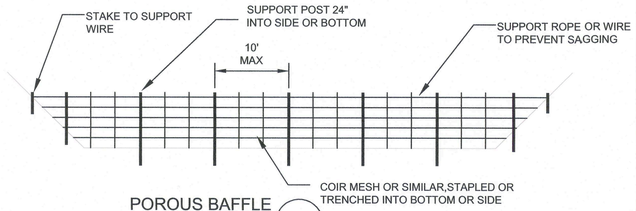




SECTION

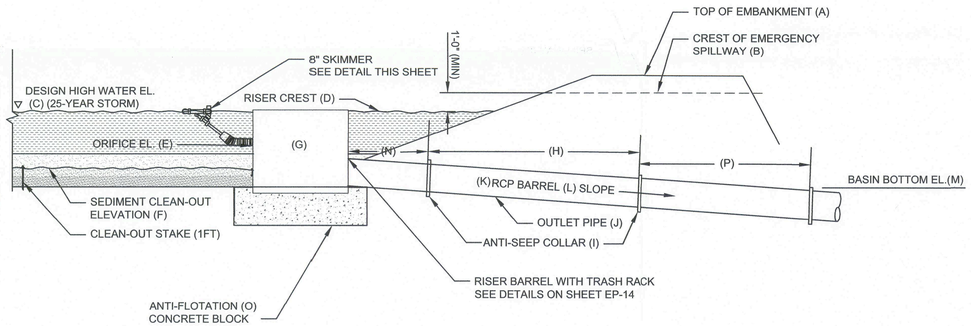
INLET PROTECTION

N.T.S. — C



POROUS BAFFLE

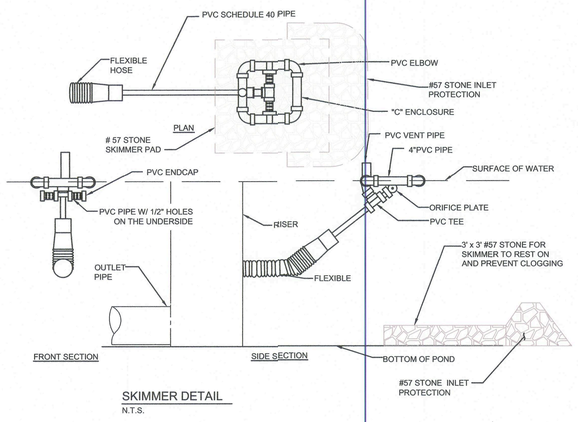
N.T.S. — G



S.B. #	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
SB-1	649	647	646.39	646	643	642.75	48"	15.4	4.2' X 4.2'	68'	24"	2.94%	642	4	8' X 8' X 1'	N/A

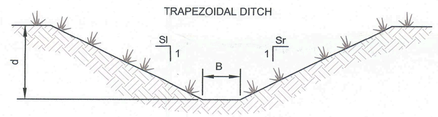
SEDIMENT BASIN PARTIAL SECTION

N.T.S. — E



SKIMMER DETAIL

N.T.S.

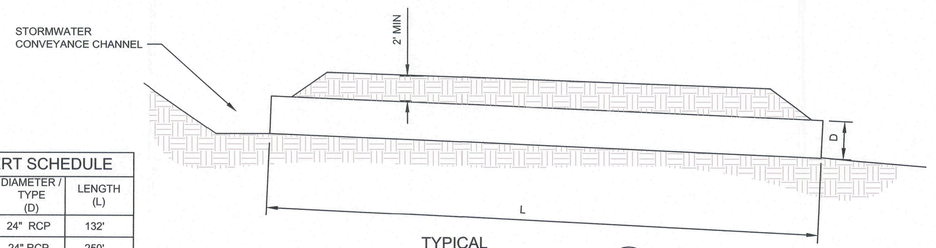


STORMWATER CHANNEL SCHEDULE						
CHANNEL SECTION NO.	CHANNEL TYPE	BOTTOM WIDTH (B) (FT)	TOTAL DEPTH (d) (FT)	LANDFILL SIDE SLOPE (SI)	OTHER SIDE SLOPE (Sr)	CHANNEL LINING (ALL CHANNELS)
SCC - 1	TRIANGULAR	0"	2'-0"	3	3	VEGETATION / EC-2
SCC - 2	TRIANGULAR	0"	2'-0"	3	3	VEGETATION / EC-2

STORMWATER CONVEYANCE CHANNEL TYPICAL DETAIL

N.T.S. — F

CULVERT SCHEDULE		
PIPE NO.	DIAMETER / TYPE (D)	LENGTH (L)
C-1	24" RCP	132'
C-2	24" RCP	250'
C-3	24" RCP	68'



TYPICAL CULVERT SECTION

N.T.S. — D

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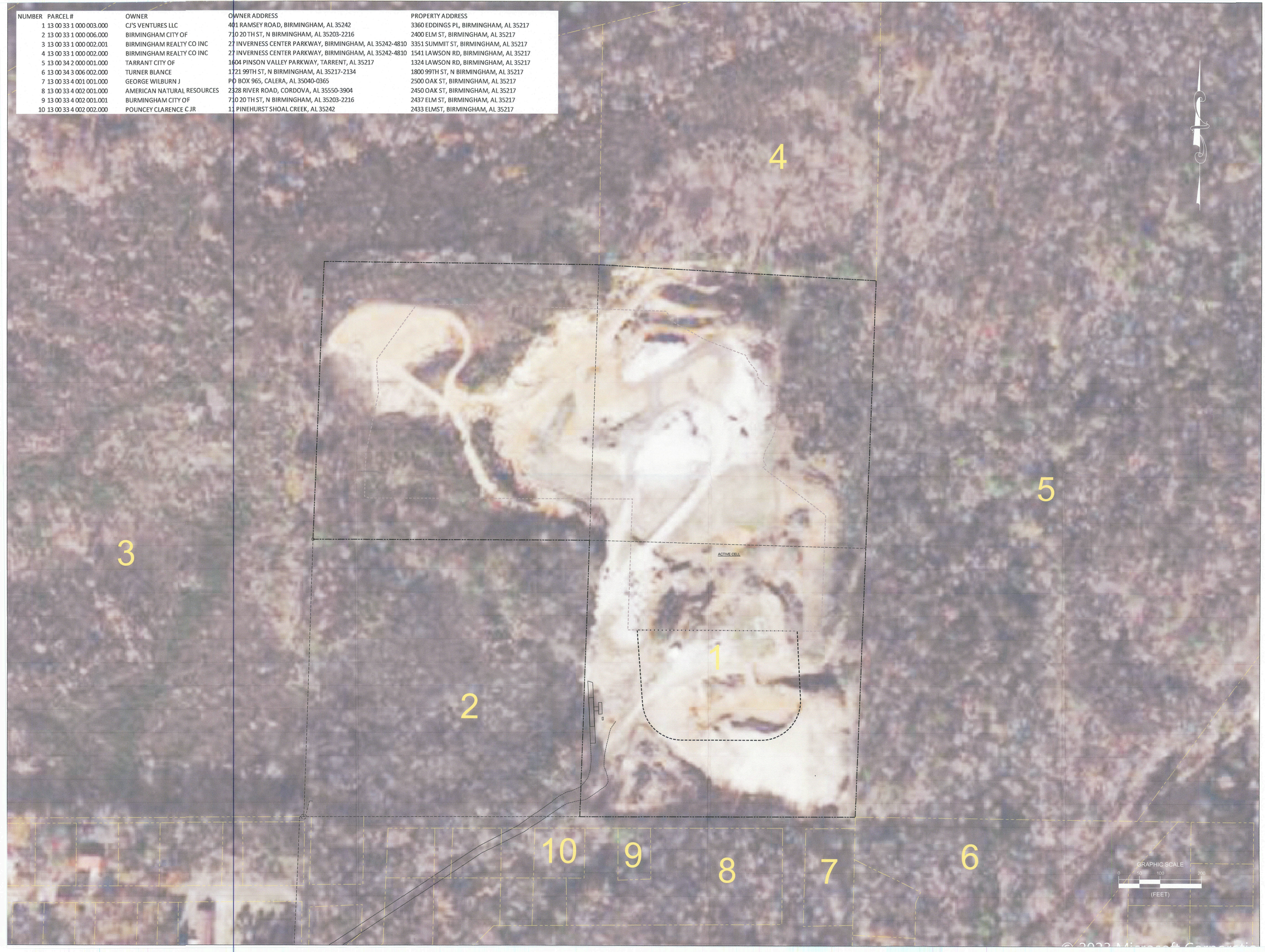
09

NUMBER	PARCEL #	OWNER	OWNER ADDRESS	PROPERTY ADDRESS
1	13 00 33 1 000 003.000	CJ'S VENTURES LLC	401 RAMSEY ROAD, BIRMINGHAM, AL 35242	3360 EDDINGS PL, BIRMINGHAM, AL 35217
2	13 00 33 1 000 006.000	BIRMINGHAM CITY OF	710 20 TH ST, N BIRMINGHAM, AL 35203-2216	2400 ELM ST, BIRMINGHAM, AL 35217
3	13 00 33 1 000 002.001	BIRMINGHAM REALTY CO INC	27 INVERNESS CENTER PARKWAY, BIRMINGHAM, AL 35242-4810	3351 SUMMIT ST, BIRMINGHAM, AL 35217
4	13 00 33 1 000 002.000	BIRMINGHAM REALTY CO INC	27 INVERNESS CENTER PARKWAY, BIRMINGHAM, AL 35242-4810	1541 LAWSON RD, BIRMINGHAM, AL 35217
5	13 00 34 2 000 001.000	TARRANT CITY OF	1604 PINSON VALLEY PARKWAY, TARRENT, AL 35217	1324 LAWSON RD, BIRMINGHAM, AL 35217
6	13 00 34 3 006 002.000	TURNER BLANCE	1721 99TH ST, N BIRMINGHAM, AL 35217-2134	1800 99TH ST, N BIRMINGHAM, AL 35217
7	13 00 33 4 001 001.000	GEORGE WILBURN J	PO BOX 965, CALERA, AL 35040-0365	2500 OAK ST, BIRMINGHAM, AL 35217
8	13 00 33 4 002 001.000	AMERICAN NATURAL RESOURCES	2328 RIVER ROAD, CORDOVA, AL 35550-3904	2450 OAK ST, BIRMINGHAM, AL 35217
9	13 00 33 4 002 001.001	BURMINGHAM CITY OF	710 20 TH ST, N BIRMINGHAM, AL 35203-2216	2437 ELM ST, BIRMINGHAM, AL 35217
10	13 00 33 4 002 002.000	POUNCEY CLARENCE C JR	11 PINEHURST SHOAL CREEK, AL 35242	2433 ELMST, BIRMINGHAM, AL 35217



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ADJACENT PROPERTY OWNERS

DRAWING NUMBER:

10

September 4, 2024

Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2059

VIA ELECTRONIC MAIL
Jwilson@adem.alabama.gov

Attention: Mr. Jason Wilson, P.E., Chief
Solid Waste Branch
Land Division

RE: Addendum to Request for Permit Modification
Petition for Variance
Green Valley Services Landfill
ADEM Permit No.: 37-35
Tarrant, Alabama
LaBella Project No.: 2230184

Dear Mr. Wilson:

On behalf of Green Valley Services, LLC. Labella Associates, D.P.C. (LaBella) is submitting this addendum to the recently submitted request for Permit modification dated July 23, 2024. Pursuant to the requirements of Chapter 8, of ADEM Admin. Code Division 335-13, and Section VIII of Solid Waste Disposal Facility Permit #37-35, Green Valley Services, LLC, request a variance from certain applicable requirements be included in the pending modification of the Permit.

In accordance with ADEM Admin. Code r. 335-13-8-.02(2)(a), the precise extent of the relief being sought, including the specific provision of the regulations addressed under this new variance request is as follows:

- Specific authorization for allowable landfill slopes to not exceed 3 to 1 (33%). Such authorization would reflect a variance from the requirements of ADEM Admin. Code r. 335-13-4-.23(1)(c), which states: *"All waste shall be…placed onto an appropriate slope not to exceed 4 to 1 (25%) or as approved by the Department."*

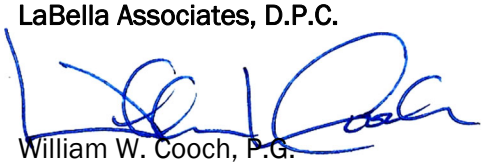
As required by ADEM Admin. Code r. 335-13-8-.02(b), Green Valley Services, LLC presents the following assessment of the impacts the requested variances would impose on public health and the environment:

- The area immediately surrounding the Green Valley Services Landfill is undeveloped, wooded property. No residences, schools, or commercial properties are located adjacent to the Landfill. Green Valley Services, LLC believes the requested variances authorizing 3 to 1 slopes would be appropriate for the type and volume of waste it is receiving for disposal and that, consistent with other similar landfills that have been granted these variances, the operation of the landfill will remain protective of public health and the environment.

In accordance with ADEM Admin. Code r. 335-13-8-.02(d), Green Valley Services, LLC asserts that the granting of the requested variance from the particular provisions of Division 13 would not threaten the public health or unreasonably create environmental pollution.

LaBella and Green Valley Services, LLC appreciate your consideration in this matter. If you have any questions concerning this submittal or require any additional information, please do not hesitate to contact me at wcooch@labellapc.com or (205) 985-4874.

Respectfully submitted,
LaBella Associates, D.P.C.



William W. Cooch, P.G.
Principal Geologist

enclosure – Check for Variance Fee

cc: Clinton Harris – Green Valley Services

HYDROGEOLOGIC EVALUATION

PROPOSED EXPANSION
GREEN VALLEY SERVICES LANDFILL
TARRANT, ALABAMA
PERMIT NO,: 37-35
PROJECT NO.: 2232349

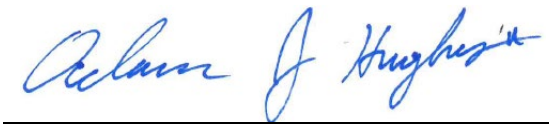
PREPARED FOR:

GREEN VALLEY SERVICES, LLC
3417 DAVEY ALLISON BOULEVARD
HUEYTOWN, ALABAMA 35023

JUNE 12, 2023

PREPARED BY:

LABELLA ASSOCIATES, D.P.C.
528 MINERAL TRACE
BIRMINGHAM, ALABAMA 35244
PHONE (205) 985-4874 FAX (205) 987-6080



Adam J. Hughes
Project Geologist

William W. Cooch, P.G.
Principal Geologist

OWNER 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 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.

Clinton Harris
Green Valley Services Landfill

Date

GEOLOGIST CERTIFICATION

I certify under penalty of law that I am a Registered Professional Geologist, licensed to practice in the State of Alabama and experienced in conducting hydro-geological investigations. The information submitted herein, to the best of my knowledge and belief is true, accurate and complete.

6/12/2023

William W. Cooch, P.G. 0152
Principal Geologist
LaBella Associates, D.P.C.

Date

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FIGURES

APPENDICES

1.0 INTRODUCTION AND SITE HISTORY

This hydrogeologic evaluation at the Green Valley Services Landfill (Landfill) in Tarrant, Jefferson County, Alabama, Permit Number 37-35, was conducted pursuant to current Alabama Department of Environmental Management (ADEM) Administrative Code Division 13 Solid Waste Regulations.

The Landfill is located in Section 33, Township 16 South, Range 2 West in Jefferson County, Alabama. The Landfill consists of a total of 30.371 acres, with approximately 7.512 acres approved for construction and demolition waste disposal. A Site Location Map is included as Figure 1.

The purpose of this investigation is to determine groundwater flow direction along the western and southern property boundary and to assist in the determination of the minimum base elevation of a proposed disposal area by establishing the elevation of the uppermost water-bearing zone beneath the proposed new disposal cell in the southern portion of the currently permitted disposal boundary. The approximate boundaries of the proposed expansion area are illustrated in Figure 2. Four piezometers (PZ-1 through PZ-4) were installed in February 2023 in close proximity of the proposed new cell to establish the seasonal high water table within the study area. Depth to groundwater measurements were collected twice per month during the months of February, March, and April 2023 from the four piezometers to develop a potentiometric surface map that covers the active cell area and proposed expansion area.

2.0 ENVIRONMENTAL SETTING

2.1 REGIONAL GEOLOGY AND HYDROGEOLOGY

According to geologic information published by the Geological Survey of Alabama, the subject facility is located within the Chepultepec and Copper Ridge Formations, which typically consist of limestone and dolomite. A geologic map is provided as Figure 3.

According to the *Geohydrology and Susceptibility of Major Aquifers to Surface Contamination in Alabama; Area 4,* 1989 prepared by the United States Geological Survey (USGS), the subject facility is located in the Birmingham-Big Canoe Valley Physiographic District. The major aquifer in the area is identified as the Knox-Shady Aquifer. The Knox-Shady Aquifer is a source of potable water in Calhoun, Jefferson, St. Clair, Shelby, and Talladega Counties. The Chepultepec and Copper Ridge Formations have a notable interaction with groundwater. Both formations have extensive and elaborate interconnected solution channels through weathered cherty soil that allow rapid rainfall infiltration. Solution openings in carbonate rocks such as these dolomites coincide with the highest yield areas of aquifers in the region.

2.2 REGIONAL SOILS

According to the *Soil Survey of Jefferson County, Alabama*, published by the United States Department of Agriculture (USDA) Soil Conservation Service, the soils underlying the subject property consist of gravelly silt and clay loams formed from cherty limestone residuum. The subsoil is typically gravelly silt loams and gravelly clays that extends to contact bedrock. The underlying bedrock is weathered chert, limestone, and dolomite that becomes more competent with increasing depth as observed in the soil borings installed as part of this hydrogeologic study.

3.0 PIEZOMETER INSTALLATION AND AQUIFER TESTING

3.1 PIEZOMETER INSTALLATION

Four piezometers (PZ-1 through PZ-4) were installed along the western and southern boundary of the planned expansion areas as part of this evaluation with the well locations chosen to serve as temporary monitoring locations to accommodate the proposed new disposal cell. The drilling activities were conducted by Earth Core Drilling from February 1 to February 3, 2023 with each boring being advanced using hollow stem auger drilling techniques through the soil overburden to intersect the uppermost water bearing zone or terminating on underlying rock. The locations of the piezometers installed as part of this evaluation are illustrated on Figure 2.

The piezometers were constructed using 2-inch diameter, Schedule 40 PVC, 0.010-slotted screen and riser casing. Each well was completed with a sand filter pack installed to a minimum of two feet above the screened interval, a two feet thick bentonite seal installed above the filter pack, and the remaining annulus filled with grout to ground surface. Piezometers PZ-1 and PZ-2 were advanced to bedrock with the well screen installed just above the top of rock. Piezometers PZ-3 and PZ-4 were advanced to first encounter of the upper water-bearing zone and were located within the proposed new cell location. Piezometer construction details are summarized in Table 1.0 below.

TABLE 1.0 – PIEZOMETER CONSTRUCTION DETAILS

Piezometer No.	Total Depth[1] (ft-btoc)	Screened Interval[1] (in feet)	Latitude/Longitude	Top of Casing Elevation (ft-amsl)
PZ-1	33.95	23.95 – 33.95	33.60159167, -86.7471000	770.88
PZ-2	34.07	24.07 – 34.07	33.60210278, -86.74619167	742.77
PZ-3	25.48	15.48 – 25.48	33.60000000, -86.74521111	663.15
PZ-4	30.50	20.50 – 30.50	33.60011389, -86.74435556	676.36

ft-btoc – feet below top of casing
[1] Measured from top of casing during piezometer installation
ft-amsl – feet above mean sea level

During drilling, subsurface materials were logged by an experienced field geologist to accurately describe subsurface lithology and aid in the determination of groundwater flow characteristics in the water-bearing zone. Drilling logs and well construction details for each of the monitoring wells installed as part of this investigation are included in Appendix A.

3.2 SITE SPECIFIC LITHOLOGY

The soil (overburden) at the site was classified as primarily gravelly silt loams and gravelly clays with overburden thickness averaging approximately 30 feet across the study area. The underlying rock consists of weathered limestone and dolomite of the Chepultepec and Copper Ridge Formations. Cross-sections illustrating the overburden material, the underlying rock, and the highest water level measurement in the piezometers are included as Figures 6 and 7. Figure 5 illustrates the lines of section A-A' (PZ-1 to PZ-3) and B-B' (PZ-2 to PZ-4).

3.3 AQUIFER TESTING

On May 19, 2023, LaBella Associates, D.P.C. (LaBella) personnel conducted slug tests at the onsite piezometers to collect data for use in calculating the average hydraulic conductivity of the uppermost water-bearing zone. The slug tests were conducted using an In-situ Level Troll 700 Data Logger™ (pressure transducer) lowered into the water column. The transducer was connected at the surface to a computer equipped with WinSitu data-logging software. The static water level in the piezometer was allowed to stabilize before introducing a slug of water into the well casing. The change in head over time, as measured by the transducer, was recorded by the software at three second intervals.

The data recorded at each piezometer during the slug tests were downloaded into AQTESOLV® aquifer testing software to calculate the hydraulic conductivity of the uppermost water-bearing zone. The hydraulic conductivity was calculated using the slope of the line derived from the change in head over time. Hydraulic conductivity was measured at 7.13×10^{-7} feet per second (ft/sec) at PZ-1, 1.07×10^{-5} ft/sec at PZ-2, 1.856×10^{-7} ft/sec at PZ-3, and 4.235×10^{-8} ft/sec at PZ-4. The groundwater flow velocity calculations and slug test data collected as part of this investigation are included as Appendices B and C, respectively.

The flow velocity of the uppermost water-bearing zone was estimated using Darcy's Law for flow velocity, V=k*I/effective porosity. The flow velocity was calculated using an average hydraulic conductivity of 0.25144 feet/day (as derived from aquifer testing), a groundwater gradient of 0.0598 feet/foot across the proposed expansion area, and an estimated effective porosity of 40 percent (Freeze and Cherry, 1979). The resulting flow rate (real velocity or pore velocity) for the water-bearing zone in the gravelly silts and gravelly clays within the study area is calculated to be approximately 13.72 feet/year. The calculation of flow velocity is included in Appendix B.

4.0 SITE GEOLOGY AND HYDROGEOLOGY

4.1 SITE GEOLOGY

As discussed in Section 2.1 above, the subject property is underlain by the Chepultepec and Copper Ridge Formations of Early Ordovician to Cambrian Age, respectively. The formations both consist primarily of limestone and dolomite and are notably cherty.

4.2 SITE HYDROGEOLOGY

As evidenced during the installation of the piezometers, groundwater was encountered within the overburden in PZ-3 and PZ-4 which were installed at lower elevations and within the boundary of the proposed new disposal cell. The first encounter of groundwater at higher elevations was observed at the top of rock in piezometers PZ-1 and PZ-2. After allowing groundwater to stabilize, the measured depth to groundwater ranged from 5.98 feet below top of casing (ft-btoc) at PZ-3 to 33.90 ft-btoc at PZ-1.

Water-level measurements were collected twice a month during the months of February, March, and April 2023 from piezometers PZ-1 through PZ-4 to aid in determining the seasonal high water table for the study area. Prior to collecting water level measurements, the top of casing measuring point elevation for piezometers PZ-1 through PZ-4 was established by a Licensed Professional Land Surveyor and referenced to mean sea level.

During each measuring event, the depth to water in each piezometer was measured to the nearest 0.01 feet from the top of casing. The depth in feet was then subtracted from the surveyed elevation of the measuring point to determine the elevation of the top of water at each monitoring well. A summary of the groundwater elevations measured during the six measuring events is included in Table 2.0 on the following page.

TABLE 2.0 – GROUNDWATER MEASUREMENTS

Well I.D.	Date Measured	Top of Casing (ft-amsl)	Ground Surface (ft-amsl)	Depth to Groundwater (ft-btoc)	Groundwater Elevation (ft-amsl)
PZ-1	2/3/2023	770.88	767.15	33.90	736.93
	2/17/2023			33.20	737.68
	3/3/2023			33.37	737.51
	3/17/2023			33.39	737.49
	3/31/2023			33.36	737.52
	4/14/2023			33.38	737.50
PZ-2	2/3/2023	742.77	739.24	33.50	709.27
	2/17/2023			33.50	709.27
	3/3/2023			33.53	709.24
	3/17/2023			33.52	709.25
	3/31/2023			33.53	709.24
	4/14/2023			33.53	709.24
PZ-3	2/3/2023	663.15	661.26	5.98	657.17
	2/17/2023			5.10	658.05
	3/3/2023			4.93	658.22
	3/17/2023			5.16	657.99
	3/31/2023			5.22	657.93
	4/14/2023			4.98	658.17
PZ-4	2/3/2023	676.36	673.56	29.10	647.26
	2/17/2023			24.70	651.66
	3/3/2023			21.95	654.41
	3/17/2023			20.60	655.76
	3/31/2023			19.90	656.46
	4/14/2023			20.00	656.36

ft-amsl – feet above mean sea level
ft-btoc – feet below top of casing

Based on the water level measurements summarized in Table 2.0 above, the seasonal high water table elevations for each of the wells used for evaluating the separation from groundwater beneath the expansion area are provided in the Table 2.1 below

TABLE 2.1 – SEASONAL HIGH GROUNDWATER MEASUREMENTS

Well I.D.	Date Measured	Top of Casing (ft-amsl)	Depth to Groundwater (ft-btoc)	Groundwater Elevation (ft-amsl)
PZ-1	2/17/2023	770.88	33.20	737.68
PZ-2	2/17/2023	742.77	33.50	709.27
PZ-3	3/3/2023	663.15	4.93	658.22
PZ-4	3/31/2023	676.36	19.90	656.46

ft-amsl – feet above mean sea level
ft-btoc – feet below top of casing

Using the depth to groundwater measurements collected from February 2023 through April 2023, the direction of groundwater flow in the study area appears to be generally to the southeast. A sitewide potentiometric surface map, based on recorded seasonal high measurements is included as Figure 4.

5.0 RECOMMENDED MINIMUM CELL BASE GRADE

Based on the findings of the this investigation and in an effort to maintain a minimum separation of 5.0 feet from the cell base and the first water-bearing zone, LaBella recommends that the minimum base grade for the proposed new disposal cell be no lower than 664.00 ft-amsl.

6.0 FINDINGS AND CONCLUSIONS

Based on the findings of this Hydrogeologic Evaluation, LaBella Associates, D.P.C. provides the following conclusions:

Conclusions

- The four piezometers installed during this investigation encountered the first water-bearing zone within the overburden or on top of bedrock underlying the study area. Piezometers PZ-1 and PZ-2 were installed on top of bedrock. Piezometers PZ-3 and PZ-4 were installed in the overburden. The borings ranged in depth from 24.0 feet below ground surface (ft-bgs) (PZ-3) to 31.0 ft-bgs (PZ-1).

- Based on the groundwater measurements collected during the months of February, March and April 2023, the direction of groundwater flow is generally to the south and southeast within the study area.

- Based on the seasonal high depth to groundwater measurements collected during the months of February, March, and April 2023, the potentiometric surface elevation of the uppermost water bearing zone beneath the study area ranged from 737.68 ft-amsl at piezometer PZ-1 to 656.46 ft-amsl at piezometer PZ-4.

- The flow velocity of the uppermost water-bearing zone was estimated using Darcy's Law for flow velocity, V=k*I/effective porosity. The flow velocity was calculated using an average hydraulic conductivity of 0.25144 feet/day (as derived from aquifer testing), a groundwater gradient of 0.0598 feet/foot across the proposed expansion area, and an estimated effective porosity of 40 percent (Freeze and Cherry, 1979). The resulting flow rate (real velocity or pore velocity) for the water-bearing zone in the gravelly silts and gravelly clays in the expansion area is calculated to be approximately 13.72 feet/year.

Recommendation

In an effort to maintain a minimum separation of 5.0 feet from the cell base and the first water-bearing zone, LaBella recommends that the minimum base grade for the proposed new disposal cell be no lower than 664.00 ft-amsl.

7.0 REFERENCES

Alabama Department of Environmental Management Administrative Code R. 334-13-4-.11 through 334-13-4.14.

Freeze, R. A. and Cherry, J. A., 1979. Groundwater: Prentice-Hall, Inc.

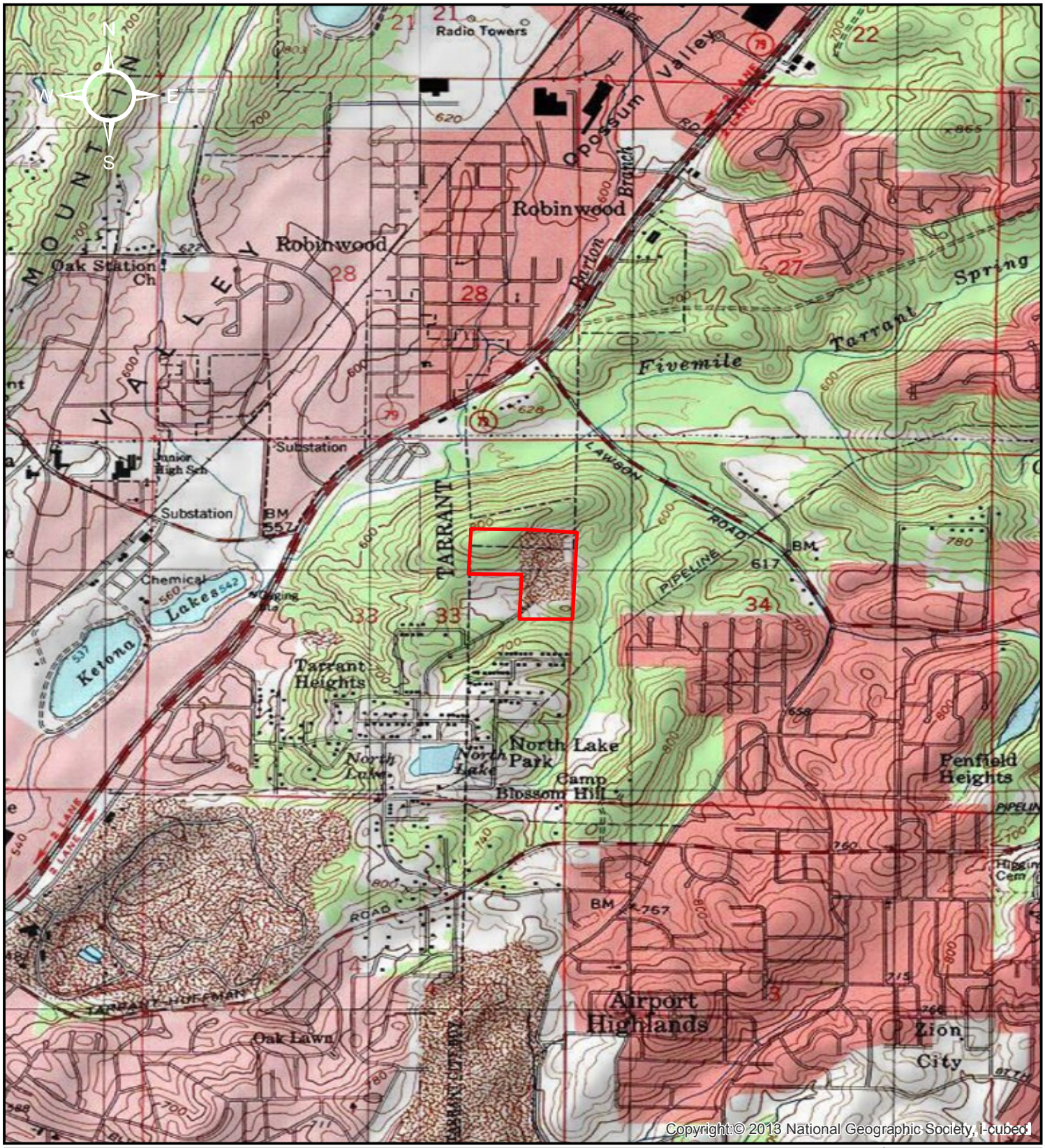
Panert, Michael, Pritchett, Jr., James L., United States Geological Survey. Geohydrology and Susceptibility of Major Aquifers to Surface Contamination in Alabama; Area 4: Water Resources Investigations Report 88-4133, 1989.

USGS Topographic Map, Tarrant, AL, 7.5 Minute Quadrangle, 1978

Web Soil Survey of Jefferson County, Alabama, USDA, Soil Conservation Service, May 2023.

Special Map 221, Geologic Map of Alabama: Geological Survey of Alabama, 1989.

FIGURES



Legend

Approximate Property Boundary

LaBella
Powered by partnership.

528 MINERAL TRACE
HOOVER, AL 35244
(205) 985-4874

TITLE: Site Location Map

Green Valley Services, LLC. Landifll

Tarrant, Alabama

SCALE: 0 1,000 2,000
1 inch = 2,000 feet

FIGURE NO. 1

PROJECT NO. 2232349

DRAWN BY AJH

DATE DRAWN 02-02-2023

Legend

Piezometer Location

LaBella
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528 MINERAL TRACE
HOOVER, AL 35244
(205) 985-4874

TITLE: Piezometer Location Map

Green Valley Services, LLC. Landifll

Tarrant, Alabama

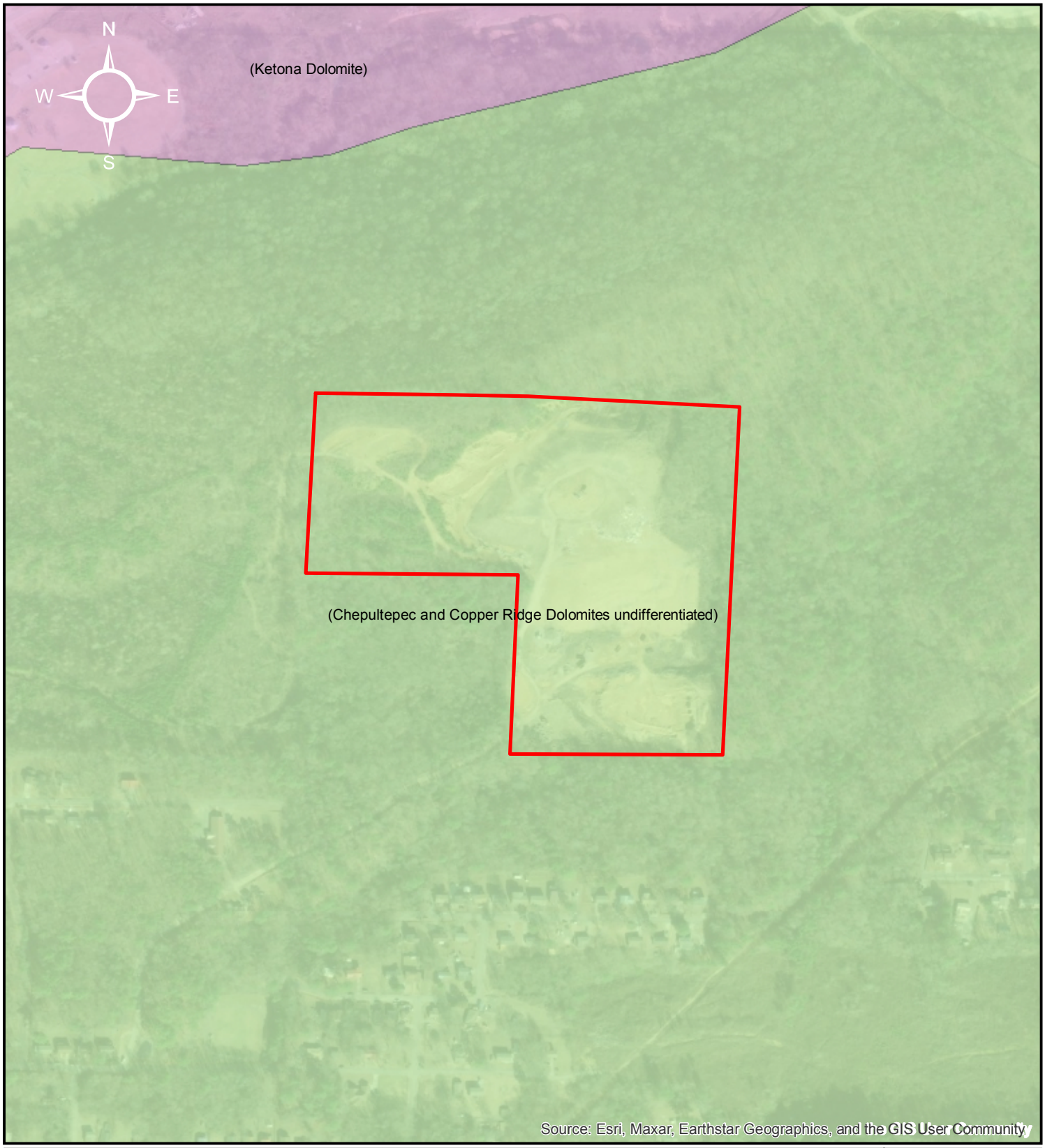
SCALE: 0 100 200
1 inch = 200 feet

FIGURE NO. 2

PROJECT NO. 2232349

DRAWN BY AJH

DATE DRAWN 02-02-2023



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Approximate Property Boundary

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528 MINERAL TRACE
HOOVER, AL 35244
(205) 985-4874

TITLE: Geologic Map

Green Valley Services, LLC. Landifll

Tarrant, Alabama

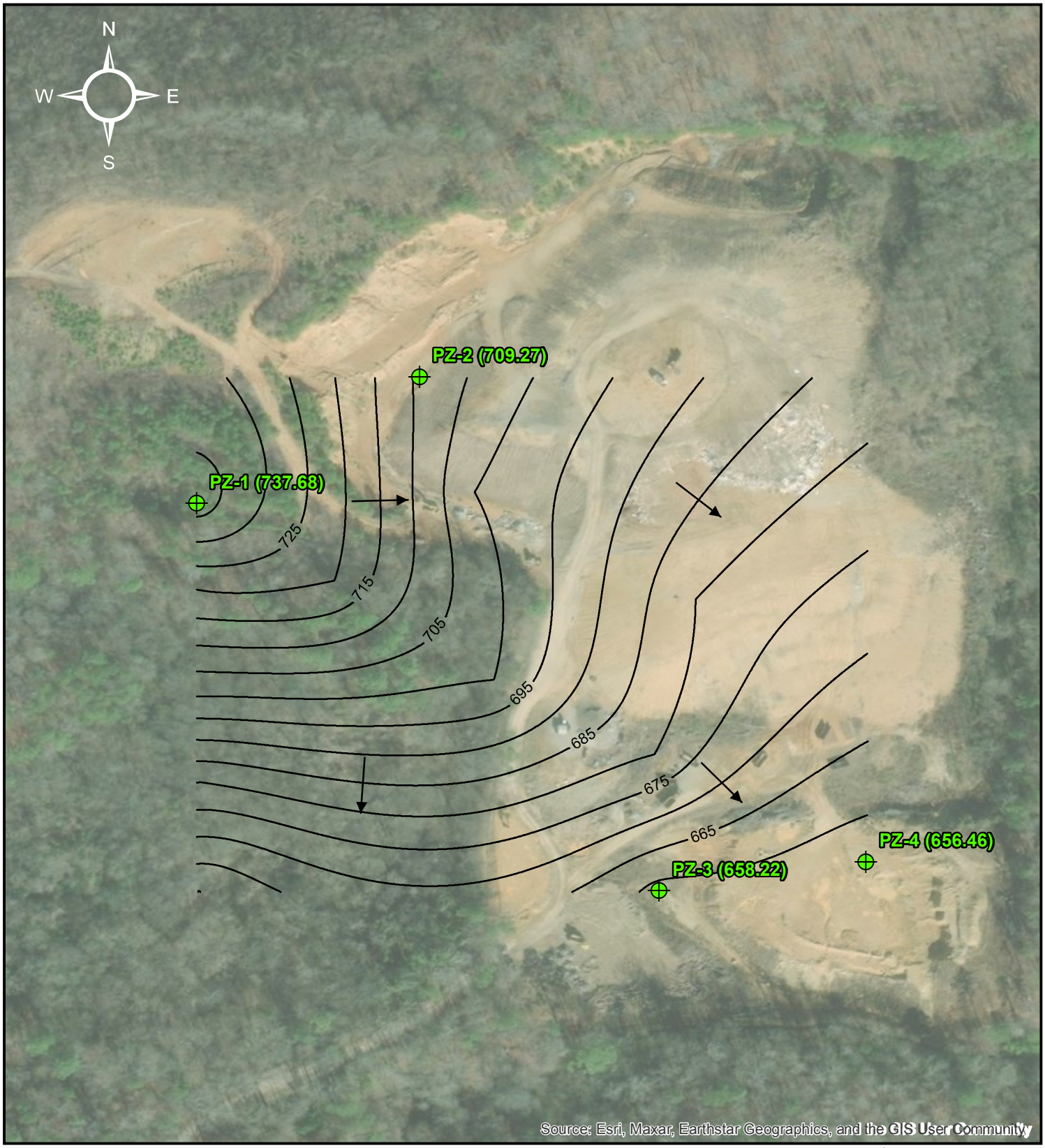
SCALE: 0 250 500
1 inch = 500 feet

FIGURE NO. 3

PROJECT NO. 2232349

DRAWN BY AJH

DATE DRAWN 05-11-2023



Legend

- Piezometer Location
- Potentiometric Contour Line
- Groundwater Flow Vector
- (737.68) Groundwater Elevation (FT-AMSL)

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HOOVER, AL 35244
(205) 985-4874

TITLE: Seasonal High Potentiometric Contour Map

Green Valley Services, LLC. Landifll

Tarrant, Alabama

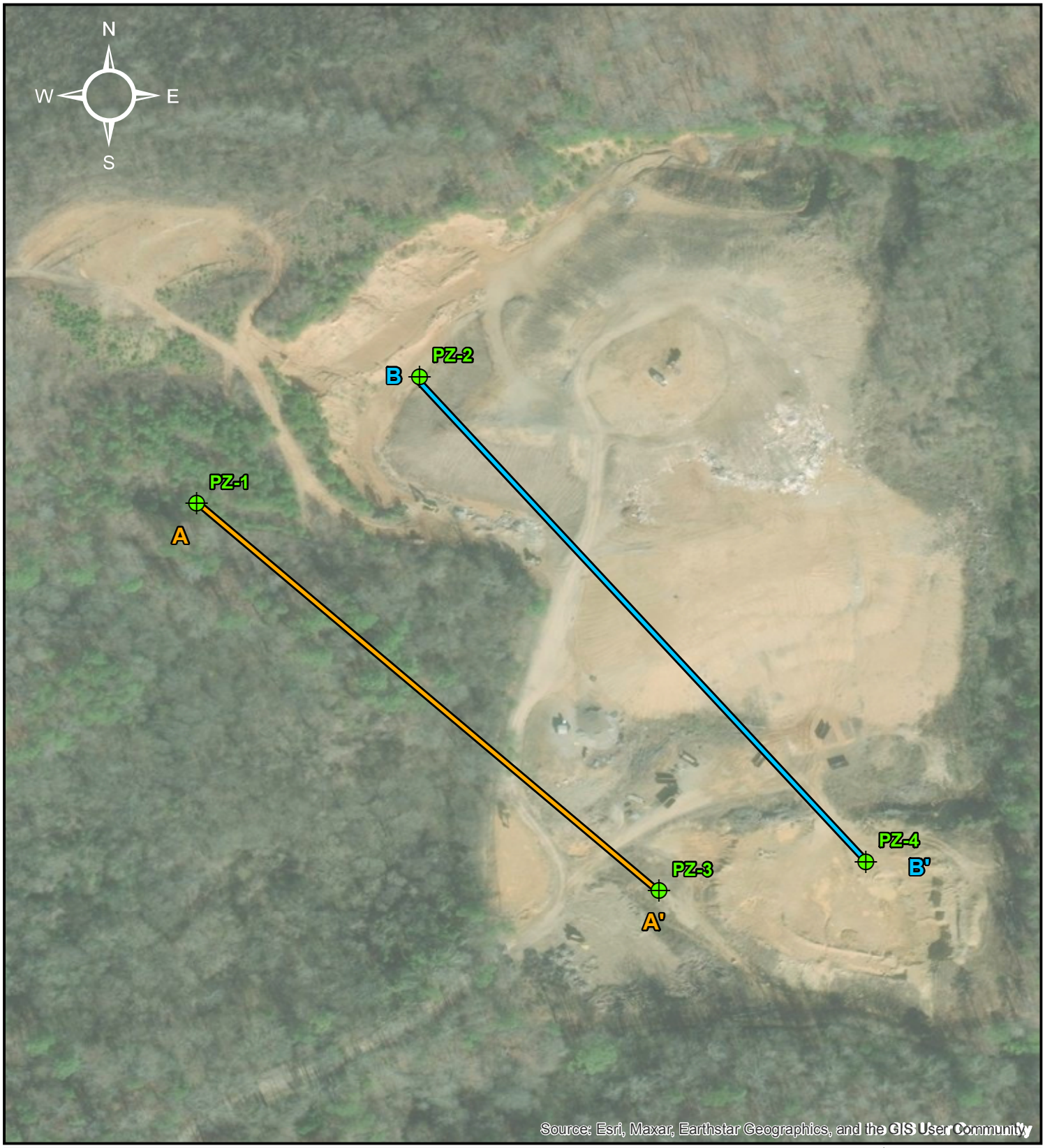
SCALE: 0 100 200
1 inch = 200 feet

FIGURE NO. 4

PROJECT NO. 2232349

DRAWN BY AJH

DATE DRAWN 05-11-2023



Legend

- Piezometer Location
- Section Line A
- Section Line B

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528 MINERAL TRACE
HOOVER, AL 35244
(205) 985-4874

TITLE: Lines of Section Map

Green Valley Services, LLC. Landifll

Tarrant, Alabama

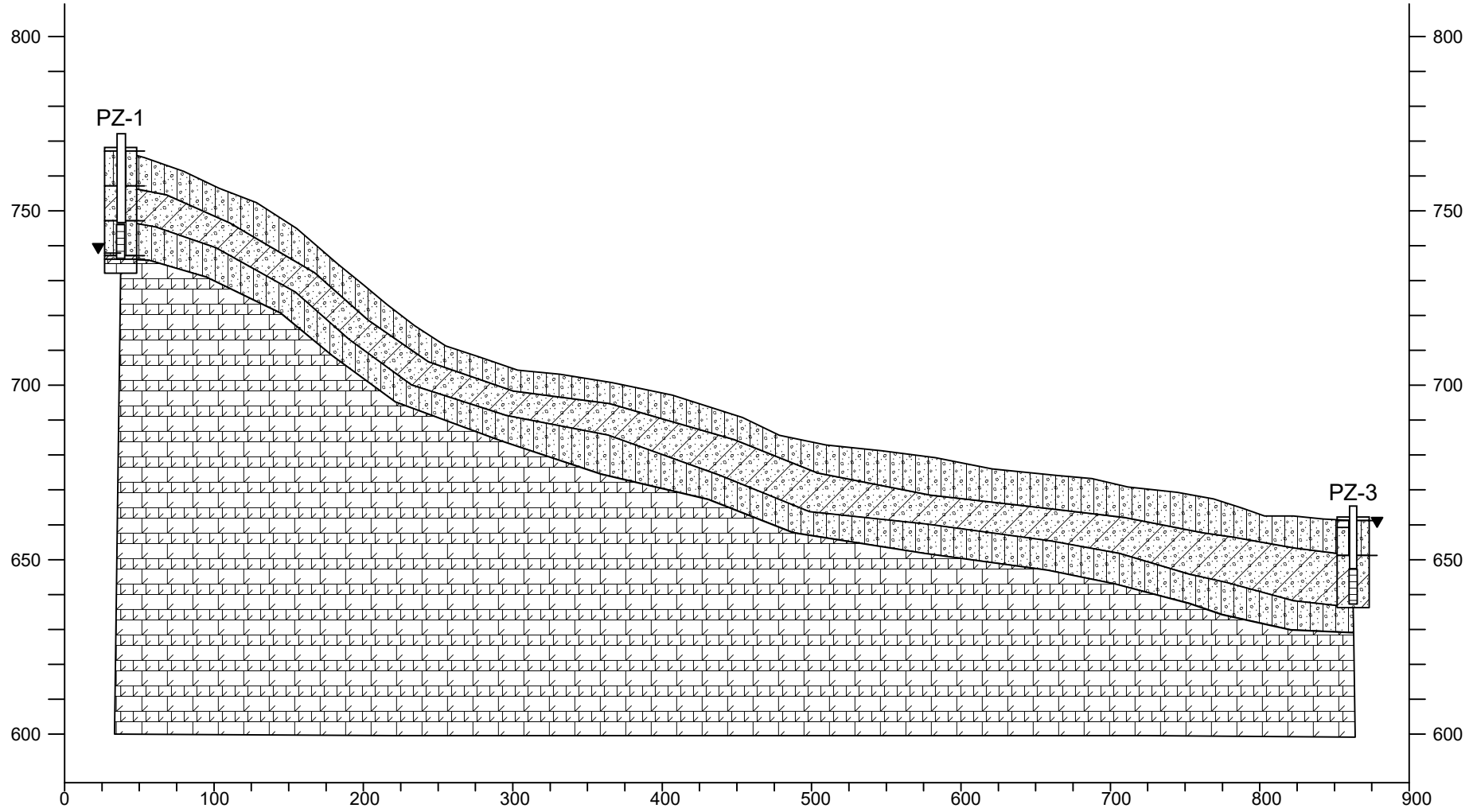
SCALE: 0 100 200
1 inch = 200 feet

FIGURE NO. 5

PROJECT NO. 2232349

DRAWN BY AJH

DATE DRAWN 05-11-2023



Green Valley Services Landfill

Hydrogeologic Investigation

Tarrant, Jefferson County, AL

LaBella
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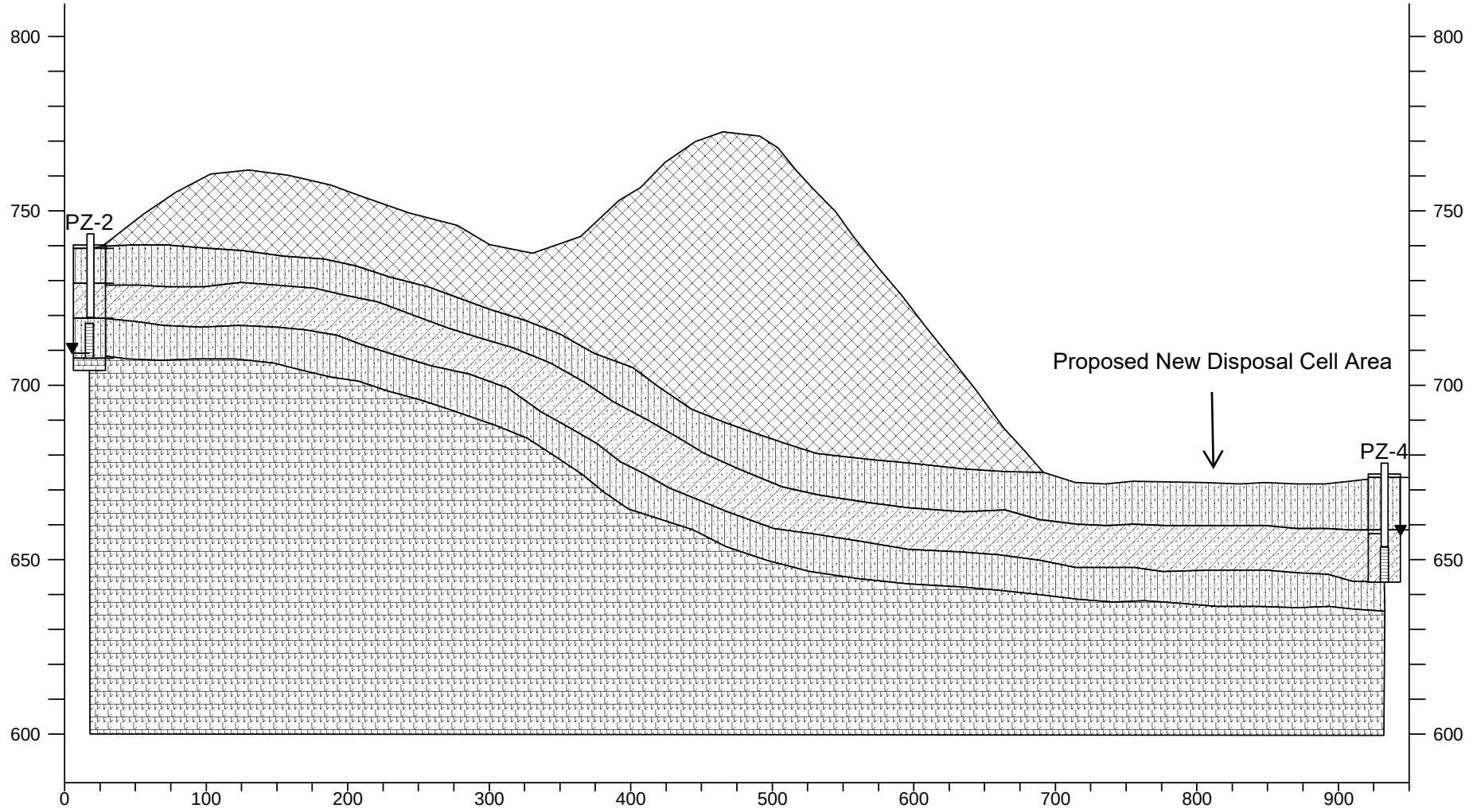
Figure 6

Cross Section of PZ-1 to PZ-3

- Gravelly Silt
- Gravelly Clay
- Limestone/Dolomite Bedrock
- Piezometer Screen
- Seasonal High Water Level



Green Valley Services Landfill

Hydrogeologic Investigation

Tarrant, Jefferson County, AL

LaBella
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Figure 7

Cross Section of PZ-2 to PZ-4

- Waste In Place
- Gravelly Silt
- Gravelly Clay
- Limestone/Dolomite Bedrock
- Piezometer Screen
- Seasonal High Water Level

APPENDIX A

Green Valley Services Landfill

Hydrogeologic Investigation

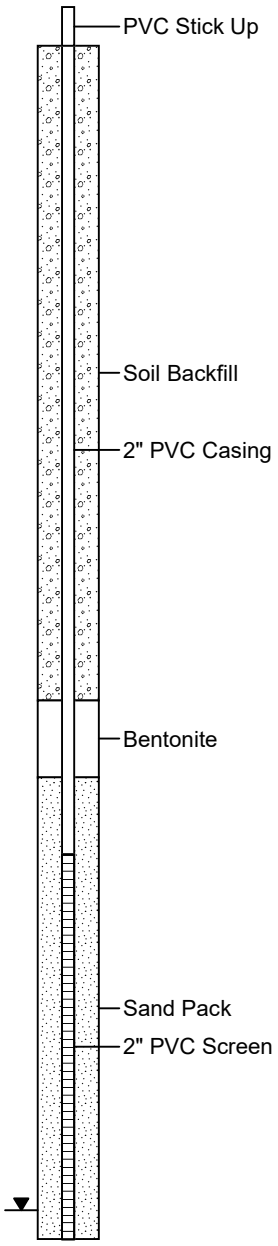
Tarrant, Jefferson County, AL

Log for SB-1/PZ-1

Date Started	: 2/3/2023	Drilling Company	: Earth Core
Date Completed	: 2/3/2023	Driller	:
Hole Diameter	: 4 1/4"	Latitude	: 33.60159167
Drilling Method	: HSA	Longitude	: -86.7471000
Sampling Method	: N/A	Logged By	: Adam Hughes

Depth in Feet (bgs)	Surf Elev.767.15	USCS	GRAPHIC	PID Result	DESCRIPTION	Sample Locations
0	767	GM			Reddish brown gravelly silt/clay loam, dry	
2	765					
4	763					
6	761					
8	759					
10	757	GC			Reddish brown silty clay loam, chert fragments, dry	
12	755					
14	753				Rig chattering on rock resistance	
16	751					
18	749					
20	747	GM			Dry, loose gravelly loam, high volume of rock fragments	
22	745					
24	743				Constant rig chattering advancing boring	
26	741					
28	739					
30	737	GC			Damp, clayey cuttings and gravel	
32	735				Refusal on bedrock, boring terminated, piezometer set	
34						

Well: PZ-1
Elev.: 770.88



Green Valley Services Landfill

Hydrogeologic Investigation

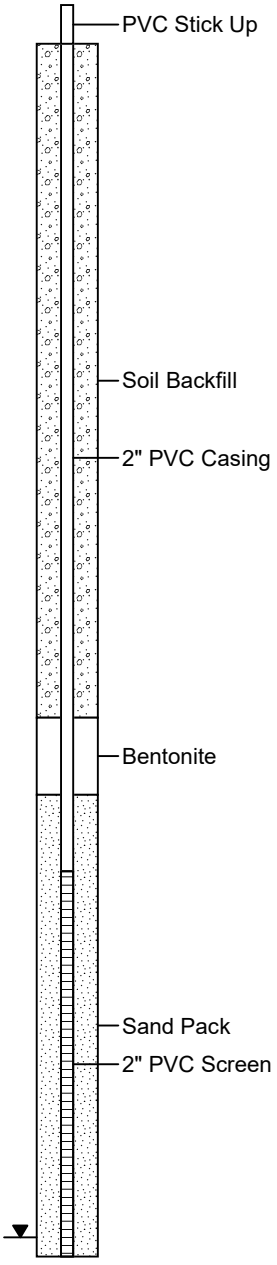
Tarrant, Jefferson County, AL

Log for SB-2/PZ-2

Date Started	: 2/1/2023	Drilling Company	: Earth Core
Date Completed	: 2/1/2023	Driller	:
Hole Diameter	: 4 1/4"	Latitude	: 33.60210278
Drilling Method	: HSA	Longitude	: -86.74619167
Sampling Method	: N/A	Logged By	: Adam Hughes

Depth in Feet (bgs)	Surf Elev.739.24	USCS	GRAPHIC	PID Result	DESCRIPTION	Sample Locations
0	739	GM			Reddish brown cherty silt loam, dry	
2	737					
4	735					
6	733					
8	731					
10	729	GC			Reddish brown cherty silt loam, dry	
12	727					
14	725				Rig chattering on rock resistance, increasing volume of rock fragments	
16	723					
18	721					
20	719	GM			Dry, loose gravelly silt loam, high volume of rock fragments	
22	717					
24	715				Rig chattering on rock resistance	
26	713					
28	711					
30	709					
32	707				Refusal on bedrock, boring terminated, piezometer set	
34						

Well: PZ-2
Elev.: 742.77



Green Valley Services Landfill

Hydrogeologic Investigation

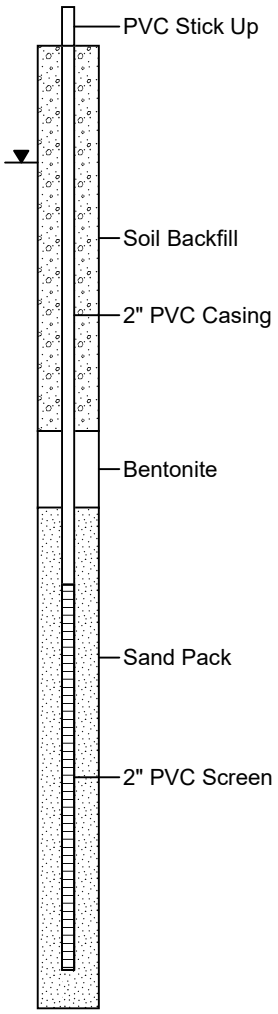
Tarrant, Jefferson County, AL

Log for SB-3/PZ-3

Date Started	: 2/1/2023	Drilling Company	: Earth Core
Date Completed	: 2/1/2023	Driller	:
Hole Diameter	: 4 1/4"	Latitude	: 33.60000000
Drilling Method	: HSA	Longitude	: -86.74521111
Sampling Method	: N/A	Logged By	: Adam Hughes

Depth in Feet (bgs)	Surf Elev.661.26	USCS	GRAPHIC	PID Result	DESCRIPTION	Sample Locations
0	661	GM			Yellow/pale brown, cherty, silty clay loam	
2	659					
4	657				Same as above, wet below ~5' below ground surface	
6	655					
8	653					
10	651	GC			Damp, reddish brown, cherty, silty clay loam	
12	649					
14	647					
16	645				Same as above	
18	643					
20	641					
22	639				Sufficient depth reached, boring terminated, piezometer set	
24	637					
26	635					
28	633					
30	631					
32	629					
34						

Well: PZ-3
Elev.: 663.15



Green Valley Services Landfill

Hydrogeologic Investigation

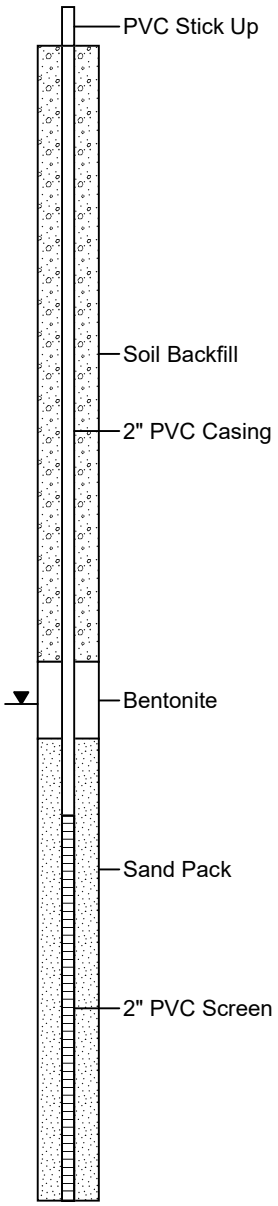
Tarrant, Jefferson County, AL

Log for SB-4/PZ-4

Date Started	: 2/1/2023	Drilling Company	: Earth Core
Date Completed	: 2/1/2023	Driller	:
Hole Diameter	: 4 1/4"	Latitude	: 33.60011389
Drilling Method	: HSA	Longitude	: -86.74435556
Sampling Method	: N/A	Logged By	: Adam Hughes

Depth in Feet (bgs)	Surf Elev.673.56	USCS	GRAPHIC	PID Result	DESCRIPTION	Sample Locations
0	673.5	GM			Reddish brown, dry, cherty, silty clay loam	
2	671.5					
4	669.5					
6	667.5					
8	665.5				Same as above	
10	663.5					
12	661.5					
14	659.5					
16	657.5	GC			Brown, dry, cherty, gravelly clay loam	
18	655.5					
20	653.5					
22	651.5				Damp, gravelly clay loam	
24	649.5					
26	647.5					
28	645.5				Wet cuttings, sufficient depth reached, piezometer set	
30	643.5					
32	641.5					
34						

Well: PZ-4
Elev.: 676.36



APPENDIX B

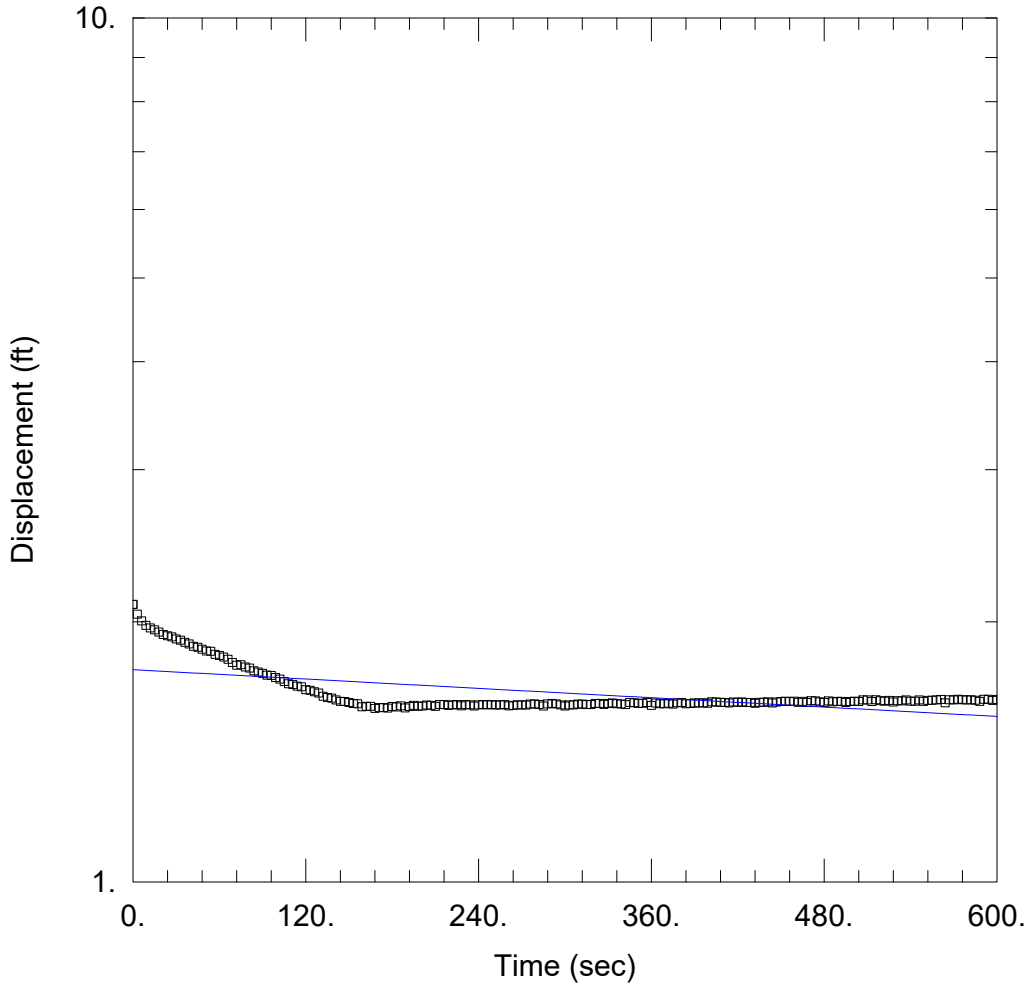
Appendix B Calculated Groundwater Flow Velocities Seasonal High 2023						
Monitoring Well	Groundwater Elevation (ft-amsl)	Distance from up- to down-gradient well (feet)	Gradient (i)	Hydraulic Conductivity (feet/day)	Effective Porosity (ne)	Estimated Flow Velocity (feet/year)
PZ-2	709.27	825.00	0.0619	0.25144	0.40	14.20
PZ-3	658.22			0.25144	0.40	
PZ-2	709.27	915.00	0.0577	0.25144	0.40	13.24
PZ-4	656.46			0.25144	0.40	
		average gradient	0.0598		average flow velocity	13.72

Notes:

1. Effective porosity values from Freeze & Cherry (1979) Table 2.4.
2. Hydraulic conductivity values were obtained from aquifer testing at on-site piezometers

ft-amsl - feet above mean sea level

APPENDIX C



WELL TEST ANALYSIS

Data Set:
Date: 05/23/23 Time: 08:59:45

PROJECT INFORMATION

Company: LaBella
Client: Green Valley
Location: Tarrant
Test Well: PZ-1
Test Date: 5-19-2023

AQUIFER DATA

Saturated Thickness: 0.69 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-1)

Initial Displacement: 2.095 ft
Total Well Penetration Depth: 31. ft
Casing Radius: 0.167 ft
Static Water Column Height: 0.69 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.13E-7 ft/sec
y0 = 1.761 ft

Data Set:
Date: 05/23/23
Time: 09:01:42

PROJECT INFORMATION

Company: LaBella
Client: Green Valley
Location: Tarrant
Test Date: 5-19-2023
Test Well: PZ-1

AQUIFER DATA

Saturated Thickness: 0.69 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-1

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.095 ft
Static Water Column Height: 0.69 ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft
Well Skin Radius: 0.3125 ft
Screen Length: 10. ft
Total Well Penetration Depth: 31. ft

No. of Observations: 201

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	2.095	303.	1.603
3.	2.041	306.	1.603
6.	2.005	309.	1.606
9.	1.981	312.	1.606
12.	1.968	315.	1.604
15.	1.958	318.	1.604
18.	1.946	321.	1.609
21.	1.934	324.	1.609
24.	1.927	327.	1.605
27.	1.921	330.	1.609
30.	1.911	333.	1.611
33.	1.904	336.	1.608
36.	1.894	339.	1.607
39.	1.886	342.	1.604
42.	1.874	345.	1.613
45.	1.869	348.	1.612
48.	1.859	351.	1.609
51.	1.851	354.	1.61
54.	1.849	357.	1.613
57.	1.834	360.	1.601
60.	1.829	363.	1.611
63.	1.821	366.	1.608
66.	1.81	369.	1.608
69.	1.795	372.	1.61
72.	1.782	375.	1.606
75.	1.784	378.	1.612
78.	1.773	381.	1.613
81.	1.768	384.	1.608
84.	1.755	387.	1.609
87.	1.749	390.	1.611
90.	1.743	393.	1.611

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
93.	1.735	396.	1.612
96.	1.734	399.	1.61
99.	1.724	402.	1.616
102.	1.717	405.	1.615
105.	1.706	408.	1.614
108.	1.696	411.	1.613
111.	1.692	414.	1.611
114.	1.685	417.	1.615
117.	1.682	420.	1.614
120.	1.669	423.	1.615
123.	1.666	426.	1.613
126.	1.66	429.	1.613
129.	1.654	432.	1.61
132.	1.64	435.	1.614
135.	1.635	438.	1.614
138.	1.632	441.	1.616
141.	1.624	444.	1.611
144.	1.618	447.	1.615
147.	1.617	450.	1.617
150.	1.613	453.	1.619
153.	1.609	456.	1.617
156.	1.608	459.	1.619
159.	1.595	462.	1.614
162.	1.597	465.	1.618
165.	1.597	468.	1.613
168.	1.588	471.	1.621
171.	1.591	474.	1.62
174.	1.591	477.	1.616
177.	1.589	480.	1.613
180.	1.596	483.	1.62
183.	1.594	486.	1.616
186.	1.599	489.	1.618
189.	1.59	492.	1.618
192.	1.596	495.	1.613
195.	1.601	498.	1.617
198.	1.597	501.	1.619
201.	1.598	504.	1.617
204.	1.602	507.	1.624
207.	1.601	510.	1.624
210.	1.597	513.	1.617
213.	1.604	516.	1.625
216.	1.604	519.	1.621
219.	1.601	522.	1.619
222.	1.603	525.	1.622
225.	1.604	528.	1.615
228.	1.599	531.	1.621
231.	1.604	534.	1.62
234.	1.603	537.	1.624
237.	1.598	540.	1.619
240.	1.603	543.	1.619
243.	1.604	546.	1.624
246.	1.603	549.	1.618
249.	1.604	552.	1.622
252.	1.602	555.	1.623
255.	1.603	558.	1.624
258.	1.604	561.	1.626
261.	1.599	564.	1.612
264.	1.601	567.	1.625
267.	1.603	570.	1.624
270.	1.603	573.	1.627
273.	1.602	576.	1.625
276.	1.606	579.	1.624
279.	1.607	582.	1.625
282.	1.604	585.	1.623
285.	1.598	588.	1.618
288.	1.607	591.	1.627

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
291.	1.609	594.	1.627
294.	1.607	597.	1.622
297.	1.603	600.	1.626
300.	1.598		

SOLUTION

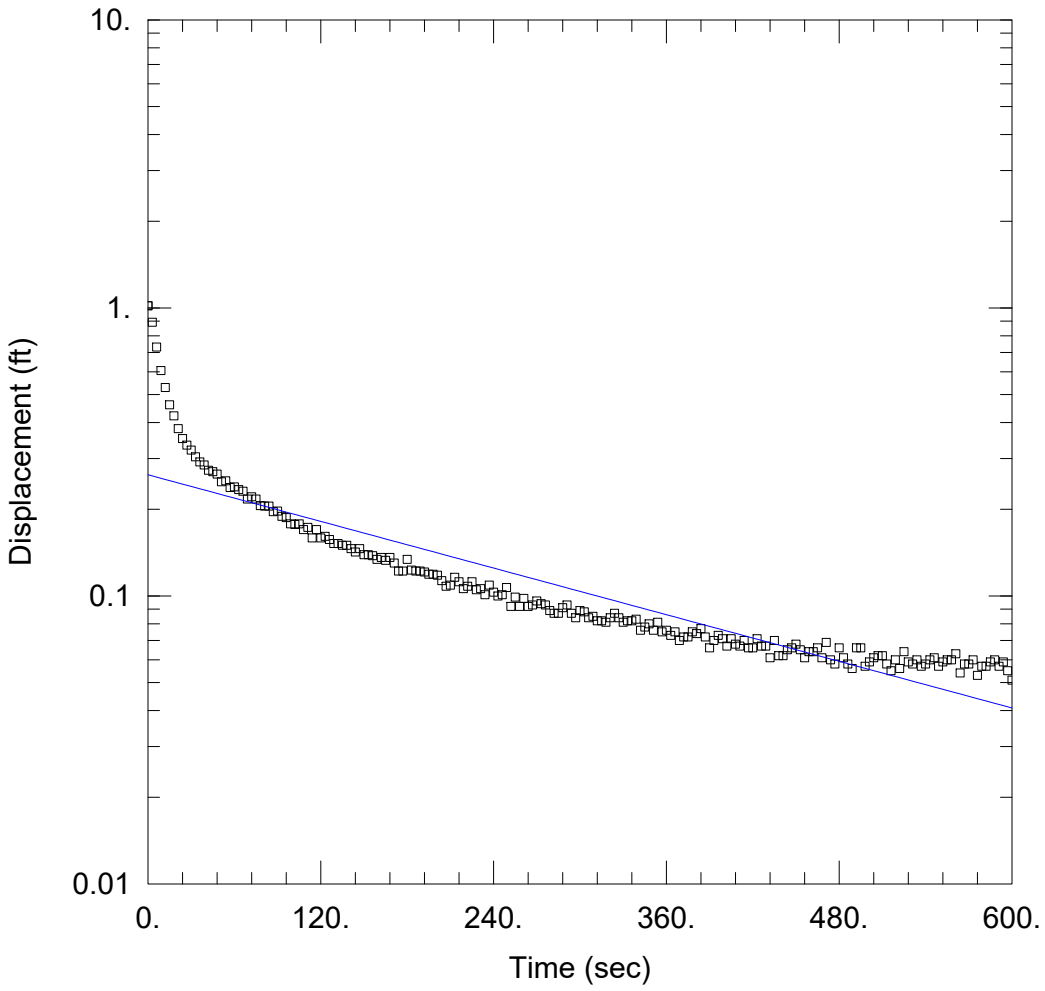
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.84

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	7.13E-7	ft/sec
y0	1.761	ft

K = 2.173E-5 cm/sec
T = K*b = 4.92E-7 ft²/sec (0.0004571 sq. cm/sec)



WELL TEST ANALYSIS

Data Set:
Date: 05/23/23 Time: 09:48:47

PROJECT INFORMATION

Company: LaBella
Client: Green Valley
Location: Tarrant
Test Well: PZ-2
Test Date: 5-19-2023

AQUIFER DATA

Saturated Thickness: 0.655 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-2)

Initial Displacement: 1.018 ft
Total Well Penetration Depth: 31.5 ft
Casing Radius: 0.167 ft
Static Water Column Height: 0.655 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 1.07E-5 ft/sec y0 = 0.2634 ft

Data Set:
Date: 05/23/23
Time: 09:49:43

PROJECT INFORMATION

Company: LaBella
Client: Green Valley
Location: Tarrant
Test Date: 5-19-2023
Test Well: PZ-2

AQUIFER DATA

Saturated Thickness: 0.655 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-2

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.018 ft
Static Water Column Height: 0.655 ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft
Well Skin Radius: 0.3125 ft
Screen Length: 10. ft
Total Well Penetration Depth: 31.5 ft

No. of Observations: 201

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	1.018	303.	0.088
3.	0.892	306.	0.084
6.	0.731	309.	0.085
9.	0.606	312.	0.082
12.	0.529	315.	0.082
15.	0.461	318.	0.081
18.	0.422	321.	0.084
21.	0.381	324.	0.087
24.	0.352	327.	0.084
27.	0.334	330.	0.081
30.	0.321	333.	0.082
33.	0.304	336.	0.082
36.	0.292	339.	0.083
39.	0.285	342.	0.076
42.	0.273	345.	0.078
45.	0.27	348.	0.08
48.	0.265	351.	0.076
51.	0.249	354.	0.081
54.	0.251	357.	0.075
57.	0.238	360.	0.076
60.	0.239	363.	0.073
63.	0.234	366.	0.075
66.	0.231	369.	0.07
69.	0.217	372.	0.072
72.	0.221	375.	0.072
75.	0.217	378.	0.075
78.	0.206	381.	0.074
81.	0.205	384.	0.077
84.	0.205	387.	0.072
87.	0.196	390.	0.066
90.	0.197	393.	0.07

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
93.	0.189	396.	0.073
96.	0.187	399.	0.071
99.	0.178	402.	0.067
102.	0.177	405.	0.071
105.	0.178	408.	0.068
108.	0.17	411.	0.067
111.	0.173	414.	0.07
114.	0.159	417.	0.066
117.	0.17	420.	0.066
120.	0.159	423.	0.071
123.	0.161	426.	0.067
126.	0.157	429.	0.067
129.	0.152	432.	0.061
132.	0.152	435.	0.07
135.	0.15	438.	0.062
138.	0.15	441.	0.062
141.	0.146	444.	0.065
144.	0.142	447.	0.066
147.	0.146	450.	0.068
150.	0.139	453.	0.065
153.	0.139	456.	0.061
156.	0.138	459.	0.064
159.	0.134	462.	0.064
162.	0.136	465.	0.066
165.	0.133	468.	0.061
168.	0.136	471.	0.069
171.	0.13	474.	0.06
174.	0.122	477.	0.058
177.	0.122	480.	0.066
180.	0.134	483.	0.061
183.	0.123	486.	0.058
186.	0.122	489.	0.056
189.	0.122	492.	0.066
192.	0.121	495.	0.066
195.	0.119	498.	0.057
198.	0.119	501.	0.059
201.	0.118	504.	0.061
204.	0.113	507.	0.062
207.	0.108	510.	0.062
210.	0.109	513.	0.058
213.	0.116	516.	0.055
216.	0.112	519.	0.06
219.	0.106	522.	0.056
222.	0.108	525.	0.064
225.	0.112	528.	0.059
228.	0.105	531.	0.058
231.	0.106	534.	0.06
234.	0.101	537.	0.057
237.	0.109	540.	0.058
240.	0.103	543.	0.06
243.	0.1	546.	0.061
246.	0.101	549.	0.057
249.	0.107	552.	0.059
252.	0.092	555.	0.06
255.	0.099	558.	0.06
258.	0.092	561.	0.063
261.	0.098	564.	0.054
264.	0.092	567.	0.058
267.	0.093	570.	0.058
270.	0.096	573.	0.06
273.	0.094	576.	0.053
276.	0.093	579.	0.057
279.	0.089	582.	0.057
282.	0.087	585.	0.059
285.	0.087	588.	0.06
288.	0.091	591.	0.057

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
291.	0.093	594.	0.059
294.	0.087	597.	0.055
297.	0.084	600.	0.051
300.	0.089		

SOLUTION

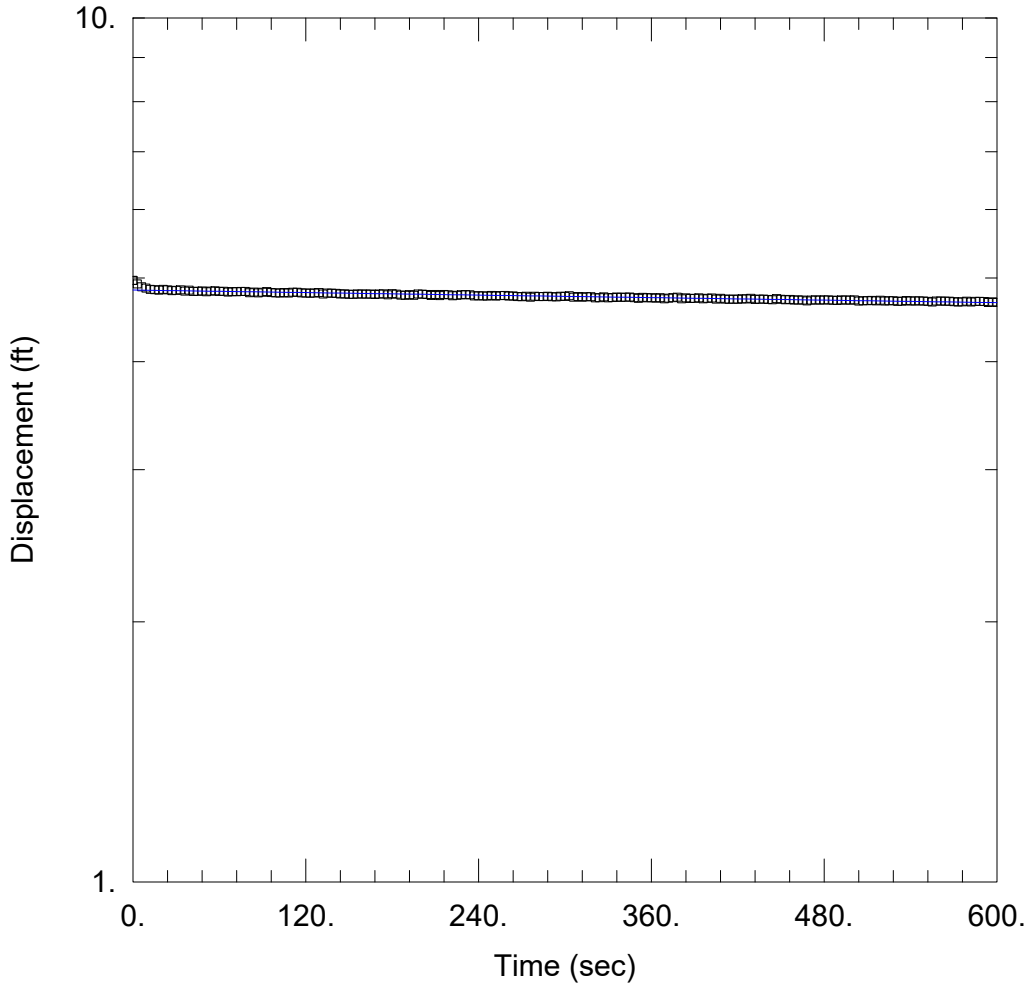
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.849

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.07E-5	ft/sec
y0	0.2634	ft

K = 0.0003261 cm/sec
T = K*b = 7.008E-6 ft²/sec (0.00651 sq. cm/sec)



WELL TEST ANALYSIS

Data Set:
Date: 05/23/23 Time: 10:23:14

PROJECT INFORMATION

Company: LaBella
Client: Green Valley
Location: Tarrant
Test Well: PZ-3
Test Date: 5-19-2023

AQUIFER DATA

Saturated Thickness: 20.35 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-3)

Initial Displacement: 4.968 ft
Total Well Penetration Depth: 25. ft
Casing Radius: 0.167 ft
Static Water Column Height: 20.35 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 1.856E-7 ft/sec
y0 = 4.842 ft

Data Set:
Date: 05/23/23
Time: 10:24:18

PROJECT INFORMATION

Company: LaBella
Client: Green Valley
Location: Tarrant
Test Date: 5-19-2023
Test Well: PZ-3

AQUIFER DATA

Saturated Thickness: 20.35 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-3

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 4.968 ft
Static Water Column Height: 20.35 ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft
Well Skin Radius: 0.3125 ft
Screen Length: 10. ft
Total Well Penetration Depth: 25. ft

No. of Observations: 201

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	4.968	303.	4.77
3.	4.921	306.	4.75
6.	4.885	309.	4.759
9.	4.868	312.	4.751
12.	4.851	315.	4.756
15.	4.847	318.	4.757
18.	4.84	321.	4.743
21.	4.851	324.	4.744
24.	4.844	327.	4.755
27.	4.834	330.	4.743
30.	4.839	333.	4.746
33.	4.844	336.	4.752
36.	4.828	339.	4.749
39.	4.841	342.	4.751
42.	4.825	345.	4.753
45.	4.826	348.	4.744
48.	4.831	351.	4.736
51.	4.82	354.	4.749
54.	4.829	357.	4.742
57.	4.832	360.	4.745
60.	4.825	363.	4.739
63.	4.826	366.	4.744
66.	4.816	369.	4.731
69.	4.822	372.	4.739
72.	4.82	375.	4.745
75.	4.824	378.	4.75
78.	4.824	381.	4.731
81.	4.807	384.	4.742
84.	4.815	387.	4.735
87.	4.806	390.	4.737
90.	4.814	393.	4.742

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
93.	4.822	396.	4.731
96.	4.809	399.	4.736
99.	4.805	402.	4.74
102.	4.804	405.	4.726
105.	4.809	408.	4.737
108.	4.804	411.	4.726
111.	4.814	414.	4.724
114.	4.814	417.	4.727
117.	4.806	420.	4.724
120.	4.803	423.	4.73
123.	4.802	426.	4.728
126.	4.804	429.	4.736
129.	4.809	432.	4.722
132.	4.792	435.	4.726
135.	4.803	438.	4.726
138.	4.801	441.	4.723
141.	4.799	444.	4.719
144.	4.792	447.	4.732
147.	4.794	450.	4.725
150.	4.788	453.	4.718
153.	4.788	456.	4.722
156.	4.792	459.	4.715
159.	4.791	462.	4.717
162.	4.789	465.	4.715
165.	4.791	468.	4.705
168.	4.785	471.	4.714
171.	4.791	474.	4.716
174.	4.793	477.	4.714
177.	4.782	480.	4.716
180.	4.795	483.	4.716
183.	4.79	486.	4.712
186.	4.777	489.	4.71
189.	4.775	492.	4.716
192.	4.783	495.	4.715
195.	4.776	498.	4.714
198.	4.792	501.	4.717
201.	4.789	504.	4.703
204.	4.785	507.	4.706
207.	4.774	510.	4.707
210.	4.786	513.	4.711
213.	4.771	516.	4.705
216.	4.785	519.	4.713
219.	4.781	522.	4.703
222.	4.77	525.	4.707
225.	4.775	528.	4.707
228.	4.781	531.	4.698
231.	4.784	534.	4.7
234.	4.782	537.	4.708
237.	4.766	540.	4.703
240.	4.769	543.	4.704
243.	4.766	546.	4.705
246.	4.764	549.	4.702
249.	4.773	552.	4.699
252.	4.765	555.	4.69
255.	4.771	558.	4.702
258.	4.773	561.	4.702
261.	4.765	564.	4.7
264.	4.766	567.	4.701
267.	4.759	570.	4.695
270.	4.756	573.	4.691
273.	4.762	576.	4.692
276.	4.751	579.	4.701
279.	4.762	582.	4.691
282.	4.758	585.	4.698
285.	4.758	588.	4.699
288.	4.763	591.	4.697

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
291.	4.757	594.	4.685
294.	4.755	597.	4.693
297.	4.763	600.	4.685
300.	4.76		

SOLUTION

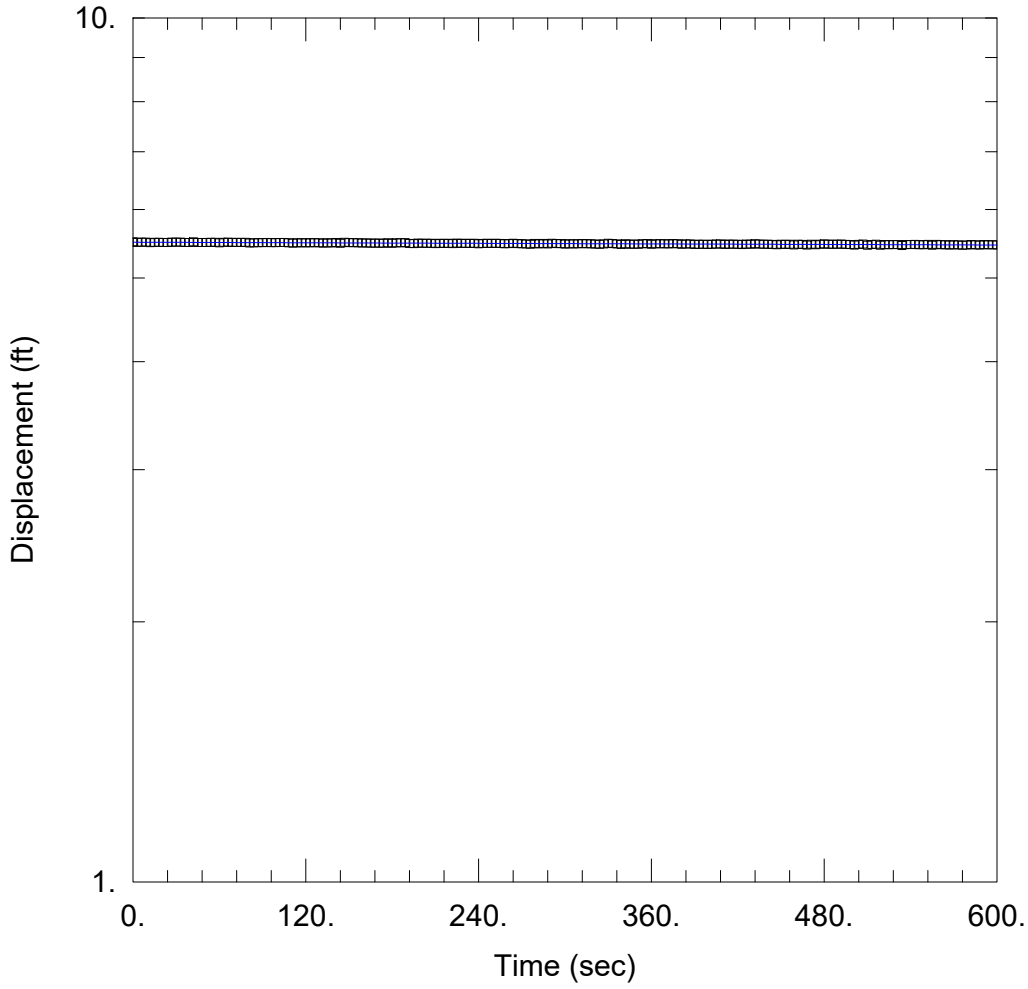
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.711

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.856E-7	ft/sec
y0	4.842	ft

K = 5.659E-6 cm/sec
T = K*b = 3.779E-6 ft²/sec (0.00351 sq. cm/sec)



WELL TEST ANALYSIS

Data Set:
Date: 05/23/23 Time: 10:35:34

PROJECT INFORMATION

Company: LaBella
Client: Green Valley
Location: Tarrant
Test Well: PZ-4
Test Date: 5-19-2023

AQUIFER DATA

Saturated Thickness: 9.844 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-4)

Initial Displacement: 5.504 ft Static Water Column Height: 9.844 ft
Total Well Penetration Depth: 30. ft Screen Length: 10. ft
Casing Radius: 0.167 ft Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice
K = 4.235E-8 ft/sec y0 = 5.5 ft

Data Set:
Date: 05/23/23
Time: 10:36:04

PROJECT INFORMATION

Company: LaBella
Client: Green Valley
Location: Tarrant
Test Date: 5-19-2023
Test Well: PZ-4

AQUIFER DATA

Saturated Thickness: 9.844 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-4

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 5.504 ft
Static Water Column Height: 9.844 ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft
Well Skin Radius: 0.3125 ft
Screen Length: 10. ft
Total Well Penetration Depth: 30. ft

No. of Observations: 201

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	5.504	303.	5.477
3.	5.499	306.	5.475
6.	5.501	309.	5.477
9.	5.501	312.	5.48
12.	5.494	315.	5.477
15.	5.5	318.	5.477
18.	5.499	321.	5.474
21.	5.497	324.	5.472
24.	5.497	327.	5.475
27.	5.502	330.	5.485
30.	5.502	333.	5.48
33.	5.502	336.	5.476
36.	5.497	339.	5.468
39.	5.497	342.	5.477
42.	5.505	345.	5.472
45.	5.496	348.	5.473
48.	5.497	351.	5.47
51.	5.497	354.	5.478
54.	5.499	357.	5.48
57.	5.5	360.	5.47
60.	5.493	363.	5.477
63.	5.5	366.	5.477
66.	5.501	369.	5.478
69.	5.496	372.	5.476
72.	5.498	375.	5.481
75.	5.497	378.	5.477
78.	5.499	381.	5.472
81.	5.49	384.	5.475
84.	5.493	387.	5.476
87.	5.495	390.	5.469
90.	5.495	393.	5.472

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
93.	5.496	396.	5.47
96.	5.495	399.	5.468
99.	5.495	402.	5.47
102.	5.497	405.	5.474
105.	5.497	408.	5.475
108.	5.491	411.	5.469
111.	5.487	414.	5.473
114.	5.492	417.	5.47
117.	5.492	420.	5.471
120.	5.491	423.	5.467
123.	5.492	426.	5.473
126.	5.495	429.	5.47
129.	5.493	432.	5.477
132.	5.488	435.	5.474
135.	5.492	438.	5.471
138.	5.489	441.	5.47
141.	5.496	444.	5.469
144.	5.486	447.	5.465
147.	5.498	450.	5.471
150.	5.495	453.	5.469
153.	5.495	456.	5.472
156.	5.491	459.	5.461
159.	5.49	462.	5.472
162.	5.489	465.	5.468
165.	5.488	468.	5.459
168.	5.488	471.	5.472
171.	5.487	474.	5.464
174.	5.486	477.	5.472
177.	5.491	480.	5.476
180.	5.485	483.	5.471
183.	5.491	486.	5.471
186.	5.493	489.	5.472
189.	5.495	492.	5.474
192.	5.483	495.	5.468
195.	5.481	498.	5.466
198.	5.487	501.	5.46
201.	5.484	504.	5.469
204.	5.485	507.	5.473
207.	5.485	510.	5.458
210.	5.48	513.	5.466
213.	5.485	516.	5.471
216.	5.482	519.	5.458
219.	5.484	522.	5.466
222.	5.481	525.	5.463
225.	5.488	528.	5.466
228.	5.482	531.	5.466
231.	5.484	534.	5.453
234.	5.483	537.	5.466
237.	5.484	540.	5.467
240.	5.478	543.	5.468
243.	5.483	546.	5.465
246.	5.484	549.	5.464
249.	5.482	552.	5.468
252.	5.486	555.	5.458
255.	5.482	558.	5.468
258.	5.478	561.	5.463
261.	5.481	564.	5.464
264.	5.484	567.	5.46
267.	5.48	570.	5.465
270.	5.479	573.	5.461
273.	5.475	576.	5.456
276.	5.472	579.	5.46
279.	5.482	582.	5.466
282.	5.476	585.	5.461
285.	5.483	588.	5.459
288.	5.476	591.	5.466

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
291.	5.485	594.	5.462
294.	5.481	597.	5.463
297.	5.48	600.	5.46
300.	5.474		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.82

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.235E-8	ft/sec
y0	5.5	ft

K = 1.291E-6 cm/sec
T = K*b = 4.169E-7 ft²/sec (0.0003873 sq. cm/sec)

LaBella
Powered by partnership.

October 21, 2024

Alabama Department of Environmental Management
Post Office Box 301463
Montgomery, Alabama 36130-1463

VIA ELECTRONIC MAIL
hunter.baker@adem.alabama.gov

Attention: Mr. Hunter Baker
Solid Waste Branch
Land Division

Received
OCT 22 2024
Land Division

RE: Permit Modification
Green Valley Services Landfill
Permit No.: 37-35
Tarrant, Alabama

Dear Mr. Baker:

On behalf of Green Valley Services, LLC (Green Valley), LaBella Associates, D.P.C. (LaBella) is submitting the enclosed information in support of the previously submitted Permit Modification for the Green Valley Landfill Solid Waste Disposal Permit 37-35.

LaBella has prepared a final grade contour using 3:1 slopes that includes the proposed new cell and the previously permitted disposal areas. The proposed expansion will require the relocation of several of the facility's landfill gas monitoring points. As such we have also included a revised gas monitoring plan to be incorporated as part of the requested permit modification.

LaBella Associates, D.P.C. and Green Valley appreciate your consideration in this matter. If you have questions regarding this submittal or require any additional information, please contact me at (205) 985-4874 or wcooch@labellapc.com.

Sincerely,
LaBella Associates

William W. Cooch, P.G.
Principal Geologist

Enclosures Overall Final Grading Plan
Explosive Gas Monitoring & Reporting Plan

cc: Clinton Harris – Green Valley Services, LLC

EXPLOSIVE GAS MONITORING & REPORTING PLAN

GREEN VALLEY SERVICES, LLC LANDFILL
3360 EDDINGS PLACE
BIRMINGHAM, ALABAMA 35217
PERMIT NO.: 37-35
PROJECT NO.: 2233518P02

PREPARED FOR:

GREEN VALLEY SERVICES, LLC
P.O. BOX 170034
BIRMINGHAM, ALABAMA 35217

OCTOBER 14, 2024

PREPARED BY:

LABELLA ASSOCIATES, D.P.C.
528 MINERAL TRACE
BIRMINGHAM, ALABAMA 35244
PHONE: (205) 985-4874 *FAX: (205) 987-6080*

Phillip D. Davis, P.E.
Senior Engineer

David Wall, REM
Technical Scientist

OWNER 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 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.

Clinton Harris
Green Valley Services, LLC

Date

528 Mineral Trace | Hoover, AL 35244 | p (205) 985-4874 | f (205) 987-6080
www.labellapc.com

PROFESSIONAL ENGINEER CERTIFICATION

I certify under penalty of law that I am a Registered Professional Engineer, licensed to practice in the State of Alabama, and that this document and all attachments were prepared under my direct 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.

October 14, 2024

Phillip D. Davis, P.E. #19547
Senior Engineer
LaBella Associates, D.P.C.

Date

TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

This Explosive Gas Monitoring and Reporting Plan (EGMRP or "the Plan") was prepared for the Green Valley Services, LLC Landfill (herein referred to as "the Landfill") located in the Southeast ¼ of Northeast ¼ of Section 33, Township 16 South, Range 2 West in Jefferson County, Alabama and operates under the Alabama Department of Environmental Management (ADEM) Solid Waste Disposal Facility Permit Number 37-35 (Permit). The purpose of this EGMRP is to detail how the Landfill will control and monitor for explosive gases, especially methane, in accordance with Division 13 of the ADEM Administrative Code. The information obtained during monitoring events will be used to evaluate the explosive gas migration/accumulation (if any) at the Landfill. In accordance with the ADEM Land Division – Solid Waste Division Administrative Code, Section 335-13-4-.16, the Landfill will:

1. *Control:*
    a. *Explosive gases shall not exceed the lower explosive limit (LEL) at the facility boundary.*
    b. *Explosive gases shall not exceed 25 percent of the LEL in the facility structures except for gas control or recovery system components.*
    c. *Facility structures shall be designed and constructed so as not to allow explosive gases to collect in, under or around structures in concentrations exceeding the requirements of this rule.*

Per ADEM requirements, explosive gas monitoring points shall be located every 300 feet along the Landfill permit boundary. In areas where a dwelling is within 1,000 feet of the Landfill boundary, the monitoring points shall be 100 feet apart, or as otherwise directed by the ADEM.

Described herein includes the monitoring methods and procedures for gas sample collection which are based on ADEM guidance and U.S. Environmental Protection Agency (EPA) Region 4 Standard Operating Procedures (SOPs). Any modifications to this Plan will be approved by ADEM and applicable changes appropriately documented and placed in the Landfill's Operating Record.

2.0 LANDFILL GAS MONITORING PROGRAM

The Landfill currently monitors explosive gases at the facility. These gas monitoring procedures will comply with the control and monitoring requirements of ADEM Administrative Code r. 335-13-4-.16 and the Solid Waste Permit Number 12-02.

The Landfill will conduct gas monitoring annually as is required for Construction and Demolition (C & D) landfills. Explosive gas monitoring wells, site structures, and any other location conducive to gas accumulation will be monitored with a portable gas meter. Readings will be recorded in "percent LEL" (lower explosive limit) for methane and "percent methane by volume". The annual explosive gas monitoring report will include a site plan map showing the explosive gas monitoring locations, and the results from each well/bar-hole/structure monitored (example field form for the documentation of gas readings is provided in Appendix A). Explosive gas monitoring reports will be submitted to the ADEM within 30 days of the explosive gas monitoring event and the gas monitoring data will be included in the Landfill's Operating Record and be made available to ADEM upon request.

2.1 CONCENTRATION LIMITS

The Landfill will operate to maintain:

- Methane gas concentrations shall not exceed 25 percent of the LEL (i.e., 1.25% methane by volume) in any Landfill structure.
- Methane gas concentrations shall not exceed the 100 percent of the LEL (i.e., 5% methane by volume) at the Landfill property boundary.

2.2 EXPLOSIVE GAS MONITORING

As stated above, the Landfill will test for explosive gas (methane) on an annual basis. The explosive gas monitoring locations are presented on Figure 1.

As shown on Figure 1, monitoring locations designated as G-1 through G-18 (bar-hole punch locations) will be used to monitor the Landfill on an annual basis.

Representative gas measurements will be collected with a portable gas meter that calculates methane concentrations as percent LEL. The portable gas meter is typically equipped with a flexible extension hose and rigid plastic probe. At a minimum, the portable gas meter should be calibrated on a quarterly basis or in accordance with the manufacturer's specifications. The

amount of monitoring and the handling of the portable gas meter will influence whether the calibration frequency should be increased.

In the event that a gas monitoring location (permanent gas monitoring well or bar-hole punch location) indicates a concentration of explosive gas greater than 5 percent methane by volume, step-out bar-holes will be advanced at approximately 5 to 10 foot intervals (within the property boundary), radiating outward from the original gas monitoring location until readings of zero are obtained. Once limits of migration are defined by the bar-hole sampling effort, Landfill management will be notified and corrective action activities will be implemented (Notification requirements and corrective action activities are discussed in Section 3.0 of this Plan).

2.2.1 Bar-Hole Sampling

Bar-hole sampling will be performed at locations without a permanent gas monitoring well using a plunger bar advanced to a minimum depth of four (4) feet below ground surface (in accordance with ADEM regulations). After the plunger bar is removed, the portable gas meter tubing will be inserted into the hole immediately and will remain for approximately 10 seconds to obtain a reading for the percent LEL.

2.2.2 Site Structure Sampling

Explosive gas accumulation will be monitored in site buildings with continuous gas monitors, permanent gas wells located within 100 feet of each building, or with a portable gas meter. Areas to be monitored in accessible spaces of a structure would be corners, along baseboards, attics, drainage structures (drains, toilets, sumps) or other accessible areas where explosive gas could enter unnoticed. (Confined spaces where gas accumulation may occur should not be entered without proper Occupational Safety and Health Administration [OSHA] required training and preparation).

In the event explosive gas is detected in a site structure above the regulatory limit of 25 percent of the LEL, the Landfill will take immediate steps to protect human health, such as evacuating the structure and notifying ADEM immediately upon identifying an exceedance. Section 3.0 discusses the applicable corrective action requirements of the ADEM Solid Waste Program regulations.

3.0 CORRECTIVE ACTION

In the event that explosive gas levels exceed the limits specified in this Plan, pursuant to the applicable requirements of the ADEM Solid Waste Program regulations, the Landfill will:

1. Immediately take all necessary steps to ensure protection of human health and the property. This action may include restricting access to employees/customers in the identified area or structure(s) until abatement actions have been completed and subsequent monitoring indicates that the identified area or structure(s) are safe to return; and by eliminating potential ignition sources;

2. Immediately notify the ADEM of the explosive gas concentrations detected and the steps taken to protect human health and the property;

3. Within 7 days of detection, place in the Landfill Operating Record the explosive gas concentrations detected and the immediate steps taken to protect human health and property;

4. Submit an Explosive Gas Remedial Plan for approval by the ADEM within 20 days of the detection of the exceedance(s). The Explosive Gas Remedial Plan should include a description of the nature and extent of the explosive gases, and the proposed remedy. The remedy is not limited to, but may include, the installation of interception trench and vent systems, installation of membrane barriers, re-location of equipment or structures, venting areas of gas accumulation, installation of recovery and controlled combustion systems, etc.

5. Implement the ADEM approved Explosive Gas Remedial Plan within 60 days of the detection. Within 60 days of the detection, place the Explosive Gas Remedial Plan and a Notification to the ADEM that the Explosive Gas Remedial Plan has been implemented in the Landfill's Operating Record.

4.0 POTENTIAL SAFETY HAZARDS

When monitoring on landfill sites, the monitoring technicians should be alert to the hazards caused by the presence of potentially explosive landfill gas. Hazards that might occur could be one or more of the following:

- Fires that may start from exposed or decomposing solid waste.
- Fires and explosions that may occur from the presence of landfill/methane gas.
- Landfill gas that may cause an oxygen deficiency in underground trenches, vaults, conduits, and structures; confined space entry procedures should be followed where applicable.
- Hydrogen sulfide (H_2S) that may be present. H_2S is a colorless, very flammable gas that in low concentrations has an offensive odor similar to that of rotten eggs. H_2S is highly toxic. Although the odor of H_2S is recognizable (unless masked) at 1/400 of the lowest possible amount that can cause injurious effects, sense of smell is lost within 2 to 15 minutes of exposure. At higher concentrations,it will deaden the sense of smell instantly and cause death within seconds by terminating the function of the nerve and motor center in the brain.

4.1 Safety Precautions

The following minimum safety precautions should be adhered to by personnel monitoring for combustible gas:

- When feasible, at least two people should be present at all times when monitoring for potentially explosive gas concentrations (buddy system).
- Hard hats and glasses must be worn in designated areas.
- Smoking is prohibited during monitoring.
- A fire extinguisher must be readily available, especially when monitoring gas concentrations within structures or confined spaces.
- The site-specific Landfill safety program should be followed.
- Bar-hole probing will not be conducted near buildings unless:
    - Sub-grade utility lines are located and clearly marked before the monitoring event.
    - A person with knowledge of all sub-grade utility lines is consulted prior to the monitoring event.
    - Monitoring personnel have an accurate site utility plan/map.

- Methane is an odorless, tasteless gas, and it is undetectable by the human senses. Therefore, sampling personnel must be continually aware of and avoid all potential sources of ignition. When technicians are monitoring in confined areas, a portable gas meter should be used to monitor the gas conditions continually within the working area. This gas monitoring device should continually monitor for methane, oxygen, and hydrogen sulfide and provide both a visual and audible alarm if gas concentrations exceed or drop below a specified level.

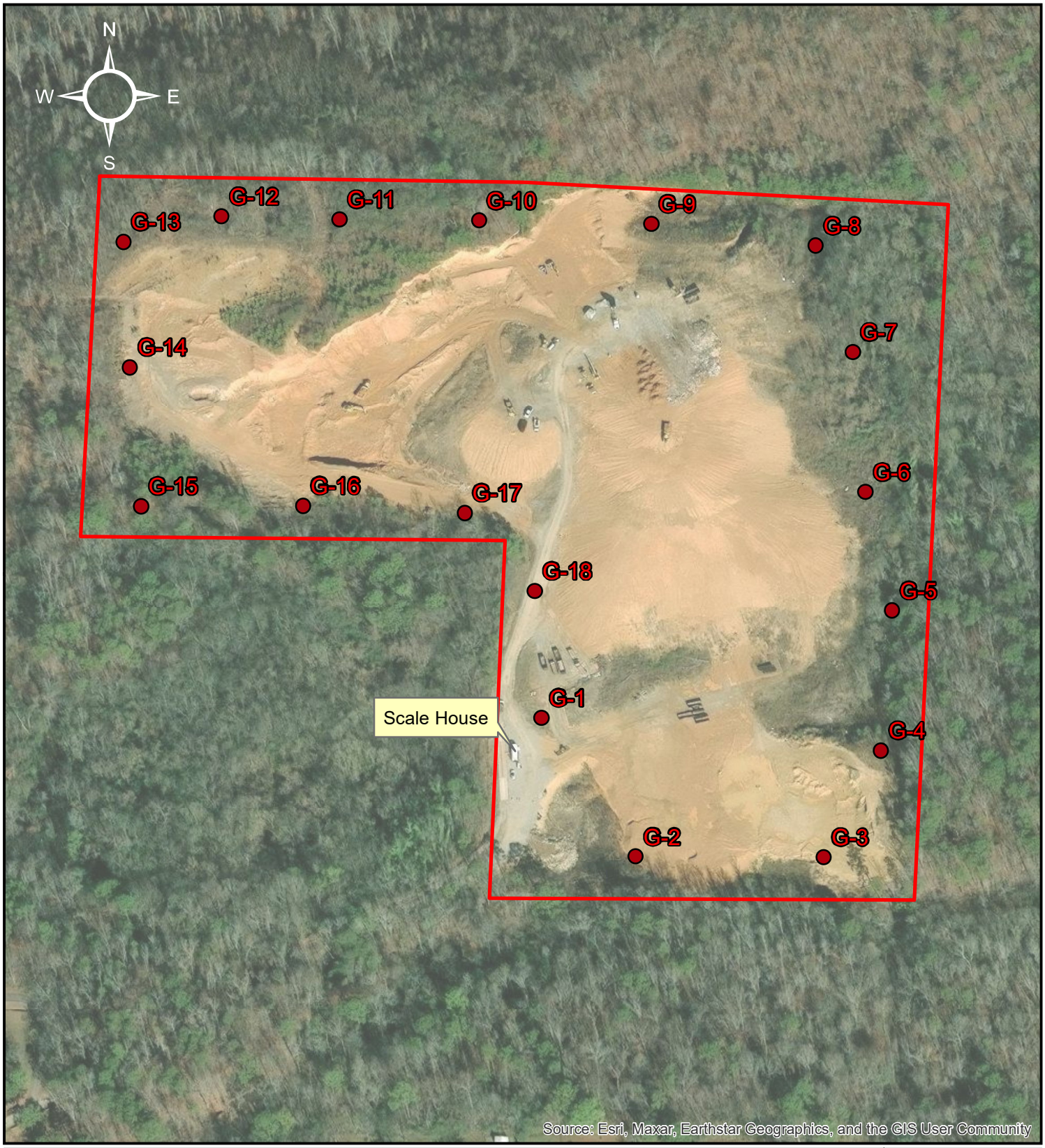
5.0 REFERENCES

Alabama Department of Environmental Management Administrative Code, Section 335-13-4-.16.

Green Valley Services, LLC Landfill, Green Valley Services, LLC, Alabama Department of Environmental Management, Solid Waste Permit Number 37-35.

United States Environmental Protection Agency, Solid Waste and Emergency Response, Solid Waste Disposal Facility Criteria, Technical Manual, EPA530-R-93-017, November 1993.

FIGURES



Legend

- Gas Monitoring Location
- Approximate Property Boundary

LaBella
Powered by partnership.

528 MINERAL TRACE
HOOVER, AL 35244
(205) 985-4874

TITLE: Gas Monitoring Locations

Green Valley Services, LLC. Landifll
3360 Eddings Place
Tarrant, Alabama

SCALE: 0 125 250
1 inch = 250 feet

FIGURE NO. 1

PROJECT NO. 2233518P02

DRAWN BY DW

DATE DRAWN 10-14-2024

APPENDIX A

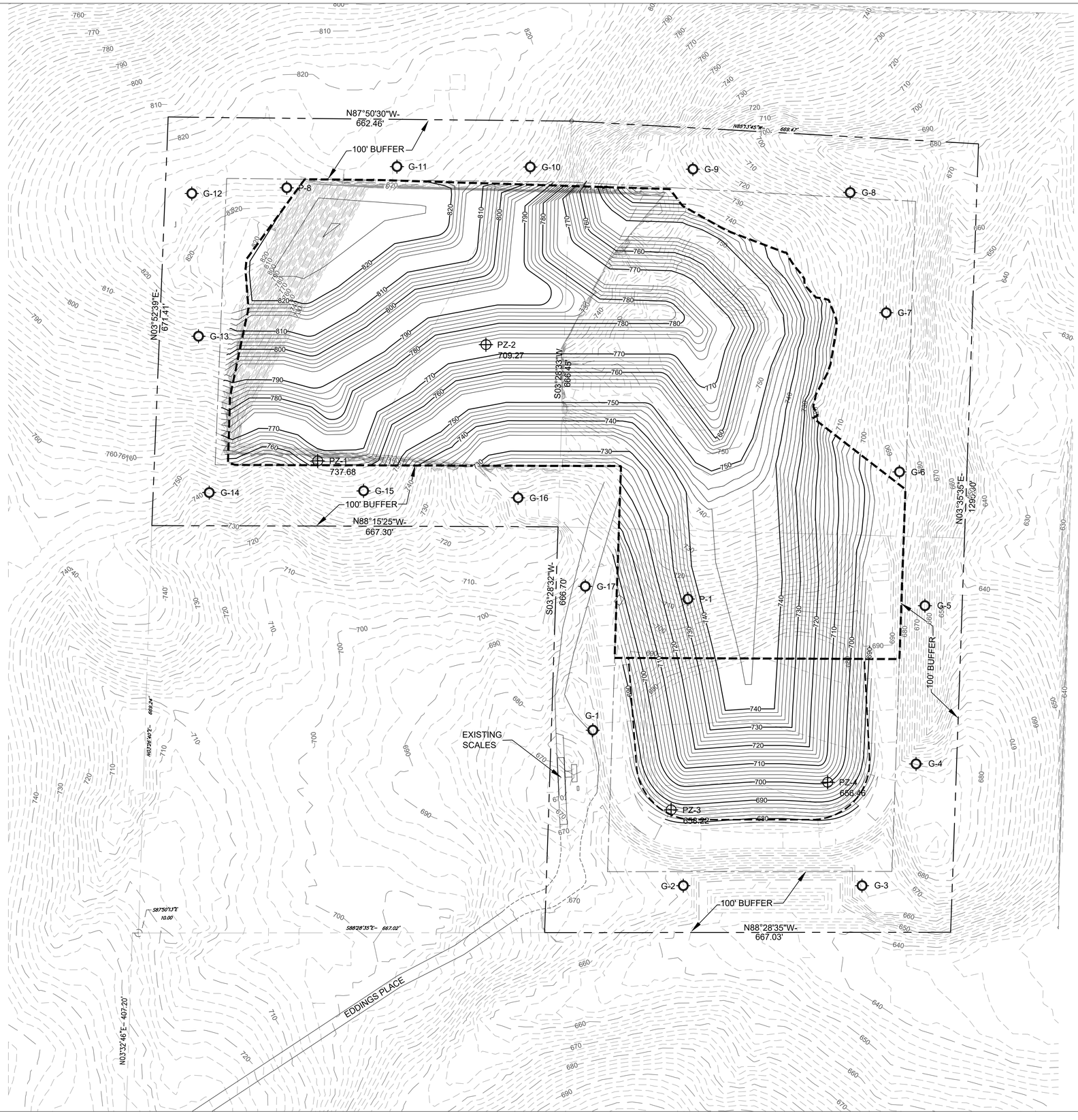
Table 1 - Annual Explosive Gas Monitoring Results

Green Valley Services, LLC Landfill
Birmingham, Alabama

Date: _____

Sampler: _____

Monitoring Point	Sample ID	Sample Type	% Lower Explosive Level	% Gas
1	G-1	Bar-Hole		
2	G-2	Bar-Hole		
3	G-3	Bar-Hole		
4	G-4	Bar-Hole		
5	G-5	Bar-Hole		
6	G-6	Bar-Hole		
7	G-7	Bar-Hole		
8	G-8	Bar-Hole		
9	G-9	Bar-Hole		
10	G-10	Bar-Hole		
11	G-11	Bar-Hole		
12	G-12	Bar-Hole		
13	G-13	Bar-Hole		
14	G-14	Bar-Hole		
15	G-15	Bar-Hole		
16	G-16	Bar-Hole		
17	G-17	Bar-Hole		
18	G-18	Bar-Hole		
20	Scale House	NA		



GRAPHIC SCALE

0 50 100 200

(FEET)

LaBella
Powered by partnership.

528 MINERAL TRACE
HOOVER, AL 35244
(205) 985-4874

labellapc.com

GREEN VALLEY SERVICES, LLC

3417 DAVEY ALLISON BLVD.
HUEYTOWN, ALABAMA 35023

GREEN VALLEY SERVICES, LLC
LANDFILL

3360 EDDINGS PLACE
BIRMINGHAM, ALABAMA 35217

NO:	DATE:	DESCRIPTION:
Revisions		

PROJECT NUMBER: 2233518

DRAWN BY: IWW

REVIEWED BY: DWT

ISSUED FOR: PERMITTING

DATE: 07/15/2024

DRAWING NAME:

OVERALL FINAL GRADING PLAN

DRAWING NUMBER:

11

L:\Alabama\Green Valley\dwg\2024\11 - Overall Final Grading Plan.dwg Layout=Layout1

March 19, 2025

Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2059

VIA ELECTRONIC MAIL
hunter.baker@adem.alabama.gov

Attention: Mr. Hunter Baker
Solid Waste Branch
Land Division

RE: Response to Comments
Green Valley Services, LLC Landfill
ADEM Permit No.: 37-35
Tarrant, Alabama
LaBella Project No.: 2230184

Dear Mr. Baker:

On behalf of Green Valley Services, LLC, LaBella Associates, D.P.C. (LaBella) submits this response to the Alabama Department of Environmental Management (ADEM) comment letter dated February 25, 2025, resulting from the Department's review of the Solid Waste Disposal Facility Permit Modification Application submitted on July 23, 2024, for the above-referenced facility. The ADEM comments are provided below followed by the LaBella response.

1. A boundary plat and legal description of the proposed disposal area prepared, signed, and sealed by a land surveyor should be submitted in accordance with ADEM Admin. Code 335-l 3-4-.12(2)(c).

   Response: Enclosed is a boundary plat including the legal description of both the property and the boundary of the proposed new disposal cell.

2. The Hydrogeologic Evaluation states that the minimum base grade elevation for the proposed expansion area is 664 ft-amsl, while design drawings sheet 02 and associated cross sections show a minimum base grade elevation of 672 ft-amsl. Please clarify which base grade elevation is being proposed for the expansion area. Also, a demonstration should be provided that the bottom elevation of the proposed cell will be a minimum of 5 feet above the highest measured groundwater elevation in accordance with ADEM Admin. Code 335-1 3-4-.11 (2)(a).

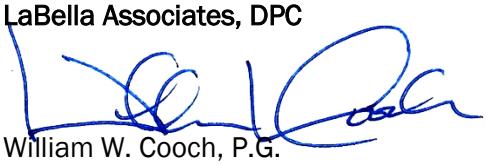
   Response: Based on the findings of the above-referenced Hydrogeologic Evaluation, it was recommended that the cell base elevation be no lower than 664 ft-amsl. In an effort to achieve optimal grade and surface water flow, the cell grade of 672 ft-amsl was determined by engineering by design to be the cell base grade. This cell base elevation provides in excess of 10 feet of separation from the seasonal high water table.

3. The submitted ADEM Form 439 lists the Facility Name as Green Valley Landfill. If the permittee intends to change the Facility Name, an ADEM Form 568 and appropriate documentation and fees should be submitted. Otherwise, the ADEM Form 439 should be revised to show the currently permitted Facility Name.

   Response: The enclosed copy of Form 439 includes the corrected facility name, Green Valley Services LLC Landfill.

LaBella and Green Valley Services, LLC, trust that our responses adequately address the Department's comments regarding the Solid Waste Disposal Facility Permit Modification Application currently under review. If you have any questions concerning this submittal or require any additional information, please contact at (205) 516-8735 or wcooch@labellapc.com.

Respectfully submitted,
LaBella Associates, DPC



William W. Cooch, P.G.
Principal Geologist

enclosures

cc: Clinton Harris – Green Valley Services, LLC

Legal Description of Property Boundary

JEFFERSON COUNTY, ALABAMA

SE ¼ of the SE ¼ of the NE ¼, Section 33, Township 16 South, Range 2 West, Jefferson County, Alabama.

ALSO:

The NE ¼ / / / Jefferson County, Alabama.

ALSO:

The NW ¼ / / / Jefferson County, Alabama.

Legal Description of Proposed New Disposal Area

JEFFERSON COUNTY, ALABAMA

A part of the SE ¼ of the NE ¼ of Section 33, Township 18 South, Range 2 West, Jefferson County, Alabama and described as follows: Commence at the SE Corner of the SE ¼ of the NE ¼ of Section 33, Township 18 South, Range 2 West, Jefferson County, Alabama; thence S 89°52'25" W a distance of 96.33 feet; thence N 00°03'06" W a distance of 100.00 feet to the Point of Beginning; thence S 89°56'54" W for a distance of 467.25 ft; thence N 01°54'01" E for a distance of 666.44 ft; thence N 75°44'02" E for a distance of 324.32 ft; thence S 52°08'24" E for a distance of 193.68 ft; thence S 02°01'04" W for a distance of 627.09 ft to the the point of beginning;

Said Cell having an area of 327,235.6 square feet, or 7.512 acres more or less.

PROJECT NOTES:

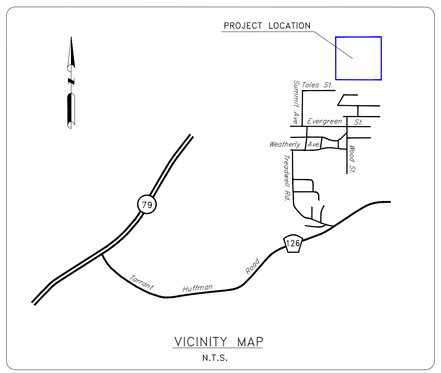
1. Field Work was Updated Completed in Jan. 2023.

2. Right of way shown is taken from Recorded Plats for the subject property and monuments located in the field.

3. No title commitment was provided to the surveyor at the time of this survey.

4. Underground utilities are based on the best available records and information provided by the utility providers and evidence of utilities as located in the field. The contractor and owner is advised that a full utility location should be requested from each utility or from Alabama One-Call prior to any excavation.

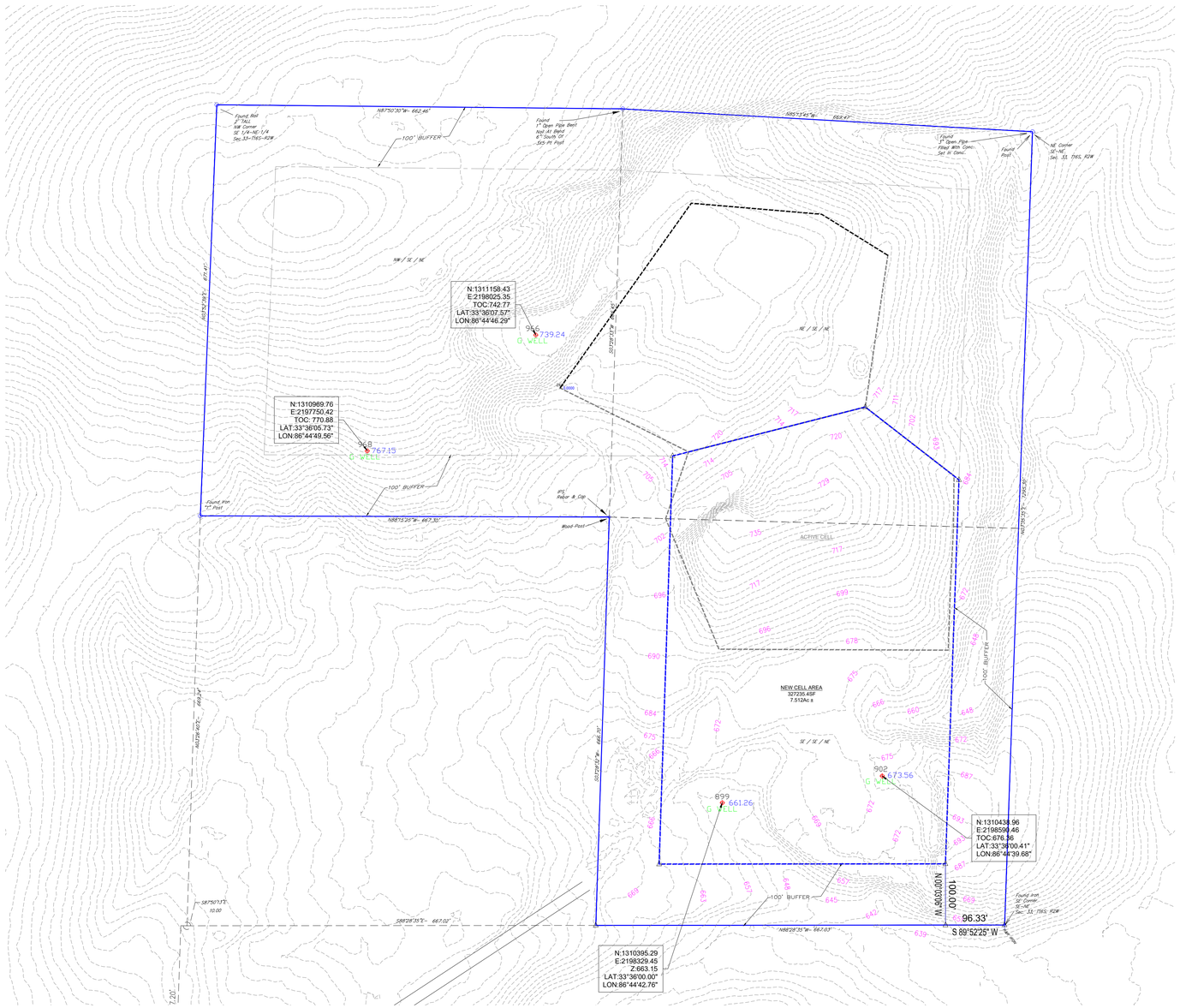
5. Location of underground storm drains could not be determined. Inlets were located in the field and shown as per the date of this survey. All storm pipes, sizes, locations and junctions should be field verified prior to excavation in these areas.



North

100 0 100 200 300 400 FEET

SCALE: 1"=100'



TOTAL EXISTING FACILITY AREA: 30.371 ACRES±
PROPOSED CELL AREA: 7.512 ACRES±

For the aboved described property, I, Karl Hager, hereby state that all parts of this survey and drawing have been completed in accordance with the current standards for the practice of Land Surveying in the State of Alabama to the best of my knowledge, information and belief.

ALABAMA REGISTERED LAND SURVEYOR KARL L. HAGER

HCI
HAGER COMPANY, INC.
1623 2ND AVE. NORTH
BESSEMER, AL 35020
PHONE: 205.229.1738
FAX: 205.425.6310

811 Know what's **below.** **Call** before you dig.

A PROJECT FOR:

City of Chelsea

PREPARED FOR Green Valley Services Tarrant, Alabama

01/27/23

DATE	NUMBER	DESCRIPTION

DETAILS

PROJECT:
Tarrant landfill (CD)

LOCATION:
Tarrant, Alabama

HagerCo-LLC
keithlhager@icloud.com
Keith L. Hager, PE
1025 MONTGOMERY HIGHWAY, S 110
Birmingham, AL 35216
Direct: 205.229.1738

Green Valley Services

SHEET NUMBER

C1.0