WASTE MANAGEMENT

CWM CHEMICAL SERVICES, LLC
1550 Balmer Road
Model City, NY 14107
(716) 286-1550
(716) 286-0211 Fax

August 15, 2012

Mr. David Denk
Division of Environmental Permits
New York State Department of
Environmental Conservation
270 Michigan Avenue
Buffalo, New York 14203

Re: Part 373 Permit Modification Request
RMU-1 Permanent Access Road

Dear Mr. Denk:

Attached please find a permit modification request for the CWM Chemical Services, LLC (CWM), Model City Facility, Sitewide Part 373 Permit No. 9-2934-00022/00097. This permit modification request revises the design for the Residuals Management Unit No. 1 (RMU-1) landfill final cover system to include the construction of a permanent access road on the north side of the landfill. CWM requests that this permit modification be considered a minor modification in accordance with 6NYCRR 373-1.7(c)(1)(i) and 6NYCRR Part 621.

During later stages of waste filling, the increasing elevations of the waste mass will prevent the use of traditional haul roads, which typically have encroached into the permitted waste envelop. Thus, a new landfill plateau access road (planned for construction in late 2012) will be constructed on top of existing final cover areas so that the landfill final buildout may proceed without further restrictions imposed by vehicle access needs. A new single-lane width gravel road will be constructed from the perimeter berm diagonally up the northern face of the landfill and onto the plateau. Other than topsoil removal within the road footprint, no other modifications should be needed to the existing final cover to accommodate the road. The majority of the road will be constructed of general fill and will be surfaced with an 18-inch thick layer of crusher run, which will be underlain with a woven geotextile. A guiderail will be included along the outside edge. Once constructed, the landfill plateau access road will remain in place as a permanent feature. The accompanying drawings illustrate the planned access into RMU-1.

Design details included in the attached documents have been prepared by Arcadis with slope stability calculations prepared by P. J. Carey and Associates, Inc. This permit modification request includes proposed modifications to several sections of the CWM Sitewide Part 373 Permit No. 9-2934-00022/00097. In addition to the requested permit modification, additional revisions are needed to two documents which are not included in the Sitewide Part 373 Permit, but are listed as reference documents, i.e., the RMU-1 Engineering Report and RMU-1 Operations and Maintenance (O&M) Manual. Instructions for incorporating the revised pages into the applicable documents are provided in the attached. Proposed revisions to the following documents are attached:

Modifications to Part 373 Permit No. 9-2934-00022/00097

Attachment J, Appendix D-6 (RMU-1 Landfill Drawings)

Drawing Nos. 1a and 12-a have been revised and new Drawing No. 23a has been prepared which includes permanent access road details.

Reference Documents

RMU-1 Engineering Report Revisions

Select pages of text have been revised including the cover page, drawing list, and page 3-14.

Appendix D-11 Landfill Plateau Access Road Stability): New appendix prepared by PJC to document the stability analyses performed for the proposed access road.

Appendix I (Surface Water Drainage and Erosion Calculations): Miscellaneous revisions to reflect changes to drainage areas due to proposed access road. A new calculation sheet has also been prepared to support the design of drainage features associated with the proposed road.

RMU-1 O&M Manual Revisions

The Cover Page, Table of Contents, Pages 18, 19, 20C and 35 have been revised (revised Pages 20C through 20F and new Pages 19A and 20G have also been included due to pagination) and the addition of new Fill Progression Figure 1a and are intended to replace existing pages or be included in the current O&M Manual.

Attachment #5 (Landfill Plateau Access Road Design Calculations): New attachment to demonstrate that the proposed road section can accommodate the anticipated truck volume and applied loads. The calculation sheet also evaluates the puncture potential for the final cover geomembrane due to isolated stones in the overlying general fill and considering the added loads associated with the proposed access road.

As required by Attachment O of the referenced permit, an updated Permit Modification Log was submitted on April 4, 2008. An updated Attachment O is attached to indicate the date of this submittal.

If you have any questions or comments, please contact either myself at (716) 286-0246 or Mr. Jonathan Rizzo at (716) 286-0354.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to 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."

Sincerely,
CWM CHEMICAL SERVICES, LLC

Jill A. Banaszak

Jill A. Banaszak
Technical Manager
Model City Facility

JPR/JAB/jpr
Attachment

cc:	J. Strickland	- NYSDEC/Region 9
	D. Weiss	- NYSDEC/Region 9
	B. Rostami	- NYSDEC/Region 9
	On-site Monitors	- NYSDEC/ Model City, NY
	M. Cruden	- NYSDEC/Albany, NY
	T. Killeen	- NYSDEC/Albany, NY
	G. Burke	- NYSDEC/Albany, NY
	M. Mason	- NYSDEC/Albany, NY
	M. Mortefolio	- NYSDEC/Albany, NY
	P. Flax	- USEPA/Region II
	J. Devald	- NCHD/Lockport, NY
	M. Mahar	- CWM/Model City, NY
	J. Rizzo	- CWM/Model City, NY
	D. Darragh	- C&G/Pittsburgh, Pa
	EMD Subject File	
	Q & A	

617.20

Appendix C

State Environmental Quality Review

SHORT ENVIRONMENTAL ASSESSMENT FORM

For UNLISTED ACTIONS Only

PART I - PROJECT INFORMATION (To be completed by Applicant or Project Sponsor)

1. APPLICANT/SPONSOR
CWM Chemical Services, LLC

2. PROJECT NAME
Model City Facility

3. PROJECT LOCATION:
Municipality Town of Porter   County Niagara

4. PRECISE LOCATION (Street address and road intersections, prominent landmarks, etc., or provide map)
1550 Balmer Road, Model City, NY 14107

5. PROPOSED ACTION IS:
☐ New ☐ Expansion ☑ Modification/alteration

6. DESCRIBE PROJECT BRIEFLY:
Installation of a permanent access road above final cover of RMU-1

7. AMOUNT OF LAND AFFECTED:
Initially 0 acres   Ultimately 0 acres

8. WILL PROPOSED ACTION COMPLY WITH EXISTING ZONING OR OTHER EXISTING LAND USE RESTRICTIONS?
☑ Yes ☐ No   If No, describe briefly

9. WHAT IS PRESENT LAND USE IN VICINITY OF PROJECT?
☐ Residential ☑ Industrial ☐ Commercial ☐ Agriculture ☐ Park/Forest/Open Space ☐ Other
Describe:
Fully Permitted TSD Facility

10. DOES ACTION INVOLVE A PERMIT APPROVAL, OR FUNDING, NOW OR ULTIMATELY FROM ANY OTHER GOVERNMENTAL AGENCY (FEDERAL, STATE OR LOCAL)?
☑ Yes ☐ No   If Yes, list agency(s) name and permit/approvals:
A permit modification approval is needed from Region 9, New York State Department of Environmental Conservation.

11. DOES ANY ASPECT OF THE ACTION HAVE A CURRENTLY VALID PERMIT OR APPROVAL?
☑ Yes ☐ No   If Yes, list agency(s) name and permit/approvals:
This action is regulated under the NYSDEC Sitewide Part 373 Permit No. 9-2934-00022/00097.

12. AS A RESULT OF PROPOSED ACTION WILL EXISTING PERMIT/APPROVAL REQUIRE MODIFICATION?
☑ Yes ☐ No

I CERTIFY THAT THE INFORMATION PROVIDED ABOVE IS TRUE TO THE BEST OF MY KNOWLEDGE

Applicant/sponsor name: Jill A. Banaszak   Date: 8/16/12

Signature: Jill A. Banaszak

If the action is in the Coastal Area, and you are a state agency, complete the Coastal Assessment Form before proceeding with this assessment

Reset

PART II - IMPACT ASSESSMENT (To be completed by Lead Agency)

A. DOES ACTION EXCEED ANY TYPE I THRESHOLD IN 6 NYCRR, PART 617.4? If yes, coordinate the review process and use the FULL EAF.

☐ Yes ☐ No

B. WILL ACTION RECEIVE COORDINATED REVIEW AS PROVIDED FOR UNLISTED ACTIONS IN 6 NYCRR, PART 617.6? If No, a negative declaration may be superseded by another involved agency.

☐ Yes ☐ No

C. COULD ACTION RESULT IN **ANY** ADVERSE EFFECTS ASSOCIATED WITH THE FOLLOWING: (Answers may be handwritten, if legible)

C1. Existing air quality, surface or groundwater quality or quantity, noise levels, existing traffic pattern, solid waste production or disposal, potential for erosion, drainage or flooding problems? Explain briefly:

C2. Aesthetic, agricultural, archaeological, historic, or other natural or cultural resources; or community or neighborhood character? Explain briefly:

C3. Vegetation or fauna, fish, shellfish or wildlife species, significant habitats, or threatened or endangered species? Explain briefly:

C4. A community's existing plans or goals as officially adopted, or a change in use or intensity of use of land or other natural resources? Explain briefly:

C5. Growth, subsequent development, or related activities likely to be induced by the proposed action? Explain briefly:

C6. Long term, short term, cumulative, or other effects not identified in C1-C5? Explain briefly:

C7. Other impacts (including changes in use of either quantity or type of energy)? Explain briefly:

D. WILL THE PROJECT HAVE AN IMPACT ON THE ENVIRONMENTAL CHARACTERISTICS THAT CAUSED THE ESTABLISHMENT OF A CRITICAL ENVIRONMENTAL AREA (CEA)?

☐ Yes ☐ No If Yes, explain briefly:

E. IS THERE, OR IS THERE LIKELY TO BE, CONTROVERSY RELATED TO POTENTIAL ADVERSE ENVIRONMENTAL IMPACTS?

☐ Yes ☐ No If Yes, explain briefly:

PART III - DETERMINATION OF SIGNIFICANCE (To be completed by Agency)

INSTRUCTIONS: For each adverse effect identified above, determine whether it is substantial, large, important or otherwise significant. Each effect should be assessed in connection with its (a) setting (i.e. urban or rural); (b) probability of occurring; (c) duration; (d) irreversibility; (e) geographic scope; and (f) magnitude. If necessary, add attachments or reference supporting materials. Ensure that explanations contain sufficient detail to show that all relevant adverse impacts have been identified and adequately addressed. If question D of Part II was checked yes, the determination of significance must evaluate the potential impact of the proposed action on the environmental characteristics of the CEA.

☐ Check this box if you have identified one or more potentially large or significant adverse impacts which **MAY** occur. Then proceed directly to the FULL EAF and/or prepare a positive declaration.

☐ Check this box if you have determined, based on the information and analysis above and any supporting documentation, that the proposed action **WILL NOT** result in any significant adverse environmental impacts **AND** provide, on attachments as necessary, the reasons supporting this determination.

Name of Lead Agency	Date
Print or Type Name of Responsible Officer in Lead Agency	Title of Responsible Officer
Signature of Responsible Officer in Lead Agency	Signature of Preparer (If different from responsible officer)

Reset

Arcadis Permit Modification Request

Use the attached pages to replace the corresponding pages of the current permit, engineering report, and O&M Manual or insert new pages as indicated.

ARCADIS

Infrastructure · Water · Environment · Buildings

ARCADIS
6723 Towpath Road
P.O. Box 66
Syracuse
New York 13214-0066
Tel 315.446.9120
Fax 315.449.0017
www.arcadis-us.com

Mr. Jonathan Rizzo
Permitting Manager
CWM Chemical Services, LLC
1550 Balmer Road
Model City, New York 14107

Subject:
Landfill Plateau Access Road
RMU-1 Permit Modification Request
Model City, New York

Environment

Date:
August 15, 2012

Contact:
Brian M. Stone, P.E.

Phone:
315.671.9445

Email:
brian.stone@arcadis-us.com

Our ref:
B0023729.2012

Dear Jonathan:

As requested by CWM Chemical Services, LLC (CWM), ARCADIS has prepared a permit modification for a permanent access road to the plateau of Residuals Management Unit-1 (RMU-1). The proposed road is needed to allow waste grades to continue to advance towards landfill closure. The existing road at the southeast corner of the landfill is built into the permitted waste envelop and therefore prevents the achievement of final waste grades in that area. Although it was previously envisioned that the existing road could be maintained during waste placement within its footprint, further review by CWM indicates that landfill operation will be simplified by creating an entirely new access point from the north and across closed portions of the landfill. Because the road will be built on existing final cover, there is no need to remove the road once the landfill has closed completely and thus the road is proposed to remain in place as a permanent feature.

The new single-lane-width gravel road will be constructed along the northern face of the landfill extending from the perimeter berm adjacent to Cell 3 and proceeding upslope to the east through Cells 5 and 7. The proposed road will turn to the south-southwest near the grade break between the plateau and sideslope areas and pass through Cells 6 and 8. The road has generally been designed as an embankment with 2H:1V sideslopes and a top width of 15 feet, which will allow travel in one direction only at any given time, similar to the road shown in the most recent fill progression plan (ARCADIS, November 2011). A wider segment has been designed at the top of the landfill sidelope to allow exiting vehicles to stop and verify the road is clear before proceeding down to the base of the perimeter berm.

For traffic ability reasons, the maximum road grade is approximately 12%. The actual road grade varies between 5% and 12% depending on location based on the desire to cross the surface water diversion berms at the high points to minimize drainage complications and to minimize fill projection towards the Cell 3 riser vaults. Because the landfill sideslopes are steeper than the maximum desired road grade, the proposed road is designed to climb by running transverse to the existing sideslopes. In order to prevent surface water runoff shed from upgradient sideslope areas from running onto the road surface, the proposed road is designed to protrude above the existing final cover grade and the resulting ditch along the inside edge of the road will intercept and convey surface water runoff down to the surface water diversion berms and the perimeter channel at the top of the perimeter berm. A geomembrane lining will be installed continuously along this roadside ditch to limit the potential for saturation of the road fill by surface water within the ditch. The geomembrane will be under and overlain by a nonwoven geotextile to offer some amount of puncture protection. A riprap layer will be installed over the geosynthetics and two 8-inch-diameter perforated pipes will be installed within the roadside ditch to convey the runoff down the ditch lengths. The majority of the expected ditch flow is expected to be conveyed by these pipes, which limits the required size of the riprap in the roadside ditch. An existing culvert pipe in front of the Cell 3 riser vaults will be extended towards the west to the toe of the road fill to maintain drainage within the perimeter channel.

The majority of the road will be constructed of general fill and will be surfaced with an 18-inch-thick layer of crusher run, which will be underlain with a woven geotextile. A guiderail will be included along the outside edge. The existing 6-inch-thick topsoil layer within the foorprint of the road will be removed and the underlying general fill surface will be scarified before placement of new general fill to create the road embankment. Other than topsoil removal within the road footprint, no other modifications should be needed to the existing final cover to accommodate the road. A portion of the removed topsoil will be reused to cover the outside 2H:1V embankment sideslope and a permanent erosion control mat will be installed on this slope to reduce the potential for erosion and soil loss.

CWM's geotechnical consultant, P.J. Carey & Associates, PC (PJC) has performed a slope stability assessment of the proposed road and determined that the design provides for a minimum factor of safety of 1.5, which is consistent with the slope stability requirements for RMU-1. The slope stability evaluations included both long-term (no vehicle loads) and short-term (vehicle loads) scenarios. The slope stability evaluations indicated the need for geogrid reinforcement within the general fill of the road embankment in order to meet the minimum required factors of safety. According to PJC's analyses, two layers of geogrid approximately 4.3 and 6.8 feet below the proposed road surface are sufficient to reinforce the berm general fill. Geogrid is not proposed for the portion of the road to be constructed on the plateau because of the much flatter slope gradient and thinner fills.

The application of concentrated wheel loads on the final cover has the potential to damage the final cover geosynthetics. The thickness of the soil layer separating the geosynthetics from the ground surface affects the at-depth normal pressure increase experienced by the geosynthetics. Section 9.11.1 of the RMU-1 Quality Assurance Manual requires a minimum of 3 feet of cover soil over an installed geomembrane to allow vehicle operation other than low-ground-pressure machines. The proposed road provides this minimum separation on the plateau and exceeds this minimum separation on the sideslopes. Additionally, the road design includes a woven geotextile beneath the crusher run layer, which further distributes the concentrated wheel loads and thus offers additional protection of the final cover geosynthetics.

The attached permit modification includes the following components:

- *RMU-1 Permit Drawing 1-a (Title and Index):* Revised to indicate updates to Permit Drawing 12-a and new Permit Drawing 23A.

- *RMU-1 Permit Drawing 12-a (Top of Vegetative Cover Grades):* Revised to include final grading for proposed access road and associated detail callouts.

- *RMU-1 Permit Drawing 23A (Landfill Plateau Access Road Details):* New drawing depicting typical cross sections and details for the proposed access road.

- *RMU-1 O&M Manual Figure 1A (Fill Progression and Truck Routes Cells 1 Thru 14 – Final Sequence Phase 3 with Landfill Plateau Access Road):* New drawing created from most recently approved fill progression drawing (ARCADIS, November 2011) depicting the November 2011 fill progression plan with proposed access road and approximate location of associated truck wash.

- *RMU-1 O&M Manual Attachment 5 (Landfill Plateau Access Road Design Calculations):* New attachment to demonstrate that the proposed road section can accommodate the anticipated truck volume and applied loads. The calculation sheet also evaluates the puncture potential for the final cover geomembrane due to isolated stones in the overlying general fill and considering the added loads associated with the proposed access road.

- *RMU-1 Engineering Report:* Revised cover page to reflect latest revision date, revised permit drawing list to include new drawing 23A, and revised page 3-14 including a discussion of the proposed access road.

- *RMU-1 Engineering Report Appendix D-11 (Landfill Plateau Access Road Stability):* New appendix prepared by PJC to document the stability analyses performed for the proposed access road.

- *RMU-1 Engineering Report Appendix I (Surface Water Drainage and Erosion Calculations):* Miscellaneous revisions to reflect changes to drainage areas due to proposed access road. A new calculation sheet has also been prepared to support the design of drainage features associated with the proposed road.

Updated/new pages of the documents listed above are included in Attachment A to this letter. These pages should be used to replace affected permit documents. Individual update instruction sheets are included to assist permit holders with the update process.

As always, if you have any questions please feel free to contact myself at 315.671.9445 or Todd Farmen at 585.662.4028.

Sincerely,

ARCADIS

Brian M. Stone, P.E.
Senior Engineer

Copies:
Mr. Philip Batten, ARCADIS
Mr. Todd Farmen, ARCADIS
Mr. Ben Girard, ARCADIS
Mr. Joseph Molina III, P.E., ARCADIS

Attachment A

RMU-1 Permit Modification

Replace the Existing Permit Drawing 1-a (Title and Index) with the Following Revised Drawing 1-a.

CWM CHEMICAL SERVICES, LLC.
RESIDUALS MANAGEMENT UNIT 1
MODEL CITY, NIAGARA COUNTY, NEW YORK

DRAWING NO.	TITLE	FILE NO.
1	TITLE AND INDEX	A-55299
1-a	TITLE AND INDEX	
2	PROPOSED RMU-1 SITE	A-55298
2-a	PROPOSED RMU-1 SITE	
3	BORING LOCATIONS	A-55297
4	EXCAVATION GRADES	A-55296
5	SUBBASE GRADES	A-55295
5-a	SUBBASE GRADES	
6	SECONDARY CLAY LINER GRADES	A-55294
6-a	SECONDARY CLAY LINER GRADES	
7	SECONDARY LEACHATE GRANULAR LAYER GRADES	A-55293
7-a	SECONDARY LEACHATE GRANULAR LAYER GRADES	
8	PRIMARY CLAY LINER GRADES	A-55292
8-a	PRIMARY CLAY LINER GRADES	
9	PRIMARY LEACHATE GRANULAR LAYER GRADES	A-55291
9-a	PRIMARY LEACHATE GRANULAR LAYER GRADES	
10	OPERATIONS LAYER GRADES	A-55290
10-a	OPERATIONS LAYER GRADES	
11	TOP OF WASTE GRADES	A-55289
11-a	TOP OF WASTE GRADES	
12	TOP OF VEGETATIVE COVER GRADES	A-55288
△ 12-a	TOP OF VEGETATIVE COVER GRADES	
13	SUMP CONSTRUCTION GRADES	A-55287
13A	SUMP CONSTRUCTION GRADES CELL 5	
13B	SUMP CONSTRUCTION GRADES CELL 5	
13C	SUMP CONSTRUCTION GRADES CELL 6	
13D	SUMP CONSTRUCTION GRADES CELL 7	
13E	SUMP CONSTRUCTION GRADES CELL 10	
13G	SUMP CONSTRUCTION GRADES CELL 13	
13H	SUMP CONSTRUCTION GRADES CELL 14	
15	CROSS SECTION 16+50E	A-55285
15A	CROSS SECTION 23+25E	A-55284
△ 15A-a	CROSS SECTION 23+25E	A-55284
16	CROSS SECTION 85+50N AND 91+00N	A-55283
△ 16-a	CROSS SECTION 85+50N AND 91+00N	A-55282
16A	CROSS SECTION 97+50N	
17	TYPICAL LINER SECTIONS CELLS 1 THROUGH 6, AND 9 THROUGH 14	A-55281
17A	TYPICAL LINER SECTIONS CELLS 7 THROUGH 14	
18	SUMP DETAILS	
18A	SUMP DETAILS CELLS 5 THROUGH 14	

DRAWING NO.	TITLE	FILE NO.
19	CELL SEPARATION BERM DETAILS	
19B	CELL SEPARATION BERM DETAILS CELLS 5 AND 6	
19C	CELL SEPERATION BERM DETAILS FOR CELLS 7 THROUGH 14	
20	RISER DETAILS	A-55280
△ 20-a	RISER DETAILS (WITH COMPACTED CLAY)	A-55279
21	FINAL COVER DETAILS	A-55279
21-a	FINAL COVER DETAILS (WITH COMPACTED CLAY)	
21A	SITE DETAILS	
△ 21A-a	SITE DETAILS (WITH COMPACTED CLAY)	
△ △ 21B	SITE DETAILS (WITH COMPACTED CLAY)	
△ 21C	FINAL COVER DETAILS (WITH GCL)	
△ 21D	FINAL COVER DETAILS (WITH GCL)	
22	SITE SURFACE WATER PLAN AND DETAILS	A-55278
22-a	SITE SURFACE WATER PLAN AND DETAILS	
23	ACCESS ROAD LAYOUT AND DETAILS	A-55277
23-a	ACCESS ROAD LAYOUT AND DETAILS	
△ 23A	LANDFILL PLATEAU ACCESS ROAD DETAILS	
24	LEACHATE TRANSFER SYSTEM AND ELECTRICAL SITE PLAN	A-55276
25	LEACHATE EXTRACTION DETAILS CELLS 1 THROUGH 4	A-55275
25A	LEACHATE EXTRACTION DETAILS CELLS 5,6,7, 10, 13 & 14	
26	LIFT STATION AND JUNCTION MANHOLES	A-55274
27	STRUCTURAL DETAILS	A-55273
28	ELECTRICAL PLAN, SYMBOLS AND DETAILS	A-55272
29	ELECTRICAL DETAILS AND DIAGRAMS	A-55271
30	LIFT STATION PANEL LAYOUT	A-55270
31	REMOTE TRANSMITTING UNIT PANEL LAYOUT	A-55269
32	PRIMARY AND SECONDARY PANEL LAYOUT	A-55268
33	INSTRUMENT RISER DIAGRAM	A-55267
34	INSTRUMENTATION SYMBOLS AND DETAILS	A-55266

NOT FOR CONSTRUCTION
FOR REGULATORY REVIEW ONLY

NOTES:

1. THIS DRAWING BASED ON DRAWING NUMBER 1 ENTITLED "TITLE AND INDEX", PREPARED BY EARTH TECH (FILE NO. A-55299, DATED FEBRUARY 1991).
2. PRIOR REVISIONS TO DRAWING NUMBER 1 BY EARTHTECH INCLUDE THE FOLLOWING:
   1 NOTICE OF DEFICIENCY RESPONSES (DATED 6/92, DRAWN BY FLD, APPROVED BY GRM).
   2 REVISED SHEET TITLES (DATED 7/93, DRAWN BY MLJ, APPROVED BY MGR).
   3 ADDED DRAWINGS (DATED 11/95, DRAWN BY VPR, APPROVED BY CPB).
   4 MODIFIED DRAWINGS FOR CELL 6 (DATED 4/96, DRAWN BY FAS, APPROVED BY CPB).
   5 REVISED DRAWINGS (DATED 6/96, DRAWN BY FAS, APPROVED BY CPB).
   6 REVISED AND ADDED DRAWINGS (DATED 7/96, DRAWN BY FAS, APPROVED BY CPB).
   7 REVISED DRAWING 25A (DATED 10/96, DRAWN BY FAS, APPROVED BY CPB).
   8 REVISED AND ADDED DRAWINGS FOR CELLS 7 AND 8 (DATED 11/96, DRAWN BY FAS, APPROVED BY CPB).
   REVISED AND ADDED DRAWINGS FOR CELL 9 (DATED 4/97, DRAWN BY FAS, APPROVED BY CPB).
   9 REVISED DRAWINGS 13D, 18A, AND 25A (DATED 6/97, DRAWN BY FAS, APPROVED BY CPB).
   10 REVISED AND ADDED DRAWINGS CELLS 9 THRU 14, REMOVED DRAWINGS 13F AND 14 (DATED 6/97, DRAWN BY FAS,
   11 APPROVED BY CPB).
   12 REVISED PER 9/22/97 DEC LETTER, REMOVED DRAWING 19A (DATED 10/97, DRAWN BY FAS, APPROVED BY CPB).
   13 REVISED AND ADDED DRAWINGS FOR AIRSPACE ENHANCEMENT (DATED 5/98, DRAWN BY FAS, APPROVED BY CPB).
3. BBL SEAL AND SIGNATURE PERTAIN ONLY TO BBL IMPLEMENTED REVISIONS AS NOTED IN THE REVISION BLOCK.

DRAWING REVISED BY BLASLAND, BOUCK & LEE, INC. THROUGH ITS PROFESSIONAL ENGINEER. WORK OF EARTHTECH NOT INDEPENDENTLY REVIEWED.

Graphic Scale

NOT TO SCALE

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED IN THE TITLE BLOCK. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR IN THE TITLE BLOCK TO DETERMINE THE ACTUAL SCALE OF THIS DRAWING.

No.	Date	Revisions	Init
△	08/12	REVISED DRAWING 12-a ADDED DRAWING 23A	
△	10/03	ADDED DRAWINGS 15A-a, 16-a, 20-a, 21A-a, 21C, 21D REVISED TITLE OF DRAWING 21B, 17	
△	9/01	ADDED DRAWING 21B	
		SEE NOTE 2 FOR PRIOR REVISIONS	

Project Mgr. TJF
Designed by BMS/CAA
Drawn by SLM
Checked by PHB
Prof. Eng. JOSEPH MOLINA III
PE License NY 072644

STATE OF NEW YORK · JOSEPH MOLINA III · 072644 · LICENSED PROFESSIONAL ENGINEER

BBL® BLASLAND, BOUCK & LEE, INC. engineers & scientists

CWM CHEMICAL SERVICES, LLC. • MODEL CITY FACILITY
RESIDUALS MANAGEMENT UNIT 1

TITLE AND INDEX

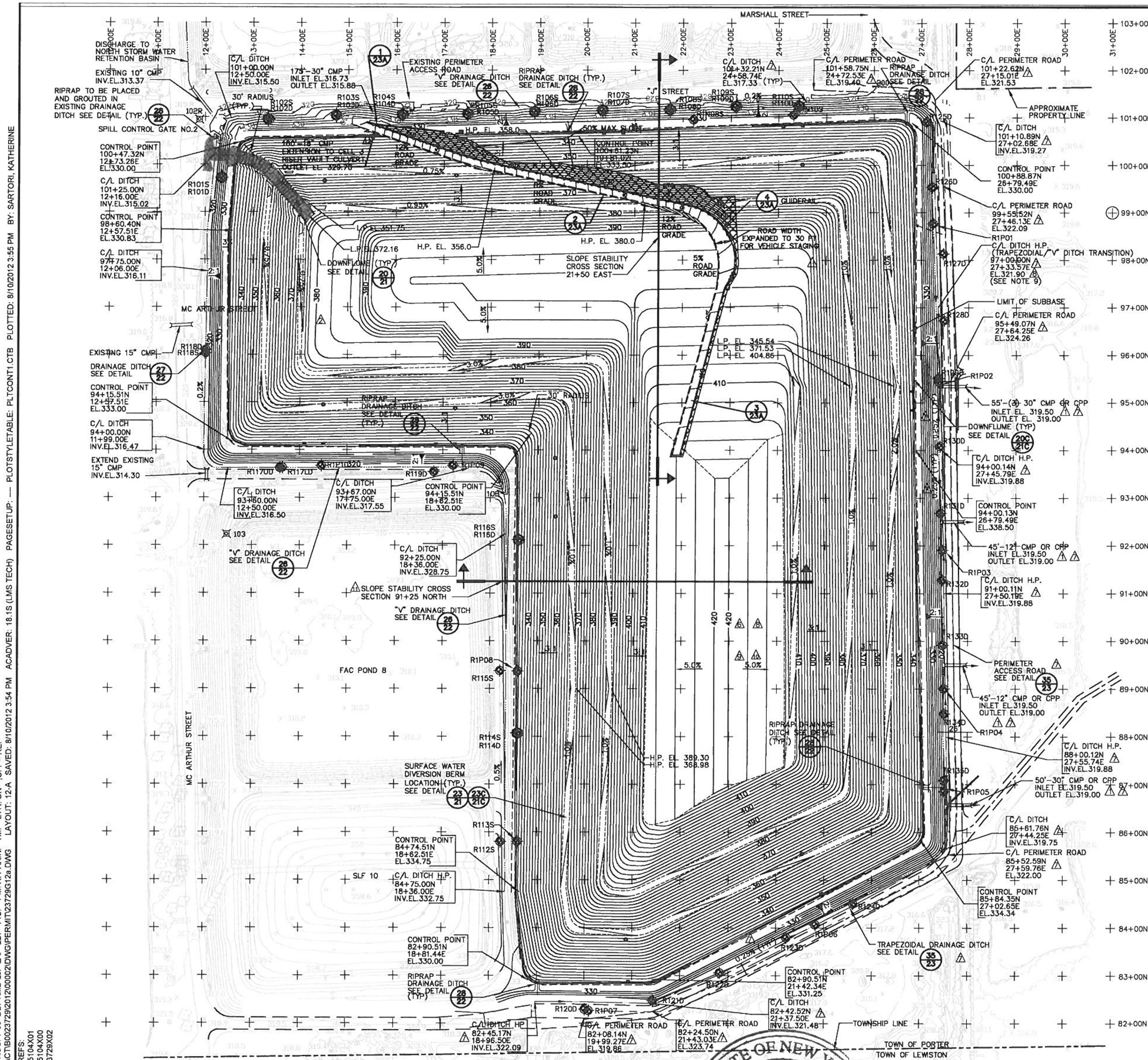
GENERAL

File Number 050.42.005
Date JUNE 2003
Blasland, Bouck & Lee, Inc. Corporate Headquarters 6723 Towpath Road Syracuse, NY 13214 315-446-9120

1-a

CITY: SYRACUSE, NY DIV/GROUP:ENV/CADD DB: KMD K.SARTORI LD:K.SARTORI PIC: W. POPHAM PM: T. FARMEN TM: B. STONE LYR:(Opt)ON=*;OFF=*REF* G:\ENVCAD\SYRACUSE\ACT\B0023729\2012\00002\DWG\PERMIT\23729G01.DWG LAYOUT: 1A SAVED: 8/10/2012 3:52 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 8/10/2012 3:52 PM BY: SARTORI, KATHERINE

Replace the Existing Permit Drawing 12-a (Top of Vegetative Cover Grades) with the Following Revised Drawing 12-a.



NOT FOR CONSTRUCTION
FOR REGULATORY REVIEW ONLY

LEGEND:

- EXISTING GRADE
- 320 PROPOSED GRADE
- LIMIT OF SUBBASE
- 3:1 SLOPE INDICATOR
- DRAINAGE DITCH
- ACCESS ROAD
- TOP OF BERM
- APPROXIMATE PROPERTY LINE
- TOWNSHIP LINE
- GROUNDWATER MONITORING WELL
- GROUNDWATER MONITORING WELL NEST
- SOIL BORING
- PERMANENT CONTROL MONUMENT
- CULVERT
- VAULT
- PERMANENT EROSION CONTROL MAT

NOTES:

1. TOPOGRAPHIC BASE MAP WAS PROVIDED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN, DATED DECEMBER 1986. GROUND CONTROL BY FRANK T. TRIPI AND ASSOC., P.C.
2. COORDINATES LABELED ON THESE PLANS ARE ACCORDING TO RMU-1 SITE GRID. REFER TO DRAWING NO. 2 FOR PLANT COORDINATES.
3. PROPOSED GRADES INDICATED ARE TOP OF VEGETATIVE COVER SOIL.
4. DRAINAGE TILE TO BE PLACED UNDER SURFACE WATER DRAINAGE DITCH. SEE DETAIL 17.
5. WELLS SHOWN ON THIS DRAWING ARE THE EXISTING MONITORING WELLS FOR RMU-1.
6. THIS DRAWING BASED ON DRAWING NUMBER 12 ENTITLED "TOP OF VEGETATIVE COVER GRADES", PREPARED BY EARTH TECH (FILE NO. A-55288 DATED FEBRUARY 1991).
7. PRIOR REVISIONS TO DRAWING NUMBER 12 BY EARTHTECH INCLUDE THE FOLLOWING:
   1. NOTICE OF DEFICIENCY RESPONSES (DATED 6/92, DRAWN BY FLD, APPROVED BY GRM).
   2. SHOW LIMIT OF PHASE I AND II FINAL CAPPING AND REVISED GRADES.(DATED 6/97, DRAWN BY FAS, APPROVED BY CPB).
   3. REVISED DIVERSION BERMS PHASE I,II,AND III CAP AREAS (DATED 4/98, DRAWN BY FAS, APPROVED BY CPB).
   4. REVISED FINAL GRADES FOR AIR SPACE ENHANCEMENT (DATED 5/98, DRAWN BY FAS, APPROVED BY CPB).
   5. REMOVED FINAL COVER ACCESS ROAD (DATED 11/98, DRAWN BY FAS, APPROVED BY CPB).
   6. REVISED MAXIMUM ELEVATIONS (DATED 2/99, DRAWN BY FAS, APPROVED BY CPB).
   7. REVISION TO PERIMETER DITCH, ACCESS ROAD, AND CULVERTS
8. BBL SEAL AND SIGNATURE PERTAIN ONLY TO BBL IMPLEMENTED REVISIONS AS NOTED IN THE REVISION BLOCK.
9. (8) USE GENERAL FILL MATERIAL TO CREATE MOUND IN PERIMETER CHANNEL AT HIGH POINT LOCATION. TOP ELEVATION OF MOUND WILL BE 321.90. DITCH INVERT ELEVATION IMMEDIATELY UPSTREAM AND IMMEDIATELY DOWNSTREAM OF MOUND WILL BE 319.90.

DRAWING REVISED BY BLASLAND, BOUCK & LEE, INC. THROUGH ITS PROFESSIONAL ENGINEER. WORK OF EARTHTECH NOT INDEPENDENTLY REVIEWED.

CITY: SYRACUSE DIV/GROUP: 85 DB: KMD LJP LAF LD: PIC: PM: R. PARINI TM: LYR: ON=*;OFF=*REF* G:\ENVCAD\SYRACUSE\ACT\B0023729\2012\00002\DWG\PERMIT\23729G12a.DWG LAYOUT: 12-A SAVED: 8/10/2012 3:54 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: PLTCONT1.CTB PLOTTED: 8/10/2012 3:55 PM BY: SARTORI, KATHERINE

XREFS:
05104X01
05104X00
23729X02

Graphic Scale: 120' 0 120' 240'

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED IN THE TITLE BLOCK. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR IN THE TITLE BLOCK TO DETERMINE THE ACTUAL SCALE OF THIS DRAWING.

No.	Date	Revisions	Init
12	8/12	ADDED PROPOSED PLATEAU ACCESS ROAD GRADING	
11	6/08	REVISED SLOPE STABILITY CROSS SECTIONS	
10	3/08	REVISED PROPOSED GRADING	
9	9/07	ADDED SLOPE STABILITY CROSS SECTIONS	
8	12/03	REVISED PROPOSED GRADES FOR AIRSPACE ENHANCEMENT AND PERIMETER DITCH HIGH POINT	
		SEE NOTE 7 FOR PRIOR REVISIONS	

Project Mgr. TJF
Designed by BMS/CAA
Drawn by SLM
Checked by PHB
Prof. Eng. JOSEPH MOLINA III
PE License NY 072644

STATE OF NEW YORK · JOSEPH MOLINA III · 072644 · LICENSED PROFESSIONAL ENGINEER

BBL® BLASLAND, BOUCK & LEE, INC. engineers & scientists

CWM CHEMICAL SERVICES, LLC. • MODEL CITY FACILITY
RESIDUALS MANAGEMENT UNIT 1

TOP OF VEGETATIVE COVER GRADES

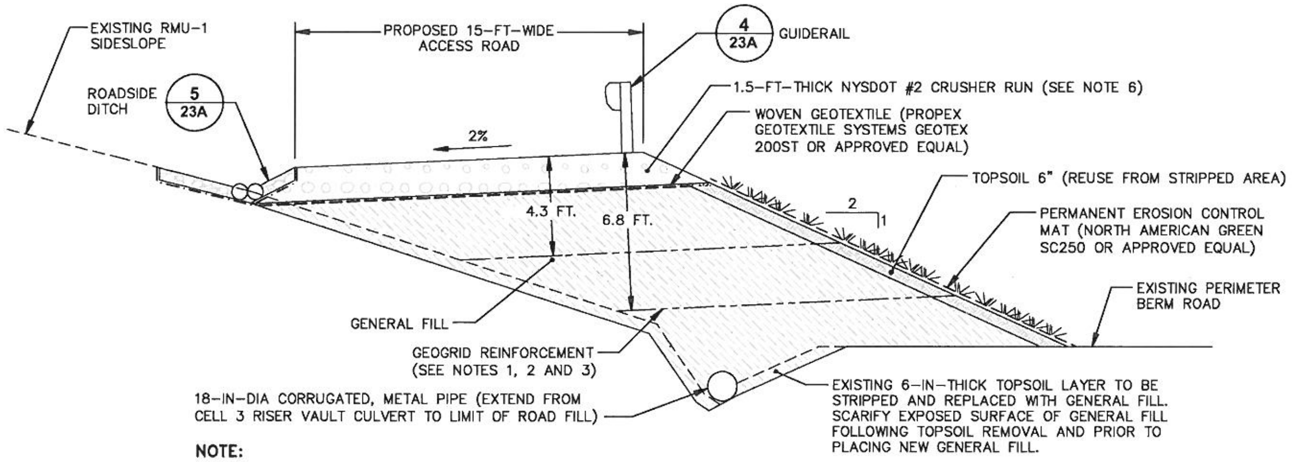
GENERAL

File Number 050.42.005
Date DECEMBER 2003

Blasland, Bouck & Lee, Inc.
Corporate Headquarters
6723 Towpath Road
Syracuse, NY 13214
315-446-9120

12-a

Insert the Following New RMU-1 Permit Drawing 23A (Landfill Plateau Access Road Details) into the RMU-1 Permit Drawings.

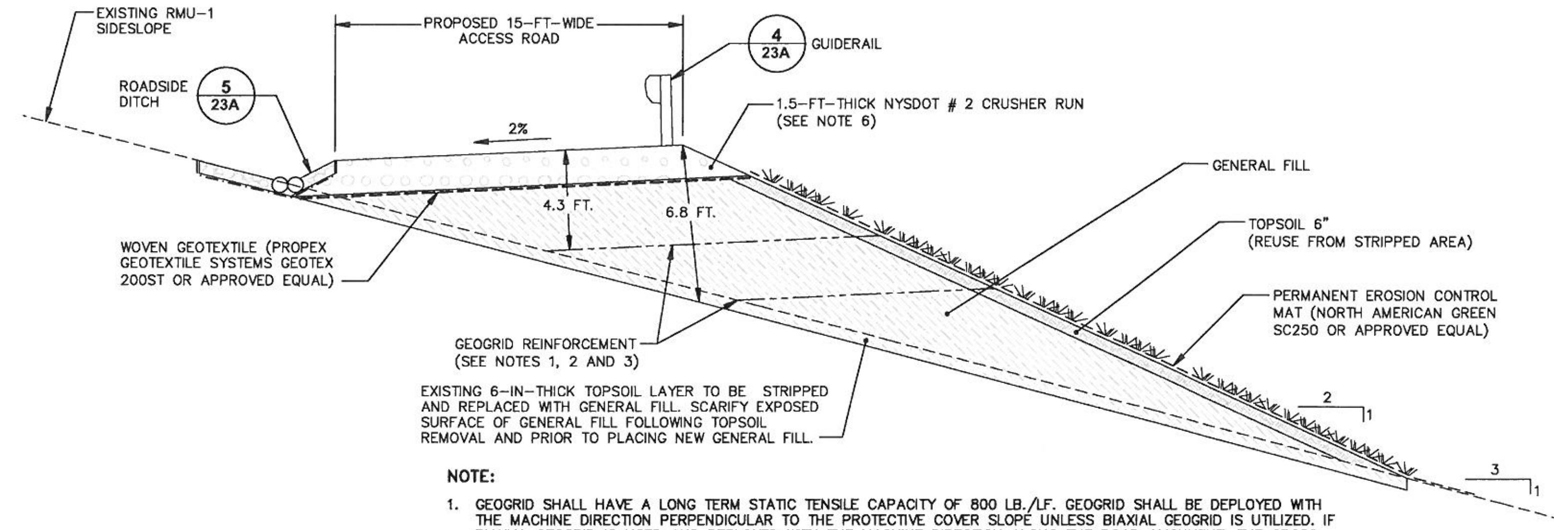


NOTE:

1. GEOGRID SHALL HAVE A LONG TERM STATIC TENSILE CAPACITY OF 800 LB./LF. GEOGRID SHALL BE DEPLOYED WITH THE MACHINE DIRECTION PERPENDICULAR TO THE PROTECTIVE COVER SLOPE UNLESS BIAXIAL GEOGRID IS UTILIZED. IF BIAXIAL GEOGRID IS USED AND DEPLOYED WITH THE MACHINE DIRECTION ALONG THE ROAD ALIGNMENT, THE CROSS MACHINE DIRECTION STRENGTH SHALL MEET THE INDICATED MINIMUM TENSILE CAPACITY AND ANY OVERLAP OF ADJACENT PANELS IN THE CROSS ROAD DIRECTION SHALL BE SUFFICIENT TO FULLY DEVELOP GRID STRENGTH.
2. GEOGRID SHALL EXTEND 17 FT. INTO ROAD GENERAL FILL FROM SIDESLOPE FACE OR 6 INCHES INTO EXISTING GENERAL FILL OF COVER SYSTEM, WHICHEVER IS LESS.
3. GEOGRID SHALL BE INSTALLED IN ACCORDANCE WITH SPECIFICATIONS CONTAINED IN APPENDIX D-11 OF THE RMU-1 ENGINEERING REPORT.
4. GENERAL FILL SHALL MEET THE REQUIREMENTS OF ITEM 2.04 OF SECTION 02210 OF THE RMU-1 TECHNICAL SPECIFICATIONS.
5. GENERAL FILL INSTALLATION SHALL BE IN ACCORDANCE WITH SECTION 02210 OF THE RMU-1 TECHNICAL SPECIFICATIONS EXCEPT THAT ONLY THE UPPER 2 FT. OF THE GENERAL FILL SHALL BE COMPACTED TO THE SPECIFIED MINIMUM DENSITY. DEEPER LIFTS SHALL ONLY BE COMPACTED BY TRACKING WITH A DOZER AND NO COMPACTION TESTING SHALL BE REQUIRED.
6. CRUSHER RUN SHALL BE PLACED, COMPACTED, AND TESTED IN ACCORDANCE WITH SECTION 02220 OF THE RMU-1 TECHNICAL SPECIFICATIONS. TESTING FREQUENCY SHALL BE ONE TEST PER 1,500 SQUARE FEET PER LIFT.

TYPICAL ROADWAY SECTION - PERIMETER BERM (1)

0 4' 8'
SCALE: 1"=4'

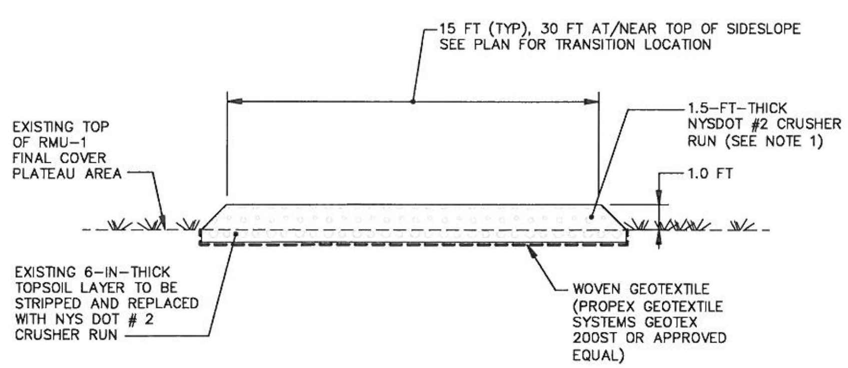


NOTE:

1. GEOGRID SHALL HAVE A LONG TERM STATIC TENSILE CAPACITY OF 800 LB./LF. GEOGRID SHALL BE DEPLOYED WITH THE MACHINE DIRECTION PERPENDICULAR TO THE PROTECTIVE COVER SLOPE UNLESS BIAXIAL GEOGRID IS UTILIZED. IF BIAXIAL GEOGRID IS USED AND DEPLOYED WITH THE MACHINE DIRECTION ALONG THE ROAD ALIGNMENT, THE CROSS MACHINE DIRECTION STRENGTH SHALL MEET THE INDICATED MINIMUM TENSILE CAPACITY AND ANY OVERLAP OF ADJACENT PANELS IN THE CROSS ROAD DIRECTION SHALL BE SUFFICIENT TO FULLY DEVELOP GRID STRENGTH.
2. GEOGRID SHALL EXTEND 17 FT. INTO ROAD GENERAL FILL FROM SIDESLOPE FACE OR 6 INCHES INTO EXISTING GENERAL FILL OF COVER SYSTEM, WHICHEVER IS LESS.
3. GEOGRID SHALL BE INSTALLED IN ACCORDANCE WITH SPECIFICATIONS CONTAINED IN APPENDIX D-11 OF THE RMU-1 ENGINEERING REPORT.
4. GENERAL FILL SHALL MEET THE REQUIREMENTS OF ITEM 2.04 OF SECTION 02210 OF THE RMU-1 TECHNICAL SPECIFICATIONS.
5. GENERAL FILL INSTALLATION SHALL BE IN ACCORDANCE WITH SECTION 02210 OF THE RMU-1 TECHNICAL SPECIFICATIONS EXCEPT THAT ONLY THE UPPER 2 FT. OF THE GENERAL FILL SHALL BE COMPACTED TO THE SPECIFIED MINIMUM DENSITY. DEEPER LIFTS SHALL ONLY BE COMPACTED BY TRACKING WITH A DOZER AND NO COMPACTION TESTING SHALL BE REQUIRED.
6. CRUSHER RUN SHALL BE PLACED, COMPACTED, AND TESTED IN ACCORDANCE WITH SECTION 02220 OF THE RMU-1 TECHNICAL SPECIFICATIONS. TESTING FREQUENCY SHALL BE ONE TEST PER 1,500 SQUARE FEET PER LIFT.

TYPICAL ROADWAY SECTION - SIDESLOPE AREA (2)

0 4' 8'
SCALE: 1"=4'

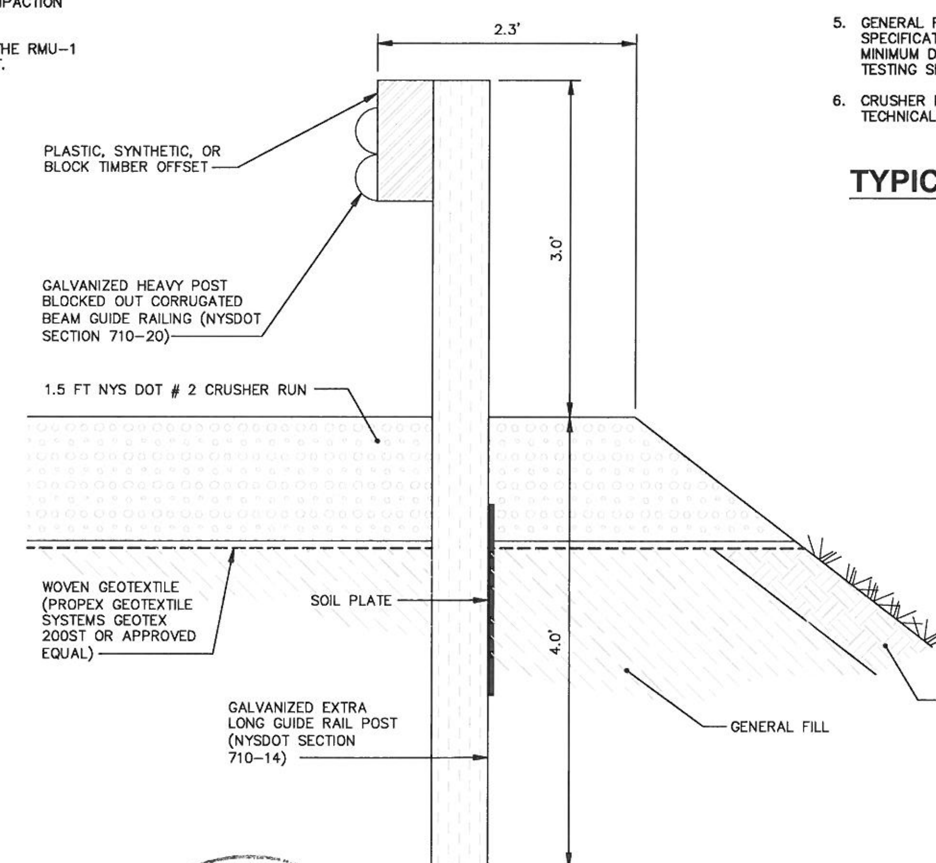


NOTE:

1. CRUSHER RUN SHALL BE PLACED, COMPACTED, AND TESTED IN ACCORDANCE WITH SECTION 02220 OF THE RMU-1 TECHNICAL SPECIFICATIONS. TESTING FREQUENCY SHALL BE ONE TEST PER 1,500 SQUARE FEET PER LIFT.

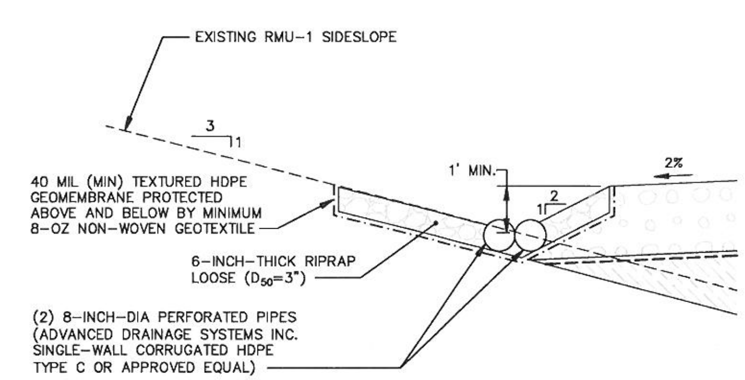
TYPICAL ROADWAY SECTION - PLATEAU AREAS (3)

NOT TO SCALE



TYPICAL GUIDERAIL DETAIL (4)

NOT TO SCALE



ROADSIDE DITCH DETAIL (5)

0 2' 4'
SCALE: 1"=2'

SCALE(S) AS INDICATED	Professional Engineer's Name: JOSEPH MOLINA III; Professional Engineer's No.: 072644; State: NY; Date Signed; Project Mgr.: BMS; Designed by: BMS/PTO; Drawn by: SLM/KLS; Checked by: BMS	ARCADIS — ARCADIS U.S., INC.
THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE	No. / Date / Revisions / By / Ckd	CWM CHEMICAL SERVICES, LLC • MODEL CITY FACILITY RESIDUALS MANAGEMENT UNIT 1

LANDFILL PLATEAU ACCESS ROAD DETAILS

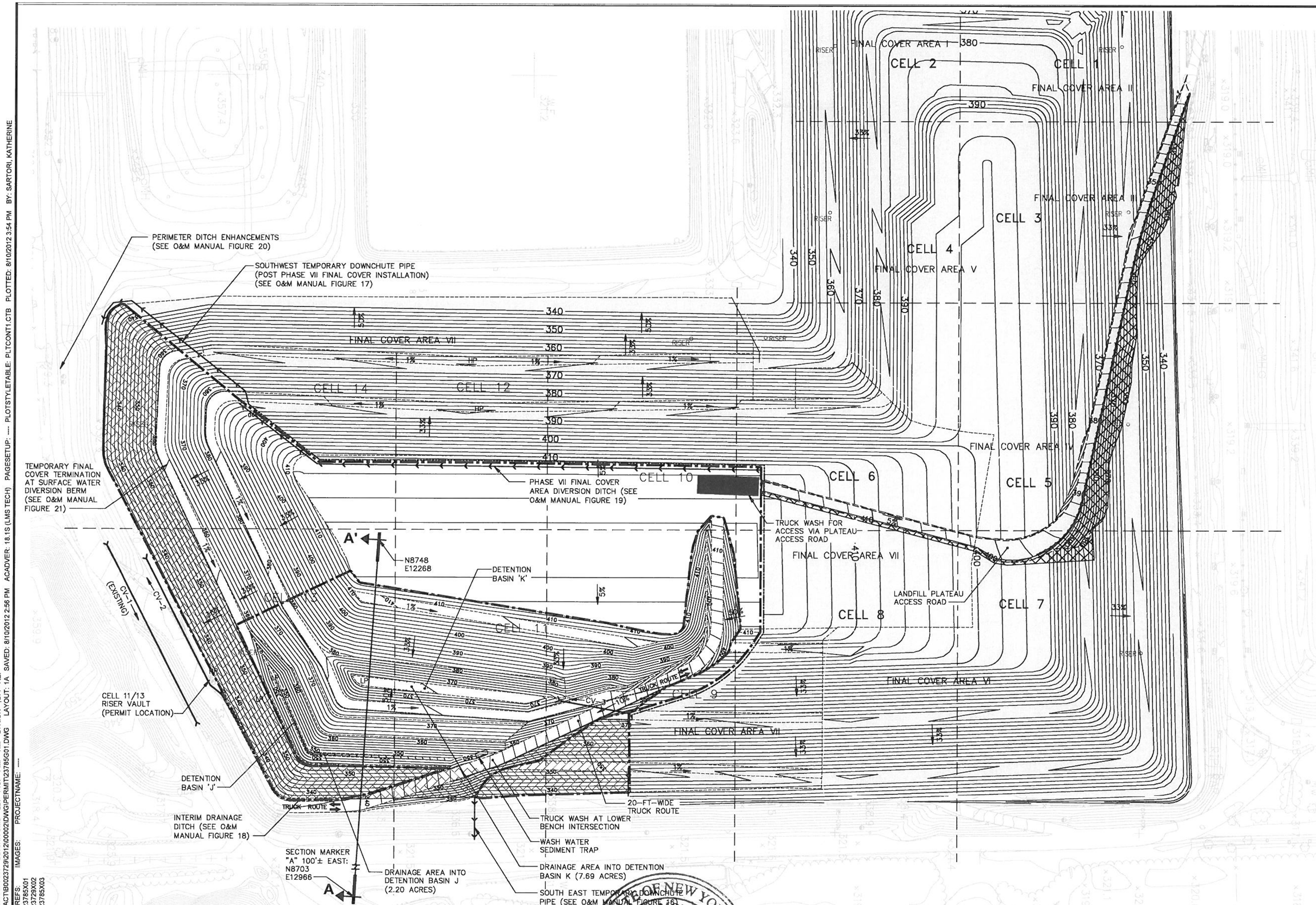
ARCADIS Project No. B0023729.2012.00002
Date AUGUST 2012
ARCADIS 6723 TOWPATH ROAD SYRACUSE, NY 13214.0066 TEL: 315.446.9120

23A

STATE OF NEW YORK — JOSEPH MOLINA III — 072644 — LICENSED PROFESSIONAL ENGINEER

CITY: SYRACUSE, NY DIV/GROUP: ENV/CADD DB: K.SARTORI LD: K.SARTORI PIC: W. POPHAM PM: T. FARMEN TM: B. STONE LYR:(Opt)ON=*;OFF=*REF* G:\ENVCAD\SYRACUSE\ACT\B0023729\2012\00002\DWG\PERMIT\23729G23a.dwg LAYOUT: 23A SAVED: 8/13/2012 3:54 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 8/13/2012 3:55 PM BY: SARTORI, KATHERINE XREFS: 23729X00 IMAGES: PROJECTNAME: ----

Insert the Following New Drawing 1A (Fill Progression and Truck Routes Cells 1 Thru 14 – Final Sequence Phase 3 With Landfill Plateau Access Road) into the RMU-1 O&M Manual.



LEGEND

- EXISTING FINAL COVER AREA (SEE NOTE 4)
- PROPOSED COVER AREA
- —340— INDEX ELEVATION CONTOUR
- INTERMEDIATE ELEVATION CONTOUR
- GRADE BREAK
- LIMIT OF DRAINAGE AREA
- LIMIT OF CURRENTLY UNCAPPED AREA DEPICTED AT FINAL WASTE GRADE
- CELL DIVIDE
- COORDINATE GRID (SEE NOTE 2)
- INTERIM DRAINAGE FEATURE AND FLOW DIRECTION
- CV-1 TEMPORARY CULVERT (SEE CULVERT TABLE AND NOTES 6 AND 7)
- N8962 E12179 SLOPE STABILITY CROSS SECTION
- HP HIGH POINT
- LP LOW POINT
- PERMANENT EROSION CONTROL MAT

NOTES:

1. BASE MAP FEATURES OUTSIDE PERMITTED LIMIT OF WASTE COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED 5/31/01 (AIR SURVEY CORP. PROJECT NO. 71010503)
2. COORDINATES REFER TO CWM PLANT SITE GRID.
3. CONTOUR INTERVAL EQUALS 2 FEET.
4. GRADES WITHIN EXISTING FINAL COVER AREAS REPRESENT PERMITTED FINAL COVER GRADES. FINAL COVER LIMIT REPRESENTS APPROXIMATE EDGE OF FULL COVER THICKNESS BASED ON QUARTERLY WASTE SURVEYS.
5. PROPOSED WASTE GRADES AND INTERIM DRAINAGE FEATURES TO BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH THE RMU-1 OPERATIONS & MAINTENANCE MANUAL WHERE APPLICABLE.
6. THE CULVERT TABLE INDICATES REQUIRED CONFIGURATIONS FOR EXISTING AND PROPOSED CULVERT LOCATIONS. CULVERT CV-1 IS EXISTING AND IS TO BE RETAINED. ALL OTHER TEMPORARY CULVERTS ARE PROPOSED. THE CONFIGURATIONS INDICATED IN THE CULVERT TABLE ARE BASED ON THE ANTICIPATED PEAK FLOWRATES ASSOCIATED WITH THIS GRADING PLAN. ALTERNATIVE CULVERT CONFIGURATIONS MAY BE SUBSTITUTED FOR THOSE INDICATED IN THE TABLE ASSUMING THEY PROVIDE EQUAL OR GREATER HYDRAULIC CAPACITY. ALTERNATIVE CULVERT CONFIGURATIONS WILL BE SUBMITTED TO THE NYSDEC FOR APPROVAL PRIOR TO CONSTRUCTION.
7. PROPOSED CULVERTS CV-2 AND CV-3 MAY BE EITHER CORRUGATED METAL PIPE OR CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE).

CULVERT TABLE

CULVERT ID	NUMBER/SIZE (IN.)	MIN. SLOPE (%)
CV-1	2/18	0.25%
CV-2	1/18	1.0%
CV-3	2/18	0.5%

80' 0 80' 160'

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JOSEPH MOLINA III
Professional Engineer's No.: NY 072644
State: NY | Date Signed: 8/13/12 | Project Mgr.: BMS
Designed by: BMS/PTO | Drawn by: GMS | Checked by: PHB

STATE OF NEW YORK · JOSEPH MOLINA III · 072644 · PROFESSIONAL ENGINEER

ARCADIS
ARCADIS U.S., INC.

CWM CHEMICAL SERVICES, LLC • MODEL CITY, NEW YORK
RESIDUALS MANAGEMENT UNIT 1

FILL PROGRESSION AND TRUCK ROUTES CELLS 1 THRU 14 - FINAL SEQUENCE PHASE 3 WITH LANDFILL PLATEAU ACCESS ROAD

GENERAL

ARCADIS Project No. B0023785.0000.00002
Date: AUGUST 2012
ARCADIS, 6723 TOWPATH ROAD, SYRACUSE, NEW YORK, 315-446-9120

1A

CITY: SYRACUSE DIV/GROUP: 141 DB: JHR GMS LD: PIC: PM: TM: LYR:ON=*;OFF=REF
G:\ENVCAD\SYRACUSE\ACT\B0023729\2012\00002\DWG\PERMIT\23785G01.DWG LAYOUT: 1A SAVED: 8/10/2012 2:56 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: PLTCONT1.CTB PLOTTED: 8/10/2012 3:54 PM BY: SARTORI, KATHERINE
XREFS: 23785X01 23729X02 23785X03 IMAGES: PROJECTNAME: ---

Insert the Following RMU-1 O&M Manual Attachment 5 (Landfill Plateau Access Road Design Calculations) into the RMU-1 O&M Manual.

ATTACHMENT #5
LANDFILL PLATEAU ACCESS ROAD DESIGN CALCULATIONS

Imagine the result

Calculation Sheet

Client: CWM Chemical Services, LLC

Project Location: Model City, New York

Project: RMU-1 Plateau Access Road Design **Project No.: B0023729.2012**

Subject: Access Road Design Calculations

Prepared By: BMS **Date: August 2012**

Reviewed By: PHB **Date: August 2012**

Checked By: PHB **Date: August 2012**

OBJECTIVE:

Demonstrate that the proposed landfill plateau access road cross-section can accommodate the anticipated truck traffic volume and loads. Evaluate the puncture potential for the final cover geomembrane due to isolated stones in the overlying general fill and considering the added loads associated with the proposed access road.

REFERENCES:

1. RMU-1 Permit Drawing No. 12-a entitled "Top of Vegetated Cover Grades," ARCADIS, August 2012.

2. RMU-1 Permit Drawing No. 23A entitled "Landfill Plateau Access Road Details," ARCADIS, August 2012.

3. Propex, Inc., Roadways and Civil Engineering (RACE) with Geotextiles. Version 1.3. Computer Software. (output attached)

4. GSE Lining Technology, Inc., GSE Geomembrane Protection Design Manual. First Edition. (portions attached)

5. Das, Braja M., Principles of Geotechnical Engineering. Second Edition. PWS-KENT Publishing Company, 1990, pp.196. (Attached)

ASSUMPTIONS:

1. A new permanent road is proposed along the northern face and on the plateau of RMU-1 to allow waste hauling trucks and other vehicles access to the landfill's plateau. The road will be constructed over the existing final cover system.

2. The proposed access road will be constructed by removing the existing 6-inch-thick topsoil layer of the final cover from within the road footprint, installing a woven geotextile, and installing an 18-inch-thick layer of New York State Department of Transportation #2 crusher run. In final cover areas with compacted clay, the total soil and aggregate thickness over the final cover geosynthetics will be 4 feet at a minimum (2.5-foot-thick general fill layer + 1.5-foot-thick crusher run layer = 4.0 feet). In final cover areas with geosynthetic clay liner (GCL), the total soil and aggregate thickness over the final cover geosynthetics will be 3 feet at a minimum (1.5-foot-thick general fill layer + 1.5-foot-thick crusher run layer = 3.0 feet).

Calculation Sheet

3. The ability of the proposed access road section to accommodate the anticipated vehicle traffic is assessed using Reference 3, which is a computer software package for the design of unpaved roads with geotextile beneath the road surface material. The assumed design axle load is 40,000 pounds based on that of an HS-25 truck. The number of design passes is 50,000 based on approximately 250,000 cubic yards (cy) of airspace remaining in RMU-1 and an assumed loaded truck capacity of approximately 20 cy per truck (i.e., 12,500 loaded trucks). Although the design of the HS-25 vehicle only has two single axles loaded at 40,000 pounds each, a typical semi has two tandem axles (four axles total) loaded equally. Each truck is, therefore, assumed to create four passes at the design load, for a total of 48,500 design axle passes (rounded to 50,000 for this analysis). It is noted that the assumed configuration represents a worst-case condition because it considers a higher than typical axle load based on an HS-25 load distribution and an axle count based on typical highway semis. The analysis is, therefore, conservative.

4. The puncture potential of the final cover geomembrane is determined using a procedure in Reference 4 and by comparing the at-depth increase in normal load on the geosynthetics to the maximum allowable normal load based on the thickness of the geomembrane, the weight of the non-woven geotextiles above the geomembrane, the maximum particle size in the general fill, and other factors.

5. The typical maximum particle size in the general fill of the final cover is approximately 2 inches based on a review of particle size distribution testing data contained in certification reports for Final Cover Phases I-III, IV, and VII.

6. The increase in normal load on the final cover geosynthetics for the assessment of puncture potential is determined using Reference 5, which accounts for the dissipation of the ground contact pressure due to burial depth.

7. The final cover geocomposite is composed of a geonet between two layers of non-woven geotextile, each with a mass per unit area of 6 ounces per square yards (oz/yd^2) (according to the RMU-1 technical specifications for geotextile). Because there are two layers of this geotextile, collectively, they are assumed to provide equivalent puncture protection of a single layer of 12 oz/yd^2 geotextile. It is noted that the void space created by the geonet core provides further cushioning but this effect is not considered herein. Thus, the degree of puncture protection provided by the geocomposite, as determined in this assessment, is conservatively low.

CALCULATIONS:

1. Road Section Design Assessment

The assumed vehicle loading for the proposed access road is discussed in Assumption 3. Reference 3 is used to determine the required aggregate layer thickness based on the design vehicle loading, the number of design passes, the aggregate characteristics, and the shear strength of the subgrade beneath the woven geotextile. The shear strength of the subgrade is assumed to be 2,400 pounds per square feet based on the requirements for general fill in the RMU-1 technical specifications. Output from Reference 3 (included as Attachment 1) indicates that a minimum 6-inch-thick aggregate layer is required over the woven geotextile. As indicated in Assumption 2, the proposed road section provides 18 inches of aggregate, which is three times the minimum required thickness. Additionally, the specified woven geotextile to be used in the road construction is one of the products recommended by Reference 3. The proposed road section is, therefore, deemed adequate to accommodate the anticipated vehicle loading.

Calculation Sheet

2. Puncture Potential of Final Cover Geomembrane

As discussed in Assumption 4, the puncture potential of the final cover geomembrane due to isolated stones in the general fill layer in the final cover can be assessed by comparing the estimated increase in normal load at the depth of the geosynthetics and the maximum allowable normal load for the geomembrane. Because the at-depth pressure increase caused by surface loads decreases with increasing burial depth, the worst-case condition will occur where the geomembrane has the shallowest burial depth with respect to the design road surface. As indicated in Assumption 2, this occurs in the GCL final cover area on the landfill plateau, where the burial depth is 3 feet. Charts in Reference 5 are used to determine the at-depth increase in normal stress as a function of burial depth, ground contact pressure, and ground contact area as follows:

Assumed ground contact pressure, q = 80 pounds per square inch (psi) (equal to tire inflation pressure) x 1.1 (impact factor) = 88 psi

Footprint of circular loaded area beneath a set of dual tires = ½ design axle load/tire inflation pressure = 20,000 pounds/80 psi = 250 in^2

Radius of circular loaded area, R = $(250\ in^2/\pi)^{1/2}$ = 8.9 in

Burial depth, z = 36 in (minimum, Assumption 2)

z/R = 4.0

Δp/q = 0.08 (from chart in Reference 5)

At-depth increase in normal stress, Δp, = 88 psi x 0.08 = 7.0 psi (maximum)

The pressure due to burial beneath 3 feet of soil is approximately 2.7 psi (3 feet x 130 pounds per cubic foot). Thus, the total normal load experienced by the geomembrane beneath the proposed road is approximately 9.7 psi or 66.9 kPa.

Reference 4 is used to evaluate the puncture potential of the geomembrane as follows:

$$p_{allow} = \left[450\frac{M}{H'^2}\right]\left[\frac{1}{MF_{PS}xFS_{CR}xFS_{CBD}}\right] - 1.3x10^5(1.5-t)H'^{-2.4}$$

Where:

p_{allow} = allowable normal pressure on geomembrane (kPa)
M = mass per unit area of nonwoven cushion geotextile (g/m^2) = 12 oz/yd^2 = 405 g/m^2
H' = effective protrusion height (mm) = H x MF_{PD}
H = protrusion height (mm) = 0.5 x max particle size = 1 in = 25 mm
MF_{PD} = modification factor for packing density = 1.0 for isolated stones
MF_{PS} = modification factor for protrusion shape = 0.5 for subangular/subrounded
FS_{CR} = factor of safety for creep of geotextile and geomembrane = 1.4
FS_{CBD} = factor of safety for chemical and biological degradation = 1.0 for burial in clean soil
t = geomembrane thickness (mm) = 40 mil = 1.0 mm

Calculation Sheet

Thus:

p_{allow} = 388 kPa

Because the expected at-depth increase in normal load is estimated to be 66.9 kPa, a factor of safety of approximately 5.8 is expected.

SUMMARY:

The proposed road section contains approximately three times the minimum required thickness of aggregate. Thus, the proposed access road section can accommodate the anticipated design vehicle loads. An evaluation of the puncture potential for the final cover geomembrane indicates that a minimum factor of safety of 5.8 is achieved with the proposed access road design and the estimated maximum particle size in the final cover general fill layer. The puncture potential evaluation is considered conservative because it does not account for the additional cushioning provided by the geonet core of the geocomposite.

Attachment 1

Road Section Design

Roadways And Civil Engineering (R.A.C.E.) with Geotextiles,
Version 1.3
by Propex Inc.

Designer:

Client: **CWM Chemical Services**

Project Name: **RMU-1 Plateau Access Road**

Project Number:

Date: **August 2012**

Comments:

Input:

Subgrade:

CBR (soaked): 4.25 %
Shear Strength: 17 PSI
Subgrade has execessive moisture: No

Vehicle Data:

Axles: Tandem
Axle Load: 40000 lbs
Wheels: Dual
Wheel Load: 24000 lbs
Contact Length: 20 in
Contact Pressure: 80 PSI
Number of Design Passes: 50000

Aggregate:

Material: Crushed Medium Hard Rock
CBR Range: 60-80 %
AASHTO Coefficient: 0.12
TEF: 0.85,
Aggregate Angularity: Angular
Lift Thickness: 12 in
Aggregate Size: 1.5 in
Aggregate Cost: 20 $/Ton
Implace Density: 130 lbs/ft3

Installation Conditions:

Soil Condition: Fine grained soils with smooth surface
Level of Monitoring: Close supervision
Geotextile Panels: Overlapped

Design Results:

Calculated Permissible Stress:
Without Geotextile: 47.6 PSI
With Geotextile: 85.0 PSI
Calculated Design Aggregate Section Thickness:
Without Geotextile: 12.3 in
With Geotextile: 6.0 in
Calculated Section Unit Cost:
Without Geotextile: 11.97 yd²
With Geotextile: 5.85 yd²

This cost is for stone only, for geotextile cost, please contact your propex Regional Sales Manager, as may be found under "Contact Us" on our website, www.geotextile.com or call us at (800) 621-1273. Our Regional Manager can help you contact your local distributor for geotextile costs and availability. For rough estimates, geotextiles used in this application can range in installed cost from about $0.70 to $1.80 per square yard.

Recommended Geotextile Products

Geotex 401, Geotex 200ST

Product Descriptions

Geotex 401: Nonwoven polypropylene needle-punched geotextile. Meets AASHTO M 288 Class 3 Nonwoven Geotextile requirements. Advantages include better filtration with a higher water flow rate, a higher coefficient of friction against soil and road base aggregate. Maximum width is 15 feet. For a generically stated product specification in downloadable Rich Text format, refer to Guideline Specifications - Separation/Stabilization "AASHTO M 288 Class 3 Nonwoven Geotextile" under Applicable Documents or under R.A.C.E. Software at www.geotextile.com. It is recommended that the maximum width geotextile be used to improve installation quality control.

Geotex 200ST: Woven polypropylene geotextile made from slit tape machine direction (warp) yarns and fibrillated yarns in the cross-machine (fill) direction. Meets AASHTO M 288 Class 3 Woven Geotextile Requirements. Maximum widths up to 17.5 feet.

For a generically stated product specification in downloadable Rich Text format, refer to Guideline Specifications - Separation/Stabilization "AASHTO M 288 Class 3 Woven Geotextile" under Applicable Documents or under R.A.C.E. Software at www.geotextile.com. It is recommended that the maximum width geotextile be used to improve installation quality control.

Information, Availability and Cost

For additional help with your project, such as distributor locations, geotextile properties or rough pricing; you may wish to contact your Propex Regional Manager as may be located for your area under "Contact Us" on our website, www.geotextile.com.

Attachment 2

Geomembrane Puncture
Potential References

in the figure) $= qr\,dr\,d\alpha$. The vertical stress, dp, at point A due to the load on the elementary area (which may be assumed to be a concentrated load) can be obtained from Eq. (6.11):

$$dp = \frac{3(qr\,dr\,d\alpha)}{2\pi}\frac{z^3}{(r^2+z^2)^{5/2}} \tag{6.23}$$

The increase of stress at A due to the entire loaded area can be found by integrating Eq. (6.23), or

$$\Delta p = \int dp = \int_{\alpha=0}^{\alpha=2\pi}\int_{r=0}^{r=R}\frac{3q}{2\pi}\frac{z^3 r}{(r^2+z^2)^{5/2}}\,dr\,d\alpha$$

So

$$\boxed{\Delta p = q\left\{1 - \frac{1}{[(R/z)^2+1]^{3/2}}\right\}} \tag{6.24}$$

The variation of $\Delta p/q$ with z/R as obtained from Eq. (6.24) is given in Table 6.3. A plot of this is also shown in Figure 6.15. The value of Δp decreases rapidly with depth; and, at $z = 5R$, it is about 6% of q, which is the intensity of pressure at the ground surface.

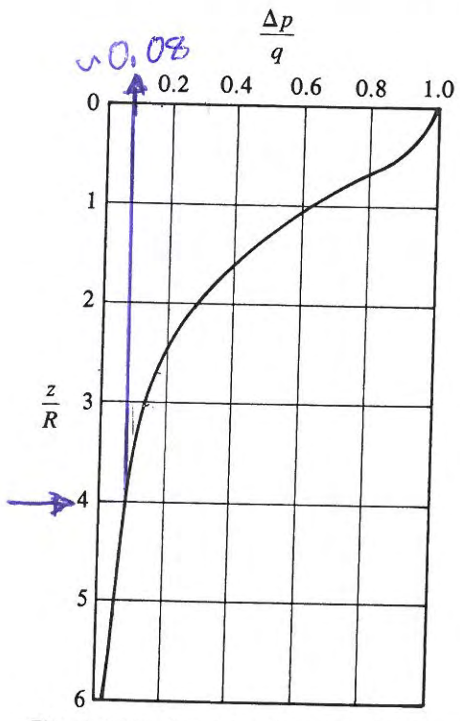


Figure 6.15 Intensity of stress under the center of a uniformly loaded flexible area

GSE

Geomembrane Protection
Design Manual

Co-Authors:

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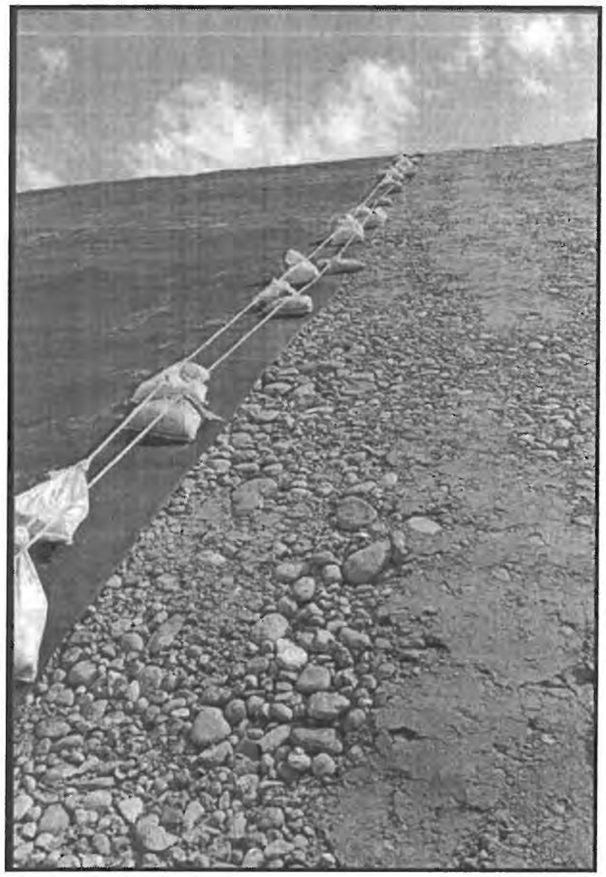
GSE Lining Technology, Inc.
and
Greg Corcoran, P.E.
GeoSyntec Consultants, Inc.

First Edition

Geomembrane Protection Design Manual



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Greg Corcoran, P.E.
Geosyntec Consultants, Inc.

First Edition

Design recommendations provided in Table 3.2 are based on studies reported in the literature and authors own experience with protection requirements for HDPE geomembranes.

Table 3.2 Mass per Unit Area of Nonwoven Needlepunched Geotextile Recommended for Geomembrane Protection During Installation.

Maximum Stone Size		Mass per Unit Area	
(mm)	(inch)	(g/m^2)	(oz/sq. yard)
≤ 12	≤ 0.5	≥ 335	≥ 10
≤ 25	≤ 1.0	≥ 405	≥ 12
≤ 38	≤ 1.5	≥ 540	≥ 16
≤ 50	≤ 2.0	≥ 1080	≥ 32

3.2 Protecting Geomembrane from Puncture Due to Static Loads

The equations presented in this section were derived based on extensive quasi-performance and performance puncture testing. The final empirical relationship presented at the end of this chapter was obtained as follows:

a) An empirical equation relating truncated cone height and mass per unit area of a nonwoven needlepunched geotextile used as protection for a 1.5 mm (60 mil) HDPE geomembrane was obtained from Hydrostatic Truncated Cone Puncture Tests performed according to ASTM procedure D 5514.
b) The basic equation in (a) above was modified for the influence of geomembrane thickness.
c) The equation in step (b) above was modified for the influence of creep of the geomembrane and geotextiles.
d) The effect of type of overburden stress (hydrostatic vs. geostatic) on the equation in (c) above was evaluated.
e) The equation obtained from step (d) above was then adjusted for protrusion shape and arrangement.
f) Finally, the equation was modified for chemical and biological degradation of geomembranes and protection geotextiles.

All of the above work was performed by the author and other researchers at the Geosynthetic Institute, Drexel University, PA, using geotextiles from a number of different manufacturers. Thus the geotextile performance and the resulting design equations are representative of nonwoven needlepunched geotextiles manufactured and supplied in the US. The following sections provide details of each of the above steps.

3.2.1 Basic Equation

The failure pressure of a 1.5 mm (60 mil) thick HDPE geomembrane in Truncated Cone Puncture Test (ASTM D 5514) is related to the cone height H (mm) and the mass per unit area of a nonwoven needle punched protection geotextile M (grams/m^2) as indicated in Figure 3.1 (Narejo, et. al., 1996). The same relationship can be expressed mathematically as:

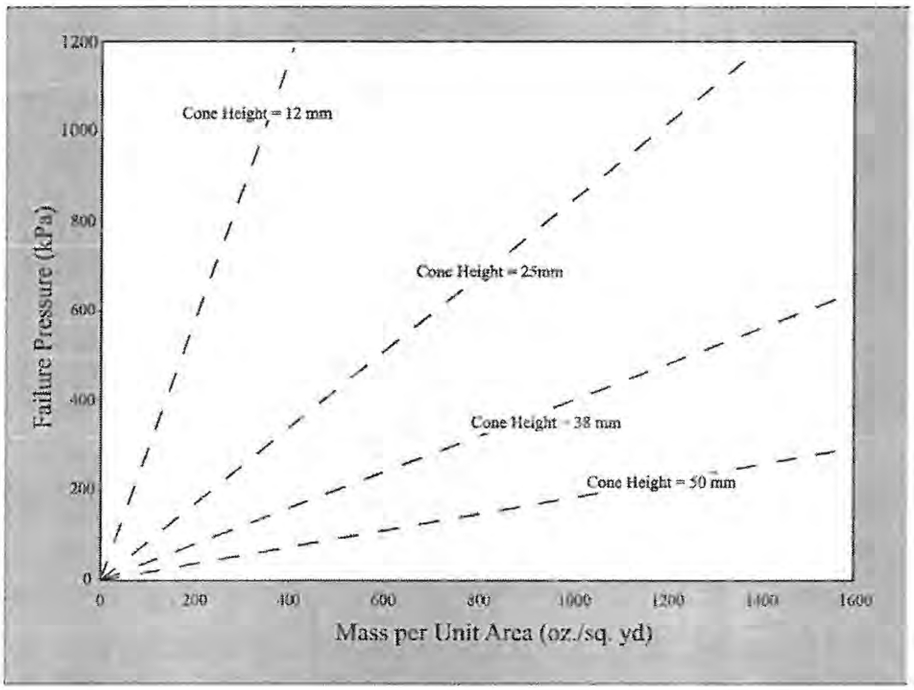


Figure 3.1 Short Term Test Results Obtained from Hydrostatic Truncated Cone Puncture Testing (Narejo et. al., 1996).

$$p_{1.5mm} = 450\frac{M}{H^2} \tag{3.1}$$

Equation (3.1) is valid only for the following conditions:

a) hydrostatic pressure applied at the rate of 7 kPa (1 psi) per minute,
b) a 1.5 mm (60 mil) HDPE geomembrane, and
c) truncated cones used as protrusions, as indicated in Figure 1.2 (b).

Obviously, conditions on actual projects are always different from the test conditions used to derive Equation 3.1. Therefore, the equation must be modified to make it applicable to the design conditions typically encountered in the field. The following sections propose modifications to the above equation to derive the final empirical design equation.

3.2.1.1 Effect of Geomembrane Thickness

The influence of the geomembrane thickness on the failure pressures is indicated in Figure 3.2. It can be seen from the figure that the influence of geomembrane thickness on failure pressures is small above a cone height of 25 mm. However, geomembrane thickness becomes significant as cone height decreases below 25 mm. The failure pressure per unit thickness of the geomembranes (kPa/mm) is plotted in Figure 3.3 against cone height. The equation of the curve in Figure 3.3 can be written as:

Rate of change of failure pressure (kPa/mm) = $1.3x10^5$ (Cone Height in mm)$^{-2.4}$ (3.3)

Equation 3.3 can also be written as:

$$\frac{p_{1.5mm} - p_t}{1.5 - t} = 1.3x10^5 (H)^{-2.4} \quad (3.4)$$

Where, $p_{1.5\,mm}$ = failure pressure for 1.5 thick HDPE geomembrane, from Equation 3.1(kPa),
p_t = geomembrane truncated cone failure pressure at a thickness t (kPa),
t = geomembrane thickness (mm), and
H = effective protrusion height (mm).

Substituting the value of $p_{1.5mm}$ in the above equation, and re-arranging:

$$p_t = 450\frac{M}{H^2} - 1.3x10^5 (1.5 - t)(H)^{-2.4} \quad (3.5)$$

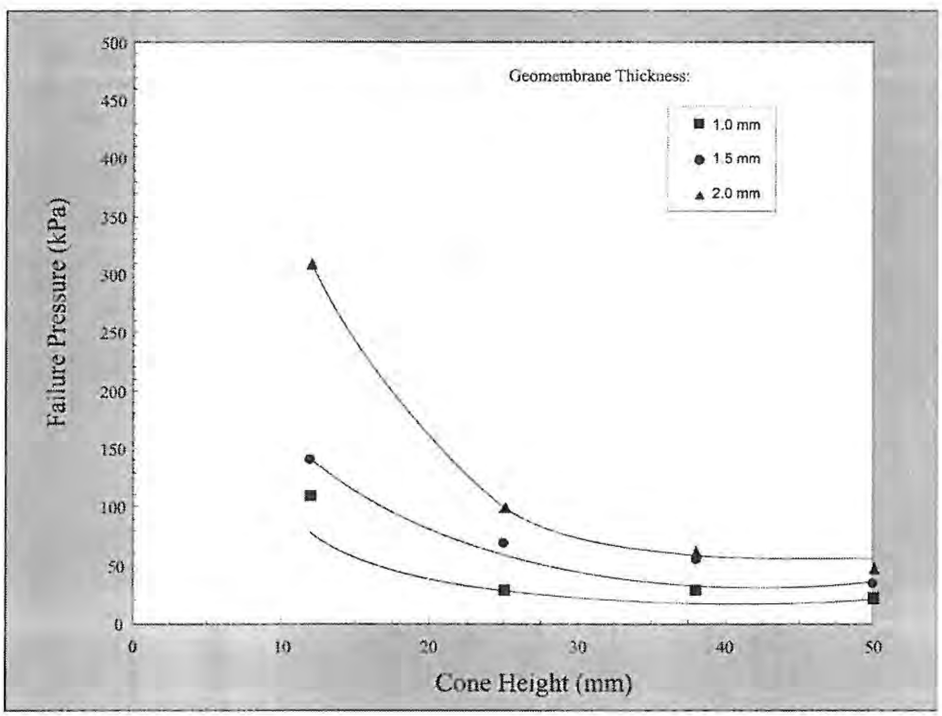


Figure 3.2 Influence of Geomembrane Thickness on Failure Pressures (Narejo et. al., 1996).

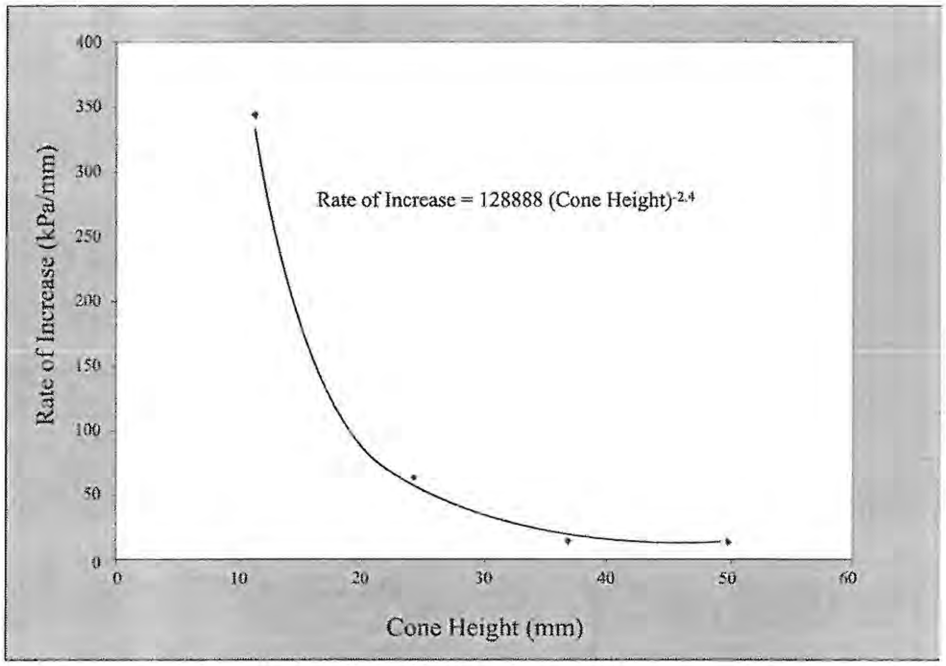


Figure 3.3 Rate of Change of Geomembrane Failure Pressure at Various Cone Heights.

$$\text{or, } p_{allow} = 450\frac{M}{H^2} - 1.3x10^5(1.5-t)H^{-2.4} \tag{3.6}$$

Note that Equation (3.6) reduces to Equation 3.1 for a geomembrane thickness of 1.5 mm. For other geomembrane thicknesses, there is small, and in many cases negligible, influence of geomembrane thickness on failure pressures. Therefore, the thickness effect in Equation 3.6 is ignored for further derivations. In those cases where a design engineer must consider the influence of thickness, the final equation can easily be modified using Equation 3.6. This is illustrated in a design example in Chapter 5.

3.2.1.2 Modification for Geotextile and Geomembrane Creep

As mentioned previously, Equation 3.1 is based on short term testing lasting only a few hours. Geomembranes and geotextiles are viscoelastic in nature. This means that time to failure is a function of rate of application of stress. To account for the effect of rate of application of stress on Equation 3.1, creep puncture tests were conducted using the same setup as short term hydrostatic truncated cone puncture test (ASTM D 5514). However, instead of increasing the pressure at the rate of 7 kPa per minute to failure, only a certain fraction of the failure pressure was applied and maintained. At this constant pressure, the time required to obtain a geomembrane puncture was noted. As an example, for a cone height of 25 mm and a protection nonwoven needlepunched geotextile of 270 grams/m^2, Figure 3.1 indicates an approximate failure pressure of 220 kPa when tested in accordance with ASTM D 5514 using short term conditions. A pressure of 75% (165 kPa), 50% (110 kPa), 25% (55 kPa) and 12% (26 kPa), respectively was applied to obtain the curve provided in Figure 3.4. It is seen that the curve is asymptotic to the x-axis at a pressure of approximately 10%. Thus for the conditions represented in Figure 3.4, only 10% of short term pressure, or 22 kPa, can be applied to prevent failure of the geomembrane over the life of a typical civil engineering project. This translates into a creep factor of safety, FS_{CR}, of 10. The test was repeated at various cone heights, pressures and protection geotextiles to obtain the types of curve provided in Figure 3.4. On the basis of puncture creep data, factors of safety for creep are provided in Table 3.3. To account for geotextile and geomembrane creep, Equation (3.1) is modified as follows:

$$p_{allow} = \left[450\frac{M}{H^2}\right]\left[\frac{1}{FS_{CR}}\right] \tag{3.7}$$

Where, FS_{CR} = factor of safety for creep of geotextiles and geomembranes in puncture mode as given in Table 3.3.

Equation (3.7) provides long-term failure pressure for HDPE geomembrane over truncated cones (manufactured protrusions) in an inert environment.

3.2.1.3 Effect of Type of Pressure

Equation (3.7) is based on hydrostatic (water) pressure testing. A number of applications, including landfills, utilize waste or soil as the overburden medium. In such cases, the nature of the overburden pressure is geostatic rather than hydrostatic. To address this concern, a number of tests were performed using geostatic (soil) pressure (Narejo, et. al., 1996). Table 3.4 provides the data with geostatic pressure.

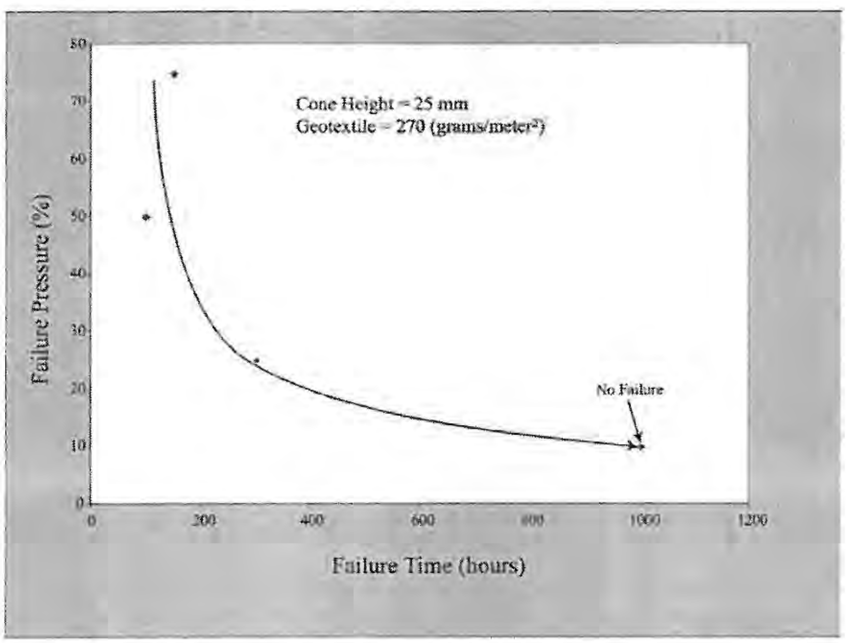


Figure 3.4 Graphical Explanation of Creep Factors of Safety.

Table 3.3 Factors of Safety for Creep Obtained from Long Term Puncture Testing (Modified from Narejo et. al., 1996).

NW-NP Geotextile Mass		**Effective Protrusion Height (mm)**		
g/m^2	oz./sq. yard	**≤38 (1.5")**	**≤25 (1.0")**	**≤12 (0.5")**
None	None	N/R	N/R	N/R
270	8	N/R	N/R	>1.5
335	10	N/R	N/R	1.4
405	12	N/R	N/R	1.4
540	16	N/R	1.5	1.3
675	20	N/R	1.4	1.2
810	24	1.5	1.3	1.2
950	28	1.4	1.3	1.1
1100	32	1.3	1.2	1.1
2000	60	1.2	1.1	1.0

Note: Values in shaded rows are extrapolated; NW-NP = Nonwoven Needlepunched; N/R = Not Recommended

Table 3.4 Geostatic Failure Pressures for a 1.5 mm HDPE Geomembrane with Various Nonwoven Needlepunched Geotextiles (from Narejo, et. al., 1996).

Geotextile Mass		**Failure Pressure (kPa) at Various Protrusion Heights**			
(g/m^2)	**($oz./yard^2$)**	**50 mm (2.0")**	**38 mm (1.5")**	**25 mm (1.0")**	**12 mm (0.5")**
None	None	240	310	450	700
270	8	380	510	>700	>700
540	16	580	>700	>700	>700
1080	32	>700	>700	>700	>700

A comparison of geostatic failure pressures (Table 3.4) with hydrostatic pressure in Figure 3.1 indicates an approximate advantage factor of 6 with the soil as the overburden medium. The higher failure pressures with soil are likely the result of soil arching. As the hydrostatic medium results in lower failure pressure, the design method based on hydrostatic testing is conservative. The authors recommend ignoring the influence of soil arching when making the design calculations for soil or waste overburden medium. Probably, in the future, after further research and testing, the influence of soil arching may be incorporated in Equation 3.7 through a modification factor. Presently, Equation 3.7 is recommended for use irrespective of type overburden medium.

3.2.1.4 Effect of Protrusion Shape and Arrangement

Equation (3.7) was derived on the basis of tests performed using truncated cones as indicated in Figure 1.2 (b). For the equation to be applicable to practical design cases, it must be modified to account for shape and arrangement of soil, aggregate or stones as discussed in Chapter 2. This was accomplished by performing tests on angular, sub-rounded and rounded stones of various sizes placed in the same manner as the truncated cones. The failure pressures thus obtained are provided in Figure 3.5. The geomembrane failure pressures are seen to decrease with an increase in angularity of the stones. On the basis of the test data in Figure 3.5, the modification factors to be incorporated in Equation 3.7 are provided in Table 3.5 (Narejo, et. al., 1996).

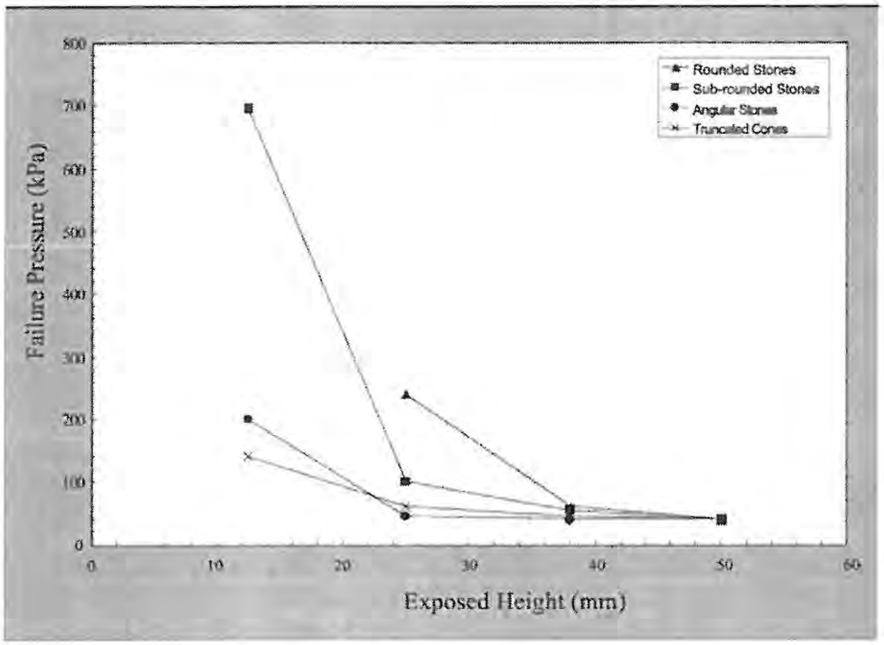


Figure 3.5 Influence of Stone Shape on Geomembrane Failure Pressures.

Table 3.5 Modification Factors for Shape of Stones.

Stone Shape	Modification Factor MF_{PS}
Angular	1.0
Subangular and subrounded	0.5
Rounded	0.25

To incorporate the effect of particle shape, Equation (3.7) can be modified as follows:

$$p_{allow} = \left[450\frac{M}{H^2}\right]\left[\frac{1}{MF_{PS} x FS_{CR}}\right] \tag{3.8}$$

Where, MF_{PS} = modification factor for particle shape.

Equation (3.8) represents the condition of isolated protrusions acting more or less independent of each other. This would be representative of an isolated stone protruding from a surface such as insitu soil or compacted clay liner. In some cases protrusions are placed so close together that their interaction can not be ignored. This is the case, for example, with a drainage layer placed on top of a geomembrane. To determine the influence of closely packed protrusions on geomembrane puncture, a number of tests were performed with AASHTO #3, 57 and 8 aggregate. For this purpose the truncated cones shown in Figure 1.2(b) were replaced by an aggregate layer. To the limit of the equipment, no failure of the geomembrane was noticed even without any protection geotextile. However, geomembrane yield was assumed to be the criteria for failure. Table 3.6 compares the truncated cone failure pressures from Figure 3.1 with yield pressures obtained in this case. It is seen that yield pressures with a layered soil are much higher than failure pressures with individualized stones in Figure 3.1.

The grouping advantage, as indicated in Table 3.6, is incorporated in Equation 3.8 by using a modification factor for packing density, MF_{PD}. Equation 3.8 can be written as:

$$p_{allow} = \left[450\frac{M}{H'^2}\right]\left[\frac{1}{MF_{PS} x FS_{CR}}\right] \quad (3.8a)$$

Table 3.6 A Comparison of Geomembrane Failure Pressures with Truncated Cones and Assemblage of Stones.

HPTC Puncture Test		**Performance Puncture Test with Assemblage of Stones**			
Cone Height mm (in)	**Failure Pressure (kPa)**	**AASHTO Stone**			**Yield Pressure (kPa)**
		No	**d_{50} (mm)**	**d_{max} (mm)**	
50 (2.0)	35	3	38	50	70
38 (1.5)	55	57	12	38	170
25 (1.0)	69	8	10	25	690

Where,

H' = Effective protrusion size = $H x MF_{PD}$
H= Maximum protrusion size
MF_{PD} = Modification factor for packing density
= 1.0 for isolated stones
= 0.5 for packed stones

3.2.1.5 Effect of Biological and Chemical Degradation

Biological degradation is generally not a concern for polypropylene and polyester geotextiles and HDPE geomembranes. Therefore, effectively a factor of safety of 1.0 can be used for biological degradation.

Chemical degradation is a function of type and concentration of chemicals. A factor of safety of 1.0 to 2.0 has been suggested in the literature with a value of 2.0 applicable to aggressive environments and a value of 1.0 to more inert usage conditions (Koerner, 1998). For example, for potable water ponds and canal liners a value of 1.0 may be used. For containment of brine or diluted acids, a value of 2.0 is generally proposed. For landfill leachate an intermediate value of 1.5 is generally proposed. The reader is recommended to use these values with adequate caution and engineering judgment. Equation 3.8 may be modified for chemical and biological degradation as follows:

$$p_{allow} = \left[450 \frac{M}{H'^2} \right] \left[\frac{1}{MF_{PS} x FS_{CR} x FS_{CBD}} \right] \tag{3.9}$$

Where, FS_{CBD} = factor of safety for chemical and biological degradation.

Equation 3.9 is the final relationship for the calculation of allowable overburden pressure for an geomembrane protected by a nonwoven needlepunched geotextile of mass per unit area M grams/m^2. All terms in the equation and their values have been discussed in the forgoing sections.

3.3 Global Factor of Safety

A global factor of safety against the puncture of a geomembrane can be defined by Equation 3.10.

$$FS = \frac{p_{allow}}{p_{reqd}} \tag{3.10}$$

Where, p_{allow} = as defined in Equation 3.9, and p_{reqd} is the site-specific overburden pressure discussed in Section 2.3.

The objective of a successful design method for protection of geomembranes should be to prevent the geomembrane puncture over the design life of a geomembrane liner system. This requires the use of a suitable value for global factor of safety in Equation 3.10 to offset the effect of various uncertainties in design, testing and installation. The authors suggest using a value of 3 in Equation 3.10 as a reasonable value against an actual puncture, defined as a hole, in the geomembrane.

It is well known that HDPE geomembranes yield much earlier in the stress-strain curve than the actual rupture (see stress-strain curves for various geomembranes in Chapter 2). Thus, although a global factor of safety of 3 in Equation 3.10 will prevent an actual puncture, it is quite possible that the yield of the geomembrane would still take place. Thus, much higher values of global factors of safety need to be used to ensure that the yield of the geomembrane over the design life is prevented. Koerner, et. al. (1996) performed theoretical analysis of yield of geomembrane and compared it with failure pressures from truncated cone puncture test. On the basis of this analysis, they suggest using global factors of safety against yield provided in Table 3.7.

Table 3.7 Proposed Values of Global Factors of Safety (modified from Koerner, et. al., 1996).

Effective Protrusion Height (mm)	Minimum Global Factor of Safety Against Yield	Minimum Global Factor of Safety Against Puncture
6	3.0	3
12	4.5	3
25	7.0	3
38	10.0	3

Replace Select Portions of the Existing RMU-1 Engineering Report With the Following Revised Portions.

ENGINEERING REPORT
FOR
CWM CHEMICAL SERVICES, LLC
MODEL CITY FACILITY, RESIDUALS MANAGEMENT UNIT 1
MODEL CITY, NIAGARA COUNTY, NEW YORK

February 1992

Revised November 1995

Revised June 1996

Revised February 1997

Revised June 1997

Revised February 1999

Revised December 2003

Revised December 2004

Revised June 2008

Revised August 2012

ACCOMPANYING SET OF PLANS

(Cont'd)

15A	Cross Section 23+25E	EarthTech
15A-a	Cross Section 23+25E	BBL
16	Cross Sections 85+50N, 91+00N	EarthTech (A-55284)
16-a	Cross Sections 85+50N, 91+00N	BBL
16A	Cross Section 97+50N	EarthTech
17	Typical Liner Sections Cells 1 through 6	EarthTech (A-55283)
17A	Typical Liner Sections Cells 7 through 14	EarthTech
18	Sump Details	EarthTech (A-55282)
18A	Sump Details Cells 5 through 14	EarthTech
19	Cell Separation Berm Details	EarthTech (A-55281)
19B	Cell Separation Berm Details Cells 5 and 6	EarthTech
19C	Cell Separation Berm Details for Cells 7 through 14	EarthTech
20	Riser Details	EarthTech (A-55280)
20-a	Riser Details	BBL
21	Final Cover Details	EarthTech
21-a	Final Cover Details	BBL
21A	Site Details	EarthTech
21A-a	Site Details	BBL
21B	Site Details (with Compacted Clay)	BBL
21C	Final Cover Details (with GCL)	BBL
21D	Final Cover Details (with GCL)	BBL
22	Site Surface Water Plan and Details	EarthTech (A-55278)
22-a	Site Surface Water Plan and Details	BBL
23	Access Road Layout and Details	EarthTech (A-55277)
23-a	Access Road Layout and Details	BBL
23A	Landfill Plateau Access Road Details	ARCADIS
24	Leachate Transfer System and Electrical Site Plan	EarthTech (A-55276)
25	Leachate Extraction Details Cells 1 through 4	EarthTech (A-55275)
25A	Leachate Extraction Details Cells 5, 6, 7, 10, 13 & 14	EarthTech
26	Lift Station and Junction Manholes	EarthTech (A-55274)
27	Structural Details	EarthTech (A-55273)
28	Electrical Plan, Symbols, and Details	EarthTech (A-55272)

affect the integrity of the final cover geomembrane, because it is expected to be predominantly even over the entire surface due to waste filling procedures. There is potential for differential settlement and the geomembrane has been designed to accommodate the minor movement. Result of waste settlement analysis is presented in Appendix D-2. Recognize this analysis assumes highly compressible municipal waste materials and as such calculated settlements will likely exceed actual settlements experience by RMU-1.

SURFACE WATER

To provide long-term protection against possible erosion of the cover slope, 15-foot wide benches, with surface water diversion ditches spaced at approximately 90-foot intervals collect a majority of the runoff surface water which is directed to the south and discharged through down flume piping to the east retention basin. Only surface water from below the first bench on the northern half of the unit and the northeast corner, above the first bench, will be directed to the north retention basin. Surface water calculations utilizing a 25-year 24-hour storm event are presented in Appendix I. Drawing No. 12 of the accompanying drawings shows the alignment of the surface water drainage system. The seeded topsoil slope will be maintained to prevent erosion. Sideslope diversion ditches will be constructed to minimize slope erosion. Appendix I contains erosion calculations for the final cover conditions.

Surface water during construction and operation of RMU-1 will be handled within the landfill cell. At completion of the final cover, some of the surface water will be allowed to drain to the north exiting retention basin, then off the site naturally. The majority of the surface water will drain to the east, through the new retention basin and then off-site in a channel. Jute mesh or other biodegradable mesh will be used to enhance the establishment of vegetation as soon as possible within the drainage channels. The channels may require sodding to reduce erosion rates if vegetation is not readily established.

ROADS

RMU-1 will be accessed via Balmer Road to the site's access roads. The truck entrance is located along Balmer Road at the northern section of the site where Balmer intersects the site's Marshall Street. Marshall Street provides access to perimeter access roads immediately adjacent to RMU-1. The road entering RMU-1 has been designed to enter over the perimeter berm at the cell separation berms and into the cells. The proposed filling sequence and waste types do not require a cell separation berm to be extended during operations (as in the past landfills). If CWM chooses to construct road support berms, the gravel removed during this construction within the landfill limits will remain in the landfill and be used as temporary road subgrade across the lift of waste.

During later stages of waste filling, the increasing elevations of the waste mass will prevent the use of traditional haul roads, which typically have encroached into the permitted waste envelop. Thus, a new landfill plateau access road (planned for construction in late 2012) will be constructed on top of existing final cover areas so that the landfill final buildout may proceed without further restrictions imposed by vehicle access needs. The new single-lane width gravel road will be constructed from the perimeter berm diagonally up the northern face of the landfill and onto the plateau. Other than topsoil removal within the road footprint, no other modifications should be needed to the existing final cover to accommodate the road. The majority of the road will be constructed of general fill and will be surfaced with an 18-inch-thick layer of crusher run, which will be underlain with a woven geotextile. A guiderail will be included along the outside edge. Once constructed, the landfill plateau access road will remain in place as a permanent feature. The accompanying drawings illustrate the planned access into RMU-1.

Insert the Following New RMU-1 Engineering Report Appendix D-11 (Landfill Plateau Access Road Stability) into the RMU-1 Engineering Report.

Appendix D-11

Landfill Plateau Access Road Stability

1 FINAL COVER STABILITY WITH ACCESS ROAD

1.1 INTRODUCTION

Evaluate the stability of the final cover under the following conditions:

(1) Long-Term Stability - using peak and residual shear strengths without construction equipment loadings;

(2) Short-Term Stability - using peak and residual shear strengths with trucks on the road surface.

As indicated above, analyses for peak and residual strengths are provided for long and short-term analyses. The proposed road traverses areas that have already been final covered. Therefore, the analyses have been performed using the results of interface shear tests that were performed at the time of construction in Phases I-III and Phase IV. In addition, the quality control testing also included a test of the cover soils above the cap fml/drainage geocomposite. This test result was utilized to represent the existing protective cover that will remain in place. Properties of the soils that comprise the proposed access road and the proposed geo-reinforcement are specified as minimum values that will be met or exceeded at the time of construction.

1.2 PROPERTY SELECTION

The access road traverses two phases of the final cover system that have already been constructed. The shear testing for the final cover interfaces and cover soils is presented in Figures 1, 2 and 3 for Phase I-III interfaces, Phase IV interfaces, and Protective cover, respectively. As can be seen in the aforementioned figures, the interface testing for the two phases had different values of both peak and residual (large displacement (LD)) shear strengths. Each figure also contains the best fit of the data to a Mohr-Coulomb envelope. The shear test results are summarized below.

RMU-1 Shear Test Results

Material	φ'_{peak}	c'_{peak}	φ'_{LD}	c'_{LD}
Phase I-III Interfaces	26.7°	162.6 psf	16.96°	153.6 psf
Phase IV Interfaces	25.91°	105.9 psf	12.07°	77.31 psf
Protective Cover Soil [1]	20.7 °	503.8 psf	NA	NA

1. For the protective cover the fully softened shear strength was chosen to represent the soil shear behavior in the test.

These tests were conducted with a normal stress range of 400 or 500 psf minimum to 1700 psf maximum for interface shear and up to 2269 psf for the protective soils.

Selected properties for Design are summarized below, including the materials not yet incorporated into the work.

RMU-1 Access Road Design Values

Material	φ'_{peak}	c'_{peak}	φ'_{LD}	c'_{LD}
Phase I-III Interfaces	26.7°	162.6 psf	16.96°	153.6 psf
Phase IV Interfaces	25.91°	105.9 psf	12.07°	77.31 psf
Protective Cover Soil [1]	20.7 °	503.8 psf	NA	NA
Added Compacted Fill	30°	0	NA	NA

RMU-1 Access Road Design Geo-Reinforcement Strengths

Reinforcing Layer	**Long Term Tension Capacity (TAL)** **(lbs/ft)**	**Short Term Tension Capacity** **(lbs/ft)**
Phase I-III	800	800/0.85 = 941
Phase IV	800	800/0.85 = 941

(Capacities refer to the direction normal to the slope of the landfill including reduction factors for placement, damage, and length of service)

1.3 ANALYSIS

Stability analyses were performed using the SlopeW module of GeoStudio 2012 geotechnical software version 8.0.7.1629, the latest version available at the time of this work. The analyses were performed using Spencer's Method.

The conditions with and without geo-reinforcement within the fills above the existing protective cover, with peak and large displacement shear strengths assigned to the interfaces were evaluated.

Simulation of a loaded waste delivery truck was performed using a 300 psf surcharge 10 feet wide centered on the berm or , where the berm widened, 14 feet wide.

Five sections were analyzed, representing the various locations of the proposed roadway berm relative to the existing benches, and also within the two closure phases. The locations are shown in Figure 4 The access road and final grading were provided by Arcadis. Each of the sections, named Sec R1 through R5, were used in the file name, which is called out in the Geostudio graphic output figures. Block and rotation failures were analyzed and optimization of all failure surfaces was allowed.

Graphical outputs of all the analyses are presented in Figures 5 through 34.

1.4 RESULTS

The analyses indicated that all critical failure surfaces were located within the proposed fill and or protective cover soils. Factors of safety of 1.5 or higher required the inclusion of typically 2 layers of geo-reinforcement with or without truck loading. Failures forced to FML interface level within the final cover system had higher factors of safety. This was true even when the geo-reinforcement was omitted from the analyses. In general geo-reinforcement layers located 4.3 and 6.8 feet below the proposed road surface and projecting back either 17 feet or 1 foot into the existing protective cover, whichever is less, were sufficient to provide the desired factor of safety. Where the road is located almost directly over the bench and fill is minimal, as reflected in Sec R-4, the lower geo-reinforcement layer was not necessary. Graphical outputs at this section show the reinforcement layer 2 to have a 0 strength.

In addition, a factor of safety well in excess of 1 was obtained when residual strengths were assigned to the interfaces, even when the geo-reinforcement was omitted from the design

1.5 RECOMMENDATIONS

- Construct the access road as currently depicted with 2:1 out slopes

- Incorporate geo-reinforcement with a long term static tensile capacity of 800 pounds per lineal foot at depths of 4.3 and 6.8 feet below the road surface. The geo-reinforcement should be deployed with the machine direction perpendicular the to the protective cover slope unless biaxial geogrid is utilized. If biaxial grid is used it may be deployed with the machine direction along the road alignment provided the strength in the cross machine direction meets the above specified strengths.

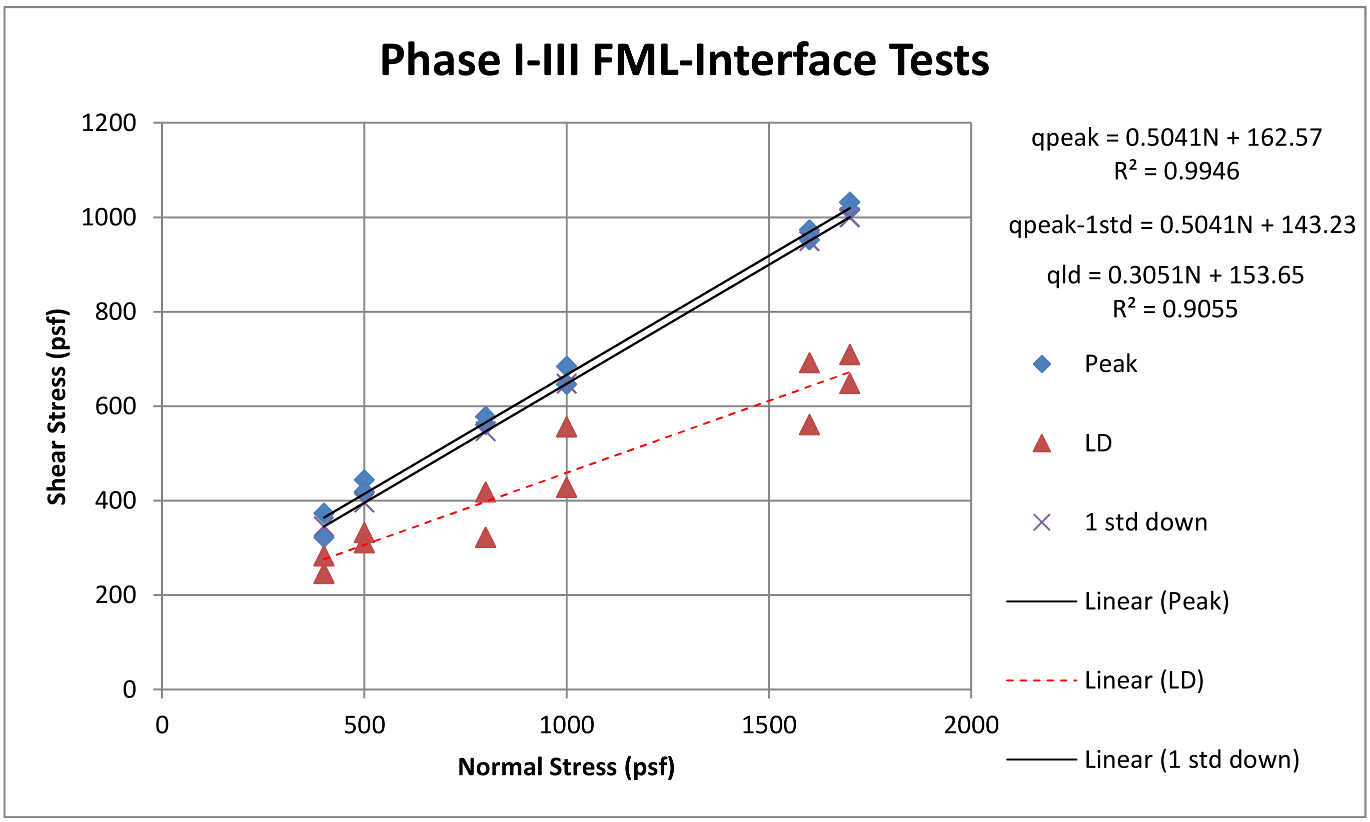
- If deployed along the road alignment, overlap of geo-reinforcement shall be sufficient to fully develop the grid strength.

- Line the drainage ditch at the uphill side of the berm with an FML to prevent development of piezometric heads within the berm.

- Strip the vegetative layer and scarify the upper surface of the protective cover prior to construction of the access road fill

- Compact only the upper two feet of the fill added to form the road embankment. Below that depth track the materials with a dozer. Compaction of the lower portions of these soils will result in poor drainage over time and negatively impact stability.

- Geo-reinforcement should conform to the attached general specifications.



Phase I-III FML-Interface Tests
Shear Stress (psf)
Normal Stress (psf)
1200
1000
800
600
400
200
0
0
500
1000
1500
2000
qpeak = 0.5041N + 162.57
R² = 0.9946
qpeak-1std = 0.5041N + 143.23
qld = 0.3051N + 153.65
R² = 0.9055
Peak
LD
1 std down
Linear (Peak)
Linear (LD)
Linear (1 std down)

FIG - 1

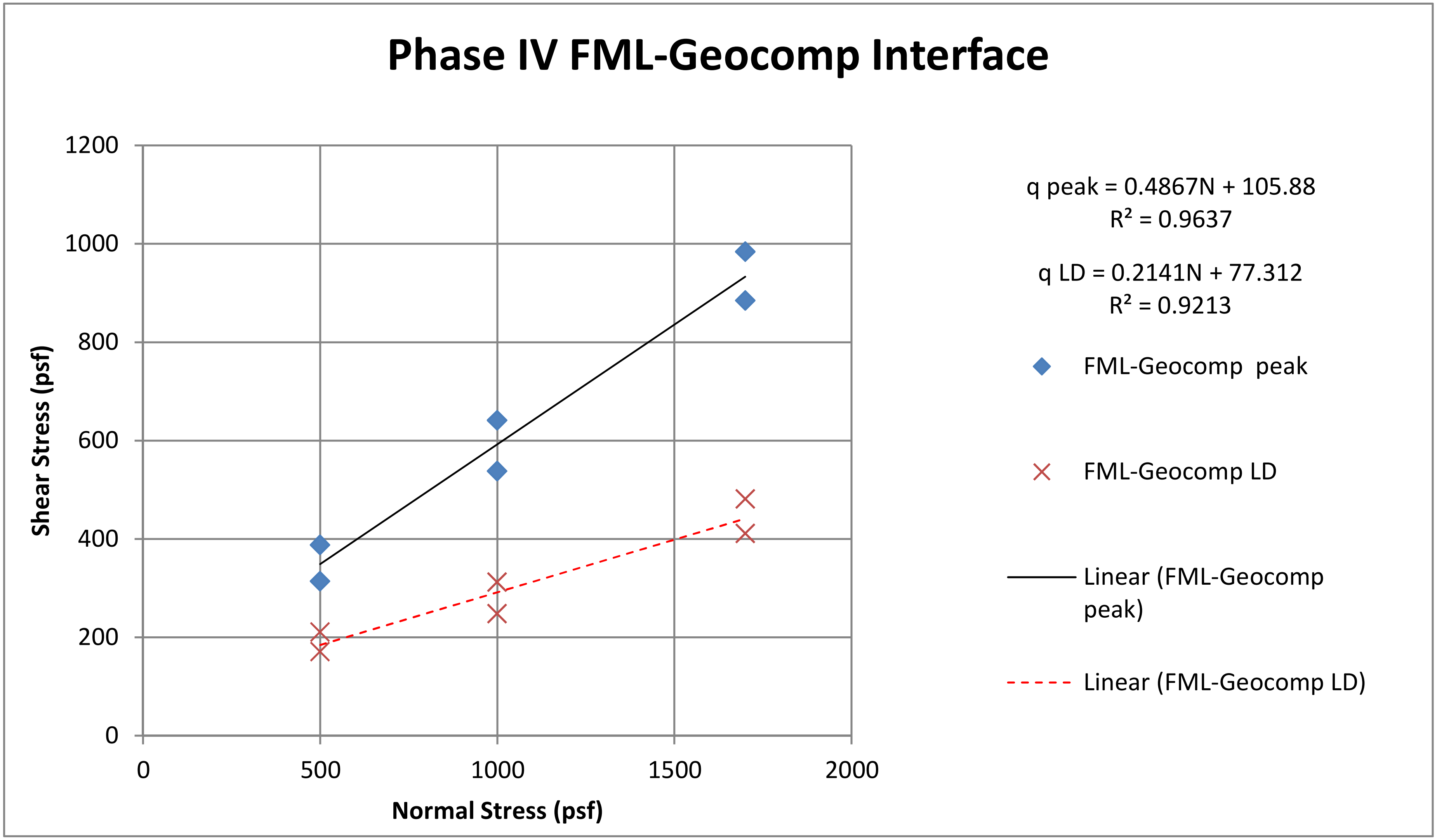
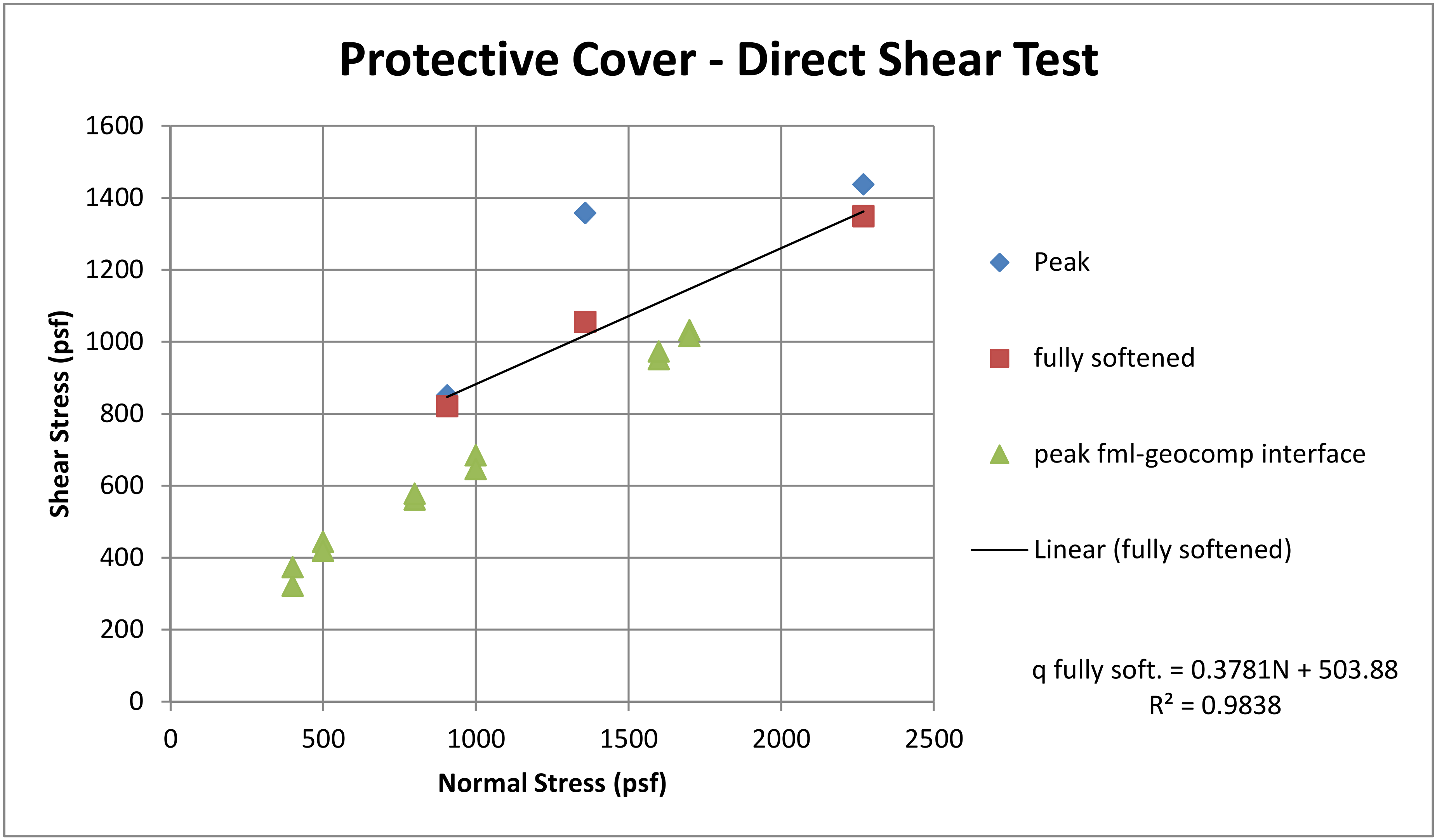
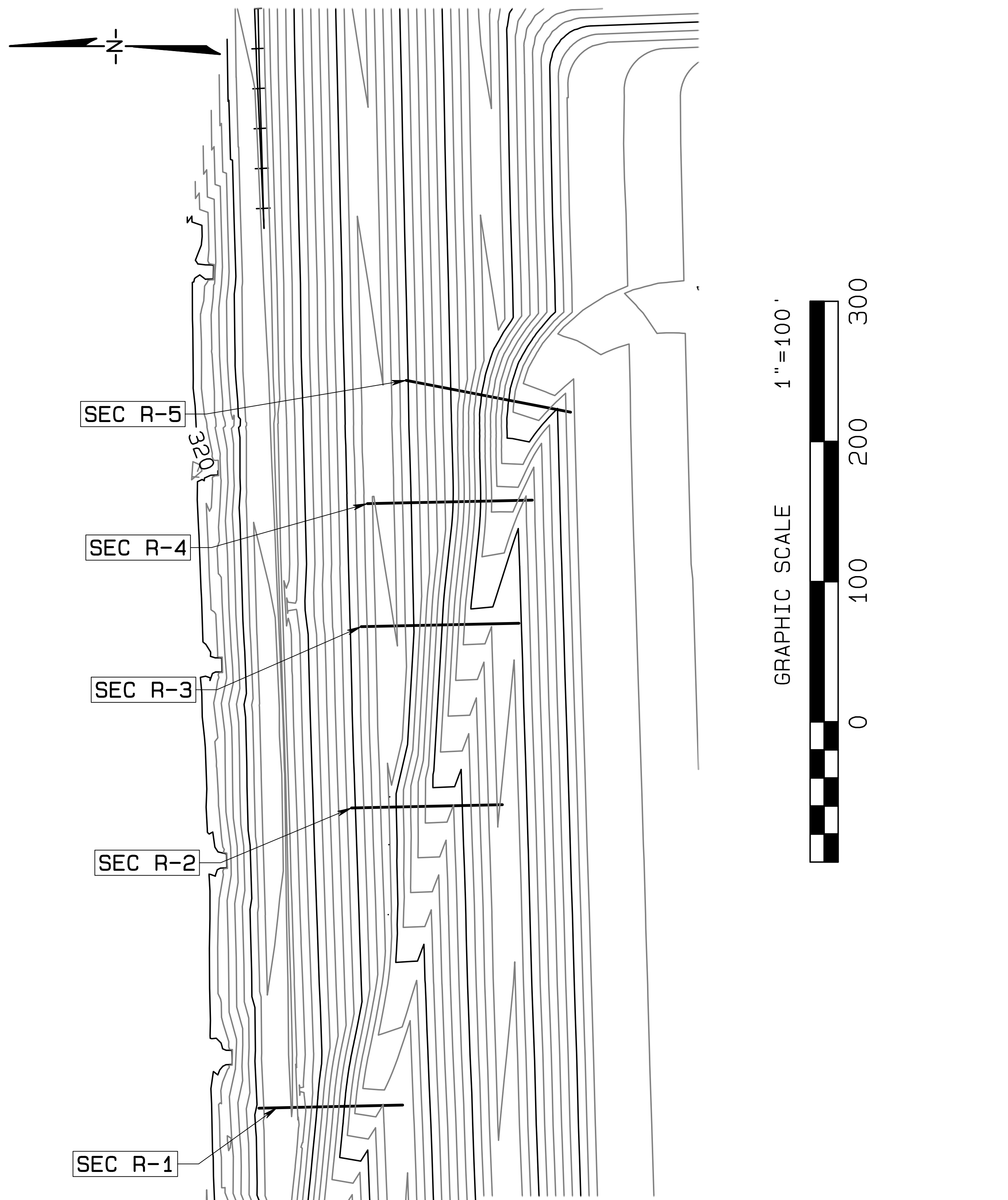

Phase IV FML-Geocomp Interface
1200
1000
800
600
400
200
0
Shear Stress (psf)
0
500
1000
1500
2000
Normal Stress (psf)
q peak = 0.4867N + 105.88
R² = 0.9637
q LD = 0.2141N + 77.312
R² = 0.9213
FML-Geocomp peak
FML-Geocomp LD
Linear (FML-Geocomp peak)
Linear (FML-Geocomp LD)

FIG - 2



Protective Cover - Direct Shear Test
Shear Stress (psf)
1600
1400
1200
1000
800
600
400
200
0
0
500
1000
1500
2000
2500
Normal Stress (psf)
Peak
fully softened
peak fml-geocomp interface
Linear (fully softened)
q fully soft. = 0.3781N + 503.88
R² = 0.9838

FIG - 3



CWM - RMU-1 ACCESS ROAD ADDITION
MODEL CITY, NY

FIGURE -1
ACCESS ROAD WITH STABILTY SECTIONS

DESIGNED BY	PJC	CHECKED BY	
DRAWN BY	PJC	DATE	8/8/2012
SCALE: AS SHOWN		SHEET No. FIGURE 1	Revision No. 0

FIG - 4

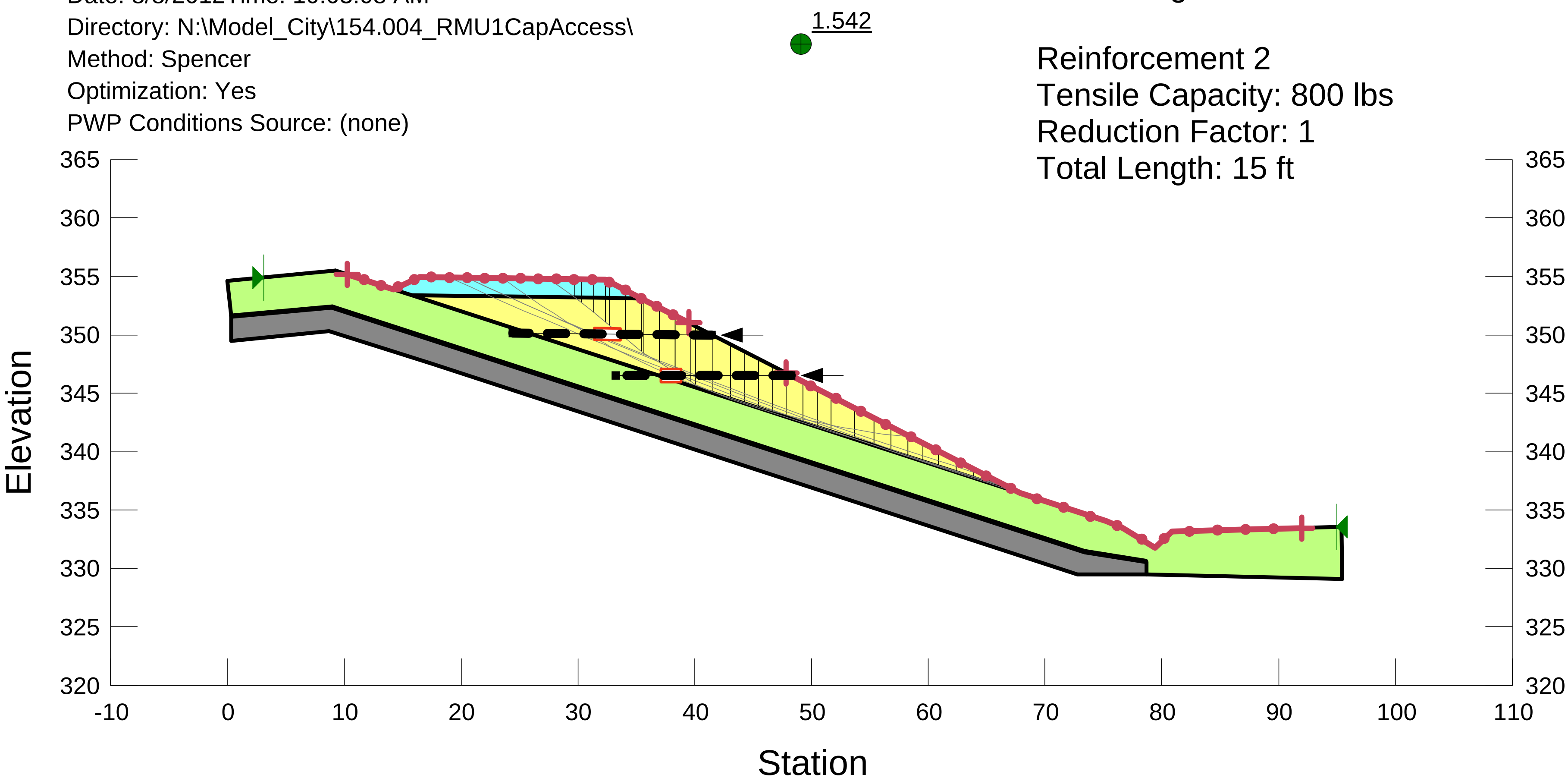
P. J. Carey & Associates, P.C.

Project Desc.: Path: N:\Model_City\154.004_RMU1CapAccess\dwgs\RMU-1AccessRD.pro Plot Date/Time: Wed Aug 8,2012 / 16:58:54

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads
Description: Road Berm with no added loads
Name: SEC R-1.gsz
Date: 8/8/2012Time: 10:03:08 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 16.999997 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 15 ft

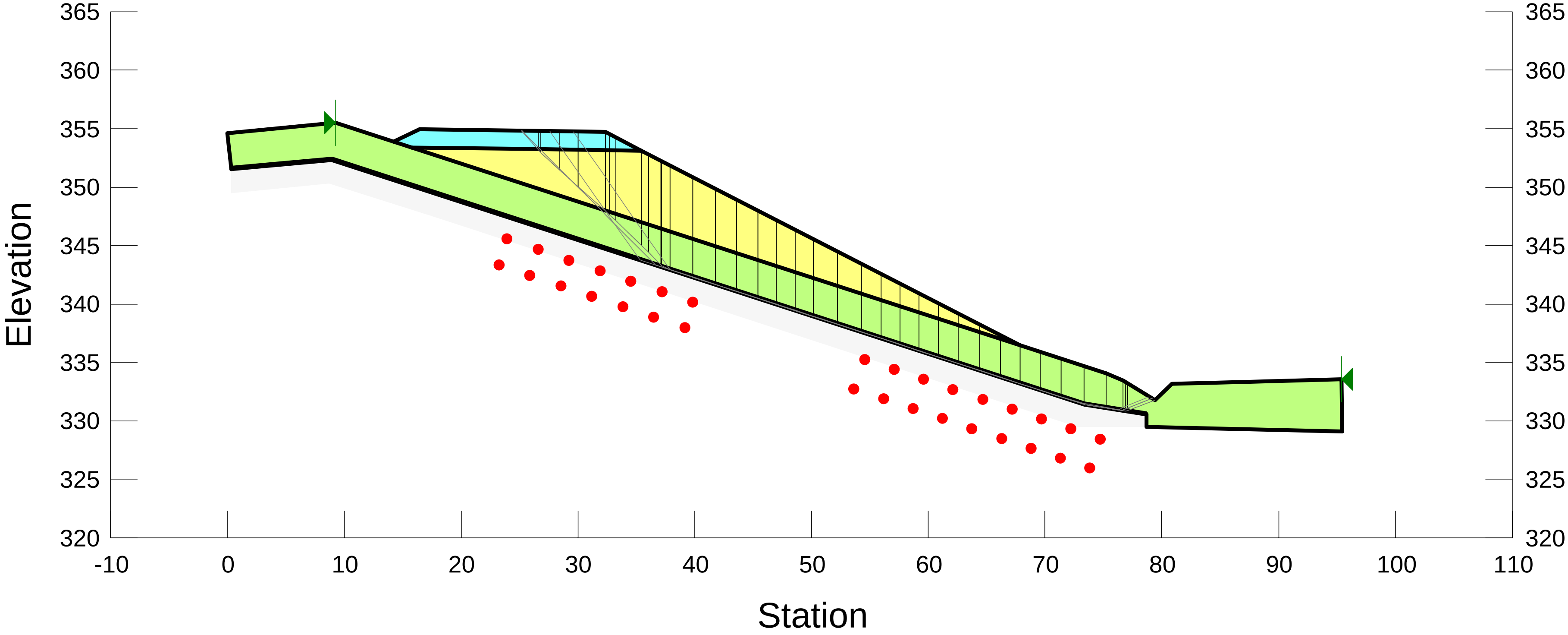


Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 5

2.018

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads fml interface (2)
Description: block searches
Name: SEC R-1.gsz
Date: 8/8/2012Time: 10:03:08 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



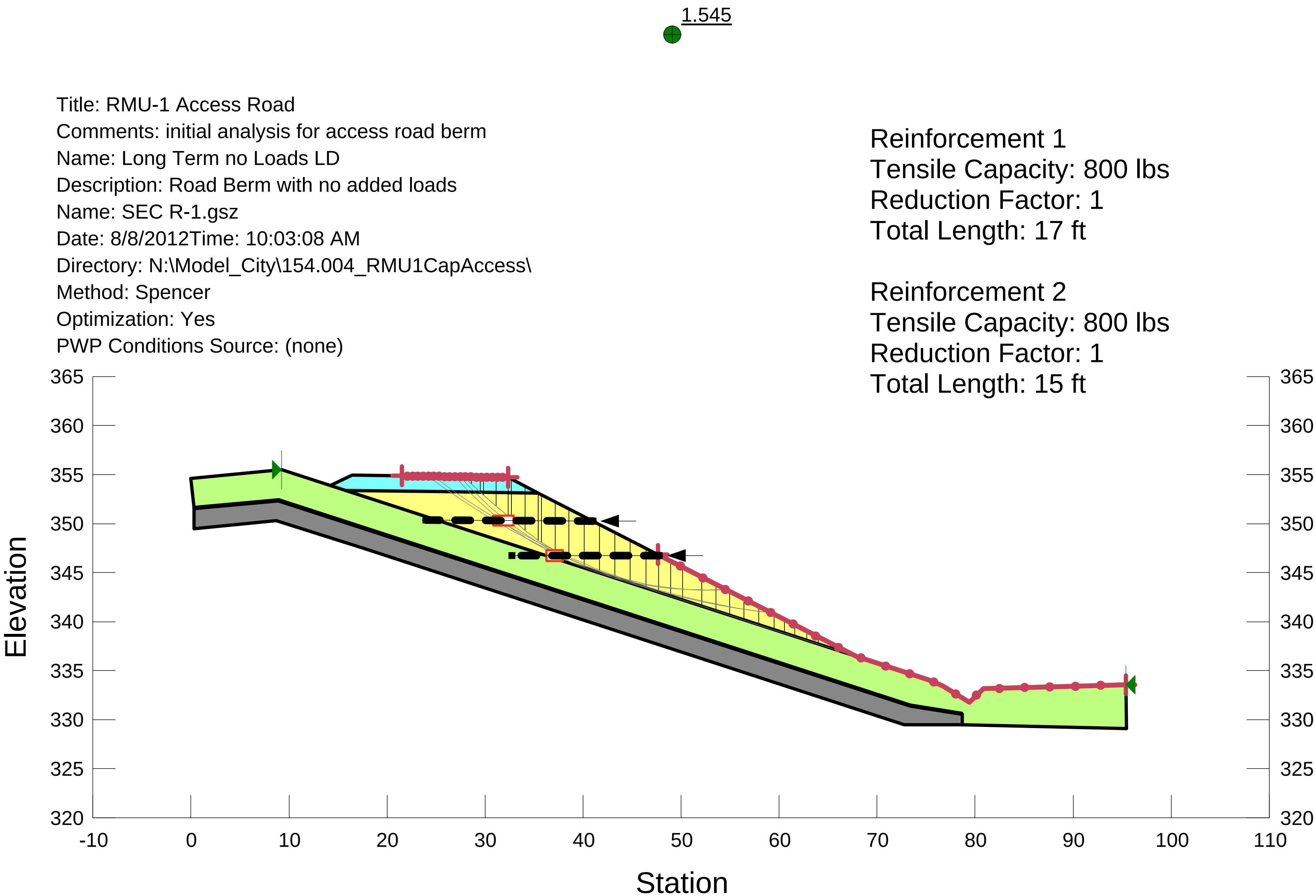
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 6

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads LD
Description: Road Berm with no added loads
Name: SEC R-1.gsz
Date: 8/8/2012Time: 10:03:08 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 17 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 15 ft

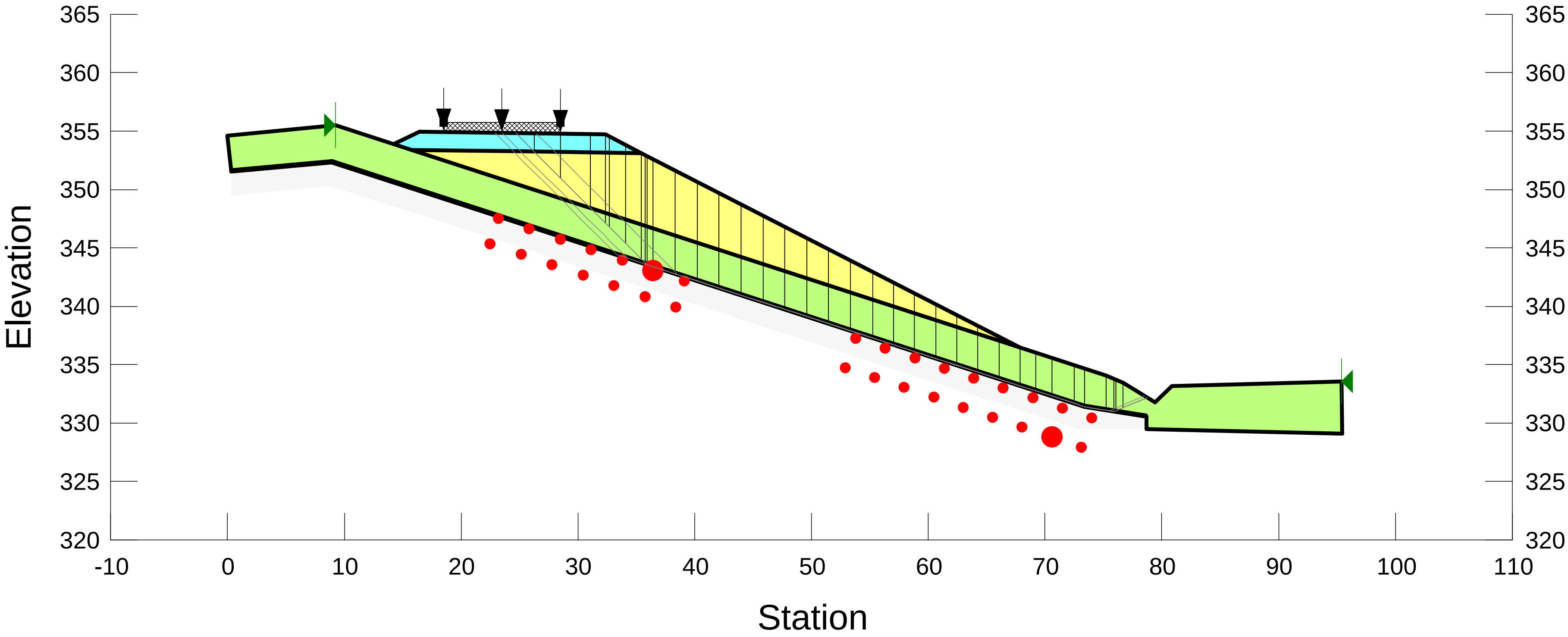


Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 153 psf Phi': 16.96 °

FIG - 7

2.008

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Truck Loading
Description: block searches
Name: SEC R-1.gsz
Date: 8/8/2012Time: 10:03:08 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

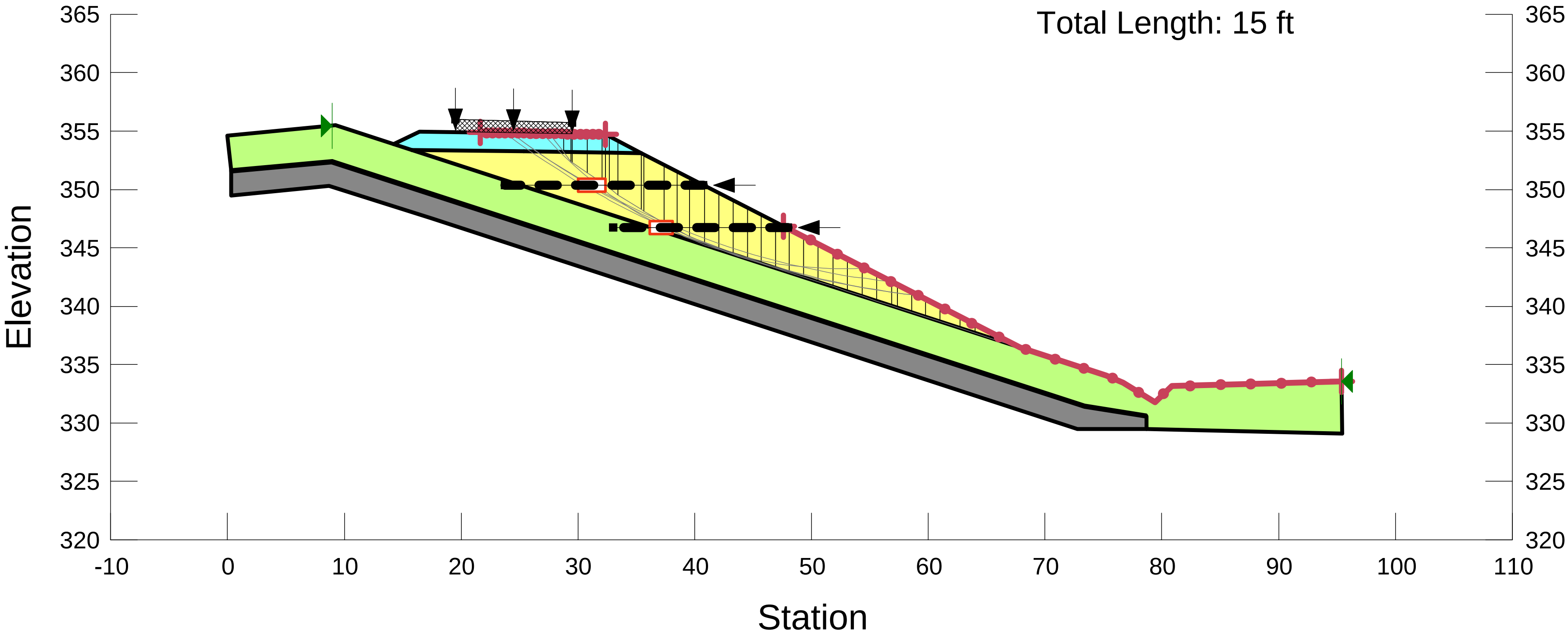
FIG - 8

1.544

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles
Description: Road Berm with truck loading
Name: SEC R-1.gsz
Date: 8/8/2012Time: 10:03:08 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 15 ft



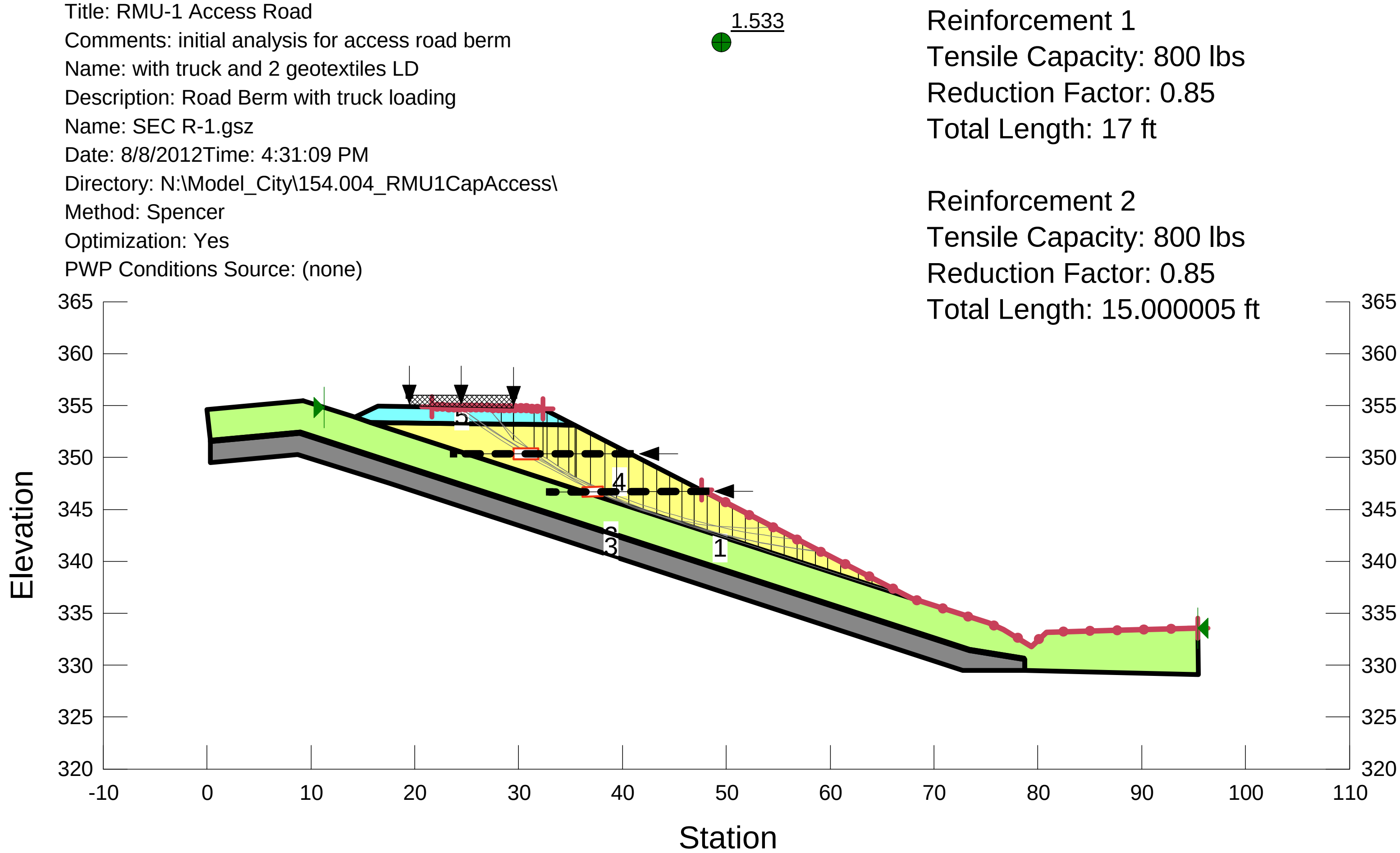
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 9

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles LD
Description: Road Berm with truck loading
Name: SEC R-1.gsz
Date: 8/8/2012Time: 4:31:09 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 15.000005 ft



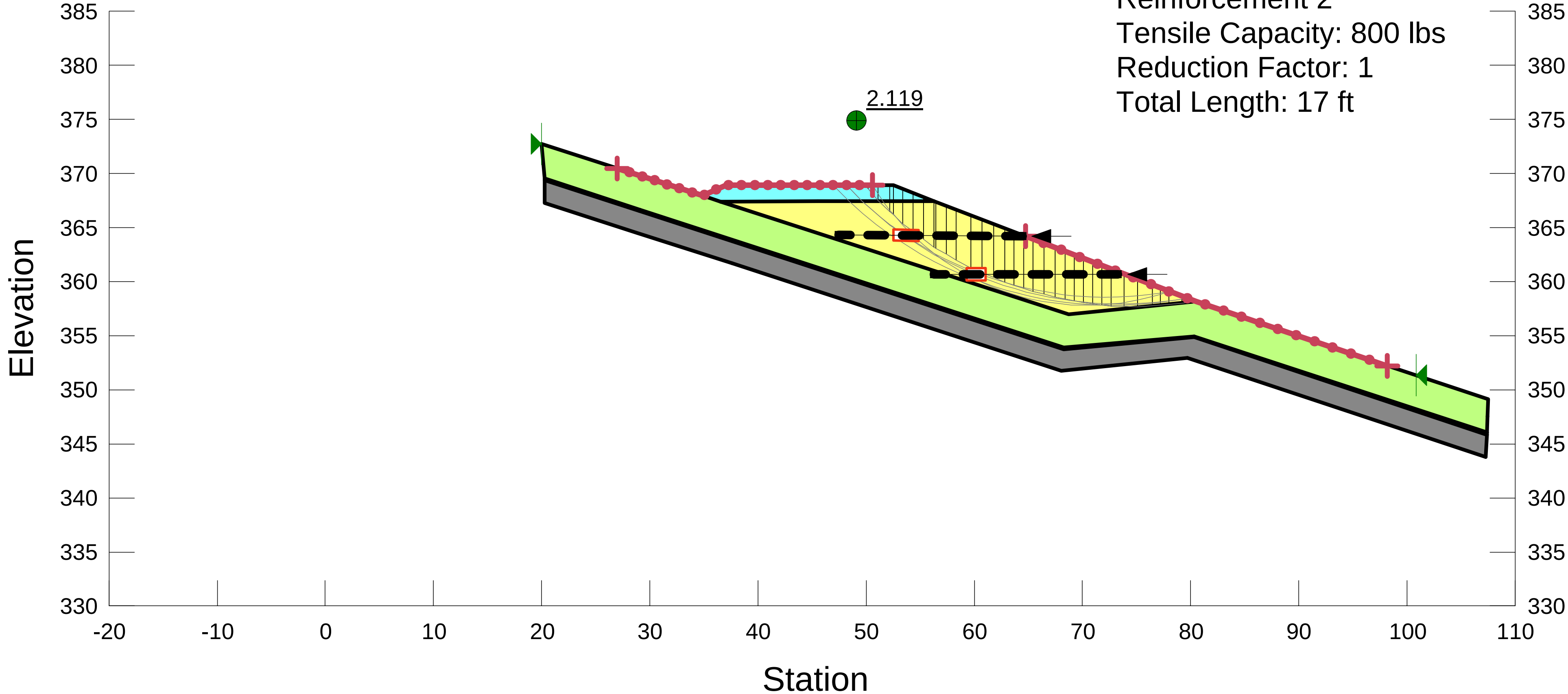
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 153 psf Phi': 16.96 °

FIG - 10

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads
Description: Road Berm with no added loads
Name: SEC R-2.gsz
Date: 8/8/2012Time: 11:36:45 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 16.999997 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 17 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 11

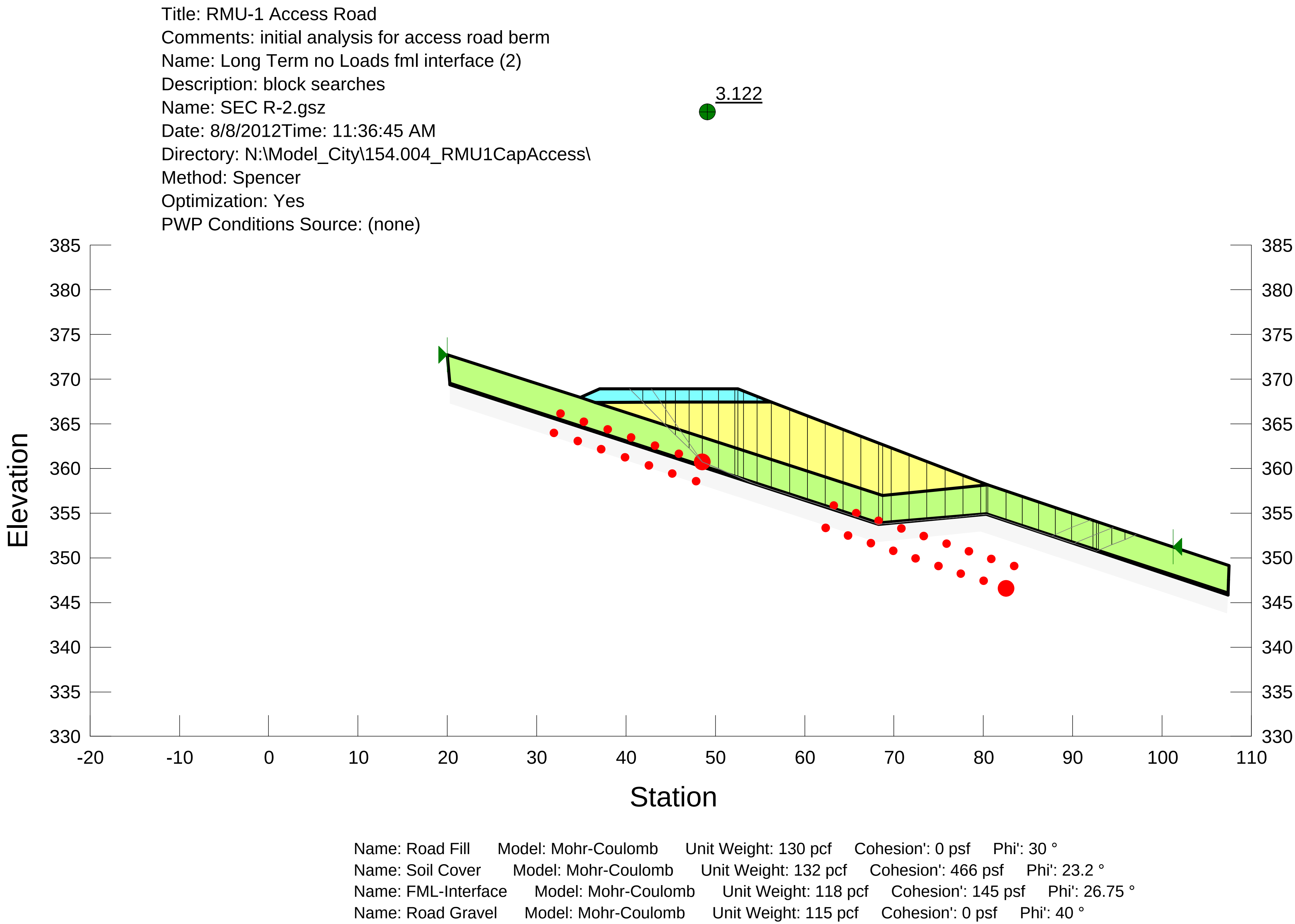
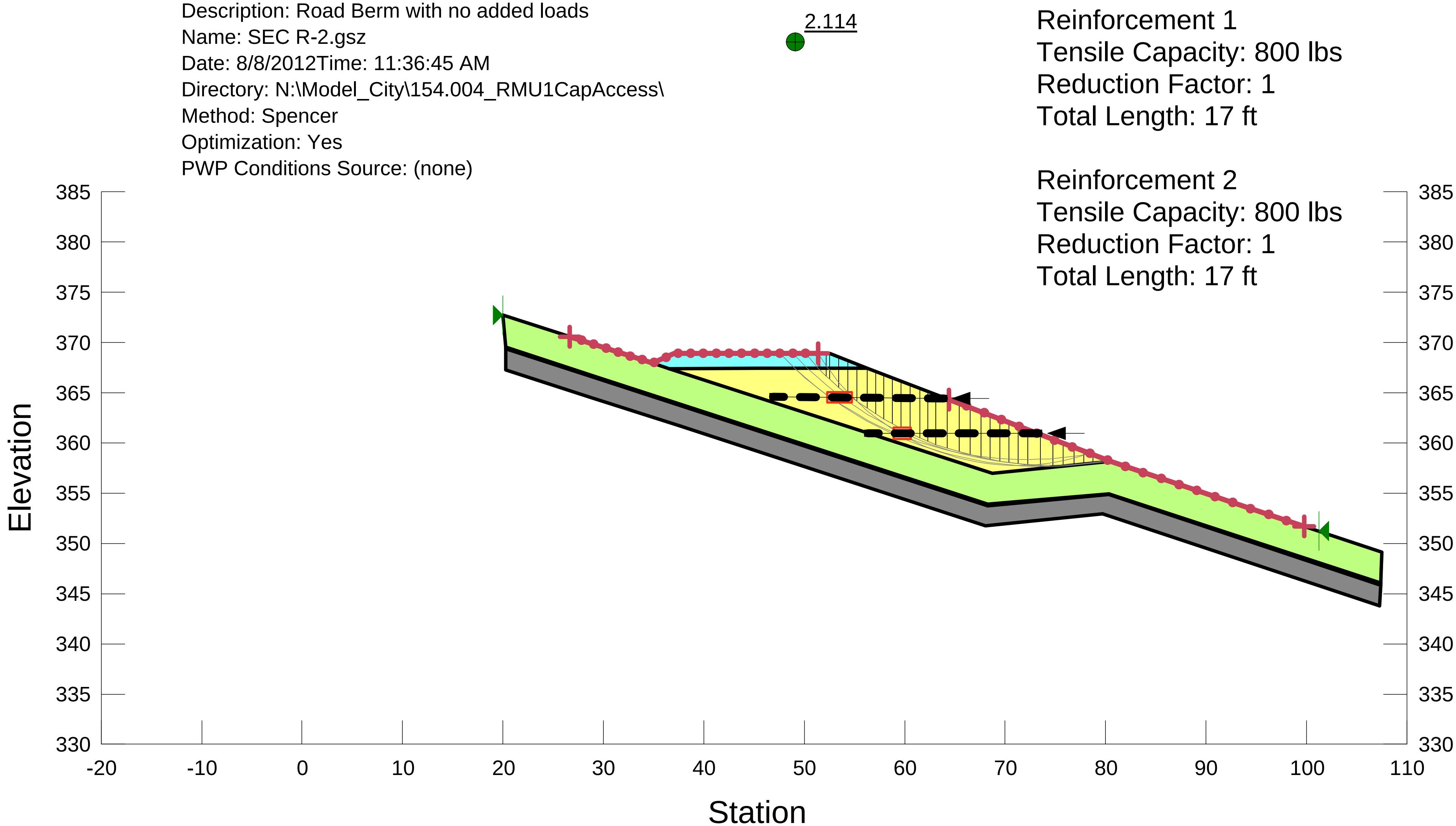

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads fml interface (2)
Description: block searches
Name: SEC R-2.gsz
Date: 8/8/2012Time: 11:36:45 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)
3.122
Elevation
385
380
375
370
365
360
355
350
345
340
335
330
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
Station
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 12

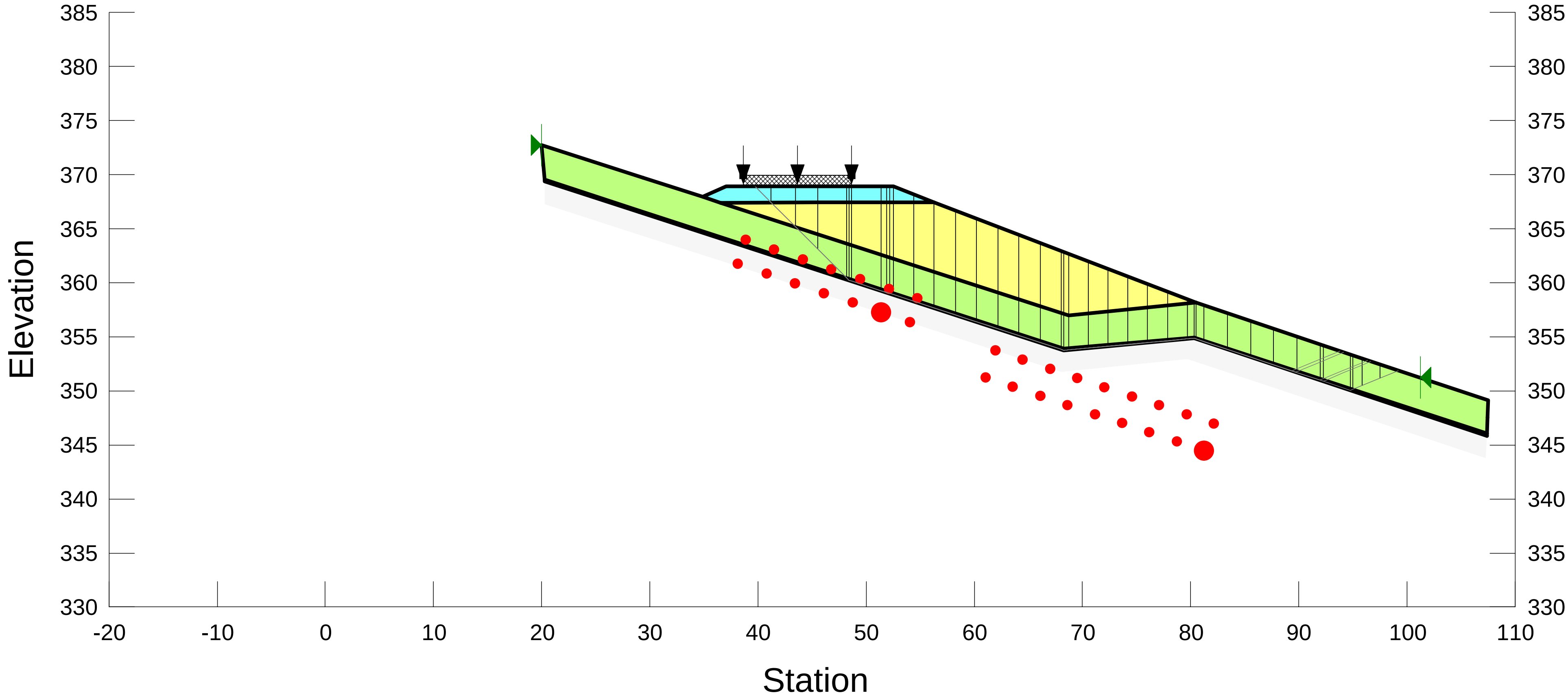
Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads LD
Description: Road Berm with no added loads
Name: SEC R-2.gsz
Date: 8/8/2012Time: 11:36:45 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 153 psf Phi': 16.96 °

FIG - 13

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Truck Loading
Description: block searches
Name: SEC R-2.gsz
Date: 8/8/2012Time: 11:36:45 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



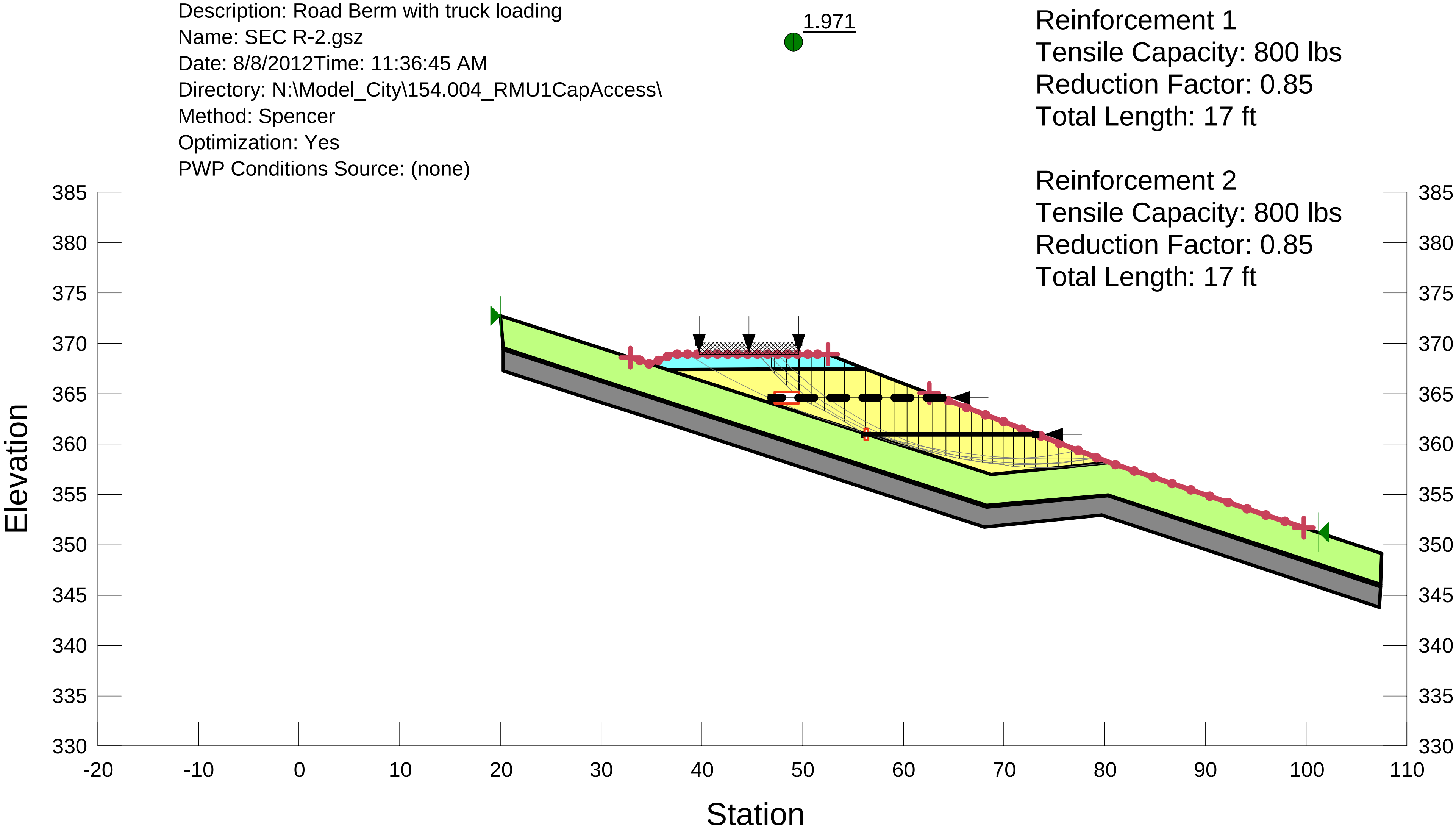
Name: Road Fill   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 30 °
Name: Soil Cover   Model: Mohr-Coulomb   Unit Weight: 132 pcf   Cohesion': 466 psf   Phi': 23.2 °
Name: FML-Interface   Model: Mohr-Coulomb   Unit Weight: 118 pcf   Cohesion': 145 psf   Phi': 26.75 °
Name: Road Gravel   Model: Mohr-Coulomb   Unit Weight: 115 pcf   Cohesion': 0 psf   Phi': 40 °

FIG - 14

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles
Description: Road Berm with truck loading
Name: SEC R-2.gsz
Date: 8/8/2012Time: 11:36:45 AM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

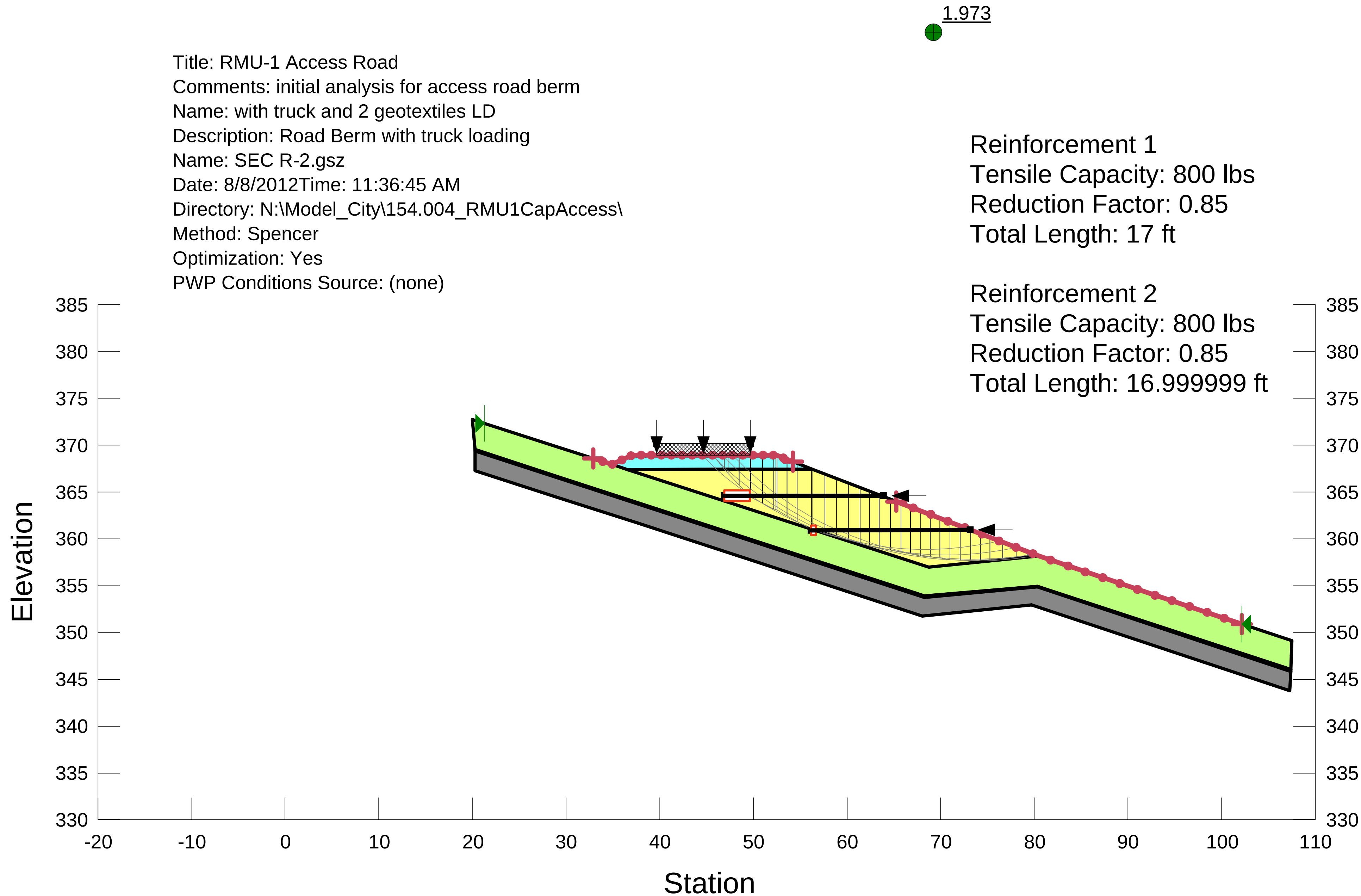
Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 15



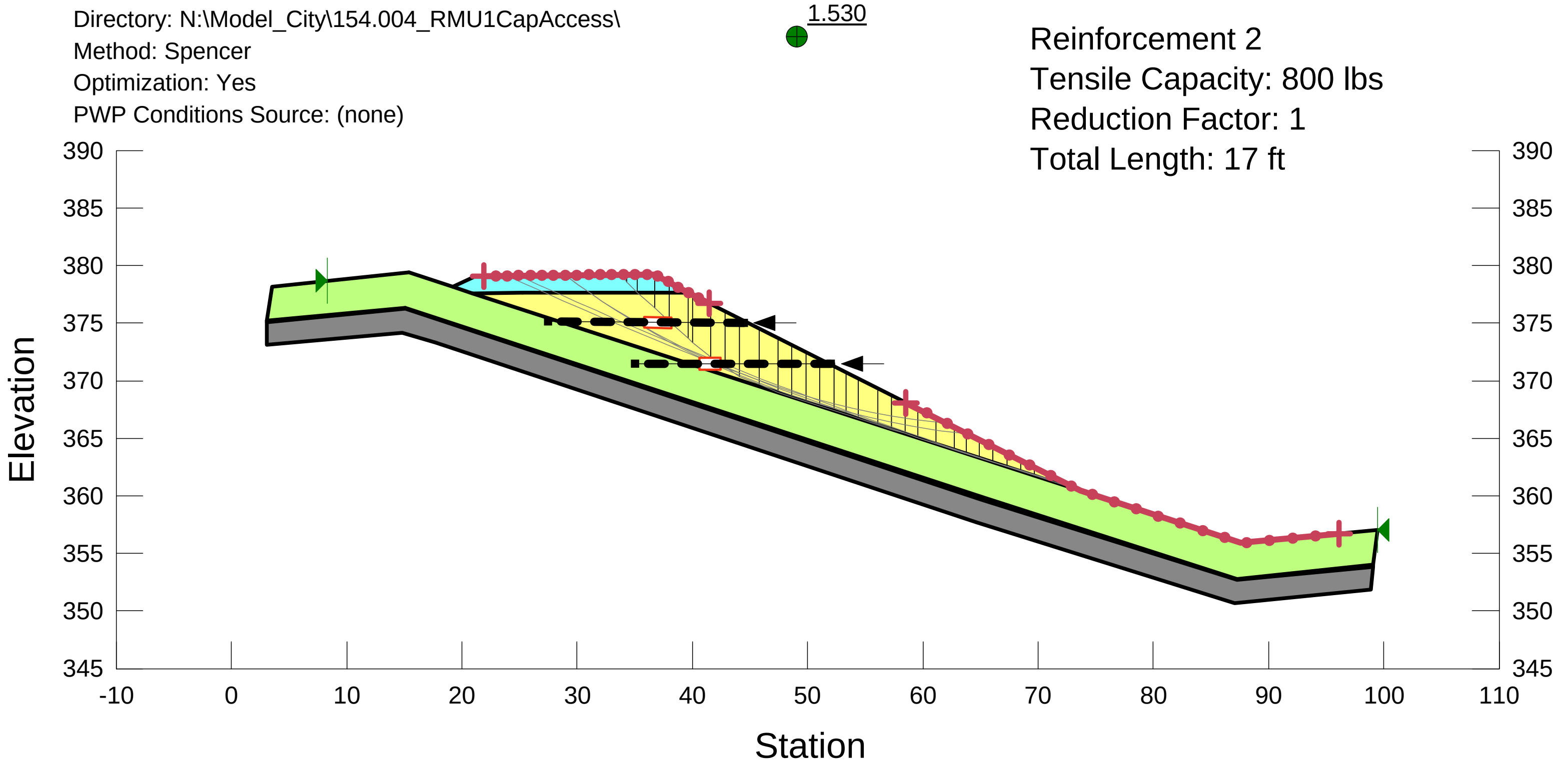
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 153 psf Phi': 16.96 °

FIG - 16

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads
Description: Road Berm with no added loads
Name: SEC R-3.gsz
Date: 8/7/2012Time: 6:41:48 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 16.999997 ft

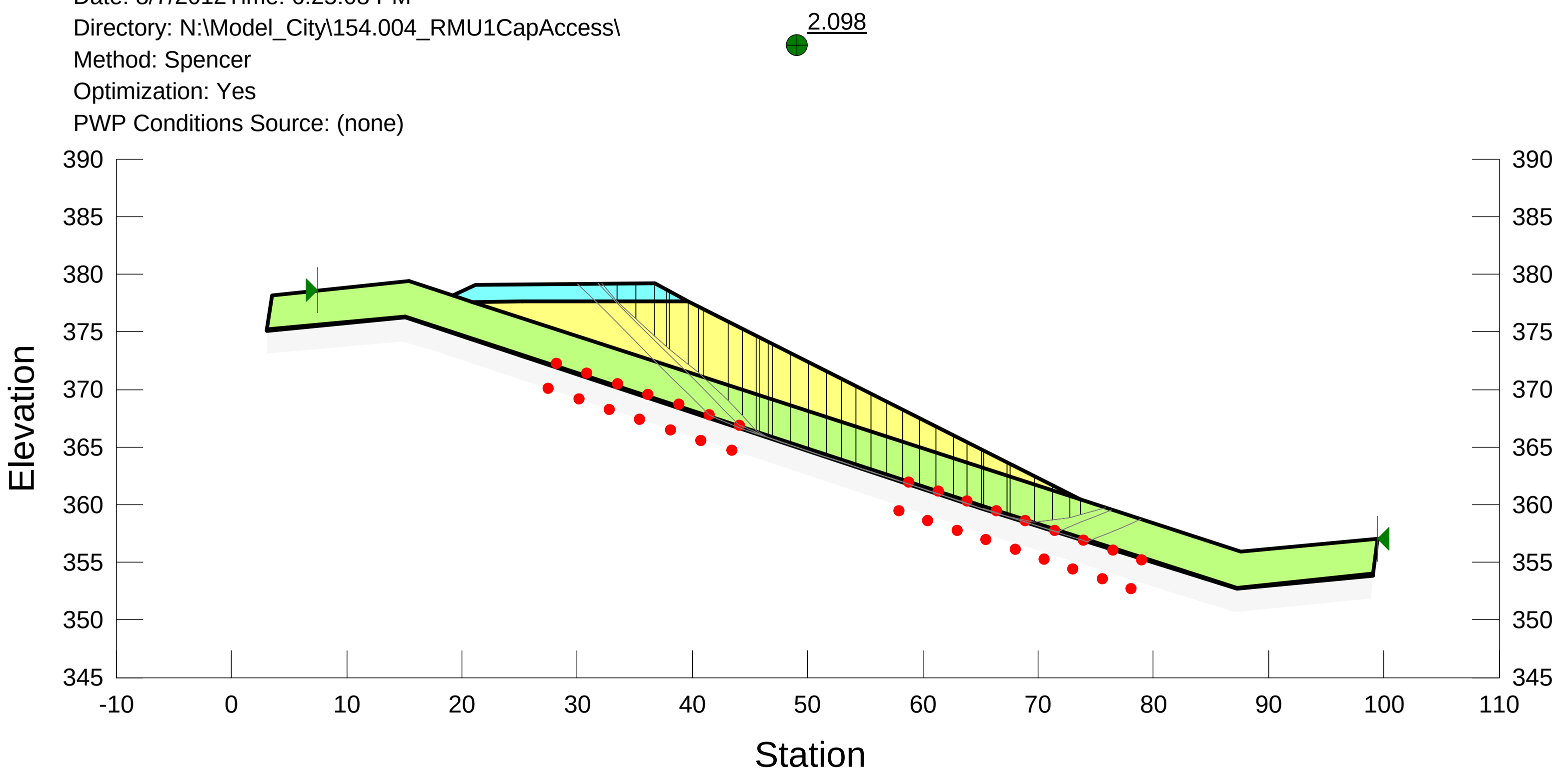
Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 17 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 17

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads fml interface (2)
Description: block searches
Name: SEC R-3.gsz
Date: 8/7/2012Time: 6:25:08 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



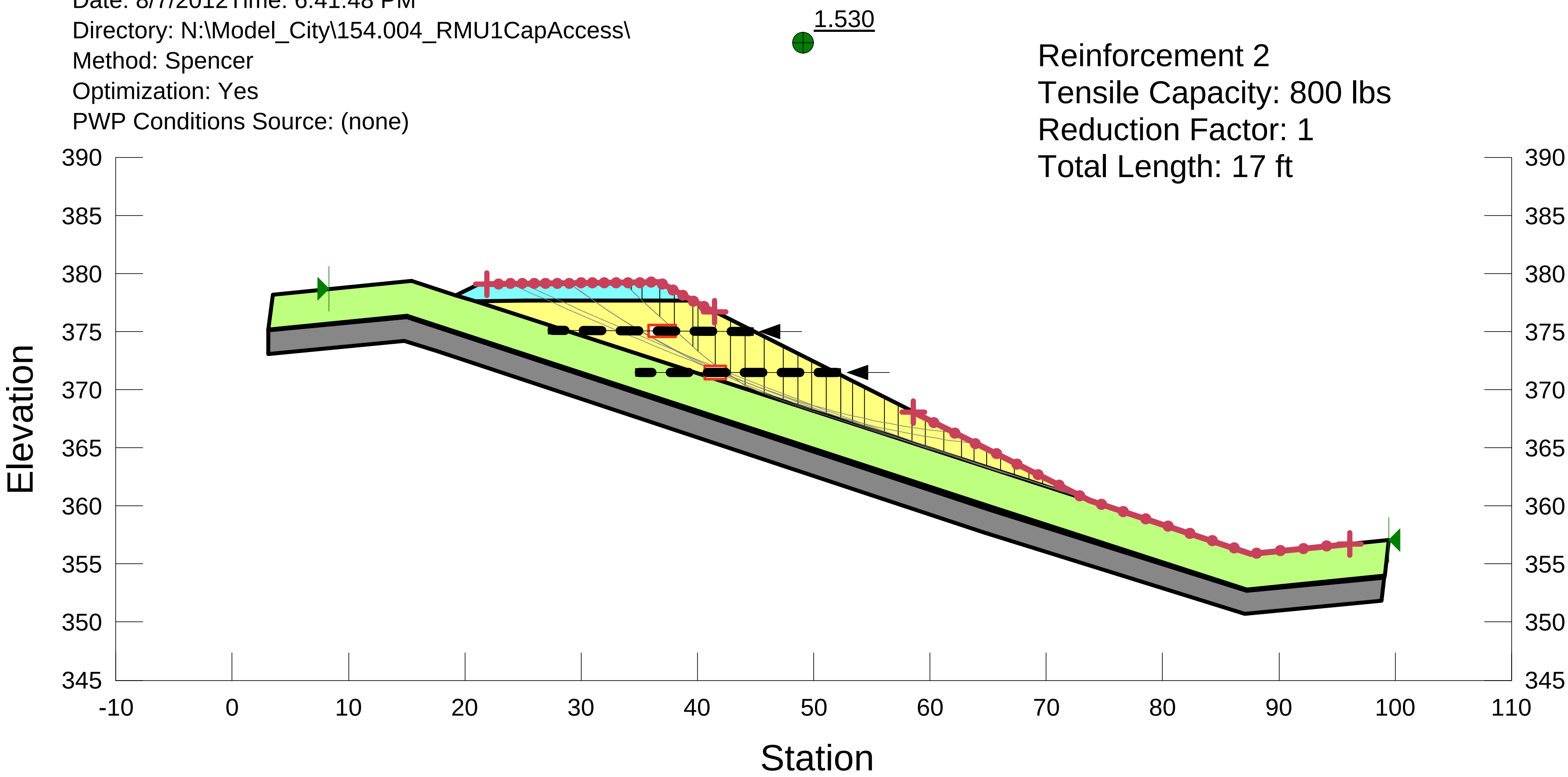
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 18

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads LD
Description: Road Berm with no added loads
Name: SEC R-3.gsz
Date: 8/7/2012Time: 6:41:48 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 16.999997 ft

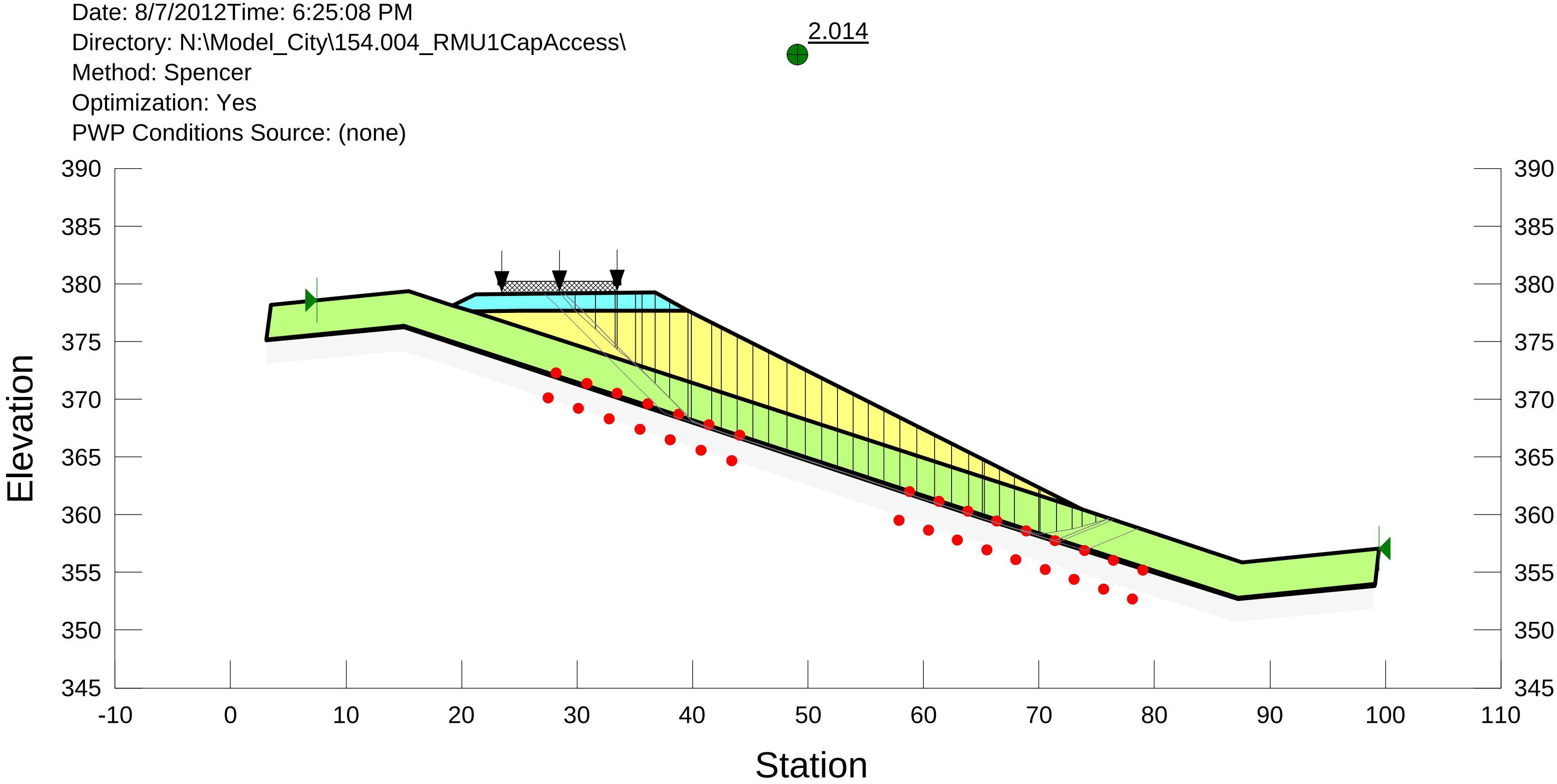
Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 17 ft



Name: Road Fill	Model: Mohr-Coulomb	Unit Weight: 130 pcf	Cohesion': 0 psf	Phi': 30 °
Name: Soil Cover	Model: Mohr-Coulomb	Unit Weight: 132 pcf	Cohesion': 466 psf	Phi': 23.2 °
Name: Compacted Soil Liner	Model: Mohr-Coulomb	Unit Weight: 133 pcf	Cohesion': 500 psf	Phi': 20.7 °
Name: Road Gravel	Model: Mohr-Coulomb	Unit Weight: 115 pcf	Cohesion': 0 psf	Phi': 40 °
Name: FML-Interface LD	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 153 psf	Phi': 16.96 °

FIG - 19

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Truck Loading
Description: block searches
Name: SEC R-3.gsz
Date: 8/7/2012Time: 6:25:08 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

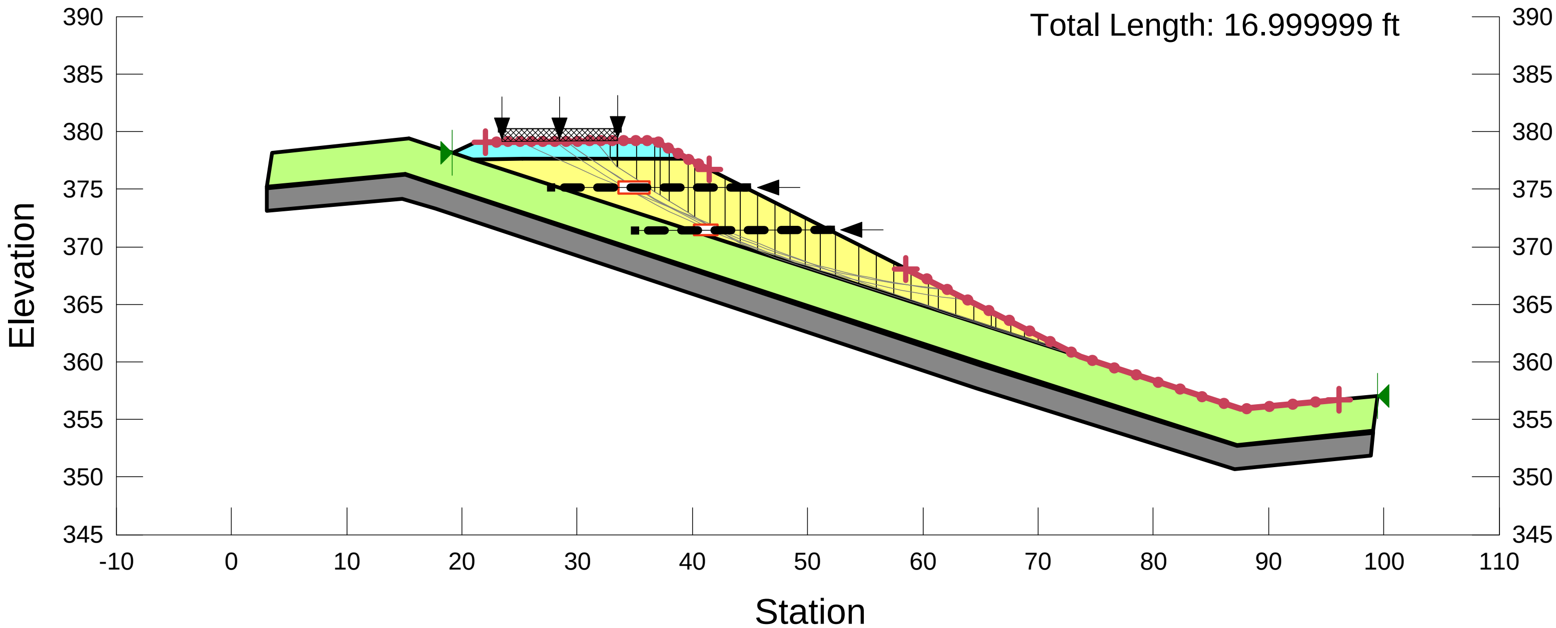
FIG - 20

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles
Description: Road Berm with truck loading
Name: SEC R-3.gsz
Date: 8/7/2012Time: 6:41:48 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

1.556

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 16.999999 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

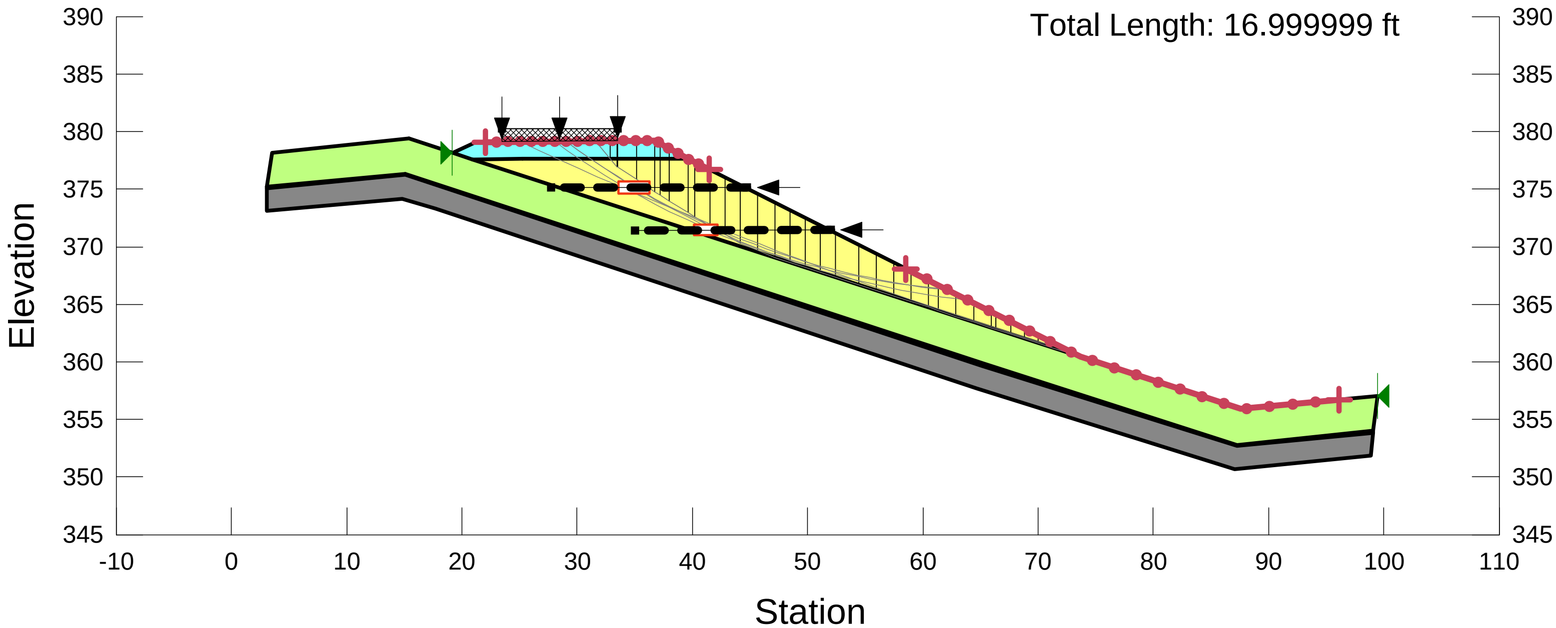
FIG - 21

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles LD
Description: Road Berm with truck loading
Name: SEC R-3.gsz
Date: 8/7/2012Time: 6:41:48 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

1.556

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 16.999999 ft



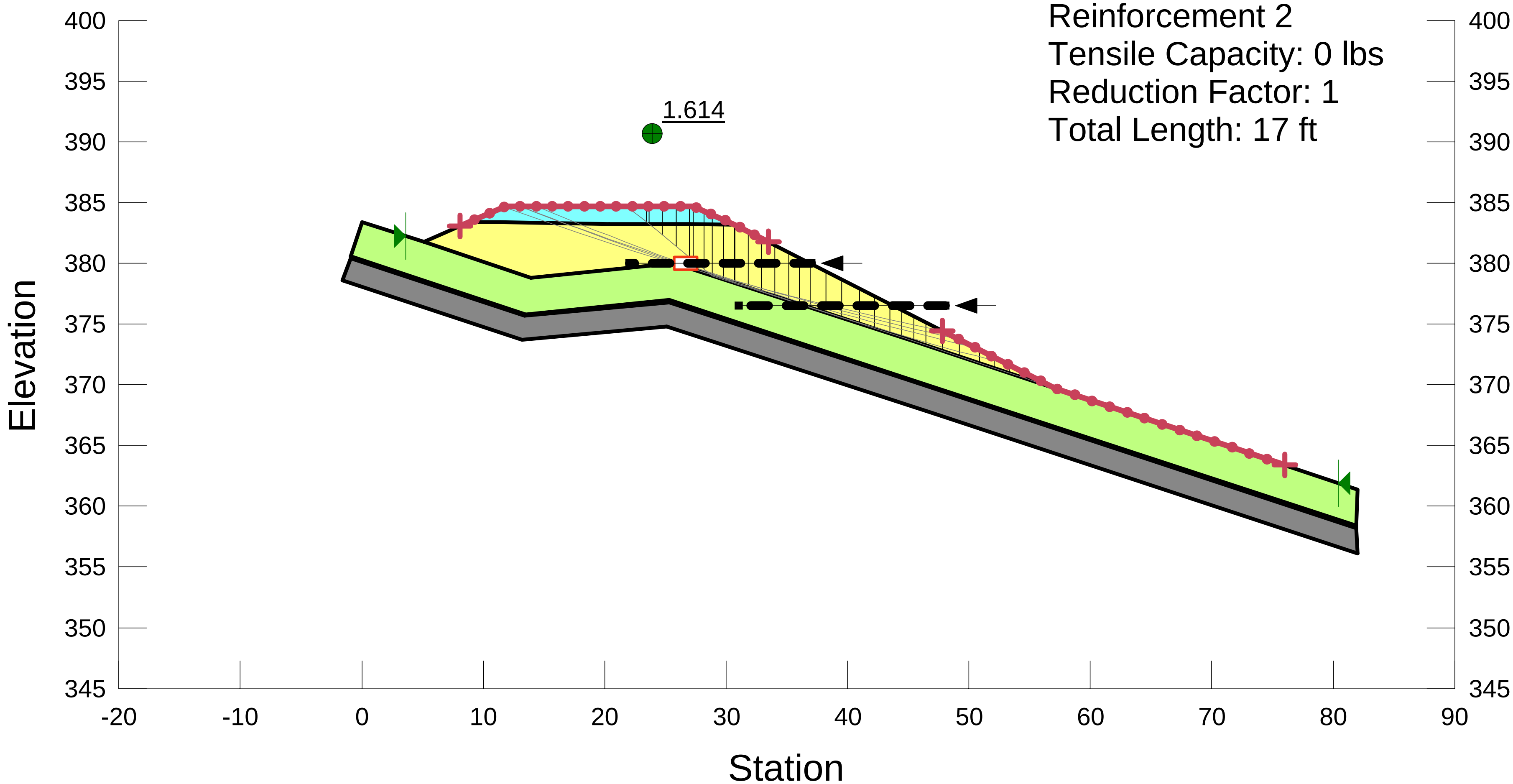
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 153 psf Phi': 16.96 °

FIG - 22

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads
Description: Road Berm with no added loads
Name: SEC R-4.gsz
Date: 8/8/2012Time: 2:08:45 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 15 ft

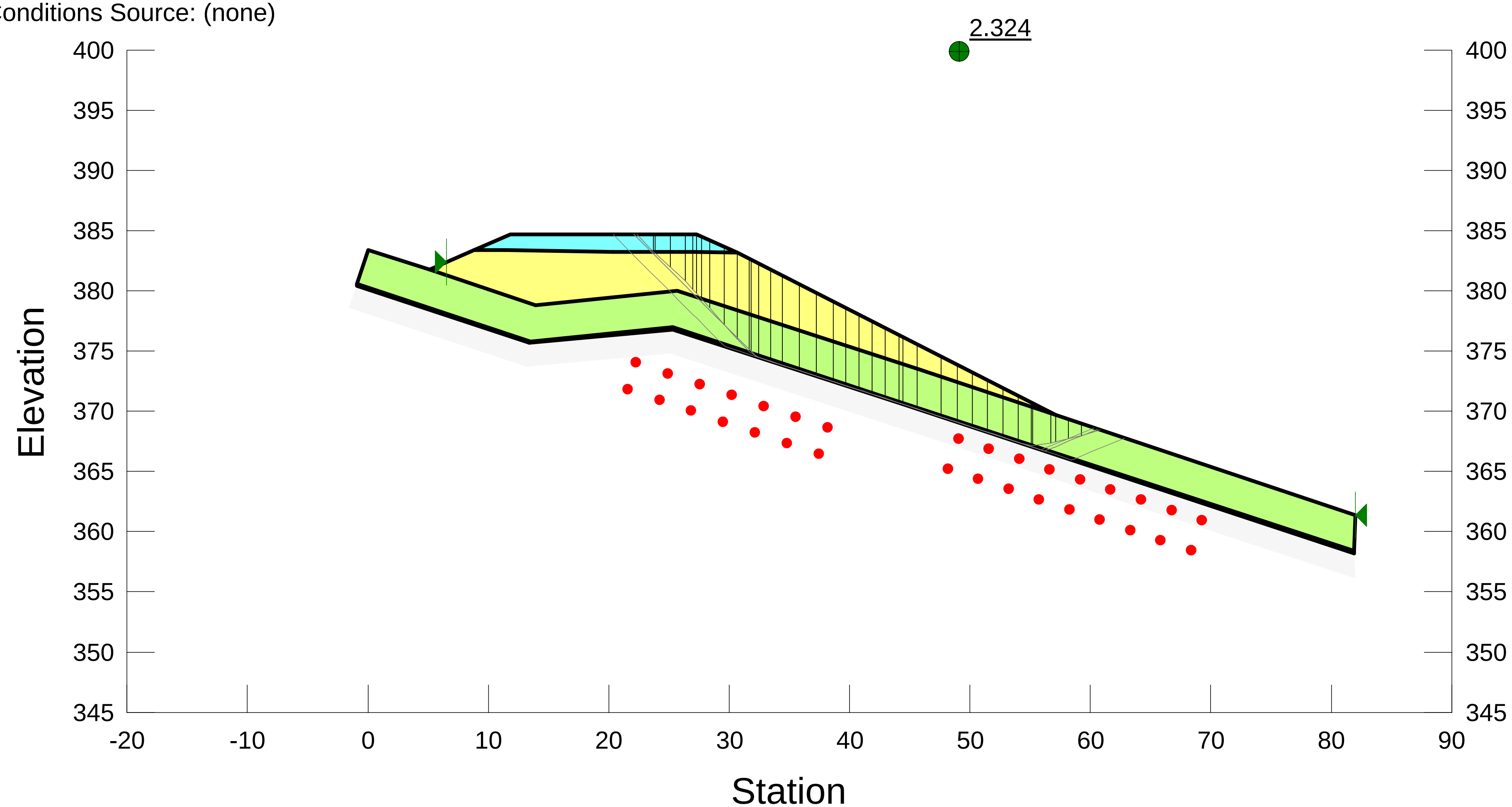
Reinforcement 2
Tensile Capacity: 0 lbs
Reduction Factor: 1
Total Length: 17 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 23

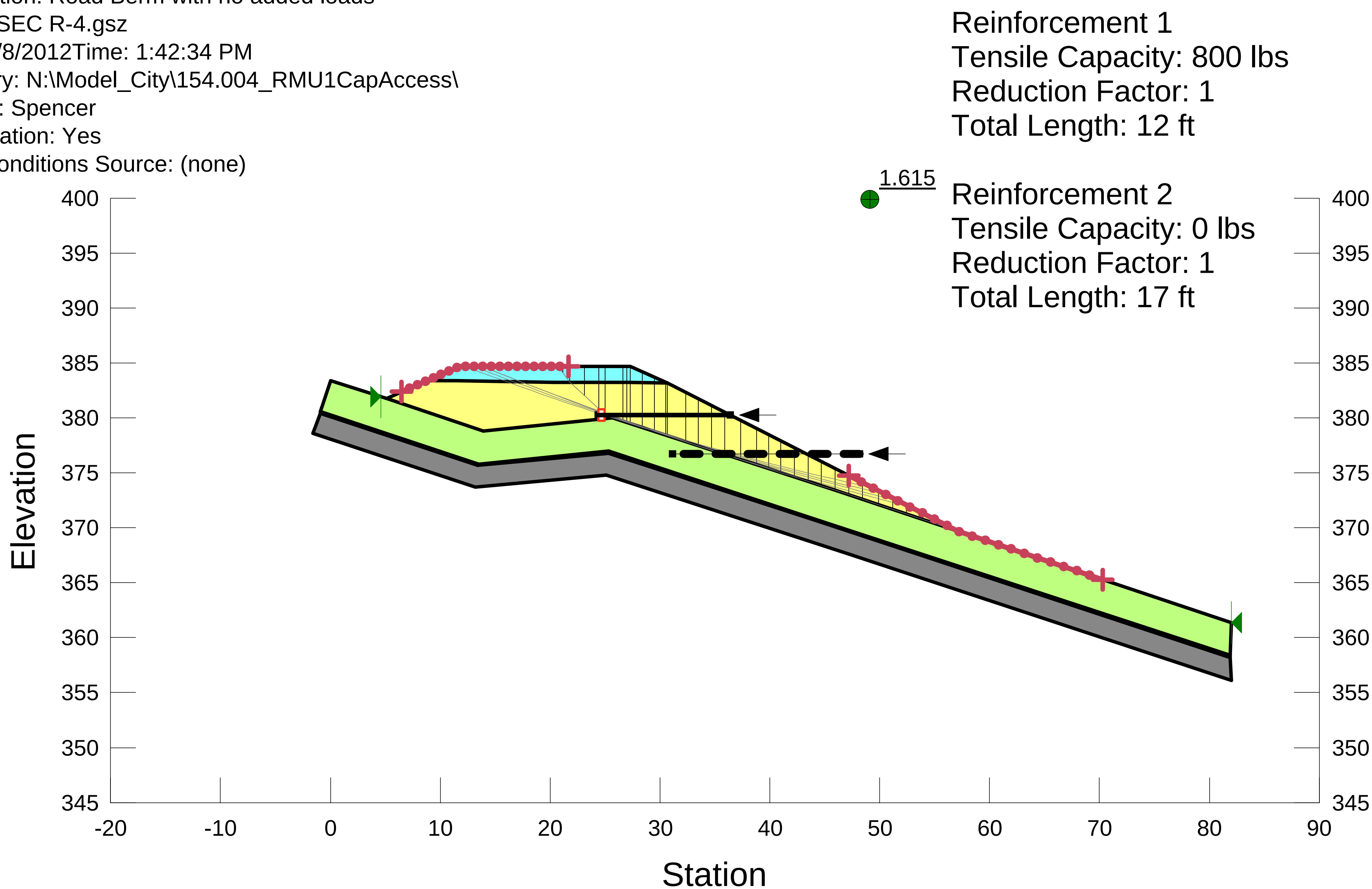
Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads fml interface (2)
Description: block searches
Name: SEC R-4.gsz
Date: 8/8/2012Time: 1:39:18 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 24

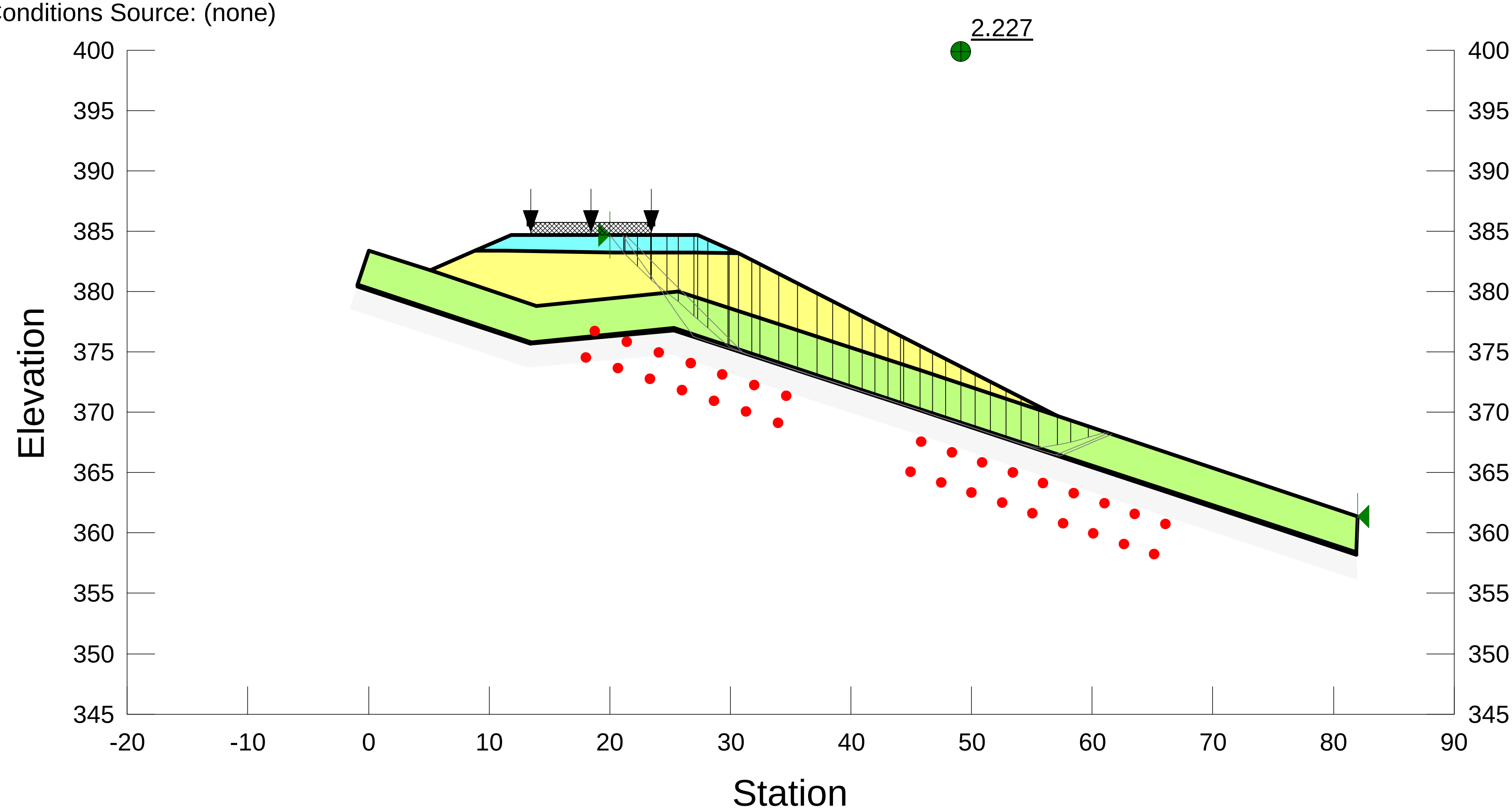
Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads LD
Description: Road Berm with no added loads
Name: SEC R-4.gsz
Date: 8/8/2012Time: 1:42:34 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 153 psf Phi': 16.96 °

FIG - 25

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Truck Loading
Description: block searches
Name: SEC R-4.gsz
Date: 8/8/2012Time: 1:45:05 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



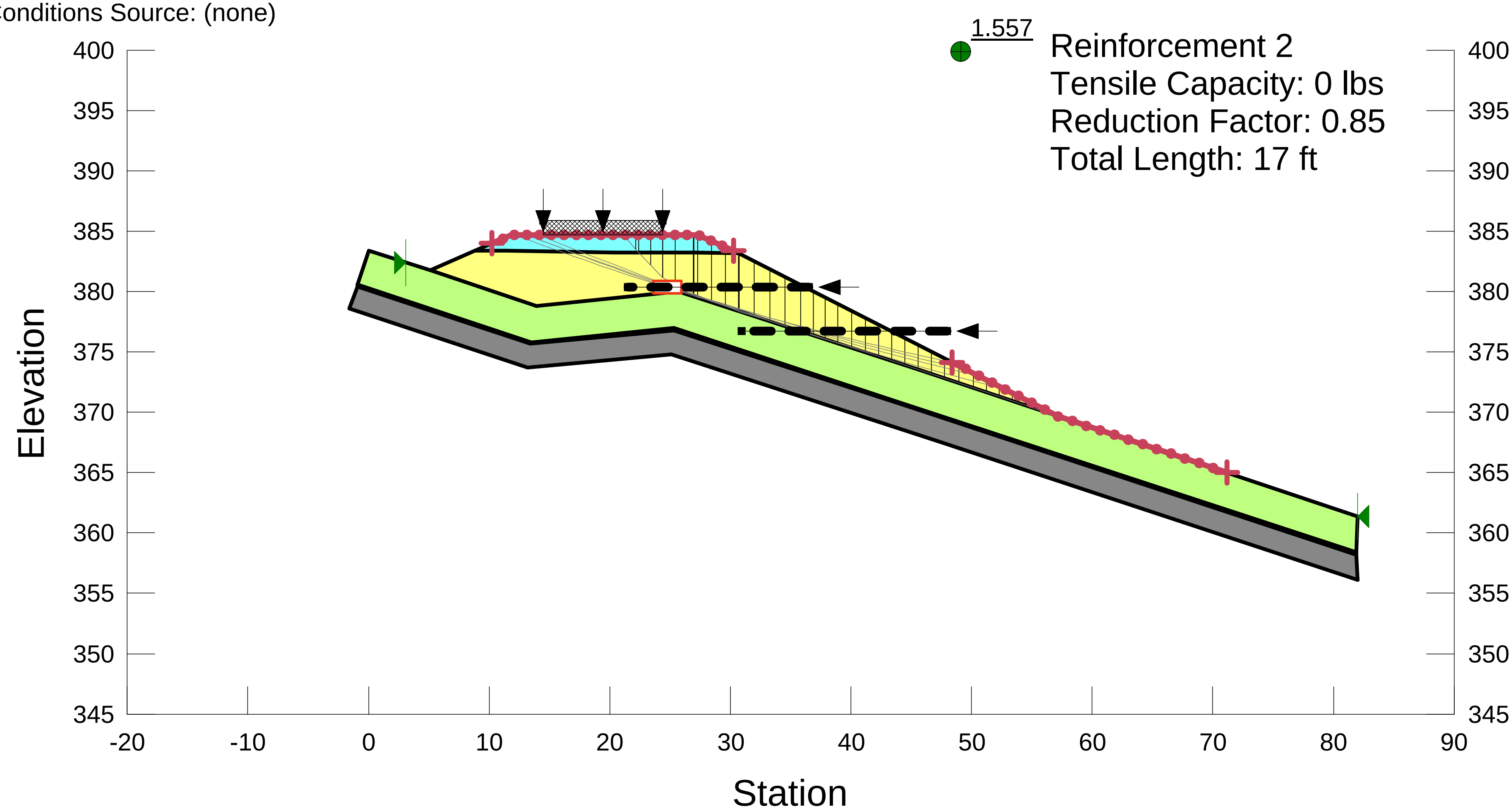
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 26

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles
Description: Road Berm with truck loading
Name: SEC R-4.gsz
Date: 8/8/2012Time: 2:08:45 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 15 ft

Reinforcement 2
Tensile Capacity: 0 lbs
Reduction Factor: 0.85
Total Length: 17 ft



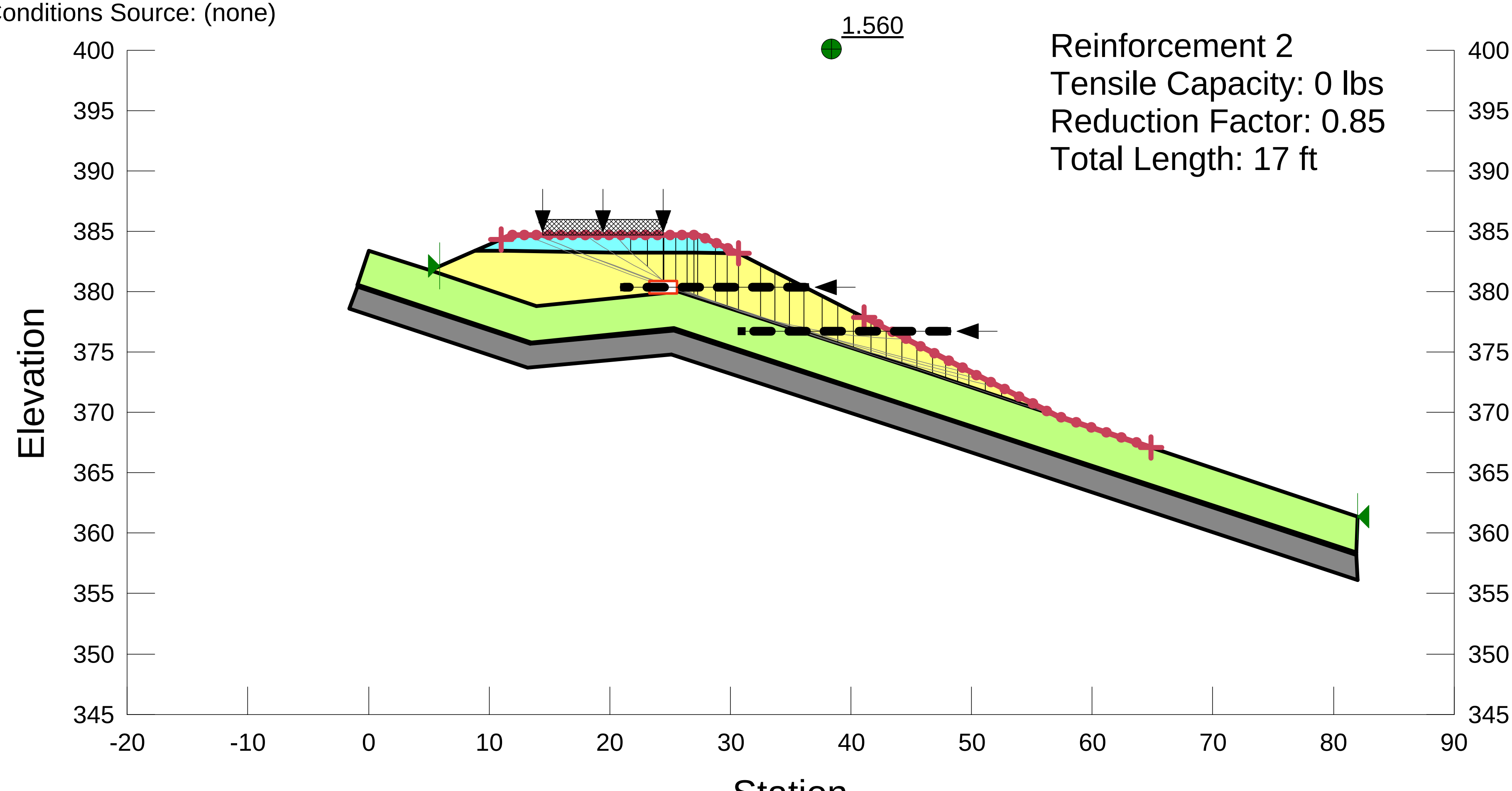
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 145 psf Phi': 26.75 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 27

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles LD
Description: Road Berm with truck loading
Name: SEC R-4.gsz
Date: 8/8/2012Time: 4:21:08 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 15 ft

Reinforcement 2
Tensile Capacity: 0 lbs
Reduction Factor: 0.85
Total Length: 17 ft



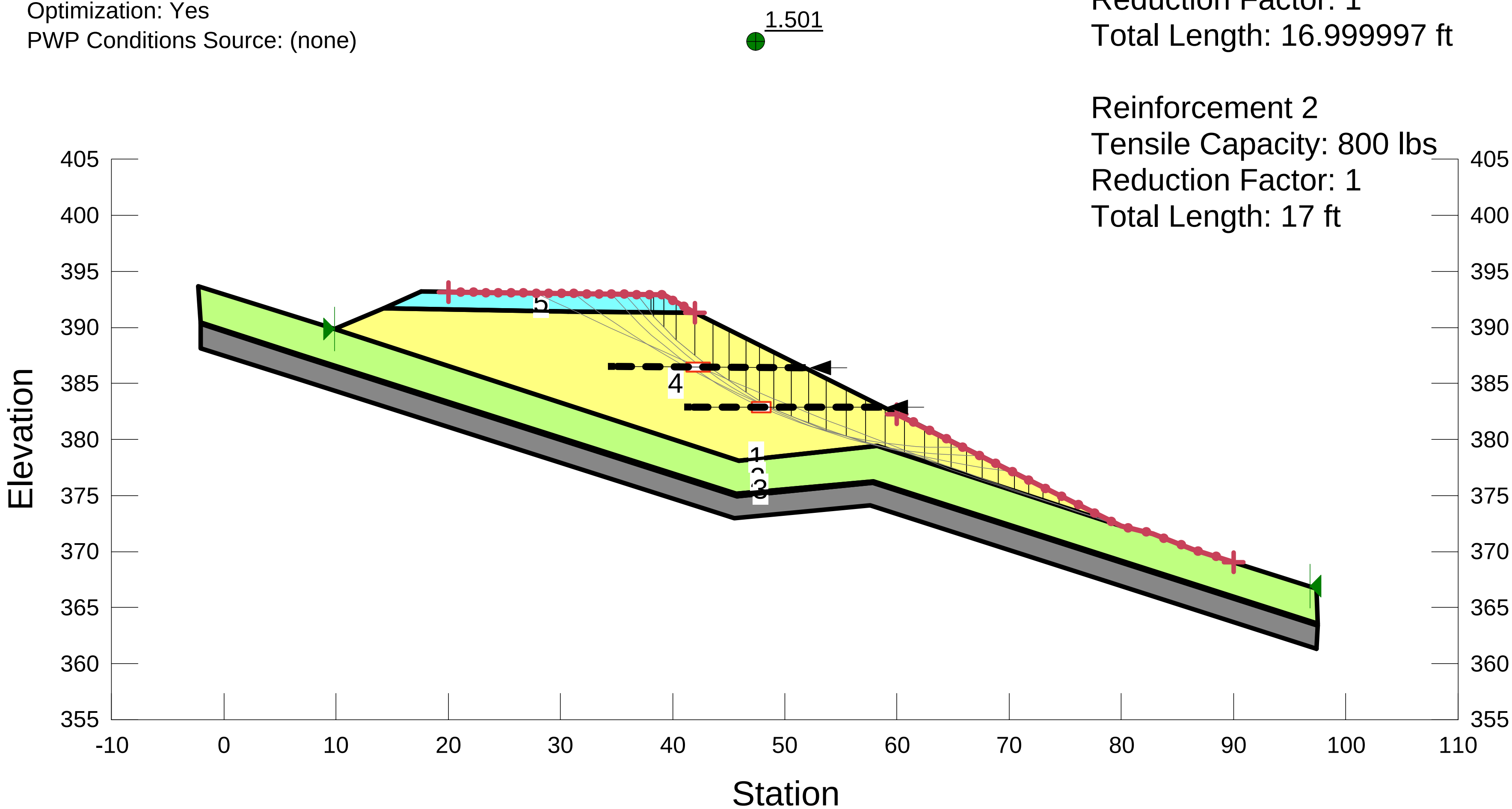
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 153 psf Phi': 16.96 °

FIG - 28

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads
Description: Road Berm with no added loads
Name: SEC R-5.gsz
Date: 8/8/2012Time: 3:24:54 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 16.999997 ft

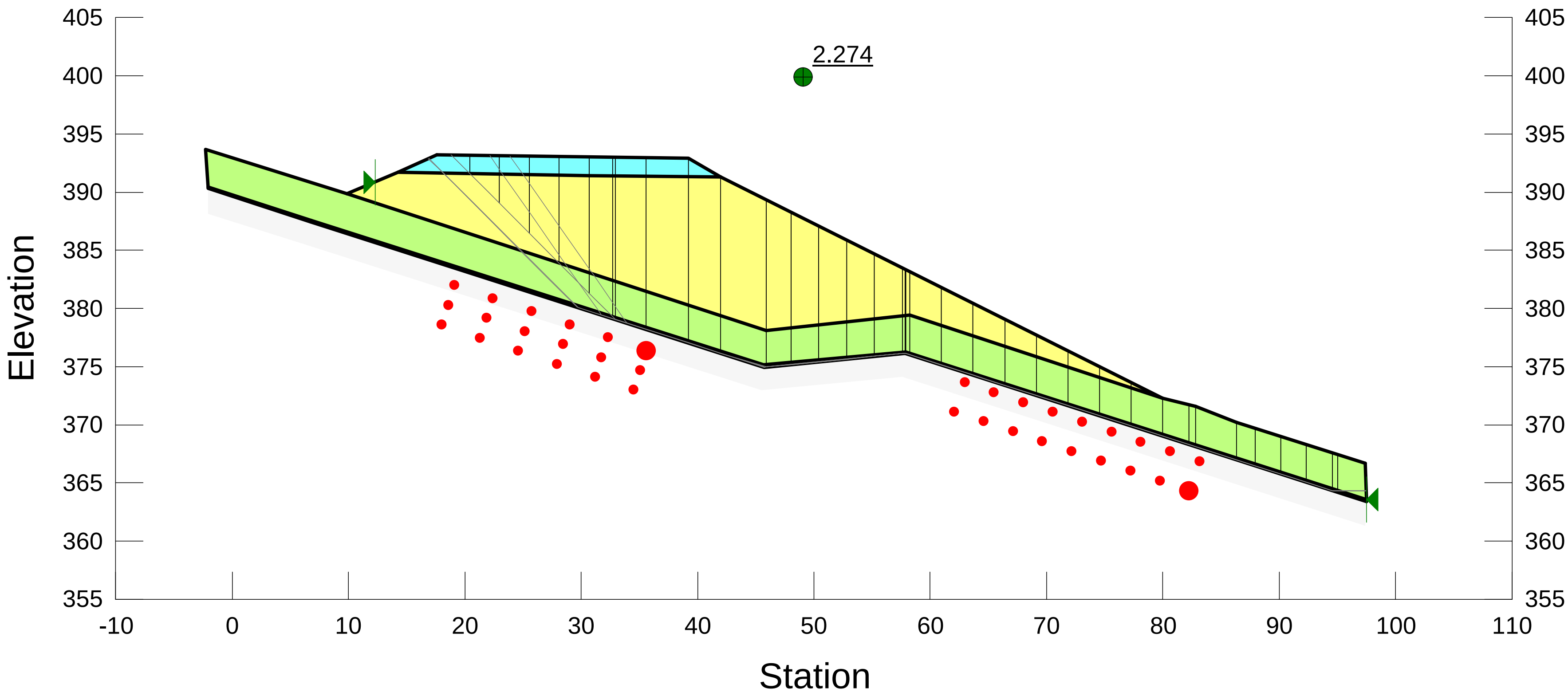
Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 17 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface phase IV Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 105.9 psf Phi': 25.91 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 29

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads fml interface (2)
Description: block searches
Name: SEC R-5.gsz
Date: 8/8/2012Time: 3:24:54 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



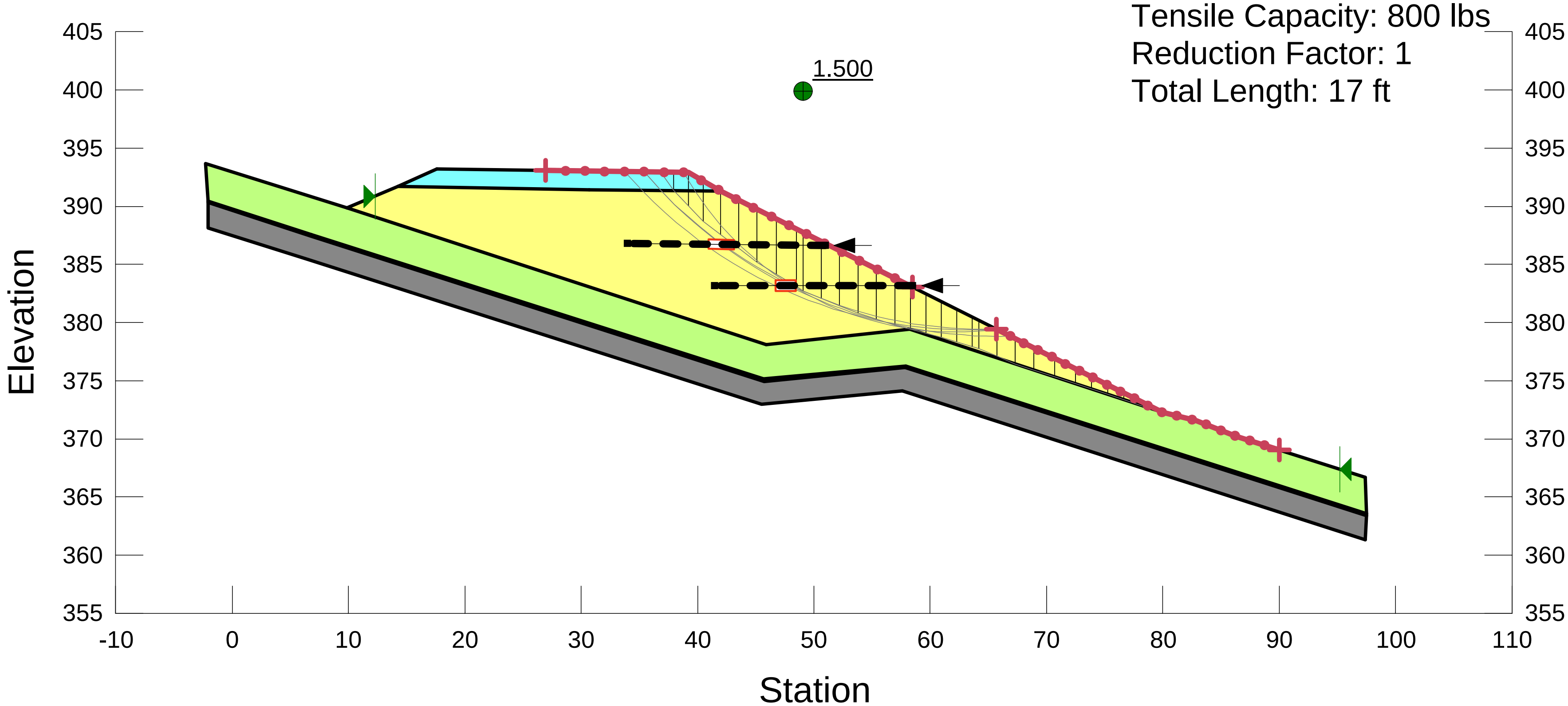
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface phase IV Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 105.9 psf Phi': 25.91 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 30

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Long Term no Loads LD
Description: Road Berm with no added loads
Name: SEC R-5.gsz
Date: 8/8/2012Time: 3:24:54 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 17 ft

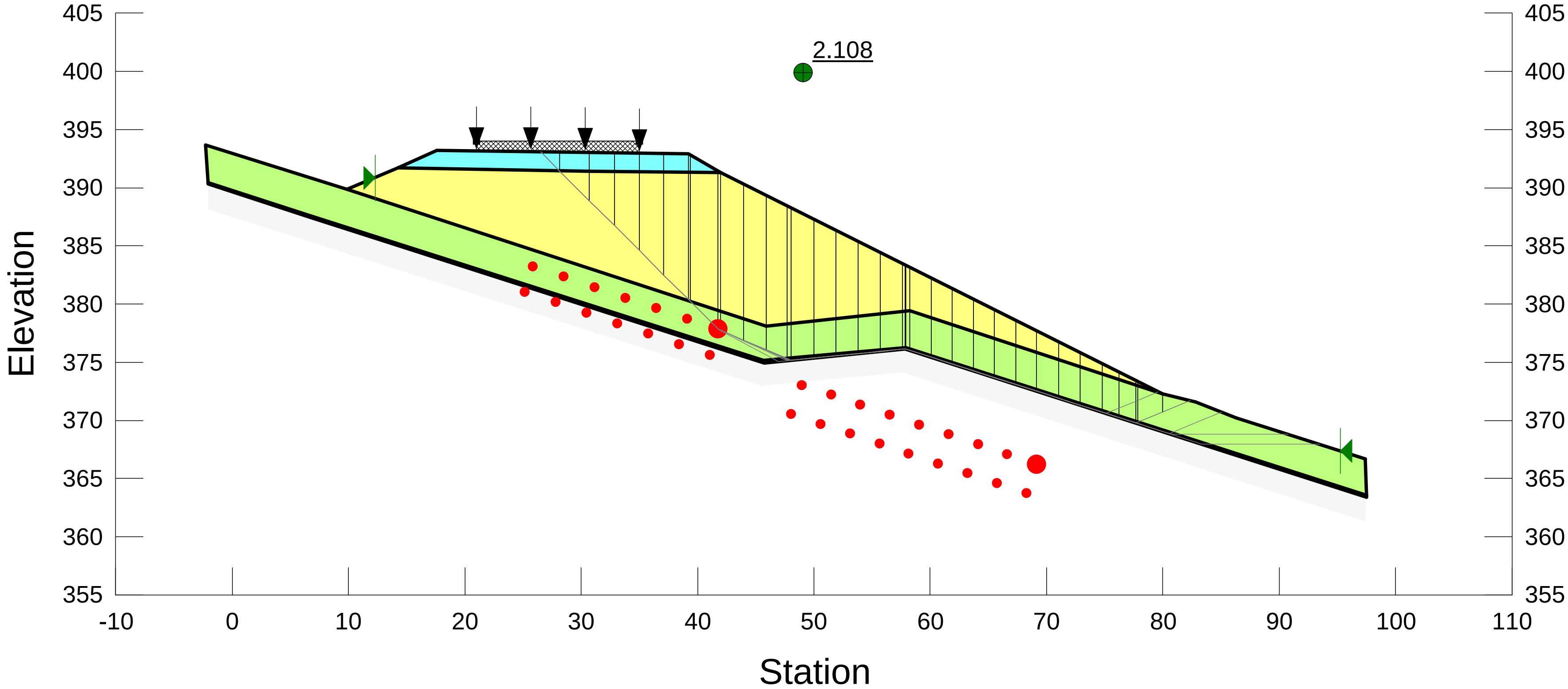
Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 1
Total Length: 17 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD phase IV Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 77.3 psf Phi': 12.7 °

FIG - 31

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: Truck Loading
Description: block searches
Name: SEC R-5.gsz
Date: 8/8/2012Time: 3:24:54 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)



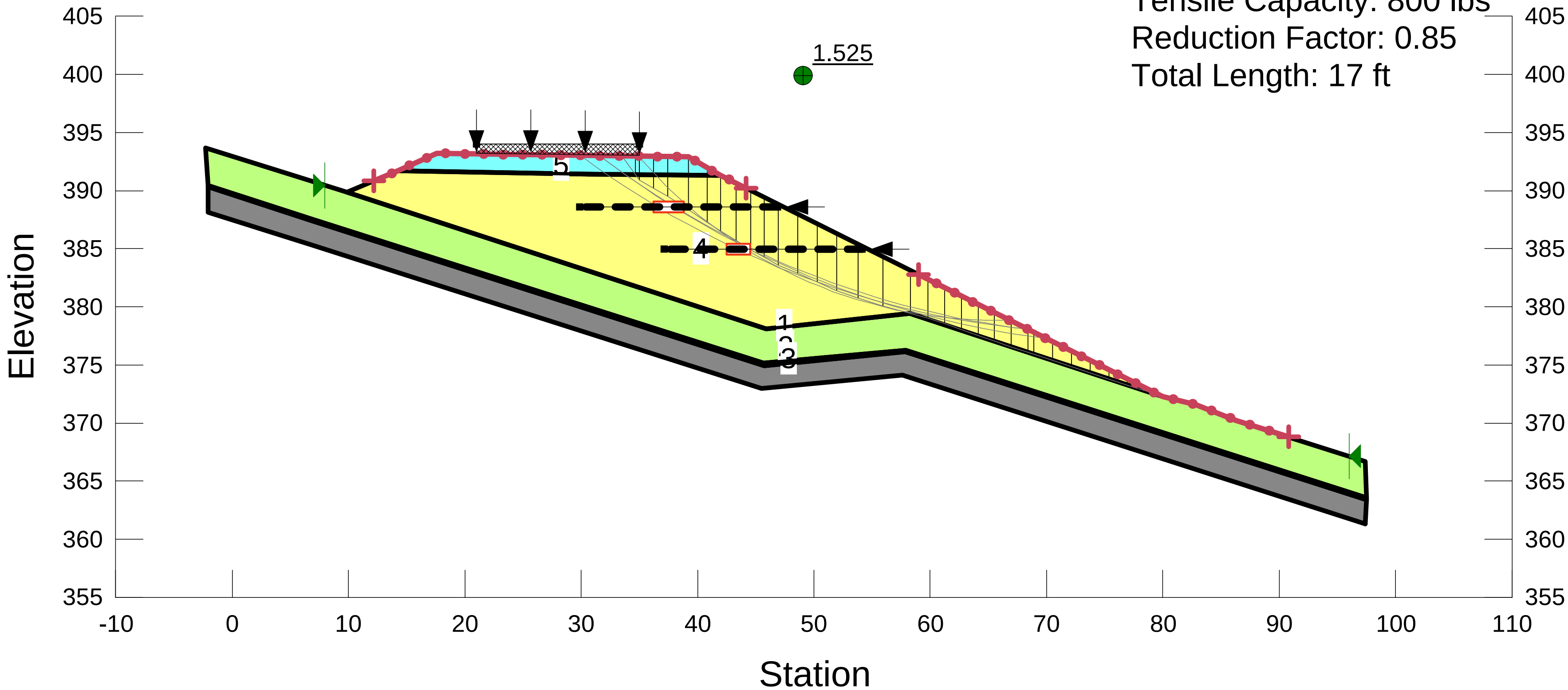
Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface phase IV Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 105.9 psf Phi': 25.91 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

FIG - 32

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles
Description: Road Berm with truck loading
Name: SEC R-5.gsz
Date: 8/8/2012Time: 3:24:54 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: FML-Interface phase IV Model: Mohr-Coulomb Unit Weight: 118 pcf Cohesion': 105.9 psf Phi': 25.91 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °

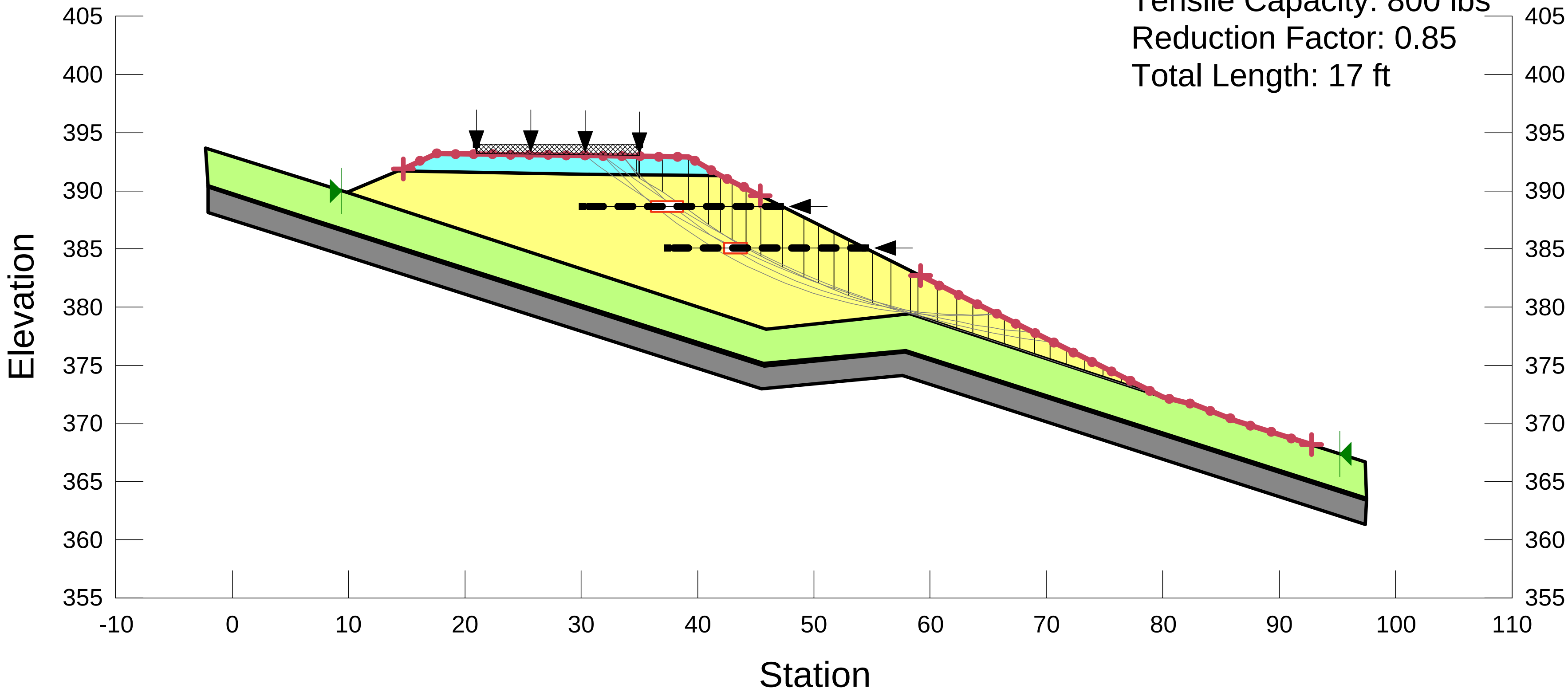
FIG - 33

Title: RMU-1 Access Road
Comments: initial analysis for access road berm
Name: with truck and 2 geotextiles LD
Description: Road Berm with truck loading
Name: SEC R-5.gsz
Date: 8/8/2012Time: 3:24:54 PM
Directory: N:\Model_City\154.004_RMU1CapAccess\
Method: Spencer
Optimization: Yes
PWP Conditions Source: (none)

1.524

Reinforcement 1
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft

Reinforcement 2
Tensile Capacity: 800 lbs
Reduction Factor: 0.85
Total Length: 17 ft



Name: Road Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Soil Cover Model: Mohr-Coulomb Unit Weight: 132 pcf Cohesion': 466 psf Phi': 23.2 °
Name: Compacted Soil Liner Model: Mohr-Coulomb Unit Weight: 133 pcf Cohesion': 500 psf Phi': 20.7 °
Name: Road Gravel Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 40 °
Name: FML-Interface LD phase IV Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 77.3 psf Phi': 12.7 °

FIG - 34

SECTION 02600
GEOGRIDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geogrids and Geotextiles used to reinforce and stabilize soil.

1.2 REFERENCES

A. Standard Test Methods for Mass Per Unit Area (Weight) of Fabric ASTM D 3776

B. Wide Width Tensile (geotextiles) ASTM D-4595

C. Specific Gravity (HDPE only) ASTM D-1505

D. Melt Flow index (PP & HDPE) ASTM D-1238

E. Intrinsic Viscosity (PET only) ASTM D-4603

F. Carboxyl End Group (PET only) ASTM D-2455

G. Single Rib Tensile (geogrids) GRI:GG1

H. FHWA Publication No FHWA-NH1-00-043

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers include Miragrid, Huesker, Stratagrid and Tensar . Requests for substitutions will be considered if supported with adequate documentation of equivalence.

2.2 GEOGRIDS

A. Primary and Secondary Reinforcement
   1. Open area: 60 percent minimum.
   2. Long-term allowable design load (T_{AL}) as shown on drawings
      a) T_{AL} to consider reductions for creep, chemical and biodegration, and installation damage.
      b) Service time to be 100 yr minimum
      c) Backfill will be structural fill (compacted silty clay/clayey silt)

B. Geotextile Reinforcement

1. Long-term allowable design load (T_{AL}) as shown on drawings
2. T_{AL} to consider reductions for creep, chemical and biodegration, and installation damage.
   a) Service time to be 100 yr minimum
   b) Backfill will be structural fill (compacted silty clay/clayey silt)

2.3 PRE APPROVAL SUBMITTALS

A. Contractor shall submit manufacturer's information for each type and strength of geosynthetic product to be used. Submittal shall contain quality control testing and manufacturer control procedures. At a minimum the following shall be submitted.

1. The primary resin used in manufacturing shall be identified as to its ASTM type, class, grade, and category.
   a) For HDPE resin type, class, grade and category in accordance with ASTM D-1248 shall be identified. For example type III, class A, grade E5, category 5.
   b) For PP resins, group, class and grade in accordance with ASTM D-4101 shall be identified. For example group 1, class 1, grade 4.
   c) For Polyester (PET) resins minimum production intrinsic viscosity (ASTM-4603) and maximum carboxyl end groups (ASTM D-2455) shall be identified.
   d) For all products the minimum UV resistance as measured by ASTM D-4355 shall be identified.
2. The adequacy of the data in support of allowable strength (T_a) for geosynthetic reinforcements including
   a) Laboratory test results documenting creep performance over a range of load levels for minimum duration of 10,000 hr. in accordance with ASTM D-5262.
   b) Laboratory test results and methodology for extrapolation of creep data for 75- and 100- year design life.
   c) Laboratory test results documenting ultimate strength in accordance with ASTM D-4595, or GRI-GG1 for geogrids. Tests to be conducted at a strain rate of 10 percent per minute.
   d) Laboratory test results and extrapolation techniques, documenting the hydrolysis resistance of PET, oxidative resistance of PP and HDPE, and stress cracking resistance of HDPE for all components of geosynthetic and values for partial factor of safety for aging degradation calculated for a 75- and 100-year design life. Recommended methods are outlined in FHWA RD 97-144.
   e) Field and laboratory test results along with literature review documenting values for partial factor of safety for installation damage as a function of backfill gradation
   f) Laboratory tests documenting pullout interaction coefficients for various soil types or site specific soils in accordance with GRI: GG5 and GT7.
   g) Laboratory tests documenting direct sliding coefficients for various soil types or project specific soils in accordance with ASTM D-5321

3. The adequacy of the QA/QC plan for the manufacture of geosynthetic reinforcements. Including at a minimum

   a) Manufacturing quality control program and data indicating minimum test requirements, test methods, test frequency, and lot size for each product. Further minimum conformance requirements as proscribed by the manufacturer shall be indicated. The following is a minimum list of conformance criteria required for approval:

Test	Test Procedure	Minimum Conformance Requirement
Wide Width Tensile (geotextiles)	ASTM D-4595	*To be provided*
Specific Gravity (HDPE only)	ASTM D-1505	*by material*
Melt Flow index (PP & HDPE)	ASTM D-1238	*supplier or*
Intrinsic Viscosity (PET only)	ASTM D-4603	*specialty company*
Carboxyl End Group (PET only)	ASTM D-2455	
Single Rib Tensile (geogrids)	GRI:GG1	

4. All determinations of T_{AL} values are to be based on MARV measurements

2.4 CONSTRUCTION SUBMITTALS

A. The Contractor shall submit a manufacturer's certification that the geosynthetics supplied meet the respective index criteria set when the geosynthetic was approved by the Owner, measured in full accordance with all test methods and standards specified. In case of dispute over validity of values, the Engineer can require the Contractor to supply test data from an agency approved laboratory to support the certified values submitted, the Contractor’s cost.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Geosynthetics shall be unloaded, and inspected for damage prior to storing on level ground or pallets. The Contractor shall protect the work described in this Section before, during, and after installation, and shall protect the installed work covered by other Sections.

B. The Contractor shall, during all periods of shipment and storage, protect the geosynthetics from direct sunlight, ultraviolet rays, temperatures greater than 120°F, mud, dirt, dust, debris and other deleterious sources.

C. If the Engineer determines material is damaged the Contractor shall immediately make all repairs and replacements, at no additional cost to the Owner

3.2 INSTALLATION

A. The geosynthetic reinforcement shall be installed in accordance with the manufacturer's recommendations, unless otherwise modified by these specifications. The geosynthetic reinforcement shall be placed within the layers of the compacted soil as shown on the plans or as directed.

B. The geosynthetic reinforcement shall be placed in continuous longitudinal strips in the direction of main reinforcement. Joints in the design strength direction (perpendicular to the slope) shall not be permitted with geotextile or geogrid, except as indicated on the drawings.

C. Horizontal coverage of less than 100 percent shall not be allowed unless specifically detailed in the construction drawings. In the case of 100% coverage in plan view adjacent strips need not be overlapped.

D. Adjacent rolls of geosynthetic reinforcement shall be overlapped or mechanically connected where exposed in a wrap-around face system, as applicable.

E. Place only that amount of geosynthetic reinforcement required for immediately pending work to prevent undue damage. After a layer of geosynthetic reinforcement has been placed, the next succeeding layer of soil shall be placed and compacted as appropriate. After the specified soil layer has been placed, the next geosynthetic reinforcement layer shall be installed. The process shall be repeated for each subsequent layer of geosynthetic reinforcement and soil.

F. Geosynthetic reinforcement shall be placed to lay flat and pulled tight prior to backfilling. After a layer of geosynthetic reinforcement has been placed, suitable means, such as pins or small piles of soil, shall be used to hold the geosynthetic reinforcement in position until the subsequent soil layer can be placed. Under no circumstances shall a track-type vehicle be allowed on the geosynthetic reinforcement before at least 9 inch of soil has been placed. Sudden braking and sharp turning – sufficient to displace fill – shall be avoided.

G. During construction, the surface of the fill should be kept approximately horizontal. Geosynthetic reinforcement shall be placed directly on the compacted horizontal fill surface. Geosynthetic reinforcements are to be placed within 3 inches of the design elevations and extend the length as shown on the elevation view unless otherwise directed by the Owner's Engineer. Correct orientation of the geosynthetic reinforcement shall be verified by the Contractor.

3.3 FINAL SLOPE GEOMETRY VERIFICATION

A. Contractor shall confirm that as-built slope geometries conform to approximate geometries shown on construction drawings.

PART 4 FIELD QUALITY CONTROL

4.1 GENERAL FILL MATERIAL

A. Soil Testing

1. Perform soil testing accordance with the Section 02210 of the RMU-1 technical specifications, except in-place density testing, which shall be performed as indicated in this specification section and on Permit Drawing No. 23 A..

B. In-place Soil Moisture-Density Testing

1. Perform in-place density testing, ASTM 2922, on the upper 2 feet of general fill used in the landfill plateau access road at the frequency described in Section

02210 of the RMU-1 Technical Specifications. Deeper lifts (below the upper 2 ft of general fill) shall only be compacted by tracking over the material with a dozer, except for compaction and in-place density testing, which shall be performed as indicated on Permit Drawing No. 23A

4.2 GEOREINFORCEMENT

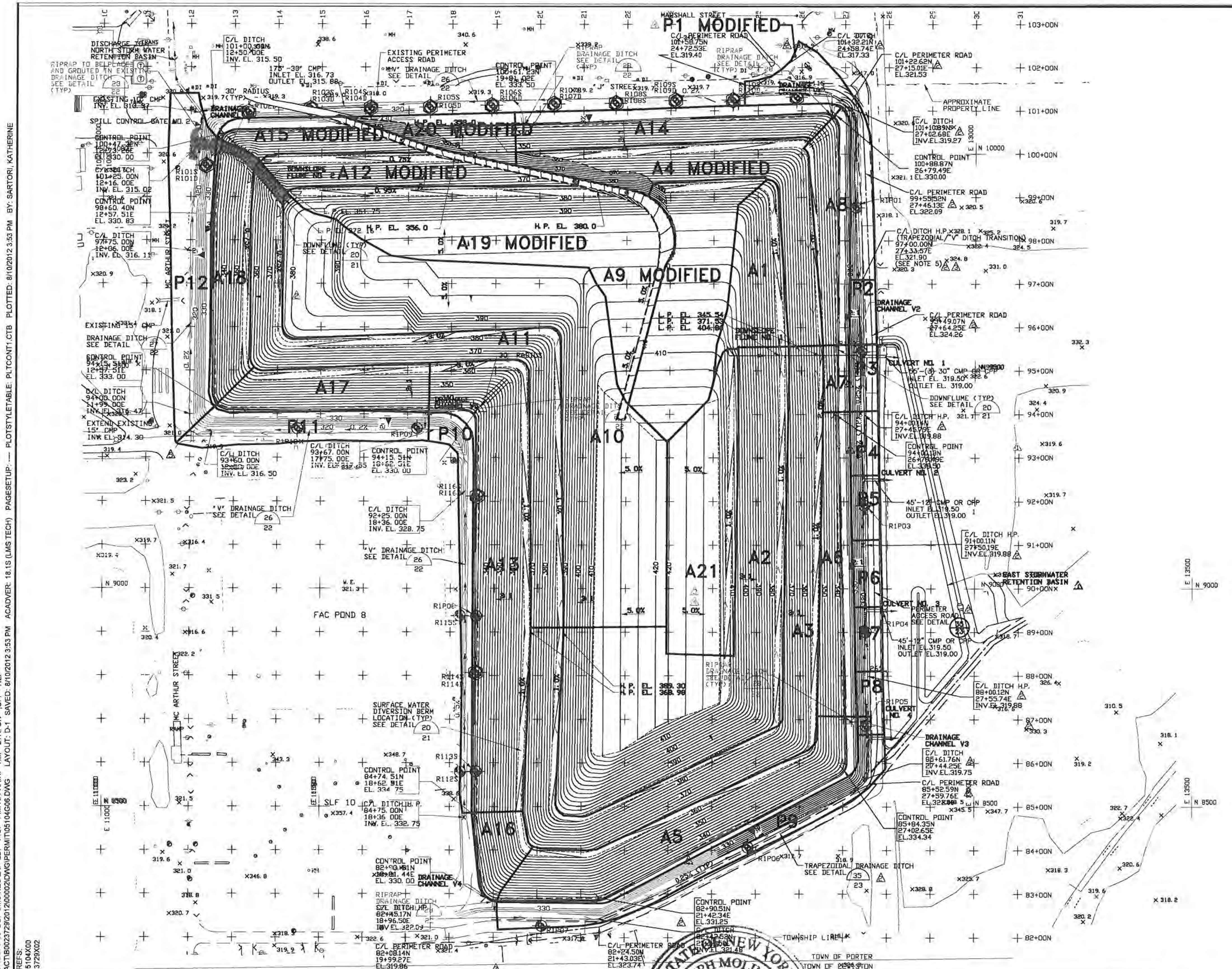
A. Inspect all rolls as deployed for damage.

B. Monitor placement of fill and geosynthetics.

C. Perform check for tolerance with design geometry by survey.

END OF SECTION

Replace the Existing Figure D-1 (Drainage Subarea Map) in the RMU-1 Engineering Report Appendix I With the Following Revised Figure D-1



LEGEND:

- 320 EXISTING GRADE
- 320 PROPOSED GRADE
- LIMIT OF SUBBASE
- 3:1 SLOPE INDICATOR
- DRAINAGE DITCH
- ACCESS ROAD
- TOP OF BERM
- APPROXIMATE PROPERTY LINE
- TOWNSHIP LINE
- GROUNDWATER MONITORING WELL
- GROUNDWATER MONITORING WELL NEST
- SOIL BORING
- PERMANENT CONTROL MONUMENT
- CULVERT
- VAULT

NOTES:

1. TOPOGRAPHIC BASE MAP WAS PROVIDED BY AIR SURVEY CORP. STERLING, VIRGINIA. DATE OF PHOTOGRAPHY, DECEMBER, 1996.
2. COORDINATES LABELED ON THESE PLANS ARE ACCORDING TO RMU-1 SITE GRID.REFER TO DRAWING NO. 2 FOR PLANT COORDINATES.
3. PROPOSED GRADES INDICATED ARE TOP OF VEGETATIVE COVER SOIL.
4. DRAINAGE TILE TO BE PLACED UNDER SURFACE WATER DRAINAGE DITCH. SEE DETAIL 17.
5. WELLS SHOWN ON THIS DRAWING ARE THE EXISTING MONITORING WELLS FOR RMU-1.

NOT FOR CONSTRUCTION
FOR REGULATORY REVIEW ONLY

⚠ NOTES:

1. THIS DRAWING IS BASED ON A DRAWING ENTITLED "DRAINAGE SUBAREA MAP", PREPARED BY EARTH TECH (DATED JUNE 1997).
2. BBL IMPLEMENTED REVISIONS ARE AS NOTED IN THE REVISION BLOCK.

DRAWING REVISED BY BLASLAND, BOUCK & LEE, INC. THROUGH ITS PROFESSIONAL ENGINEER. WORK OF EARTHTECH (FORMERLY RUST ENVIRONMENT & INFRASTRUCTURE) NOT INDEPENDENTLY REVIEWED.

CITY: SYRACUSE DIV/GROUP: 85 DB: GMS NES LAF LD: PIC: PM: R. PARINI TM: LYR: ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0023729\2012\00002\DWG\PERMIT\05104G06.DWG LAYOUT: D-1 SAVED: 8/10/2012 3:53 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: PLTCONT1.CTB PLOTTED: 8/10/2012 3:53 PM BY: SARTORI, KATHERINE
XREFS: 05104X00 23729X02

Graphic Scale: 120' 0 120' 240'

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED IN THE TITLE BLOCK. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR IN THE TITLE BLOCK TO DETERMINE THE ACTUAL SCALE OF THIS DRAWING.

No.	Date	Revisions	Init
⚠	8/12	REVISED WATERSHED LIMITS FOR ACCESS ROAD CONSTRUCTION	
⚠	3/08	REVISED PROPOSED GRADES AND P1 WATERSHED	
⚠	12/03	REV. DRAIN BOUNDARIES, PERIM. DITCH, H.P., LANDFILL CONTOURS, AND NOTES	
⚠	6/02	REVISED PERIMETER DITCH, ACESS ROAD, AND CULVERTS	
⚠	6/01	REVISIONS TO STORMWATER RETENTION BASIN	

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Project Mgr. TJF
Designed by BMS/CAA
Drawn by SLM
Checked by PHB
Prof. Eng. JOSEPH MOLINA III
PE License NY 072644

STATE OF NEW YORK JOSEPH MOLINA III 072644 LICENSED PROFESSIONAL ENGINEER

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

CWM CHEMICAL SERVICES, LLC. • MODEL CITY FACILITY
RESIDUALS MANAGEMENT UNIT 1

DRAINAGE SUBAREA MAP

GENERAL

File Number 050.42.005
Date DECEMBER 2003
Blasland, Bouck & Lee, Inc. Corporate Headquarters 6723 Towpath Road Syracuse, NY 13214 315-446-9120

D-1

Replace Select Portions of the RMU-1 Engineering Report Appendix I Section Entitled “Summary of Design” with the Following Sheets

TABLE OF CONTENTS

SURFACE WATER DRAINAGE AND EROSION CALCULATIONS

Revised: Date : August 2012

B. Culvert Sizes

To handle a combined peak flow of 73.5 cfs, use the following:

1. *Culvert No. 1 (North to East Basin)*
Three 30-inch diameter corrugated high density polyethylene pipes with mitered headwalls;

2. *Culvert No. 2 (North Central to East Basin)*
One 12-inch diameter corrugated high density polyethylene pipe with mitered headwalls;

3. *Culvert No. 3 (South Central to East Basin)*
One 12-inch diameter corrugated high density polyethylene pipe with mitered headwalls;

4. *Culvert No. 4 (South to East Basin)*
One 30-inch diameter corrugated high density polyethylene pipe with mitered headwalls;

C. Riprap Downflumes

1. Downflume 1 - Discharges to Culvert No. 1. It will handle a design flow of 54.53 cfs.

2. Downflume 2 - Discharges to the north. It will handle a design flow of 53.75 cfs.

D. East Stormwater Retention Basin

The basin provides 8.375 acre-feet (364,815 cubic feet) of storage at the invert elevation of the emergency spillway (321.7 feet).

The design high water elevation associated with the 25-year, 24-hour storm event is 321.08 feet under the interim condition. The storage at this elevation is 6.872 acre-feet (299,344 cubic feet), including 1.141 acre-feet (49,702 cubic feet) of annual sediment accumulation. The basin provides 0.62 feet of freeboard at this elevation. The 25-year, 24-hour estimated peak discharge into the basin under the interim condition is 86.05 cfs. The 25-year, 24-hour estimated peak discharge from the basin after the discharge valve is opened is 4.15 cfs under the interim condition.

The design high water elevation associated with the 25-year, 24-hour storm event is 320.18 feet under the final condition. The storage at this elevation is 4.817 acre-feet (209,829 cubic feet), including 0.023 acre-feet (1,002 cubic feet) of annual sediment accumulation. The basin provides 1.52 feet of freeboard at this elevation. The 25-year, 24-hour estimated peak discharge into the basin under the final condition is 71.20 cfs. The 25-year, 24-hour estimated peak discharge from the basin after the discharge valve is opened is 3.33 cfs under the final condition.

Replace Existing Subarea Table I-1 in the RMU-1 Engineering Report Appendix I with the Following Table.

Table I-1
Drainage Subareas
CWM Chemical Services, LLC
Model City Facility

Subarea No.	Measured Area (sq. ft.)	Area (acres)
A1	47,430	1.09
A2	239,485	5.50
A3	161,355	3.70
A4 Modified	84,942	1.95
A5	100,130	2.30
A6	54,560	1.25
A7	10,075	0.23
A8	41,230	0.95
A9 Modified	95,396	2.19
A10	280,986	6.45
A11	124,930	2.87
A12 Modified	46,797	1.07
A13	143,220	3.29
A14	60,113	1.38
A15 Modified	32,670	0.75
A16	20,150	0.46
A17	44,795	1.03
A18	51,770	1.19
A19 Modified	161,172	3.70
A20 Modified	25,700	0.59
A21	93,995	2.16
P1 Modified	41,900	0.96
P2	26,136	0.60
P3	8,276	0.19
P4	9,148	0.21
P5	9,148	0.21
P6	8,712	0.20
P7	8,276	0.19
P8	7,841	0.18
P9	45,738	1.05
P10	31,620	0.73
P11	57,505	1.32
P12	70,990	1.63
P13 (East Basin)	132,422	3.04

Replace the Select Existing Time of Concentration Worksheets in the RMU-1 Engineering Report Appendix I With the Following Subarea Time of Concentration Reports.

:::
TIME OF CONCENTRATION CALCULATOR
:::

```
------------------------------------------------------------------------

Segment #1:  Tc: TR-55 Sheet

Mannings n          .1500
Hydraulic Length    34.00 ft
2yr, 24hr P        2.3000 in
Slope             .500000 ft/ft

Avg.Velocity          .42 ft/sec

                                        Segment #1 Time:     .0224 hrs
------------------------------------------------------------------------

Segment #2:  Tc: Length & Vel.

Hydraulic Length  1140.00 ft
Avg.Velocity         3.00 ft/sec

                                        Segment #2 Time:     .1056 hrs
------------------------------------------------------------------------

                                              =========================
                                               Total Tc:     .1280 hrs
                                              =========================
```

```
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
TIME OF CONCENTRATION CALCULATOR
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::


------------------------------------------------------------------------


Segment #1:  Tc: TR-55 Sheet

Mannings n           .1500
Hydraulic Length   100.00 ft
2yr, 24hr P        2.3000 in
Slope            .050000 ft/ft

Avg.Velocity          .21 ft/sec

                                         Segment #1 Time:     .1335 hrs
------------------------------------------------------------------------

Segment #2:  Tc: TR-55 Shallow

Hydraulic Length   442.00 ft
Slope            .050000 ft/ft
Unpaved

Avg.Velocity         3.61 ft/sec

                                         Segment #2 Time:     .0340 hrs
------------------------------------------------------------------------

Segment #3:  Tc: TR-55 Shallow

Hydraulic Length    62.00 ft
Slope            .330000 ft/ft
Unpaved

Avg.Velocity         9.27 ft/sec

                                         Segment #3 Time:     .0019 hrs
------------------------------------------------------------------------

                                               =========================
                                                Total Tc:     .1694 hrs
                                               =========================
```

```
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
TIME OF CONCENTRATION CALCULATOR
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::


------------------------------------------------------------------------


Segment #1:  Tc: TR-55 Sheet

Mannings n           .1500
Hydraulic Length    89.00 ft
2yr, 24hr P        2.3000 in
Slope             .330000 ft/ft

Avg.Velocity          .43 ft/sec

                                         Segment #1 Time:     .0572 hrs
------------------------------------------------------------------------

Segment #2:  Tc: Length & Vel.

Hydraulic Length   380.00 ft
Avg.Velocity         3.00 ft/sec

                                         Segment #2 Time:     .0352 hrs
------------------------------------------------------------------------

                                               =========================
                                                Total Tc:     .0924 hrs

                                                Calculated Tc < Min.Tc:
                                                Use Minimum Tc...
                                                Use Tc =      .1000 hrs
                                               =========================
```

```
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
TIME OF CONCENTRATION CALCULATOR
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::


------------------------------------------------------------------------


Segment #1:  Tc: TR-55 Sheet

Mannings n          .1500
Hydraulic Length    68.00 ft
2yr, 24hr P        2.3000 in
Slope            .330000 ft/ft

Avg.Velocity          .41 ft/sec

                                          Segment #1 Time:     .0461 hrs
------------------------------------------------------------------------

Segment #2:  Tc: Length & Vel.

Hydraulic Length   262.00 ft
Avg.Velocity         3.00 ft/sec

                                          Segment #2 Time:     .0243 hrs
------------------------------------------------------------------------

                                                ========================
                                                 Total Tc:     .0704 hrs

                                                 Calculated Tc < Min.Tc:
                                                 Use Minimum Tc...
                                                 Use Tc =      .1000 hrs
                                                ========================
```

```
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
TIME OF CONCENTRATION CALCULATOR
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::


------------------------------------------------------------------------


Segment #1:  Tc: TR-55 Sheet

Mannings n           .1500
Hydraulic Length   100.00 ft
2yr, 24hr P        2.3000 in
Slope             .050000 ft/ft

Avg.Velocity          .21 ft/sec

                                         Segment #1 Time:     .1335 hrs
------------------------------------------------------------------------

Segment #2:  Tc: TR-55 Shallow

Hydraulic Length   315.00 ft
Slope             .050000 ft/ft
Unpaved

Avg.Velocity         3.61 ft/sec

                                         Segment #2 Time:     .0243 hrs
------------------------------------------------------------------------

Segment #3:  Tc: Length & Vel.

Hydraulic Length   655.00 ft
Avg.Velocity         3.00 ft/sec

                                         Segment #3 Time:     .0606 hrs
------------------------------------------------------------------------

                                               =========================
                                                Total Tc:     .2184 hrs
                                               =========================
```

```
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
TIME OF CONCENTRATION CALCULATOR
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::


------------------------------------------------------------------------


Segment #1:  Tc: TR-55 Sheet

Mannings n          .1500
Hydraulic Length    87.00 ft
2yr, 24hr P        2.3000 in
Slope            .330000 ft/ft

Avg.Velocity          .43 ft/sec

                                         Segment #1 Time:     .0561 hrs
------------------------------------------------------------------------

Segment #2:  Tc: Length & Vel.

Hydraulic Length   225.00 ft
Avg.Velocity         3.00 ft/sec

                                         Segment #2 Time:     .0208 hrs
------------------------------------------------------------------------

                                               =========================
                                                Total Tc:     .0770 hrs

                                                Calculated Tc < Min.Tc:
                                                Use Minimum Tc...
                                                Use Tc =      .1000 hrs
                                               =========================
```

Replace Select Existing Peak Flow Output Sheets in the RMU-1 Engineering Report Appendix I with the Following Summary Reports.

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir      = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A1 25
Tc            = .4000 hrs
Drainage Area = 1.090 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .05333 hrs
Computed Peak Time             =  12.1067 hrs
Computed Peak Flow             =     2.69 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  12.1102 hrs
Peak Flow, Interpolated Output =     2.69 cfs
============================================

                DRAINAGE AREA
             -------------------
             ID:A1
             CN   =   86
             Area =         1.090 acres
             S    =   1.6279 in
             0.2S =    .3256 in

              Cumulative Runoff
             -------------------
                     2.5463 in
                       .231 ac-ft

HYG Volume...            .231 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .40000 hrs (ID: A1)
Computational Incr, Tm =   .05333 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =     3.09 cfs
Unit peak time      Tp =   .26667 hrs
Unit receding limb, Tr =  1.06667 hrs
Total unit time,    Tb =  1.33333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir       = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A2 25
Tc             = .2000 hrs
Drainage Area = 5.500 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .02667 hrs
Computed Peak Time             =  12.0000 hrs
Computed Peak Flow             =    18.12 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  12.0002 hrs
Peak Flow, Interpolated Output =    18.12 cfs
============================================

                 DRAINAGE AREA
                -------------------
                ID:A2
                CN    =   86
                Area =        5.500 acres
                S     =   1.6279 in
                0.2S =     .3256 in

                 Cumulative Runoff
                -------------------
                        2.5463 in
                         1.167 ac-ft

HYG Volume...          1.167 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .20000 hrs (ID: A2)
Computational Incr, Tm =   .02667 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    31.16 cfs
Unit peak time      Tp =   .13333 hrs
Unit receding limb, Tr =   .53333 hrs
Total unit time,    Tb =   .66667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir      = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A3 25
Tc            = .2000 hrs
Drainage Area = 3.700 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .02667 hrs
Computed Peak Time             =  12.0000 hrs
Computed Peak Flow             =    12.19 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  12.0002 hrs
Peak Flow, Interpolated Output =    12.19 cfs
============================================

                 DRAINAGE AREA
              -------------------
              ID:A3
              CN   =   86
              Area =        3.700 acres
              S    =   1.6279 in
              0.2S =    .3256 in

               Cumulative Runoff
              -------------------
                      2.5463 in
                        .785 ac-ft

HYG Volume...           .785 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .20000 hrs (ID: A3)
Computational Incr, Tm =   .02667 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    20.96 cfs
Unit peak time      Tp =   .13333 hrs
Unit receding limb, Tr =   .53333 hrs
Total unit time,    Tb =   .66667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir      = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A4 MODIFIED 25
Tc            = .1280 hrs
Drainage Area = 1.950 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .01706 hrs
Computed Peak Time             =  11.9447 hrs
Computed Peak Flow             =     7.13 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  11.9502 hrs
Peak Flow, Interpolated Output =     7.12 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:A4 MODIFIED
              CN   =   86
              Area =       1.950 acres
              S    =   1.6279 in
              0.2S =    .3256 in

               Cumulative Runoff
              -------------------
                     2.5463 in
                       .414 ac-ft

HYG Volume...            .414 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .12798 hrs (ID: A4 MODIFIED)
Computational Incr, Tm =   .01706 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    17.26 cfs
Unit peak time      Tp =   .08532 hrs
Unit receding limb, Tr =   .34128 hrs
Total unit time,    Tb =   .42660 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir      = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A7 25
Tc (Min. Tc)  = .1000 hrs
Drainage Area = .230 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .01333 hrs
Computed Peak Time             =  11.9333 hrs
Computed Peak Flow             =      .89 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  11.9302 hrs
Peak Flow, Interpolated Output =      .88 cfs
============================================

                 DRAINAGE AREA
              -------------------
              ID:A7
              CN   =   86
              Area =         .230 acres
              S    =   1.6279 in
              0.2S =    .3256 in

               Cumulative Runoff
              -------------------
                      2.5463 in
                        .049 ac-ft

HYG Volume...           .049 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .10000 hrs (ID: A7)
Computational Incr, Tm =   .01333 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =     2.61 cfs
Unit peak time      Tp =   .06667 hrs
Unit receding limb, Tr =   .26667 hrs
Total unit time,    Tb =   .33333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir       = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A9 MODIFIED 25
Tc             = .1694 hrs
Drainage Area = 2.190 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .02259 hrs
Computed Peak Time             =  11.9936 hrs
Computed Peak Flow             =     7.53 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  11.9902 hrs
Peak Flow, Interpolated Output =     7.52 cfs
============================================

                 DRAINAGE AREA
              -------------------
              ID:A9 MODIFIED
              CN   =   86
              Area =       2.190 acres
              S    =   1.6279 in
              0.2S =    .3256 in

               Cumulative Runoff
              -------------------
                      2.5463 in
                        .465 ac-ft

HYG Volume...            .465 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .16940 hrs (ID: A9 MODIFIED)
Computational Incr, Tm =   .02259 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    14.65 cfs
Unit peak time      Tp =   .11293 hrs
Unit receding limb, Tr =   .45174 hrs
Total unit time,    Tb =   .56467 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir      = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A10 25
Tc            = .2000 hrs
Drainage Area = 6.150 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .02667 hrs
Computed Peak Time             =  12.0000 hrs
Computed Peak Flow             =    20.27 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  12.0002 hrs
Peak Flow, Interpolated Output =    20.27 cfs
============================================

                DRAINAGE AREA
             -------------------
             ID:A10
             CN   =   86
             Area =       6.150 acres
             S    =  1.6279 in
             0.2S =    .3256 in

              Cumulative Runoff
             -------------------
                     2.5463 in
                      1.305 ac-ft

HYG Volume...         1.305 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .20000 hrs (ID: A10)
Computational Incr, Tm =   .02667 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,           qp =    34.84 cfs
Unit peak time       Tp =   .13333 hrs
Unit receding limb,  Tr =   .53333 hrs
Total unit time,     Tb =   .66667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir       = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A12 MODIFIED 25
Tc (Min. Tc)  = .1000 hrs
Drainage Area = 1.074 acres  Runoff CN= 86

============================================
Computational Time Increment   =    .01333 hrs
Computed Peak Time             =  11.9333 hrs
Computed Peak Flow             =     4.14 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  11.9302 hrs
Peak Flow, Interpolated Output =     4.13 cfs
============================================

                 DRAINAGE AREA
              -------------------
              ID:A12 MODIFIED
              CN   =   86
              Area =       1.074 acres
              S    =   1.6279 in
              0.2S =    .3256 in

               Cumulative Runoff
              -------------------
                     2.5463 in
                       .228 ac-ft

HYG Volume...            .228 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .10000 hrs (ID: A12 MODIFIED)
Computational Incr, Tm =   .01333 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =    12.17 cfs
Unit peak time      Tp =   .06667 hrs
Unit receding limb, Tr =   .26667 hrs
Total unit time,    Tb =   .33333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir       = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A15 MODIFIED 25
Tc (Min. Tc)   = .1000 hrs
Drainage Area = .750 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .01333 hrs
Computed Peak Time             =  11.9333 hrs
Computed Peak Flow             =     2.89 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  11.9302 hrs
Peak Flow, Interpolated Output =     2.88 cfs
============================================

                 DRAINAGE AREA
              -------------------
              ID:A15 MODIFIED
              CN   =   86
              Area =        .750 acres
              S    =   1.6279 in
              0.2S =    .3256 in

               Cumulative Runoff
              -------------------
                     2.5463 in
                       .159 ac-ft

HYG Volume...            .159 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .10000 hrs (ID: A15 MODIFIED)
Computational Incr, Tm =   .01333 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =     8.50 cfs
Unit peak time      Tp =   .06667 hrs
Unit receding limb, Tr =   .26667 hrs
Total unit time,    Tb =   .33333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir      = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A18 25
Tc (Min. Tc)  = .1000 hrs
Drainage Area = 1.190 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .01333 hrs
Computed Peak Time             =  11.9333 hrs
Computed Peak Flow             =     4.58 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  11.9302 hrs
Peak Flow, Interpolated Output =     4.57 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:A18
              CN   =   86
              Area =       1.190 acres
              S    =   1.6279 in
              0.2S =    .3256 in

               Cumulative Runoff
              -------------------
                      2.5463 in
                        .253 ac-ft

HYG Volume...           .252 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .10000 hrs (ID: A18)
Computational Incr, Tm =   .01333 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    13.48 cfs
Unit peak time      Tp =   .06667 hrs
Unit receding limb, Tr =   .26667 hrs
Total unit time,    Tb =   .33333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir      = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A19 MODIFED 25
Tc            = .2184 hrs
Drainage Area = 3.700 acres  Runoff CN= 86

============================================
Computational Time Increment   =    .02912 hrs
Computed Peak Time             =   12.0273 hrs
Computed Peak Flow             =     11.90 cfs

Time Increment for HYG File    =     .0100 hrs
Peak Time, Interpolated Output =   12.0202 hrs
Peak Flow, Interpolated Output =     11.87 cfs
============================================

                 DRAINAGE AREA
              -------------------
              ID:A19 MODIFED
              CN    =   86
              Area  =        3.700 acres
              S     =   1.6279 in
              0.2S  =    .3256 in

               Cumulative Runoff
              -------------------
                     2.5463 in
                       .785 ac-ft

HYG Volume...            .785 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .21841 hrs (ID: A19 MODIFED)
Computational Incr, Tm =   .02912 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,           qp =    19.19 cfs
Unit peak time       Tp =   .14561 hrs
Unit receding limb,  Tr =   .58243 hrs
Total unit time,     Tb =   .72804 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir       = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A20 MODIFIED 25
Tc (Min. Tc)  = .1000 hrs
Drainage Area = .590 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .01333 hrs
Computed Peak Time             =  11.9333 hrs
Computed Peak Flow             =     2.27 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  11.9302 hrs
Peak Flow, Interpolated Output =     2.27 cfs
============================================

              DRAINAGE AREA
             -------------------
             ID:A20 MODIFIED
             CN   =   86
             Area =         .590 acres
             S    =   1.6279 in
             0.2S =    .3256 in

              Cumulative Runoff
             -------------------
                    2.5463 in
                      .125 ac-ft

HYG Volume...           .125 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .10000 hrs (ID: A20 MODIFIED)
Computational Incr, Tm =   .01333 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,           qp =     6.68 cfs
Unit peak time       Tp =   .06667 hrs
Unit receding limb, Tr =   .26667 hrs
Total unit time,     Tb =   .33333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0000 in
Rain Dir      = G:\TMProj\CWM Model City\Calculations\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = G:\TMProj\CWM Model City\Calculations\
HYG File - ID =  - A21 25
Tc            = .2000 hrs
Drainage Area = 2.160 acres  Runoff CN= 86

============================================
Computational Time Increment   =   .02667 hrs
Computed Peak Time             =  12.0000 hrs
Computed Peak Flow             =     7.12 cfs

Time Increment for HYG File    =    .0100 hrs
Peak Time, Interpolated Output =  12.0002 hrs
Peak Flow, Interpolated Output =     7.12 cfs
============================================

                  DRAINAGE AREA
              -------------------
              ID:A21
              CN   =   86
              Area =        2.160 acres
              S    =   1.6279 in
              0.2S =    .3256 in

               Cumulative Runoff
              -------------------
                      2.5463 in
                        .458 ac-ft

HYG Volume...            .458 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .20000 hrs (ID: A21)
Computational Incr, Tm =   .02667 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    12.24 cfs
Unit peak time      Tp =   .13333 hrs
Unit receding limb, Tr =   .53333 hrs
Total unit time,    Tb =   .66667 hrs
```

SUMMARY FOR HYDROGRAPH ADDITION
at Node: A1 CHANNEL

HYG Directory: G:\TMProj\CWM Model City\Calculations\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 160	A1 CHANNEL		A1 CHANNEL	25
ADDLINK 10	A9 MOD CHANNEL		A9 MOD CHANNEL	25

INFLOWS TO: A1 CHANNEL

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	A1 CHANNEL	25	.231	12.1100	2.69
	A9 MOD CHANNEL	25	.465	12.0200	7.04

TOTAL FLOW INTO: A1 CHANNEL

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	A1 CHANNEL	25	.696	12.0400	9.35

SUMMARY FOR HYDROGRAPH ADDITION
at Node: A15 CHANNEL

HYG Directory: G:\TMProj\CWM Model City\Calculations\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 180	A20 MOD CHANNEL		A20 MOD CHANNEL	25
ADDLINK 170	A15 MOD CHANNEL		A15 MOD CHANNEL	25

INFLOWS TO: A15 CHANNEL

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	A20 MOD CHANNEL	25	.125	11.9300	2.27
	A15 MOD CHANNEL	25	.159	11.9300	2.88

TOTAL FLOW INTO: A15 CHANNEL

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	A15 CHANNEL	25	.284	11.9300	5.15

SUMMARY FOR HYDROGRAPH ADDITION
at Node: FLUME 1

HYG Directory: G:\TMProj\CWM Model City\Calculations\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 20	A1		A1	25
ADDLINK 90	A3		A3	25
ADDLINK 100	A7		A7	25
ADDLINK 110	A21		A21	25
ADDLINK 40	A9 MODIFIED		A9 MODIFIED	25
ADDLINK 80	A2		A2	25
ADDLINK 30	A4 MODIFIED		A4 MODIFIED	25

INFLOWS TO: FLUME 1

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	A1	25	.231	12.1100	2.69
	A3	25	.785	12.0000	12.19
	A7	25	.049	11.9300	.88
	A21	25	.458	12.0000	7.12
	A9 MODIFIED	25	.465	11.9900	7.52
	A2	25	1.167	12.0000	18.12
	A4 MODIFIED	25	.414	11.9500	7.12

TOTAL FLOW INTO: FLUME 1

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	FLUME 1	25	3.569	12.0000	54.53

SUMMARY FOR HYDROGRAPH ADDITION
at Node: FLUME 2

HYG Directory: G:\TMProj\CWM Model City\Calculations\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 70	A20 MODIFIED		A20 MODIFIED	25
ADDLINK 150	A11		A11	25
ADDLINK 50	A12 MODIFIED		A12 MODIFIED	25
ADDLINK 140	A10		A10	25
ADDLINK 60	A15 MODIFIED		A15 MODIFIED	25
ADDLINK 120	A18		A18	25
ADDLINK 130	A19 MODIFED		A19 MODIFED	25

INFLOWS TO: FLUME 2

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	A20 MODIFIED	25	.125	11.9300	2.27
	A11	25	.609	11.9300	11.03
	A12 MODIFIED	25	.228	11.9300	4.13
	A10	25	1.305	12.0000	20.27
	A15 MODIFIED	25	.159	11.9300	2.88
	A18	25	.252	11.9300	4.57
	A19 MODIFED	25	.785	12.0200	11.87

TOTAL FLOW INTO: FLUME 2

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	FLUME 2	25	3.464	11.9700	53.75

SUMMARY FOR HYDROGRAPH ADDITION
at Node: V2

HYG Directory: G:\TMProj\CWM Model City\Calculations\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 20	A1		A1	25
ADDLINK 90	A3		A3	25
ADDLINK 100	A7		A7	25
ADDLINK 110	A21		A21	25
ADDLINK 40	A9 MODIFIED		A9 MODIFIED	25
ADDLINK 80	A2		A2	25
ADDLINK 30	A4 MODIFIED		A4 MODIFIED	25

INFLOWS TO: V2

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	A1	25	.231	12.1100	2.69
	A3	25	.785	12.0000	12.19
	A7	25	.049	11.9300	.88
	A21	25	.458	12.0000	7.12
	A9 MODIFIED	25	.465	11.9900	7.52
	A2	25	1.167	12.0000	18.12
	A4 MODIFIED	25	.414	11.9500	7.12

TOTAL FLOW INTO: V2

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	V2	25	3.569	12.0000	54.53

SUMMARY FOR HYDROGRAPH ADDITION
at Node: V6

HYG Directory: G:\TMProj\CWM Model City\Calculations\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 70	A20 MODIFIED		A20 MODIFIED	25
ADDLINK 150	A11		A11	25
ADDLINK 50	A12 MODIFIED		A12 MODIFIED	25
ADDLINK 140	A10		A10	25
ADDLINK 60	A15 MODIFIED		A15 MODIFIED	25
ADDLINK 120	A18		A18	25
ADDLINK 130	A19 MODIFED		A19 MODIFED	25

INFLOWS TO: V6

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	A20 MODIFIED	25	.125	11.9300	2.27
	A11	25	.609	11.9300	11.03
	A12 MODIFIED	25	.228	11.9300	4.13
	A10	25	1.305	12.0000	20.27
	A15 MODIFIED	25	.159	11.9300	2.88
	A18	25	.252	11.9300	4.57
	A19 MODIFED	25	.785	12.0200	11.87

TOTAL FLOW INTO: V6

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	V6	25	3.464	11.9700	53.75

Replace the Existing RMU-1 Engineering Report Appendix I, Table 2 (Channel Schedule) With the Following Revised Table 2.

Table I-2
Channel Schedule
CWM Chemical Services, LLC
Model City Facility

Channel No.	Channel Type	Slope (ft/ft)	Sideslopes LH:V	RH:V	Bottom Width (ft)	Peak Discharge (cfs)	Flow Depth (ft)	Flow Velocity (ft/s)	Lining Type	Lining Thickness (ft)	Design Depth (min, ft)
A1	Diversion Berm	0.010	3:1	2:1	0.0	2.7	0.75	1.93	Grass	N/A	3.00
A2	Diversion Berm	0.010	3:1	2:1	0.0	18.0	1.52	3.10	Grass	N/A	3.00
A3	Diversion Berm	0.010	3:1	2:1	0.0	12.0	1.31	2.80	Grass	N/A	3.00
A4 Mod	Diversion Berm	0.010	3:1	2:1	0.0	7.5	1.10	2.50	Grass	N/A	3.00
A5	Perimeter Berm	0.005	1:1	2:1	0.0	7.0	1.52	2.02	Grass	N/A	2.50
A6	Perimeter Berm	0.005	1:1	2:1	0.0	5.0	1.34	1.86	Grass	N/A	2.50
A7	Perimeter Berm	0.012	1:1	2:1	0.0	1.0	0.62	1.73	Grass	N/A	2.50
A8	Perimeter Berm	0.012	1:1	2:1	0.0	4.0	1.04	2.44	Grass	N/A	2.50
A9 Mod	Diversion Berm	0.010	3:1	2:1	0.0	7.5	1.10	2.50	Grass	N/A	3.00
A10, R1	Diversion Berm	0.010	3:1	2:1	0.0	21.0	1.61	3.22	Grass	N/A	3.00
A10, R2	Diversion Berm	0.030	3:1	2:1	0.0	21.0	1.19	5.96	d_{50} = 1.5"	1	3.00
A10, R3	Diversion Berm	0.008	3:1	2:1	0.0	21.0	1.70	2.89	Grass	N/A	3.00
A11	Diversion Berm	0.010	3:1	2:1	0.0	11.0	1.27	2.75	Grass	N/A	3.00
A12 Mod	Diversion Berm	0.008	3:1	2:1	0.0	4.1	0.93	1.93	Grass	N/A	3.00
A13	Perimeter Berm	0.005	1:1	2:1	0.0	10.0	1.74	2.21	Grass	N/A	2.50
A14	Perimeter Berm	0.005	1:1	2:1	0.0	6.0	1.43	1.95	Grass	N/A	2.50
A15 Mod	Perimeter Berm	0.005	1:1	2:1	0.0	5.1	1.35	1.87	Grass	N/A	2.50
A16	Perimeter Berm	0.025	1:1	2:1	0.0	2.0	0.70	2.71	Grass	N/A	2.50
A17	Perimeter Berm	0.005	1:1	2:1	0.0	4.0	1.23	1.76	Grass	N/A	2.50
A18	Perimeter Berm	0.005	1:1	2:1	0.0	5.0	1.34	1.86	Grass	N/A	2.50
A19 Mod	Perimeter Berm	0.010	3:1	2:1	0.0	11.7	1.31	2.74	Grass	N/A	3.00
A20 Mod	Perimeter Berm	0.005	1:1	2:1	0.0	2.3	1.00	1.53	Grass	N/A	2.50
A21	Diversion Berm	0.010	3:1	2:1	0.0	7.0	1.07	2.45	Grass	N/A	3.00
Flume 1	Downslope Flume	0.333	2:1	2:1	20.0	54.5	0.28	9.45	d_{50} = 1.5" (Grouted)	1	1.00
Flume 2	Downslope Flume	0.250	2:1	2:1	20.0	53.8	0.30	8.63	d_{50} = 1.5" (Grouted)	1	1.00
P1 Mod	Toe of Perimeter Berm	0.0078	2:1	2:1	0.0	12.9	1.54	2.71	Grass	N/A	2.00
P2	Toe of Perimeter Berm	0.0025	2:1	2:1	2.0	2.4	0.65	1.13	Grass	N/A	2.00
P3	Toe of Perimeter Berm	0.0025	2:1	2:1	2.0	0.8	0.36	0.82	Grass	N/A	2.00
P4	Toe of Perimeter Berm	0.0025	2:1	2:1	2.0	0.8	0.36	0.82	Grass	N/A	2.00
P5	Toe of Perimeter Berm	0.0025	2:1	2:1	2.0	0.8	0.36	0.82	Grass	N/A	2.00
P6	Toe of Perimeter Berm	0.0025	2:1	2:1	2.0	0.8	0.36	0.82	Grass	N/A	2.00
P7	Toe of Perimeter Berm	0.0025	2:1	2:1	2.0	0.8	0.36	0.82	Grass	N/A	2.00
P8	Toe of Perimeter Berm	0.0025	2:1	2:1	2.0	5.4	0.97	1.40	Grass	N/A	2.00
P9	Toe of Perimeter Berm	0.0025	2:1	2:1	2.0	11.1	1.38	1.69	Grass	N/A	2.00
P10	Toe of Perimeter Berm	0.005	2:1	2:1	0.0	3.0	0.97	1.59	Grass	N/A	2.00
P11	Toe of Perimeter Berm	0.002	2:1	2:1	0.0	16.0	2.16	1.71	Grass	N/A	2.50
P12	Toe of Perimeter Berm	0.002	2:1	2:1	6.0	23.9	1.48	1.81	Grass	N/A	2.00
V1	Vertical Channel on Perimeter Berm Sideslope	0.390	4:1	4:1	6.0	10.0	0.21	7.37	d_{50} = 1.5" (Grouted)	1	1.00
V2	Vertical Channel on Perimeter Berm Sideslope	0.390	2:1	2:1	20.0	54.5	0.27	9.94	d_{50} = 1.5" (Grouted)	1	1.00
V3	Vertical Channel on Perimeter Berm Sideslope	0.390	4:1	4:1	6.0	5.0	0.15	5.17	d_{50} = 1.5" (Grouted)	1	1.00
V4	Vertical Channel on Perimeter Berm Sideslope	0.390	4:1	4:1	6.0	9.0	0.19	6.85	d_{50} = 1.5" (Grouted)	1	1.00
V5	Vertical Channel on Perimeter Berm Sideslope	0.390	4:1	4:1	6.0	15.0	0.25	8.59	d_{50} = 1.5" (Grouted)	1	1.00
V6	Vertical Channel on Perimeter Berm Sideslope	0.390	2:1	2:1	20.0	53.7	0.26	9.89	d_{50} = 1.5" (Grouted)	1	1.00

Notes:
The riprap lined channels will be lined with grouted New York State Department of Transportation fine riprap (d50 = 1.5") or equivalent.
ft - feet
cfs - cubic feet per second
ft/s - feet per second
N/A - not applicable

By : JPD (ET) Date: 2/3/1999
Revised: BPS (ET Date: 7/28/2000
Revised: BMS (BE Date: 5/11/2001
Revised: BMS (BE Date: 6/25/2001
Revised: BMS (BE Date: 5/15/2002
Revised: BMS (AF Date: 3/28/2008
Revised: PTO (AR Date: 8/15/2012

Replace Select Existing Channel Design Worksheets in the RMU-1 Engineering Report Appendix I With the Following Channel Design Worksheets.

Project: CWM Model City
Project No.:23729.2012
Subject: RMU-1 Permit Modification

Prepared by: PTO
Date: 8/2012

Channel A1

Worksheet for Triangular Channel

Channel Design (Input)	
Flow Capacity (cfs)	2.69
Base Width (ft)	0.00
Left Side Slope (x:1)	3.00
Right Side Slope (x:1)	2.00
Bed Slope	0.0100
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	2.69
Required Flow Depth (ft)	0.75
Resulting Flow Velocity (ft/s)	1.93
Resulting Flow Width at Top (ft)	3.73
Resulting Flow Area (ft^2)	1.39
Resulting Wetted Perimeter (ft)	4.03
Resulting Hydraulic Radius (ft)	0.35

Project: CWM Model City
Project No.: 23729.2012
Subject: RMU-1 Permit Modification

Prepared by: PTO
Date: 8/2012

Drainage Channel A4 Modified
Worksheet for Triangular Channel

Channel Design (Input)	
Flow Capacity (cfs)	7.13
Base Width (ft)	0.00
Left Side Slope (x:1)	3.00
Right Side Slope (x:1)	2.00
Bed Slope	0.010
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	7.13
Required Flow Depth (ft)	1.08
Resulting Flow Velocity (ft/s)	2.46
Resulting Flow Width at Top (ft)	5.38
Resulting Flow Area (ft^2)	2.89
Resulting Wetted Perimeter (ft)	5.81
Resulting Hydraulic Radius (ft)	0.50

Project: CWM Model City
Project No.: 23729.2012
Subject: RMU-1 Permit Modification

Prepared by: PTO
Date: 08/2012

Drainage Channel A9 Modified
Worksheet for Triangular Channel

Channel Design (Input)	
Flow Capacity (cfs)	7.53
Base Width (ft)	0.00
Left Side Slope (x:1)	3.00
Right Side Slope (x:1)	2.00
Bed Slope	0.010
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	7.53
Required Flow Depth (ft)	1.10
Resulting Flow Velocity (ft/s)	2.50
Resulting Flow Width at Top (ft)	5.49
Resulting Flow Area (ft^2)	3.01
Resulting Wetted Perimeter (ft)	5.93
Resulting Hydraulic Radius (ft)	0.51

Channel A11

Worksheet for Triangular Channel

Channel Design (Input)	
Flow Capacity (cfs)	11.05
Base Width (ft)	0.00
Left Side Slope (x:1)	3.00
Right Side Slope (x:1)	2.00
Bed Slope	0.0100
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	11.05
Required Flow Depth (ft)	1.27
Resulting Flow Velocity (ft/s)	2.75
Resulting Flow Width at Top (ft)	6.34
Resulting Flow Area (ft^2)	4.02
Resulting Wetted Perimeter (ft)	6.85
Resulting Hydraulic Radius (ft)	0.59

Drainage Channel A12 Modified

Worksheet for Triangular Channel

Channel Design (Input)	
Flow Capacity (cfs)	4.14
Base Width (ft)	0.00
Left Side Slope (x:1)	3.00
Right Side Slope (x:1)	2.00
Bed Slope	0.008
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	4.14
Required Flow Depth (ft)	0.93
Resulting Flow Velocity (ft/s)	1.93
Resulting Flow Width at Top (ft)	4.63
Resulting Flow Area (ft^2)	2.14
Resulting Wetted Perimeter (ft)	5.00
Resulting Hydraulic Radius (ft)	0.43

Project: CWM Model City
Project No.: 23729.2012
Subject: RMU-1 Permit Modification

Prepared by: PTO
Date: 8/2012

Drainage Channel A15 Modified
Worksheet for Triangular Channel

Channel Design (Input)	
Flow Capacity (cfs)	2.88
Base Width (ft)	0.00
Left Side Slope (x:1)	1.00
Right Side Slope (x:1)	2.00
Bed Slope	0.005
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	2.88
Required Flow Depth (ft)	1.09
Resulting Flow Velocity (ft/s)	1.62
Resulting Flow Width at Top (ft)	3.26
Resulting Flow Area (ft^2)	1.78
Resulting Wetted Perimeter (ft)	3.97
Resulting Hydraulic Radius (ft)	0.45

Drainage Channel A20 Modified

Worksheet for Triangular Channel

Channel Design (Input)	
Flow Capacity (cfs)	2.27
Base Width (ft)	0.00
Left Side Slope (x:1)	1.00
Right Side Slope (x:1)	2.00
Bed Slope	0.005
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	2.27
Required Flow Depth (ft)	1.00
Resulting Flow Velocity (ft/s)	1.53
Resulting Flow Width at Top (ft)	2.99
Resulting Flow Area (ft^2)	1.49
Resulting Wetted Perimeter (ft)	3.64
Resulting Hydraulic Radius (ft)	0.41

Project: CWM Model City
Project No.: 23729.2012
Subject: RMU-1 Permit Modification

Prepared by: PTO
Date: 8/2012

Drainage Flume 1 (D_{50} = 1.5" grouted)
Worksheet for Trapezoidal Channel

Channel Design (Input)	
Flow Capacity (cfs)	54.53
Base Width (ft)	20.00
Left Side Slope (x:1)	2.00
Right Side Slope (x:1)	2.00
Bed Slope	0.330
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	54.53
Required Flow Depth (ft)	0.28
Resulting Flow Velocity (ft/s)	9.45
Resulting Flow Width at Top (ft)	21.12
Resulting Flow Area (ft^2)	5.77
Resulting Wetted Perimeter (ft)	21.26
Resulting Hydraulic Radius (ft)	0.27

Drainage Flume 2 (D_{50} = 1.5" grouted)

Worksheet for Trapezoidal Channel

Channel Design (Input)	
Flow Capacity (cfs)	53.75
Base Width (ft)	20.00
Left Side Slope (x:1)	2.00
Right Side Slope (x:1)	2.00
Bed Slope	0.250
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	53.75
Required Flow Depth (ft)	0.30
Resulting Flow Velocity (ft/s)	8.63
Resulting Flow Width at Top (ft)	21.21
Resulting Flow Area (ft^2)	6.23
Resulting Wetted Perimeter (ft)	21.35
Resulting Hydraulic Radius (ft)	0.29

Drainage Channel V2 (D_{50} = 1.5" grouted)

Worksheet for Trapezoidal Channel

Channel Design (Input)	
Flow Capacity (cfs)	54.53
Base Width (ft)	20.00
Left Side Slope (x:1)	2.00
Right Side Slope (x:1)	2.00
Bed Slope	0.390
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	54.53
Required Flow Depth (ft)	0.27
Resulting Flow Velocity (ft/s)	9.94
Resulting Flow Width at Top (ft)	21.07
Resulting Flow Area (ft^2)	5.48
Resulting Wetted Perimeter (ft)	21.19
Resulting Hydraulic Radius (ft)	0.26

Project: CWM Model City
Project No.:23729.2012
Subject: RMU-1 Permit Modification

Prepared by: PTO
Date: 8/2012

Drainage Channel V6 (D_{50} = 1.5" grouted)

Worksheet for Trapezoidal Channel

Channel Design (Input)	
Flow Capacity (cfs)	53.75
Base Width (ft)	20.00
Left Side Slope (x:1)	2.00
Right Side Slope (x:1)	2.00
Bed Slope	0.390
Manning "n"	0.038

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	53.75
Required Flow Depth (ft)	0.26
Resulting Flow Velocity (ft/s)	9.89
Resulting Flow Width at Top (ft)	21.06
Resulting Flow Area (ft^2)	5.44
Resulting Wetted Perimeter (ft)	21.18
Resulting Hydraulic Radius (ft)	0.26

Replace Existing ESRB Calculation Sheet in the RMU-1 Engineering Report Appendix I With the Following Revised ESRB Calculation Sheet.

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

CLIENT: CWM Chemical Services, LLC **PROJECT:** Model City, NY **Prepared By:** BMS **Date:** 12/2/03
TITLE: RMU-1 Permit Modification **Reviewed By:** **Date:**
Revised By: PTO **Date:** 8/15/2012

SUBJECT: East Stormwater Retention Basin

TASK:

Redesign the East Stormwater Retention Basin (ESRB) to contain runoff from the 25-year, 24-hour design storm, provide storage for at least one year of accumulated sediment, and demonstrate a minimum of one foot of freeboard under final conditions. Demonstrate that the ESRB redesign can contain runoff from the 25-year, 24-hour design storm and provide storage for one year of accumulated sediment under interim conditions. Incorporate an emergency spillway which provides adequate hydraulic capacity to route the 100-year, 24-hour design storm.

REFERENCES:

1. Appendix I to the Engineering Report for Residuals Management Unit 1 entitled "Surface Water Drainage and Erosion Calculations."

2. "New York Guidelines for Urban Erosion and Sediment Control," April 1997.

3. "Conservation Practice Standard Code 378 (Pond)," Natural Resources Conservation Service, October 1987.

4. Technical Release 55 "Urban Hydrology for Small Watersheds," Soil Conservation Service, June 1986.

5. PondPack for Windows, Version 7.5, hydrology modeling program, Haestad Methods, Inc.

6. "Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada," Northeast Regional Climate Center, September 1993.

7. RMU-1 Permit Drawing No. 22-a entitled "Site Surface Water Plan and Details," BBL June 2003, Last Revised March 2008

METHODOLOGY:

Approximately 26.39 acres of RMU-1 and peripheral areas, including the gravel road at the toe of the perimeter berm and the basin area itself, drain into the ESRB. The ESRB redesign is evaluated under two scenarios, each with different stormwater runoff conditions, annual sediment accumulations, and freeboard conditions. The first scenario ("interim" condition) assumes that approximately half of the RMU-1 area tributary to the ESRB (with the exception of the basin area itself and any gravel roads) is newly graded and unvegetated. The remainder of the RMU-1 area tributary to the ESRB is assumed to be moderately vegetated ("fair" condition as defined in Table 2-2a. of reference 4). This scenario is intended to model RMU-1 as establishment of final cover vegetation progresses. The second scenario (the "final" condition) assumes that the entire RMU-1 area tributary to the ESRB is moderately vegetated ("fair" condition as defined in Table 2-2a. of reference 4) and is intended to model RMU-1 following establishment of the final cover vegetation.

The ESRB redesign has been sized to accommodate a minimum of one year of sediment accumulation under each scenario in addition to the 25-year, 24-hour runoff volume. The methodology used to redesign the basin is outlined below.

1. Annual Sediment Accumulation

As discussed above, annual sediment accumulations are calculated for both scenarios (interim and final). The annual sediment loading on the basin under the interim condition reflects increased soil loss conditions associated with newly graded areas.

According to soil loss calculations in the final cover soil loss calculations contained in Section VI of reference 1, approximately 1.79 tons/acre/year will be lost from the final cover once vegetation is established. Since the "C" value in the Universal Soil Loss Equation for unvegetated conditions is approximately 100 times that for vegetated conditions, BBL estimates that approximately 179 tons/acre/year will be lost from newly graded areas of the final cover. Consequently, annual sediment loading on the basin under the interim condition is based on 179 tons/acre/year from half of the basin watershed (minus the basin area itself), or 11.68 acres (representative of newly graded final cover) and 1.79 tons/acre/year from the remainder of the area of RMU-1 that is tributary to the ESRB (representative of established vegetation). The annual sediment loading on the basin under the final condition is based on the final cover soil loss calculations contained in Section VI of reference 1.

2. Runoff Curve Numbers and 25-year, 24-hour Stormwater Runoff Volumes

Stormwater runoff volumes for the design storm are calculated for both scenarios using a composite runoff curve number for each subarea in the ESRB watershed. The perimeter subareas (i.e., A16 and those designated with a "P") presented in Figure D-1 in Section II of reference 1, include runoff from half of the perimeter road and therefore, have a composite runoff curve number due to the RMU-1 and gravel road areas. Under the interim condition, the interior subareas (i.e., those designated with an "A" except A16) also presented in Figure D-1 have a composite runoff curve number based on half of the RMU-1 area in each subarea being newly graded and the other half being vegetated. Under the final condition, the interior subareas are homogenous and are assigned a single curve number based on a vegetated condition.

3. Design High Water Elevations and Freeboards

The design high water elevations for both the interim and final conditions are obtained directly by interpolating from the basin rating curve. The design high water elevation for each scenario is the basin elevation corresponding to one year of accumulated sediment plus the 25-year, 24-hour stormwater runoff volume. Freeboard is based on the lowest berm crest elevation of 321.7 (i.e., the invert elevation of the emergency spillway).

4. Estimated Peak Basin Discharge and Time to Drain

The ESRB will function as a retention basin, meaning that its outlet valve will be closed for the duration of the design storm. The peak discharge from the basin will occur immediately after opening the manually operated outlet valve and is dependent on the design high water elevation and the configuration of the outlet structure. The outlet structure for the revised ESRB consists of a perforated standpipe (created by installing holes through the walls of a concrete manhole structure), fabric filter, and outlet valve. The majority of the stormwater discharges through ten 2-inch diameter orifices created in the standpipe at elevation 318.4. Sediment dewatering and drawdown of the basin to the basin floor is accomplished through three 10-foot lengths of 4-inch diameter perforated corrugated HDPE pipe. To minimize the potential for migration of sediment from the basin, the sediment dewatering pipes and the 2-inch diameter orifices will be covered with crushed stone. A filter fabric will also be included over the perforated pipes to further reduce the potential for sediment migration. Additional details pertaining to the outlet structure design are depicted in reference 7. The ESRB time to drain is based on the design high water and the basin floor elevation (317.0).

5. Emergency Spillway Design

An emergency spillway will be incorporated in the ESRB design to route the 100-year, 24-hour design storm. The invert of the emergency spillway is established at the design high water elevation for the final watershed condition plus 1.33 feet. Thus, the freeboard under the final watershed condition is 1.33 feet. The emergency spillway dimensions are based on the peak discharge over the spillway during the 100-year, 24-hour design storm. Peak discharges over the emergency spillway are calculated assuming the basin is dry at the beginning of the 100-year, 24-hour design storm and that the basin outlet gate is closed. Therefore, the ESRB functions as a complete retention basin until the basin elevation equals the invert elevation of the emergency spillway, at which point it functions as a detention basin.

6. Adherence to Basin Design Criteria

The basin and outlet structure design criteria presented in references 2 and 3 are discussed and compared with the revised ESRB design to assess compliance and justify any deviations.

ASSUMPTIONS:

1. The following runoff curve numbers (CN values) are based on reference 4 and assume a hydrologic group "C" (consistent with reference 1):

    - Vegetated areas of RMU-1 = 79 (open space, fair condition);
    - Newly graded areas of RMU-1 = 91 (newly graded areas);
    - Perimeter roads = 89 (gravel roads); and
    - Basin water surface = 100 (100% runoff).

2. The basin water surface area (for the purposes of calculating runoff from the CN=100 area) is conservatively based on the elevation contour 321.5, which is above the high water elevations for both the interim and final conditions.

3. The time of concentration and acreage for each subarea in the ESRB watershed are based on Reference 1.

4. The minimum required freeboard under the final condition is 1.0 foot. Due to its temporary nature, less than 1.0 foot of freeboard is acceptable under the interim condition.

5. The basin is dry and contains one year of accumulated sediment at the beginning of the design storm.

6. The 25-year, 24-hour design storm produces 4.00 inches of rainfall.

7. The 100-year, 24-hour design storm produces 5.65 inches of rainfall.

CALCULATIONS:

1. Annual Sediment Accumulation

Interim Condition

Annual sediment accumulation for the interim condition is based on calculated final cover soil loss rates (Section VI of reference 1) and estimated soil loss rates for the newly graded areas (i.e., 100 times the calculated final cover soil loss rate as described above):

Annual Sediment Accumulation = (179 tons/acre/year)(11.68 acres) + (1.79 tons/acre/year)(11.68 acres)
= 2,111.6 tons/year

Based on a unit weight of 85 lbs/cu.ft. for silty clay (reference 2), the annual sediment accumulation in terms of volume is:

Annual Sediment Accumulation = (2,111.6 tons/year)(2,000)(1/85)(1/43,560)
= **1.141 acre-feet**

Final Condition

Annual sediment accumulation for the final condition is based on calculated final cover soil loss rates (Section VI of reference 1):

Annual Sediment Accumulation = (1.79 tons/acre/year)(23.35 acres)
= 41.797 tons/year

Based on a unit weight of 85 lbs/cu.ft. for silty clay (reference 2), the annual sediment accumulation in terms of volume is:

Annual Sediment Accumulation = (41.8 tons/year)(2,000)(1/85)(1/43,560)
= **0.023 acre-feet**

2. Runoff Curve Numbers and 25-year, 24-hour Stormwater Runoff Volumes

Interim Condition

The following table summarizes the acreages and runoff curve numbers (both the individual CN components and the composite CN value) for the ESRB watershed subareas under the interim condition.

Subarea ID	Total Area [acres]	Tc [hr]	Individual CN Components				Composite CN
			CN=79	CN=91	CN=89	CN=100	
A1	1.09	0.36	0.54	0.55	-	-	85
A2	5.50	0.24	2.75	2.75	-	-	85
A3	3.70	0.16	1.85	1.85	-	-	85
A4 Modified	1.95	0.13	0.98	0.98	-	-	85
A5	2.30	0.30	1.15	1.15	-	-	85
A6	1.25	0.11	0.62	0.63	-	-	85
A7	0.23	0.10	0.11	0.12	-	-	85
A9 Modified	2.19	0.17	1.08	1.08	0.03	-	85

Subarea ID	Total Area [acres]	Tc [hr]	Individual CN Components				Composite CN
			CN=79	CN=91	CN=89	CN=100	
A16	0.46	0.24	0.19	0.20	0.07	-	86
A21	2.16	0.17	1.08	1.08	-	-	85
P2	0.29	0.10	0.10	0.11	0.08	-	86
P3	0.19	0.10	0.07	0.08	0.04	-	86
P4	0.21	0.10	0.08	0.09	0.04	-	86
P5	0.21	0.10	0.08	0.09	0.04	-	86
P6	0.20	0.10	0.07	0.08	0.05	-	86
P7	0.19	0.10	0.07	0.07	0.05	-	86
P8	0.18	0.10	0.07	0.07	0.04	-	86
P9	1.05	0.15	0.40	0.41	0.24	-	86
P13 (Basin)	3.04	0.10	0.25	-	0.37	2.42	97

The resulting 25-year, 24-hour stormwater runoff volume is 5.731 acre-feet and the resulting peak discharge into the basin is 85.05 cfs under the interim condition.

Final Condition

The following table summarizes the acreages and runoff curve numbers (both the individual CN components and the composite CN value) for the ESRB watershed subareas under the final condition.

Subarea ID	Total Area [acres]	Tc [hr]	Individual CN Components				Composite CN
			CN=79	CN=91	CN=89	CN=100	
A1	1.09	0.36	1.09	-	-	-	79
A2	5.50	0.24	5.50	-	-	-	79
A3	3.70	0.16	3.70	-	-	-	79
A4 Modified	1.95	0.13	1.95	-	-	-	79
A5	2.30	0.30	2.30	-	-	-	79
A6	1.25	0.11	1.25	-	-	-	79

Subarea ID	Total Area [acres]	Tc [hr]	Individual CN Components				Composite CN
			CN=79	CN=91	CN=89	CN=100	
A7	0.23	0.10	0.23	-	-	-	79
A9 Modified	2.19	0.17	2.16	-	0.03	-	79
A16	0.46	0.24	0.39	-	0.07	-	81
A21	2.16	0..17	2.16	-	-	-	79
P2	0.29	0.10	0.21	-	0.08	-	82
P3	0.19	0.10	0.15	-	0.04	-	81
P4	0.21	0.10	0.17	-	0.04	-	81
P5	0.21	0.10	0.17	-	0.04	-	81
P6	0.20	0.10	0.15	-	0.05	-	82
P7	0.19	0.10	0.14	-	0.05	-	82
P8	0.18	0.10	0.14	-	0.04	-	81
P9	1.05	0.15	0.81	-	0.24	-	81
P13 (Basin)	3.04	0.10	0.25	-	0.37	2.42	97

The resulting 25-year, 24-hour stormwater runoff volume is 4.794 acre-feet and the resulting peak discharge into the basin is 71.20 cfs under the final condition.

3. Design High Water Elevations and Freeboards

Interim Condition

The design high water elevation under the interim condition is the basin elevation corresponding to 6.872 acre-feet of storage volume (1.141 acre-feet of sediment + 5.731 acre-feet of stormwater runoff). Based on the basin rating curve, this volume is achieved at 321.08 feet. The resulting freeboard is 0.62 feet (321.7 – 321.08).

Final Condition

The design high water elevation under the final condition is the basin elevation corresponding to 4.817 acre-feet of storage volume (0.023 acre-feet of sediment + 4.794 acre-feet of stormwater runoff). Based on the basin rating curve, this volume is achieved at 320.18 feet. The resulting freeboard is 1.52 feet (321.7 – 320.18), which exceeds the minimum required freeboard of 1 foot.

4. Estimated Basin Peak Discharge and Time to Drain

Interim Condition

The estimated peak discharge from the basin under the interim condition is 4.15 cfs, which will occur immediately after the basin outlet valve is open. The estimated time to drain from the design high water elevation of 321.08 is 2.5 days (60.7 hours).

Final Condition

The estimated peak discharge from the basin under the final condition is 3.33 cfs, which will occur immediately after the basin outlet valve is open. The estimated time to drain from the design high water elevation of 320.18 is 2.3 days (54.0 hours).

5. Emergency Spillway Design

Estimated peak discharges over the emergency spillway during the 100-year, 24-hour design storm are 4.08 cfs and 0.79 cfs under interim and final watershed conditions, respectively. The invert of the spillway will be reinforced with erosion control mat. The outboard face of the basin berm immediately downgradient of the spillway will be armored with a 12-inch thick layer of riprap. A 12-inch thick riprap apron measuring approximately 10 feet long by 18 feet wide will be located at the berm toe to reduce outflow velocities. All riprap will be NYSDOT fine riprap and be underlain with non-woven geotextile.

6. Adherence to Basin Design Criteria

The following is a list of applicable design criteria presented in references 2 and 3 and whether the ESRB redesign meets the criteria. Justification is presented for deviations from the design criteria.

Criteria Presented in Reference 2

1. *Permanent basins (to function more than 36 months) shall be designed and constructed to conform to SCS Standard and Specification No. 378 for ponds.*

   See list of criteria presented in reference 3 below.

2. *The sediment storage volume of the basin shall be at least 1,800 cu. ft. per acre of disturbed area draining to the basin. Where possible, the entire drainage area is used for the computation rather than the disturbed area to maximize trapping efficiency.*

   The sediment storage volume of the basin for the interim condition is 1.312 acre-feet, which equates to 2,341cu.ft. per acre of the entire basin watershed.

3. *The shape of the basin should provide at least a 2:1 length to width ratio. For basins having multiple inflow points, any inflow point that contributes 30% or more of the total peak flowrate should adhere to the 2:1 ratio.*

   Of the four culverts that discharge into the basin, only Culvert No. 1 (located at the northern end of the basin) contributes 30% or more of the total peak flowrate into the basin. The length from the discharge point of Culvert No. 1 to the basin outlet is 700 ft. The effective width of the basin is approximately 151 ft using the formula in reference 2 (W_e=A/L, where A=basin surface area at elevation 321.5 =2.42 acres=105,415 ft^2 and L=length from culvert discharge point to basin outlet=700 ft). Therefore, the length to width ratio is approximately 4.6:1. Although it contributes less than 30% of the total peak flowrate into the basin, the flow from Culvert No. 4 (located at the southern end of the basin) will be redirected north around an earthen berm to increase the flow path length and achieve a length to width ratio of approximately 3.1:1 (W_e=105,415 ft^2 ÷ 575 ft = 183 ft and L=575 ft).

4. *The basin shall have a spillway consisting of a vertical pipe joined to a pipe which shall extend through the embankment.*

   Although many aspects of the spillway criteria in reference 2 pertain to detention and not retention basins, the outlet structure has been designed in general accordance with the "Device-II" detail on page 5A.61 of reference 2.

5. *Provisions shall be incorporated to dewater the sediment.*

   The outlet structure design provides three perforated sediment dewatering pipes that will be covered with crushed stone and non-woven geotextile to minimize entry of sediment into the pipes.

6. *The riser base shall have sufficient weight to prevent flotation.*

   The riser will be a precast concrete manhole and will have sufficient weight to resist buoyant forces.

7. *Anti-Seep collars shall be installed around all conduits through earthen berms.*

   Anti-seep collars are not necessary since a gasketed connection between the basin outlet pipe and the concrete outlet structure will minimize the migration of basin water along the exterior of the outlet pipe.

8. *Freeboard shall be at least 1 ft.*

   The basin provides 1.52 ft. of freeboard under the final condition. As discussed between the NYSDEC and CWM, the interim condition is allowed to utilize this minimum freeboard because it is a temporary condition.

9. *The basin berm sideslopes shall be 2:1 or flatter and have a minimum top width of 8 ft.*

   The basin berm sideslopes are 3:1 and have a top width of 8 ft.

10. *An anti-vortex device and trash rack shall be securely installed on top of the riser.*

    Since the design high water is below the top of the basin outlet structure, vortices are not expected to form. A combination of small diameter orifices and crushed stone mounded over the orifices will prevent the entry of debris into the outlet structure.

11. *An emergency spillway must be provided unless the principal spillway is large enough to pass the peak discharge from a 10-year frequency rainfall event.*

    The basin outlet structure provides sufficient flowrate to pass the peak basin outflow resulting from a 25-year, 24-hour storm. Additionally, an emergency spillway has been incorporated into the design to allow controlled discharge of runoff from the 100-year, 24-hour storm.

<u>Criteria Presented in Reference 3</u>

CLIENT: CWM Chemical Services, LLC PROJECT: Model City, NY Prepared By: BMS Date: 12/2/03
TITLE: RMU-1 Permit Modification Reviewed By: Date:
Revised By: PTO Date: 8/15/2012

SUBJECT: East Stormwater Retention Basin

1. *Minimum top width for basin embankment shall be 6 ft.*

   The basin embankment top width is 8 ft.

2. *Combined upstream and downstream sideslopes of embankment shall not be less than 5:1 and neither slope shall be steeper than 2:1.*

   The basin berm sideslopes are 3:1.

3. *The minimum elevation of the top of the settled embankment shall be 1 ft. above the water surface in the basin with the emergency spillway flowing at design depth.*

   The design provides 1.33 feet of freeboard between the design high water elevation (under the final condition) and the lowest berm crest elevation.

4. *The basin outlet pipe shall have a minimum diameter of 4 in.*

   The basin outlet pipe will be 15 in.

5. *For dams 20 ft. or less in effective height, acceptable pipe conduit materials for the basin outlet include plastic.*

   The outlet pipe will be smooth-bore corrugated high density polyethylene.

6. *Seepage control shall be provided along the pipe conduit if the effective height of dam is greater than 15 ft. or the conduit is of smooth pipe larger than 8 inches in diameter or the conduit is of corrugated pipe larger than 12 inches in diameter.*

   Anti-seep collars are not necessary since a gasketed connection between the basin outlet pipe and the concrete outlet structure will minimize the migration of basin water along the exterior of the outlet pipe.

7. *Closed conduit spillways designed for pressure flow must have adequate anti-vortex devices.*

   Since the design high water is below the top of the basin outlet structure, vortices are not expected to form. Additionally, the capacity of the basin outlet pipe is sufficient to prevent pressure flow from occurring.

8. *To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet.*

   A combination of small diameter orifices and crushed stone mounded over the orifices will prevent the entry of debris into the outlet structure.

9. *An emergency spillway must be provided unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph without overtopping the basin.*

   The basin outlet structure provides sufficient flowrate to pass the peak basin outflow resulting from a 25-year, 24-hour storm. Since the ESRB is a retention basin, it cannot overtop for a storm event of intensity equal to or less than the design event. An emergency spillway has been incorporated to allow controlled discharge of runoff from the 100-year, 24-hour storm event.

Replace Existing Basin Outflow Hydrographs for the Interim and Final Conditions in the RMU-1 Engineering Report Appendix I With the Revised Outflow Hydrographs.

Interim

POND ROUTED TOTAL OUTFLOW HYG...
HYG file =
HYG ID   = MDRAIN 10   OUT
HYG Tag =

Peak Discharge =	4.15 cfs
Time to Peak =	.1000 hrs
HYG Volume =	6.857 ac-ft

WARNING: Hydrograph truncated on left side.

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	4.16	4.15	4.14	4.13	4.13
.5000	4.12	4.11	4.10	4.08	4.07
1.0000	4.05	4.04	4.03	4.01	4.00
1.5000	3.98	3.97	3.96	3.94	3.93
2.0000	3.92	3.90	3.89	3.88	3.86
2.5000	3.85	3.84	3.82	3.81	3.80
3.0000	3.78	3.77	3.76	3.75	3.73
3.5000	3.72	3.71	3.69	3.68	3.67
4.0000	3.66	3.64	3.63	3.62	3.61
4.5000	3.59	3.58	3.57	3.56	3.55
5.0000	3.53	3.52	3.51	3.50	3.48
5.5000	3.47	3.46	3.45	3.44	3.43
6.0000	3.41	3.40	3.39	3.38	3.37
6.5000	3.36	3.34	3.33	3.32	3.31
7.0000	3.30	3.29	3.28	3.26	3.25
7.5000	3.24	3.23	3.22	3.21	3.20
8.0000	3.19	3.18	3.17	3.16	3.15
8.5000	3.14	3.14	3.13	3.12	3.11
9.0000	3.10	3.10	3.09	3.08	3.07
9.5000	3.06	3.06	3.05	3.04	3.03
10.0000	3.02	3.02	3.01	3.00	2.99
10.5000	2.99	2.98	2.97	2.96	2.95
11.0000	2.95	2.94	2.93	2.92	2.92
11.5000	2.91	2.90	2.89	2.89	2.88
12.0000	2.87	2.86	2.86	2.85	2.84
12.5000	2.83	2.83	2.82	2.81	2.81
13.0000	2.80	2.79	2.78	2.78	2.77
13.5000	2.76	2.76	2.75	2.74	2.73

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
14.0000	2.73	2.72	2.71	2.71	2.70
14.5000	2.69	2.68	2.68	2.67	2.66
15.0000	2.66	2.65	2.64	2.64	2.63
15.5000	2.62	2.62	2.61	2.60	2.60
16.0000	2.59	2.58	2.58	2.57	2.56
16.5000	2.56	2.55	2.54	2.54	2.53
17.0000	2.52	2.50	2.49	2.47	2.45
17.5000	2.44	2.42	2.41	2.39	2.38
18.0000	2.36	2.35	2.33	2.32	2.30
18.5000	2.29	2.27	2.26	2.24	2.23
19.0000	2.21	2.20	2.18	2.17	2.16
19.5000	2.14	2.13	2.11	2.10	2.09
20.0000	2.07	2.06	2.05	2.03	2.02
20.5000	2.01	1.99	1.98	1.97	1.95
21.0000	1.94	1.93	1.92	1.90	1.89
21.5000	1.88	1.87	1.86	1.84	1.83
22.0000	1.82	1.81	1.80	1.78	1.77
22.5000	1.76	1.75	1.74	1.73	1.72
23.0000	1.70	1.69	1.68	1.67	1.66
23.5000	1.65	1.64	1.63	1.62	1.61
24.0000	1.60	1.59	1.58	1.57	1.56
24.5000	1.56	1.55	1.54	1.53	1.52
25.0000	1.51	1.50	1.50	1.49	1.48
25.5000	1.47	1.46	1.45	1.45	1.44
26.0000	1.43	1.42	1.41	1.41	1.40
26.5000	1.39	1.38	1.37	1.37	1.36
27.0000	1.35	1.34	1.34	1.33	1.32
27.5000	1.31	1.31	1.30	1.29	1.29
28.0000	1.28	1.27	1.26	1.26	1.25
28.5000	1.24	1.24	1.23	1.22	1.22
29.0000	1.21	1.18	1.16	1.14	1.12
29.5000	1.11	1.09	1.07	1.05	1.03
30.0000	1.01	1.00	.98	.96	.95
30.5000	.93	.91	.90	.88	.87
31.0000	.85	.84	.82	.81	.79
31.5000	.78	.77	.75	.74	.73
32.0000	.72	.70	.69	.68	.67
32.5000	.66	.65	.63	.62	.61
33.0000	.60	.59	.58	.57	.56
33.5000	.55	.54	.53	.52	.51
34.0000	.51	.50	.49	.48	.47
34.5000	.46	.46	.45	.44	.43
35.0000	.43	.42	.41	.40	.40
35.5000	.39	.38	.38	.37	.36
36.0000	.36	.35	.35	.34	.33

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
36.5000	.33	.32	.32	.31	.31
37.0000	.30	.30	.29	.29	.28
37.5000	.28	.27	.27	.26	.26
38.0000	.25	.25	.24	.24	.24
38.5000	.23	.23	.22	.22	.22
39.0000	.21	.21	.21	.20	.20
39.5000	.19	.19	.19	.18	.18
40.0000	.18	.18	.17	.17	.17
40.5000	.16	.16	.16	.16	.15
41.0000	.15	.15	.14	.14	.14
41.5000	.14	.14	.13	.13	.13
42.0000	.13	.12	.12	.12	.12
42.5000	.12	.11	.11	.11	.11
43.0000	.11	.10	.10	.10	.10
43.5000	.10	.10	.09	.09	.09
44.0000	.09	.09	.09	.08	.08
44.5000	.08	.08	.08	.08	.08
45.0000	.07	.07	.07	.07	.07
45.5000	.07	.07	.07	.07	.06
46.0000	.06	.06	.06	.06	.06
46.5000	.06	.06	.06	.05	.05
47.0000	.05	.05	.05	.05	.05
47.5000	.05	.05	.05	.05	.05
48.0000	.04	.04	.04	.04	.04
48.5000	.04	.04	.04	.04	.04
49.0000	.04	.04	.04	.04	.03
49.5000	.03	.03	.03	.03	.03
50.0000	.03	.03	.03	.03	.03
50.5000	.03	.03	.03	.03	.03
51.0000	.03	.03	.03	.03	.02
51.5000	.02	.02	.02	.02	.02
52.0000	.02	.02	.02	.02	.02
52.5000	.02	.02	.02	.02	.02
53.0000	.02	.02	.02	.02	.02
53.5000	.02	.02	.02	.02	.02
54.0000	.02	.02	.02	.01	.01
54.5000	.01	.01	.01	.01	.01
55.0000	.01	.01	.01	.01	.01
55.5000	.01	.01	.01	.01	.01
56.0000	.01	.01	.01	.01	.01
56.5000	.01	.01	.01	.01	.01
57.0000	.01	.01	.01	.01	.01
57.5000	.01	.01	.01	.01	.01
58.0000	.01	.01	.01	.01	.01
58.5000	.01	.01	.01	.01	.01

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
59.0000	.01	.01	.01	.01	.01
59.5000	.01	.01	.01	.01	.01
60.0000	.01	.01	.01	.01	.01
60.5000	.01	.00	.00	.00	.00
61.0000	.00	.00	.00	.00	.00
61.5000	.00	.00	.00	.00	.00
62.0000	.00	.00	.00	.00	.00
62.5000	.00	.00	.00	.00	.00
63.0000	.00	.00	.00	.00	.00
63.5000	.00	.00			

Final

POND ROUTED TOTAL OUTFLOW HYG...
HYG file =
HYG ID = MDRAIN FINALOUT
HYG Tag =

Peak Discharge = 3.33 cfs
Time to Peak = .1000 hrs
HYG Volume = 4.808 ac-ft

WARNING: Hydrograph truncated on left side.

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	3.35	3.33	3.32	3.31	3.30
.5000	3.29	3.27	3.26	3.25	3.24
1.0000	3.23	3.22	3.21	3.20	3.19
1.5000	3.18	3.17	3.16	3.15	3.14
2.0000	3.13	3.13	3.12	3.11	3.10
2.5000	3.09	3.09	3.08	3.07	3.06
3.0000	3.05	3.05	3.04	3.03	3.02
3.5000	3.02	3.01	3.00	2.99	2.98
4.0000	2.98	2.97	2.96	2.95	2.95
4.5000	2.94	2.93	2.92	2.92	2.91
5.0000	2.90	2.89	2.89	2.88	2.87
5.5000	2.86	2.86	2.85	2.84	2.83
6.0000	2.83	2.82	2.81	2.80	2.80
6.5000	2.79	2.78	2.78	2.77	2.76
7.0000	2.75	2.75	2.74	2.73	2.73
7.5000	2.72	2.71	2.70	2.70	2.69
8.0000	2.68	2.68	2.67	2.66	2.66
8.5000	2.65	2.64	2.64	2.63	2.62
9.0000	2.62	2.61	2.60	2.59	2.59
9.5000	2.58	2.57	2.57	2.56	2.55
10.0000	2.55	2.54	2.54	2.53	2.52
10.5000	2.50	2.48	2.47	2.45	2.44
11.0000	2.42	2.41	2.39	2.37	2.36
11.5000	2.34	2.33	2.31	2.30	2.28
12.0000	2.27	2.25	2.24	2.22	2.21
12.5000	2.20	2.18	2.17	2.15	2.14
13.0000	2.13	2.11	2.10	2.08	2.07
13.5000	2.06	2.04	2.03	2.02	2.00

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
14.0000	1.99	1.98	1.97	1.95	1.94
14.5000	1.93	1.91	1.90	1.89	1.88
15.0000	1.87	1.85	1.84	1.83	1.82
15.5000	1.81	1.79	1.78	1.77	1.76
16.0000	1.75	1.74	1.73	1.71	1.70
16.5000	1.69	1.68	1.67	1.66	1.65
17.0000	1.64	1.63	1.62	1.61	1.60
17.5000	1.59	1.58	1.57	1.56	1.55
18.0000	1.55	1.54	1.53	1.52	1.51
18.5000	1.50	1.49	1.49	1.48	1.47
19.0000	1.46	1.45	1.44	1.44	1.43
19.5000	1.42	1.41	1.40	1.40	1.39
20.0000	1.38	1.37	1.37	1.36	1.35
20.5000	1.34	1.34	1.33	1.32	1.31
21.0000	1.31	1.30	1.29	1.28	1.28
21.5000	1.27	1.26	1.26	1.25	1.24
22.0000	1.23	1.23	1.22	1.21	1.20
22.5000	1.18	1.16	1.14	1.12	1.10
23.0000	1.08	1.06	1.05	1.03	1.01
23.5000	.99	.98	.96	.94	.93
24.0000	.91	.90	.88	.86	.85
24.5000	.84	.82	.81	.79	.78
25.0000	.77	.75	.74	.73	.71
25.5000	.70	.69	.68	.67	.65
26.0000	.64	.63	.62	.61	.60
26.5000	.59	.58	.57	.56	.55
27.0000	.54	.53	.52	.51	.50
27.5000	.50	.49	.48	.47	.46
28.0000	.45	.45	.44	.43	.42
28.5000	.42	.41	.40	.40	.39
29.0000	.38	.38	.37	.36	.36
29.5000	.35	.34	.34	.33	.33
30.0000	.32	.32	.31	.30	.30
30.5000	.29	.29	.28	.28	.27
31.0000	.27	.27	.26	.26	.25
31.5000	.25	.24	.24	.24	.23
32.0000	.23	.22	.22	.22	.21
32.5000	.21	.20	.20	.20	.19
33.0000	.19	.19	.18	.18	.18
33.5000	.17	.17	.17	.17	.16
34.0000	.16	.16	.15	.15	.15
34.5000	.15	.14	.14	.14	.14
35.0000	.13	.13	.13	.13	.13
35.5000	.12	.12	.12	.12	.12
36.0000	.11	.11	.11	.11	.11

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
36.5000	.10	.10	.10	.10	.10
37.0000	.10	.09	.09	.09	.09
37.5000	.09	.09	.08	.08	.08
38.0000	.08	.08	.08	.08	.07
38.5000	.07	.07	.07	.07	.07
39.0000	.07	.07	.07	.06	.06
39.5000	.06	.06	.06	.06	.06
40.0000	.06	.06	.05	.05	.05
40.5000	.05	.05	.05	.05	.05
41.0000	.05	.05	.05	.05	.04
41.5000	.04	.04	.04	.04	.04
42.0000	.04	.04	.04	.04	.04
42.5000	.04	.04	.04	.03	.03
43.0000	.03	.03	.03	.03	.03
43.5000	.03	.03	.03	.03	.03
44.0000	.03	.03	.03	.03	.03
44.5000	.03	.03	.03	.02	.02
45.0000	.02	.02	.02	.02	.02
45.5000	.02	.02	.02	.02	.02
46.0000	.02	.02	.02	.02	.02
46.5000	.02	.02	.02	.02	.02
47.0000	.02	.02	.02	.02	.02
47.5000	.02	.02	.01	.01	.01
48.0000	.01	.01	.01	.01	.01
48.5000	.01	.01	.01	.01	.01
49.0000	.01	.01	.01	.01	.01
49.5000	.01	.01	.01	.01	.01
50.0000	.01	.01	.01	.01	.01
50.5000	.01	.01	.01	.01	.01
51.0000	.01	.01	.01	.01	.01
51.5000	.01	.01	.01	.01	.01
52.0000	.01	.01	.01	.01	.01
52.5000	.01	.01	.01	.01	.01
53.0000	.01	.01	.01	.01	.01
53.5000	.01	.01	.01	.01	.01
54.0000	.00	.00	.00	.00	.00
54.5000	.00	.00	.00	.00	.00
55.0000	.00	.00	.00	.00	.00
55.5000	.00	.00	.00	.00	.00
56.0000	.00	.00	.00	.00	.00
56.5000	.00	.00	.00	.00	.00
57.0000	.00	.00	.00	.00	.00
57.5000	.00	.00	.00	.00	.00
58.0000	.00	.00	.00	.00	.00
58.5000	.00	.00	.00	.00	.00

File.... G:\TMProj\CWM Model City\Calculations\permit mod\ESRB INTERIM 2012- NO OUTLET.ppw

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
59.0000	.00	.00	.00	.00	.00
59.5000	.00	.00	.00	.00	.00
60.0000	.00	.00	.00	.00	.00
60.5000	.00	.00	.00	.00	.00
61.0000	.00	.00	.00	.00	.00
61.5000	.00	.00	.00	.00	.00
62.0000	.00	.00	.00	.00	.00
62.5000	.00	.00	.00	.00	.00
63.0000	.00	.00	.00	.00	.00
63.5000	.00	.00	.00	.00	.00
64.0000	.00	.00	.00	.00	.00
64.5000	.00	.00	.00	.00	.00
65.0000	.00	.00	.00	.00	.00
65.5000	.00	.00	.00	.00	.00
66.0000	.00	.00	.00	.00	.00
66.5000	.00	.00	.00	.00	.00
67.0000	.00	.00	.00	.00	.00
67.5000	.00	.00	.00	.00	.00
68.0000	.00	.00	.00	.00	.00
68.5000	.00	.00	.00	.00	.00
69.0000	.00	.00	.00	.00	.00
69.5000	.00	.00	.00	.00	.00
70.0000	.00				

Replace Existing 100-Year, 24-Hour Peak Flow Over Emergency Spillway Output With the Following Revised Output for Both Interim and Final Condtions.

```
                    LEVEL POOL ROUTING SUMMARY

  HYG Dir          = G:\TMProj\CWM Model City\Calculations\permit mod\
  Inflow  HYG file = NONE STORED - ESRB         IN  100
  Outflow HYG file = NONE STORED - ESRB         OUT 100

  Pond Node   Data = ESRB
  Pond Volume Data = ESRB
  Pond Outlet Data = EMERGENCY SPILL

  No Infiltration

  INITIAL CONDITIONS
  ----------------------------------
  Starting WS Elev   =   318.40 ft
  Starting Volume    =    1.190 ac-ft
  Starting Outflow   =      .00 cfs
  Starting Infiltr.  =      .00 cfs
  Starting Total Qout=      .00 cfs
  Time Increment     =    .0100 hrs


  INFLOW/OUTFLOW HYDROGRAPH SUMMARY
  =====================================================
  Peak Inflow       =    133.20 cfs    at   11.9700 hrs
  Peak Outflow      =      4.08 cfs    at   15.2000 hrs
  -----------------------------------------------------
  Peak Elevation    =    321.62 ft
  Peak Storage =          8.157 ac-ft
  =====================================================


  MASS BALANCE (ac-ft)
  --------------------------
+ Initial Vol  =       1.190
+ HYG Vol IN   =       9.092
- Infiltration =        .000
- HYG Vol OUT  =       2.356
- Retained Vol =       7.922
                  ----------
  Unrouted Vol =       -.003 ac-ft  (.034% of Inflow Volume)


  WARNING: Outflow hydrograph truncated on right side.
```

```
                    LEVEL POOL ROUTING SUMMARY

  HYG Dir          = G:\TMProj\CWM Model City\Calculations\permit mod\
  Inflow  HYG file = NONE STORED - ESRB         IN  100
  Outflow HYG file = NONE STORED - ESRB         OUT 100

  Pond Node   Data = ESRB
  Pond Volume Data = ESRB
  Pond Outlet Data = Emergency Spill

  No Infiltration

  INITIAL CONDITIONS
  ----------------------------------
  Starting WS Elev   =   317.10 ft
  Starting Volume    =     .005 ac-ft
  Starting Outflow   =      .00 cfs
  Starting Infiltr.  =      .00 cfs
  Starting Total Qout=      .00 cfs
  Time Increment     =    .0100 hrs


  INFLOW/OUTFLOW HYDROGRAPH SUMMARY
  =====================================================
  Peak Inflow       =    117.71 cfs    at   11.9700 hrs
  Peak Outflow      =       .79 cfs    at   24.1000 hrs
  -----------------------------------------------------
  Peak Elevation    =    321.52 ft
  Peak Storage =          7.919 ac-ft
  =====================================================


  MASS BALANCE (ac-ft)
  --------------------------
+ Initial Vol  =        .005
+ HYG Vol IN   =       7.951
- Infiltration =        .000
- HYG Vol OUT  =        .061
- Retained Vol =       7.894
                 ----------
  Unrouted Vol =       -.002 ac-ft  (.021% of Inflow Volume)


  WARNING: Outflow hydrograph truncated on right side.
```

Replace Existing Portion of Appendix I Culvert Calculation Sheet With The Following Sheet.

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

CLIENT: CWM Chemical Services, LLC PROJECT: Model City, NY
TITLE: RMU-1 Permit Modification

Prepared By: BMS/TAS Date: 12/2/03
Reviewed By: Date:
Revised By: PTO Date: 8/2012

SUBJECT: ESRB Culvert Design

CALCULATIONS:

The following table summarizes the hydraulic capacity of each culvert with a headwater elevation of 321.9 (which is equal to the high point elevation in the perimeter ditch to the north of CV-1). Also presented in the table are the 25-year, 24-hour estimated total combined peak discharge entering the ESRB (excluding the area of the basin itself) and the total combined capacity of the four culverts.

Culvert ID	Hydraulic Capacity with Headwater El. = 321.9 [cfs]	25-year, 24-hour Estimated Total Combined Peak Discharge [cfs]
CV-1	57.0	**73.5**
CV-2	5.2	
CV-3	5.2	
CV-4	19.0	
Total	**86.4**	

SUMMARY:

The total combined hydraulic capacity of the culverts leading into the ESRB exceeds the estimated total combined peak discharge from the 25-year, 24-hour storm. The rating curve for each culvert, as determined using reference 3, is included as an attachment.

Insert the Following New Calculation Sheet (IX. RMU-1 Plateau Access Road Drainage Calculations) at the End of Existing Appendix I.

IX. RMU-1 PLATEAU ACCESS ROAD DRAINAGE CALCULATIONS

Imagine the result

Calculation Sheet

Client: CWM Chemical Services, LLC

Project Location: Model City, New York

Project: RMU-1 Plateau Access Road Design **Project No.: B0023729.2012**

Subject: Drainage Calculations

Prepared By: NWF/BMS **Date: August 2012**

Reviewed By: PTO/BMS **Date: August 2012**

Checked By: BMS **Date: August 2012**

OBJECTIVE:

Demonstrate that the drainage ditch along the inside edge of the proposed landfill plateau access road provides adequate hydraulic capacity to convey the estimated peak discharge from the 25-year, 24-hour design storm. Demonstrate that the proposed culvert beneath the landfill plateau access road provides adequate hydraulic capacity to convey the estimated peak discharge from the 25-year, 24-hour design storm.

REFERENCES:

1. RMU-1 Permit Drawing No. 12-a entitled "Top of Vegetated Cover Grades," ARCADIS, August 2012.
2. RMU-1 Permit Drawing No. 23A entitled "Landfill Plateau Access Road Details," ARCADIS, August 2012.
3. Technical Release 55 "Urban Hydrology for Small Watersheds," Soil Conservation Service, June 1986.
4. HydroCAD Software Solutions, LLC, HydroCAD. Version 8.5. Computer Software, 2006. (Output attached).
5. Manufacturer's Literature, www.ads-pipe.com, Advanced Drainage Systems, Inc. (attached).

ASSUMPTIONS:

1. A new permanent road is proposed along the northern face of RMU-1 to allow waste hauling trucks and other vehicles access to the landfill's plateau. The road design is shown on Reference 1. The road design includes two new drainage features. A roadside ditch will be installed along the inside edge of the road to convey concentrated runoff down the landfill sideslope and into the existing surface water diversion berms (SWDBs) and perimeter channel. A culvert will be installed beneath the road fill along the perimeter berm to maintain flow within the existing perimeter channel.
2. The proposed roadside ditch has a v-notch geometry with a minimum depth of 1 ft, sideslopes of 3H:1V and 2H:1V, and a variable longitudinal slope. The roadside ditch will be lined with a geomembrane to limit percolation into the existing cover soil. The geomembrane will be covered with a 6-inch-thick layer of loose riprap having a D50 of 3 inches. Two 8-inch-diameter perforated and corrugated high density polyethylene (HDPE) pipes will be installed along the invert of the roadside ditch and buried within the loose riprap. The pipes are provided as a means to convey the majority of

Calculation Sheet

the ditch flow in a non-erosive manner and to limit the required size of the ditch riprap.

3. The invert slope of the roadside ditch matches the longitudinal slope of the access road and varies from 8% to 12%. The ditch is divided into three segments as follows:

   - Upper Ditch Segment – 12% slope draining to upper SWDB.
   - Middle Ditch Segment – 8% slope draining to lower SWDB.
   - Lower Ditch Segment – 12% slope draining to perimeter channel.

4. The capacity of the roadside ditch includes the pipe-full flowrate at the indicated ditch slope, and any open channel flowrate that would occur above the riprap layer. The depth of open channel flow above the riprap considers both the required head to admit water into the perforated pipes as well as the additional flow capacity needed beyond that provided by the perforated pipes.

5. The proposed culvert is necessary to maintain drainage within the perimeter channel at the top of the perimeter berm that would otherwise be blocked by fill placement necessary for the access road construction. A culvert is currently in place in this channel in front of the riser vaults for Cell 3. Because the road fill extends to this existing culvert location, the proposed culvert is essentially an extension of the existing culvert. The extension of the existing culvert pipe is assumed to utilize the same material, diameter, and construction (i.e., 18-inch-diameter corrugated metal pipe). The culvert pipe is assumed to have a Manning "n" of 0.025. The culvert is assumed to have a slope of 0.5%.

6. Both proposed stormwater features (ditches and culvert), are based on the 25-year, 24-hour event, storm event which produces 4.0 inches of rainfall.

7. The runoff curve number for the tributary watershed to each roadside ditch segment and the proposed culvert varies according to surface conditions. The runoff curve number for gravel access roads is 89 based on Reference 3. The roadside ditch is riprap lined with a runoff curve number of 89 also based on Reference 3. The runoff curve number for capped areas is assumed to be 86 to remain consistent with original RMU-1 drainage design calculations (based on the value presented in Table 2-2a of Reference 3 for <50% grass cover, fair, Hydrologic Soil Group "C").

8. The culvert configuration is deemed acceptable if the design can convey the 25-year, 24-hour estimated peak discharge without causing a headwater depth that exceeds the depth of the perimeter channel in which the culvert is installed. The flow capacity of the culvert is estimated using Reference 4, which accounts for both pipe friction losses and energy losses at the culvert entrance and exit.

Calculation Sheet

CALCULATIONS:

1. Estimated Peak Discharge to the Roadside Ditch

Table 1 summarizes the runoff characteristics for the tributary watersheds draining to each roadside ditch segment and the resulting 25-year, 24-hour peak discharges.

Table 1 – Runoff Characteristics of Tributary Areas Draining to Roadside Ditch Segments

Ditch Segment	Cumulative Watershed Area (acres)	Composite Runoff Curve Number	Time of Concentration (min)	25-yr, 24-hr Estimated Peak Discharge (cfs)
Upper (12% Slope)	1.26	87	10.4	4.87
Middle (8% Slope)	0.36	87	6.0	1.59
Lower (12% Slope)	0.25	87	6.0	1.11

The watersheds are included as Attachment 1 to this calculation sheet. Supporting output from HydroCAD is included as Attachment 2 to this calculation sheet.

2. Roadside Ditch Capacity

As discussed in Assumption 4, the capacity of the roadside ditch includes the capacity of the perforated pipes buried in the riprap and the open channel flow that occurs above the riprap (if any). The pipe-full flow capacity of the perforated pipes is based on the Manning equation:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where,

- Q = pipe-full flowrate, cfs (unknown)
- A = cross sectional area of pipe flowing full = $\pi D^2/4$
- n = Manning "n" for corrugated HDPE pipe = 0.017 (Reference 5)
- R = hydraulic radius = A/P
- P = wetted perimeter of pipe flowing full = πD
- S = minimum longitudinal slope of pipe = varies, either 0.08 or 0.12

Solving for Q for each longitudinal ditch slope,

Q = 3.46 cfs x 2 pipes = 6.92 cfs total (12% Slopes)
= 2.82 cfs x 2 pipes = 5.64 cfs total (8% Slopes)

Thus, for all ditch segments, the pipe-full capacity exceeds the peak discharge to each segment, meaning the pipes alone can convey the peak flow and there is no need for excessive flow to be conveyed above the riprap layer.

However, in order for the flow to enter the perforated pipes, a certain head outside the pipes is needed. This head is estimated from laboratory testing by the pipe manufacturer (Reference 5), the results of

Calculation Sheet

which are included as Attachment 3 to this calculation sheet. An inflow rate per foot of pipe for each ditch segment is determined using the above-calculated peak discharges. The corresponding head (measured with respect to the pipe invert) is then determined. As indicated in Attachment 3, the head for the middle and lower ditch segments is approximately 2 inches and the head for the upper ditch segment is approximately 6 inches. Thus, the water level in all roadside ditch segments should remain below the top of the riprap layer during the peak flow period of the design storm.

3. Estimated Peak Discharge to the Perimeter Channel Culvert

Table 2 summarizes the runoff characteristics for the tributary watershed draining to the perimeter channel culvert and the resulting 25-year, 24-hour peak discharge.

Table 2 – Contributing Watershed Characteristic and Peak Discharge

Watershed ID	Area (acres)	Runoff Curve Number	Time of Concentration (min)	Resulting Peak Discharge (cfs)
Perimeter Channel Culvert	0.60	87	6.0	2.65

Supporting output from HydroCAD is included as Attachment 4.

4. Perimeter Channel Culvert Capacity

Reference 4 is used to estimate the headwater at the inlet to the culvert to be installed beneath the access road fill. This predicted water surface elevation is compared with the lowest perimeter channel containment elevation to verify that the culvert will not cause the perimeter channel to overtop while conveying the peak flow from the design storm. The results from Reference 4 are summarized in Table 3.

Table 3 – Perimeter Channel Culvert Capacity Calculations

Required Flow Rate (cfs)	Culvert Composition	Pipe Slope	Max. Allowable Water Surface El. in Upstream Perimeter Channel (ft)	Predicted Peak Water Surface El. in Perimeter Channel[1] (ft)
2.65	18-inch CMP	0.5%	333.22	331.97

Notes:
1. Maximum water elevation is based on lowest surveyed elevation at edge of perimeter channel upstream of culvert.

As indicated in Table 3, the predicted peak water surface elevation in the perimeter channel upstream of the culvert is less than the lowest surveyed elevation at the edge of the perimeter channel. Thus, the channel should not overflow while conveying the peak runoff from the design storm and the culvert capacity is therefore sufficient.

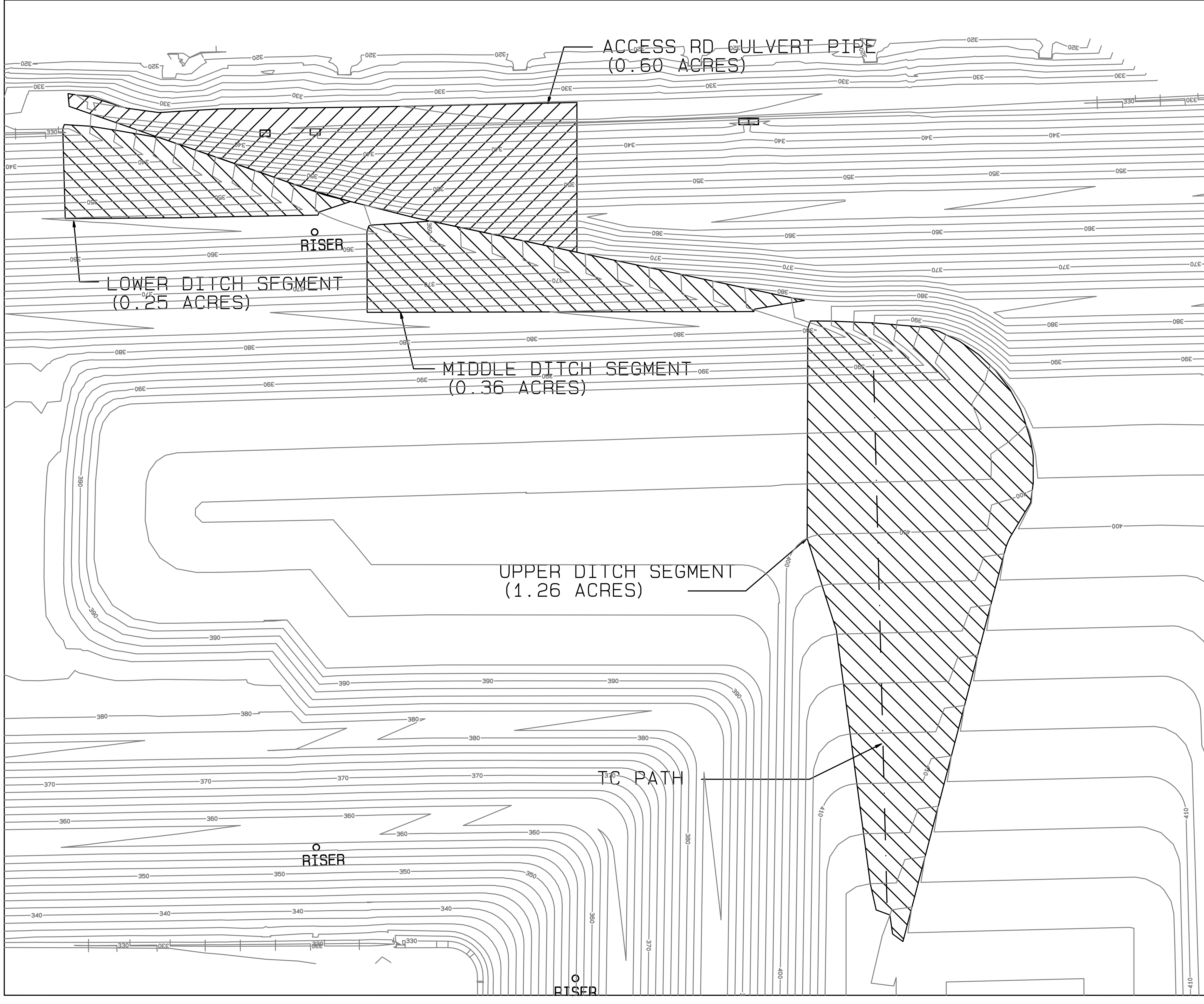
SUMMARY:

The proposed roadside ditch and culvert at the bottom of the access road provide adequate hydraulic capacity to convey the peak discharges from the 25-year, 24-hour design storm event.

ARCADIS

Attachment 1

Watershed Area Map


ACCESS RD CULVERT PIPE
(0.60 ACRES)
LOWER DITCH SEGMENT
(0.25 ACRES)
MIDDLE DITCH SEGMENT
(0.36 ACRES)
UPPER DITCH SEGMENT
(1.26 ACRES)
TC PATH
RISER
RISER
RISER

Attachment 2

HydroCAD Output for Roadside Ditches

Summary for Subcatchment 1S: Roadside Ditch (Upper Segment)

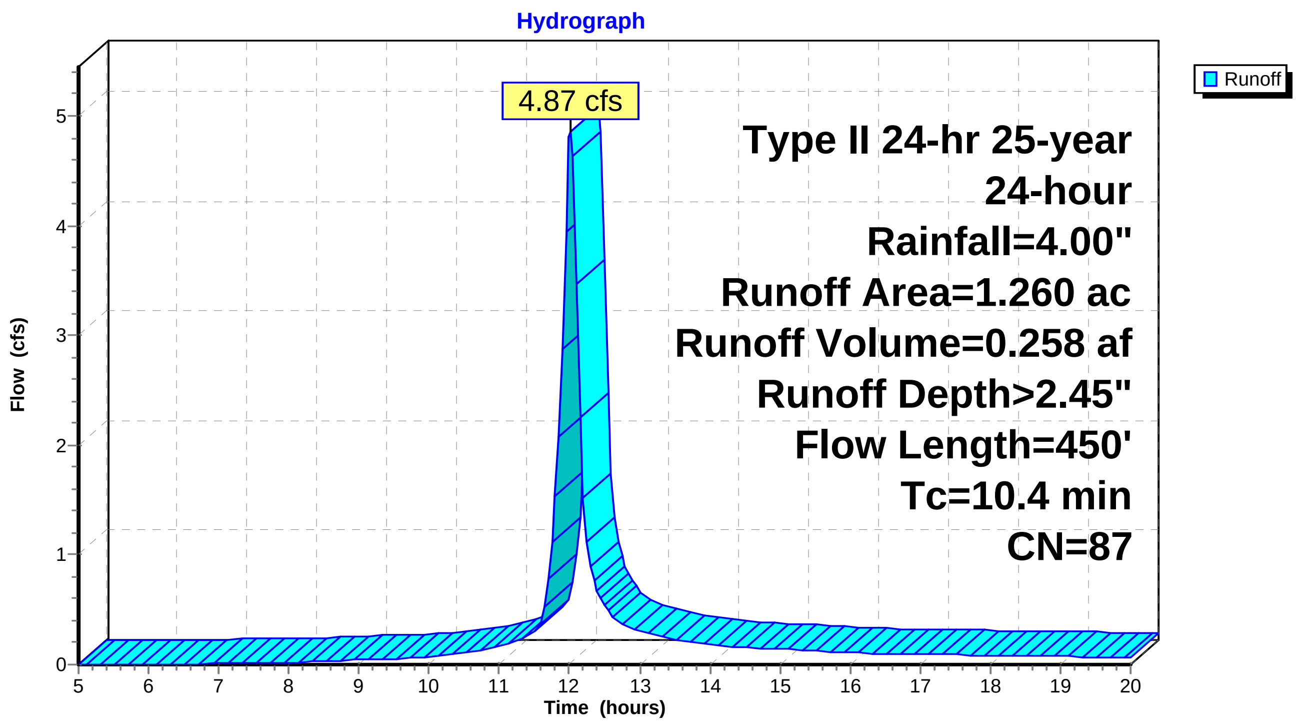
Runoff = 4.87 cfs @ 12.02 hrs, Volume= 0.258 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year, 24-hour Rainfall=4.00"

	Area (ac)	CN	Description
*	0.950	86	<50% Grass cover, Poor, HSG C
	0.310	89	Gravel roads, HSG C
	1.260	87	Weighted Average
	1.260		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0500	0.24		**Sheet Flow,** Range n= 0.130 P2= 2.50"
3.4	320	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.3333	4.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.4	450	Total			

Subcatchment 1S: Roadside Ditch (Upper Segment)



Summary for Subcatchment 3S: Roadside Ditch (Middle Section)

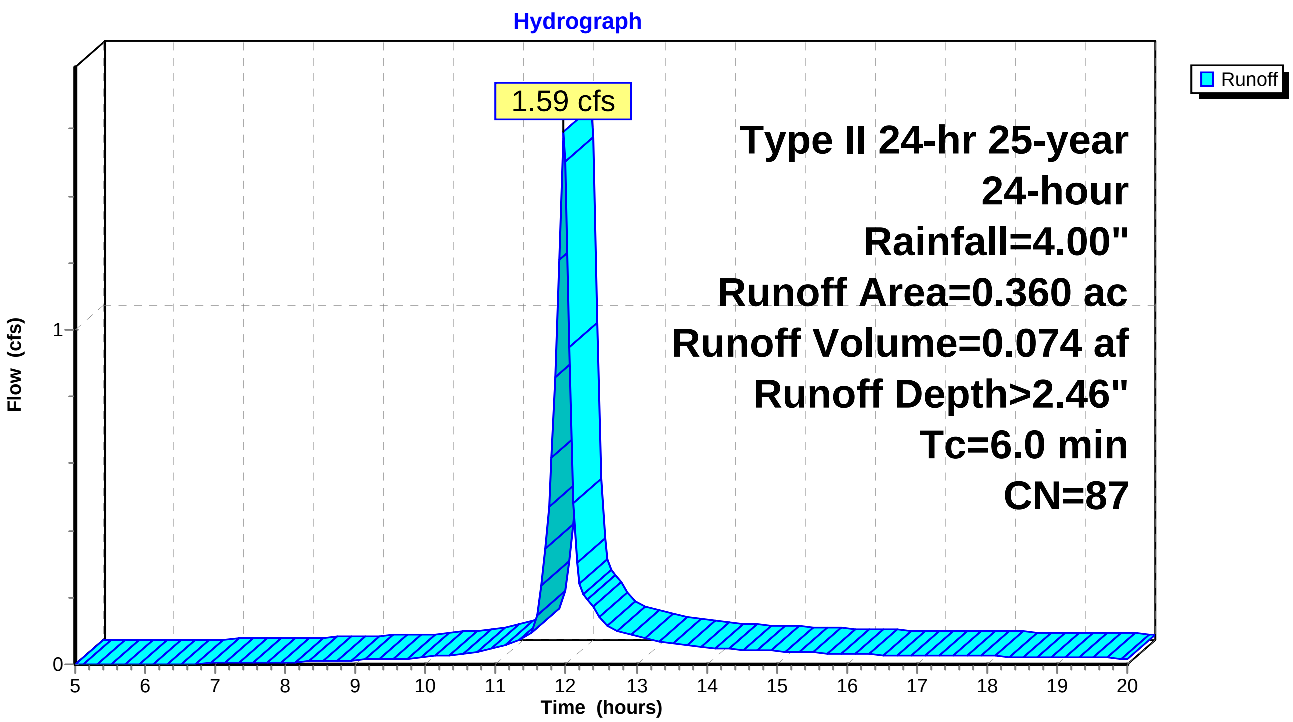
Runoff = 1.59 cfs @ 11.97 hrs, Volume= 0.074 af, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year, 24-hour Rainfall=4.00"

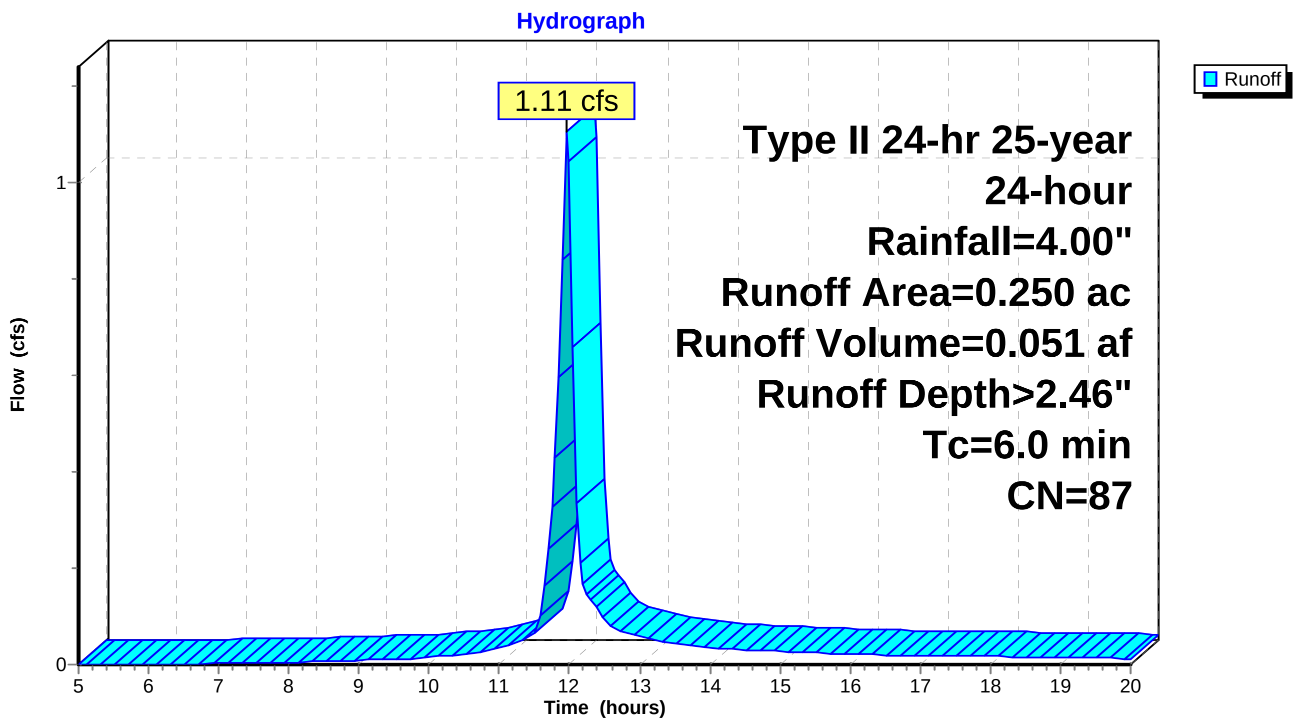
Area (ac)	CN	Description
0.210	86	<50% Grass cover, Poor, HSG C
0.150	89	Gravel roads, HSG C
0.360	87	Weighted Average
0.360		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 3S: Roadside Ditch (Middle Section)



Subcatchment 2S: Roadside Ditch (Lower Section)



Summary for Subcatchment 2S: Roadside Ditch (Lower Section)

Runoff = 1.11 cfs @ 11.97 hrs, Volume= 0.051 af, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year, 24-hour Rainfall=4.00"

Area (ac)	CN	Description
0.160	86	<50% Grass cover, Poor, HSG C
0.090	89	Gravel roads, HSG C
0.250	87	Weighted Average
0.250		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Attachment 3

Manufacturer’s Literature (Advanced Drainage Systems, Inc.)

Technical Notes

ADVANCED DRAINAGE SYSTEMS, INC.

Technical Note 2.109
Re: Flow Capacity
Date: March 1, 1995

It is the intent of this Technical Note to provide current hydraulic performance data for use by the engineering community. A bibliography is included for the engineer's use if further information or guidance is needed.

Manning's "n" values are offered for design purposes based on the best available data assembled from a variety of sources as indicated. Table 1 presents the Manning's "n" values recommended by the A.D.S. engineering staff for use in design.

Table 1
Manning's "n" Value For Design
(Storm & Sanitary Sewer and Culverts)

Pipe Type	"n"
A.D.S. Corrugated Polyethylene Pipe	
3" - 6" Diameter	0.015
8" Diameter	0.016
10" Diameter	0.017
12" - 15" Diameter	0.018
18" - 36" Diameter	0.020
A.D.S. N-12	0.012
Concrete Pipe	0.013
Corrugated Metal Pipe (2 2/3" x 1/2" corrugation)	
Annular	
Plain	0.024
Paved Invert	0.020
Fully Paved (smooth lined)	0.013
Helical	
Plain 15" Diameter	0.013
Plain 18" Diameter	0.015
Plain 24" Diameter	0.018
Plain 36" Diameter	0.021
Spiral-Rib	0.012
Plastic Pipe (SDR, S&D, Etc.)	0.011
Vitrified Clay	0.013

OUTFLOWS - ADS PIPE
6" SINGLE WALL PIPE TYPE C

FACTORS FOR OUTFLOW CALCULATIONS
ADS 6" SINGLE WALL PIPE TYPE C

OPEN AREA	AO	A1	A2	H2	H	Q=GPM/FT
2	0.1177	1.11965	0.09946	0	0	0.12
2	0.1177	1.11965	0.09946	4	2	2.75
2	0.1177	1.11965	0.09946	16	4	6.19
2	0.1177	1.11965	0.09946	36	6	10.42
2	0.1177	1.11965	0.09946	64	8	15.44
2	0.1177	1.11965	0.09946	100	10	21.26
2	0.1177	1.11965	0.09946	144	12	27.88
2	0.1177	1.11965	0.09946	196	14	35.29
2	0.1177	1.11965	0.09946	256	16	43.49
2	0.1177	1.11965	0.09946	324	18	52.50

NOTE: Q = AO + (A1*H) + (A2*H2)

DITCH SEGMENT	cfs (peak)	DITCH LENGTH (ft)	GPM/FT ÷ 2 PIPES	HEAD (in)
UPPER	4.87	125	8.7	6
MIDDLE	1.59	310	1.2	2
LOWER	1.11	185	1.3	2

Attachment 4

HydroCAD Output for Culvert

Summary for Subcatchment 4S: Perimeter Channel Culvert

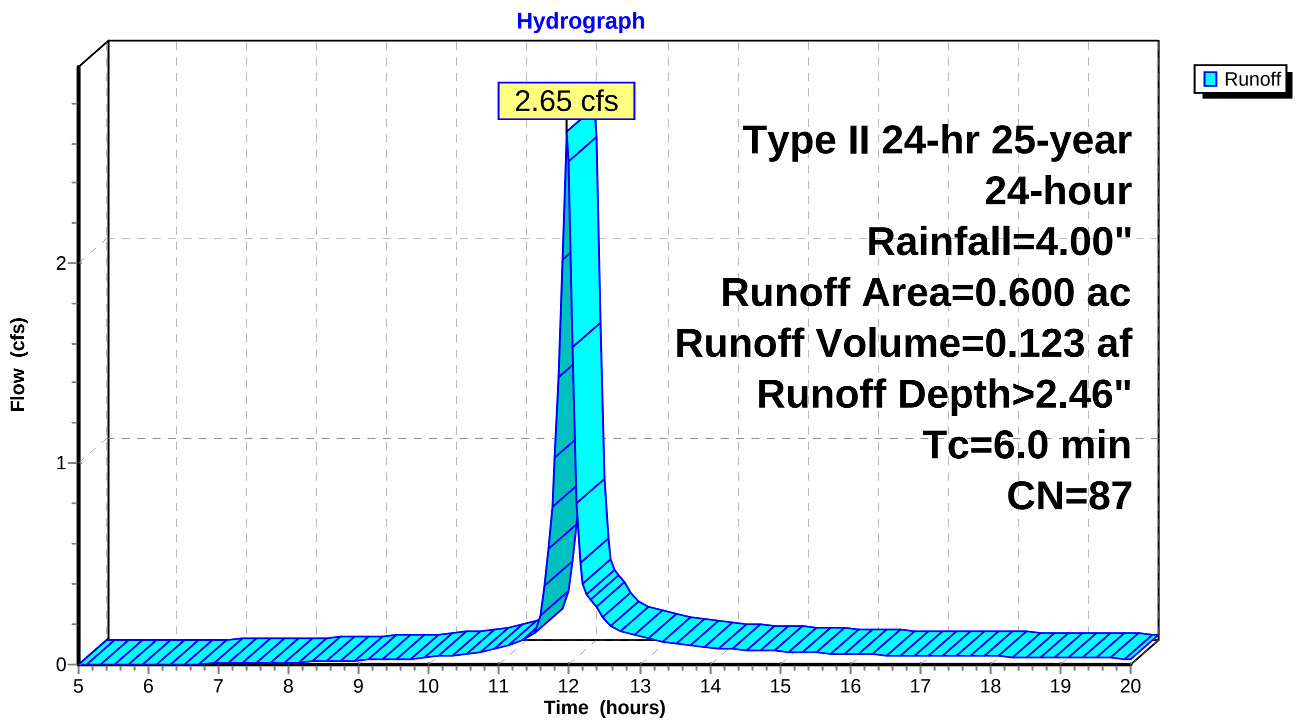
Runoff = 2.65 cfs @ 11.97 hrs, Volume= 0.123 af, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year, 24-hour Rainfall=4.00"

Area (ac)	CN	Description
0.470	86	<50% Grass cover, Poor, HSG C
0.130	89	Gravel roads, HSG C
0.600	87	Weighted Average
0.600		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 4S: Perimeter Channel Culvert



Summary for Pond 5P: 18" CMP (Cell 3 Riser Vault CV Extension)

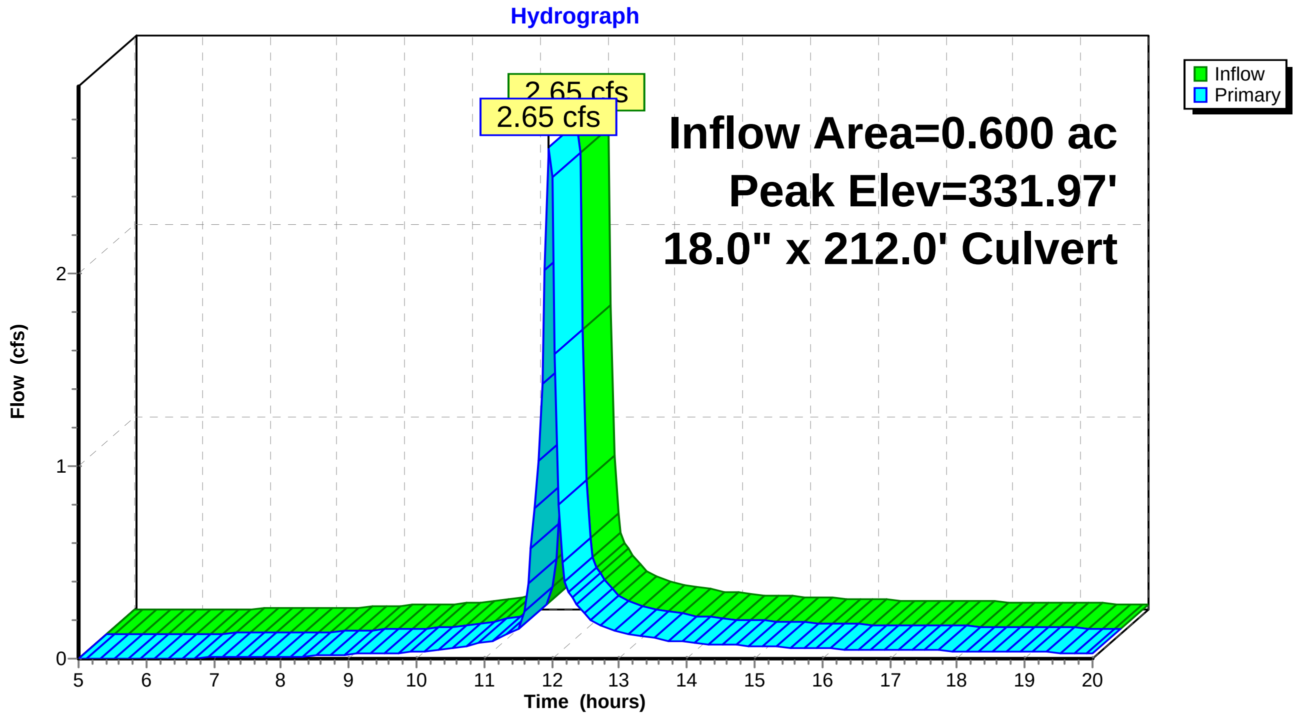
Inflow Area = 0.600 ac, 0.00% Impervious, Inflow Depth > 2.46" for 25-year, 24-hour event
Inflow = 2.65 cfs @ 11.97 hrs, Volume= 0.123 af
Outflow = 2.65 cfs @ 11.97 hrs, Volume= 0.123 af, Atten= 0%, Lag= 0.0 min
Primary = 2.65 cfs @ 11.97 hrs, Volume= 0.123 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 331.97' @ 11.97 hrs
Flood Elev= 333.22'

Device	Routing	Invert	Outlet Devices
#1	Primary	330.79'	**18.0" x 212.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 329.73' S= 0.0050 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=2.57 cfs @ 11.97 hrs HW=331.95' (Free Discharge)
↑**1=Culvert** (Barrel Controls 2.57 cfs @ 2.43 fps)

Pond 5P: 18" CMP (Cell 3 Riser Vault CV Extension)



O&M Manual Text Revisions

Use the attached pages to replace the corresponding pages of the current manual.

Operations and Maintenance Manual

For

Residuals Management Unit-1

September 1997

Revised: August 2012

CWM Chemical Services, LLC
1550 Balmer Road
Model City, New York 14107
(716) 286-1550

I.D. Number: NYD049836679

REFERENCE DRAWINGS

Drawing No.	Title	File No.
1	Title and Index	A-55299
1a	Title and Index	
2	Proposed RMU-1 Site	A-55298
3	Boring Locations	A-55297
4	Excavation Grades	A-55296
5	Subbase Grades	A-55295
6	Secondary Clay Liner Grades	A-55294
7	Secondary Leachate Granular Layer Grades	A-55293
8	Primary Clay Liner Grades	A-55292
9	Primary Leachate Granular Layer Grades	A-55291
10	Operations Layer Grades	A-55290
11	Top of Waste Grades	A-55289
12	Top of Vegetative Cover Grades	A-55288
12a	Top of Vegetative Cover Grades	
13	Sump Construction Grades	A-55287
13A	Sump Construction Grades Cell 5	
13B	Sump Construction Grades Cell 5	
13C	Sump Construction Grades Cell 6	
13D	Sump Construction Grades Cell 7	
13E	Sump Construction Grades Cell 10	
13G	Sump Construction Grades Cell 13	
13H	Sump Construction Grades Cell 14	
15	Cross Section 16+50E	A-55285
15A	Cross Section 23+25E	
16	Cross Sections 85+50N and 91+00N	A-55284
16A	Cross Section 97+50N	
17	Typical Liner Sections Cells 1 through 6	A-55283
17A	Typical Liner Sections Cells 7 through 14	
18	Sump Details	A-55282
18A	Sump Details Cells 5 through 14	
19	Cell Separation Berm Details	A-55281
19B	Cell Separation Berm Details Cells 5 and 6	
19C	Cell Separation Berm Details for Cells 7 through 14	
20	Riser Details	A-55280
21	Final Cover Details	A-55279
21A	Site Details	
21B	Site Details (with Compacted Clay)	
21C	Final Cover Details (with GCL)	
21D	Final Cover Details (with GCL)	
22	Site Surface Water Plan and Details	A-55278
23	Access Road Layout and Details	A-55277

REFERENCE DRAWINGS
(Cont'd)

As shown on typical truck routes, (see **Attachment #2**), the site may employ various truck route access road options for RMU-1 depending on time of year, adjacent construction, and which cell in RMU-1 is active. Other design options are acceptable depending on desired location providing the minimum design requirements are maintained.

It should be noted that these routes are applicable to all cells of RMU-1. For example, for filling in Cells 5 and 6 while 7 and 8 are under construction, the "over-the-berm" access Figure 2 may be employed, which allows vehicles to access the cell without having to construct a berm in adjacent unlined areas. From this design option, and the calculation sheet provided, the following construction guidance is presented:

- The incoming road ramp slope from the site roads will be between 8and 12 percent on incoming ramps and 12 percent on outgoing ramps.
- The minimum curve radius to be used for road construction is 45 feet.
- The minimum road width presented with is 15-feet and varies due to turning points and staging areas.
- Road construction material consists of gravel type material (e.g. run-of-crusher No. 2 gravel or equivalent) for the first 12" and then suitable on-site or off-site soil stockpile.
- Internal cell roads across the waste surface will be of a minimum of 12-feet wide and vary as to the location of the road (i.e., curves and unloading areas will be wider).
- Roads across the waste surface will be of a gravel type material (e.g. run-of-crusher No. 2 gravel or equivalent) and at least 12" thick.

If the initial access roads into the cell are installed on the operations layer, then the roads will be constructed on a layer of geotextile. This layer will act as a marker to show where the operations layer starts. Also, the geotextile will reduce maintenance of heavily traveled roads during inclement weather. Removal of the road to this marker will prevent damage of underlying liner system layers.

Once in the cell, vehicles may be staged on a dumping ramp for waste unloading for initial lifts. This will allow the waste filling to fan out from the ramp to allow greater access. Once waste is filled along the road, the initial gravel access roads can be removed and waste vehicles can drive on the waste.

Figure 1 of Attachment #4 shows access to RMU-1. This road is designed to accommodate semi-trailer traffic. A ramp as shown in Figure 2 of Attachment #2 may be constructed over the cell separation berm. The ramp slope will allow the vehicles to back down into the cell to off-load.

For the operation of Cell 6, vehicles with a maximum equipment wheel pressure of 5 psi will not be allowed to drive over the Cell 6/10 temporary intercell berm. Also, temporary access ramps shall not be constructed over the Cell 6/10 berm.

Once the initial lift or waste placement progresses across the cell, the vehicle will drive into the cell and turn around. At this time, the cell access road can be steepened to match filling needs.

Initial access to cells may also be provided using a temporary ramp, such as the ones used for construction equipment access. Waste can be brought in through these ramps and placed into the cell corners. Stone ramps are then constructed at these corners after sufficient waste has been placed at these locations. The waste trucks may enter and exit through these ramps. Refer to Figure 2 in Attachment #2 for typical detail.

An asphalt high point across the entire width of each truck entrance and exit road constructed after October 30, 2002, shall be provided just inside the perimeter of the landfill liner system. In instances where the road crosses the transition between capped and uncapped areas, the high point will be constructed just beyond the uncapped area edge (i.e., within the capped area). This high point must be constructed and maintained at a height sufficient to insure that contaminated surface water remains within the landfill at all times. At any point where the width of this access road is insufficient for two way traffic (i.e., less than 24 feet), CWM will apply appropriate traffic controls, such as stop signs and radio communication.

During later stages of waste filling, the increasing elevations of the waste mass will prevent the use of traditional haul roads, which typically have encroached into the permitted waste envelop. Thus, a new landfill plateau access road (planned for construction in late 2012) will be constructed on top of existing final cover areas so that the landfill final buildout may proceed without further restrictions imposed by vehicle access needs. The new single-lane width gravel road will be constructed from the perimeter berm diagonally up the northern face of the landfill and onto the plateau. Other than topsoil removal within the road footprint, no other modifications should be needed to the existing final cover to accommodate the road. The majority of the road will be constructed of general fill and will be surfaced with an 18-inch thick layer of crusher run, which will be underlain with a woven geotextile. A guiderail will be included along the outside edge. Once constructed, the landfill plateau access road will remain in place as a permanent feature. Figure 1a of Attachment #4 shows access to RMU-1 active area by the permanent access road constructed over Phase III, IV, and VII Final Cover.

3.2.6.2 Waste Vehicle Decontamination

Vehicles or any other equipment which have entered a secure land burial facility or any area where they may come into direct contact with wastes, shall be inspected for gross contamination prior to leaving such an area.

Pressure washing of tires and equipment will be performed at the landfill truck wash station, located at the exit of the landfill, as necessary to prevent contamination of on-site roads.

Additional decontamination may be required by the TSCA approval issued by USEPA. After all gross contaminants have been removed from the vehicle it is declared clean.

3.2.7 Fill Progression and Surface Water Management

Fill Progression and surface water management within RMU-1 limits include the following areas:

- constructed, non-active cells
- initial lifts
- waste placement below the perimeter berms, and
- waste placement above the perimeter berms

Waste filling and cover installation in the proposed Phase IX Final Cover area will proceed in the same manner as procedures for Phase VIII. Additionally, cover construction at the perimeter of the landfill in Cell 11/13 (Phase IX) will require reconstruction of the truck route following cover installation so that the portion of the haul route downgradient of the lowermost surface water diversion berm can be considered clean and stormwater run off can be allowed to drain off that portion of the haul route and out of the landfill.

A design detail (i.e., cross section) for the waste haul road to be constructed over the final cover on the east side of the landfill showing the thickness of soil/road bed material above final cover geosynthetics, will be submitted for NYSDEC review and approval prior to haul road construction. The design detail submission will include bearing strength capacity calculations from the Design Engineer which demonstrates that the thickness of soil/road bed material is sufficient to support the maximum wheel loading from loaded haul trucks entering the landfill without damaging underlying final cover geosynthetics, with an appropriate factor of safety. The design detail and its supporting calculations will be incorporated into the RMU-1 O&M Manual. Following construction of the new waste haul road, a topographical survey will be performed to verify the constructed thickness of the soil/road bed material meets the design.

Alternative access to the active area of RMU-1 may be provided by a permanent access road constructed over Phase III, IV, and VII Final Cover. This permanent road will be constructed by first removing the 6-inches of topsoil from the protective soil cover of the Final Cover followed by installation of appropriate soil from onsite or offsite soil stockpiles and installation of a 18-inches of road base consisting of crushed stone. The design detail submission includes bearing strength capacity calculations from the Design Engineer which demonstrates that the thickness of soil/road bed material is sufficient to support the maximum wheel loading from loaded haul trucks entering the landfill without damaging underlying final cover geosynthetics, with an appropriate factor of safety. The design detail and its supporting calculations are incorporated into the RMU-1 O&M Manual as Attachment #5.

The equipment/vehicle decontamination area will be relocated upgradient from its current location to the intersection of the truck route and the lowermost surface-water diversion berm. This allows for decontamination of exiting vehicles to occur before the vehicles cross onto the Phase IX final cover. Washwater from decontamination activities will drain to the southern edge of the truck route and into a sediment trap located on the side slope of the truck route. Washwater overflow from the sediment trap will drain into Detention Basin J.

An alternate location of the equipment/vehicle decontamination area will be provided if the permanent access road is constructed over Phase III, IV, and VII Final Cover as shown on Figure 1a of Attachment 4. This will allow for decontamination of exiting vehicles to occur before the vehicles cross onto the Phase III, IV, and VII Final Cover. Washwater from decontamination activities will drain to the eastern edge of the truck route and into a drainage ditch lined with sediment controls specified in Section 6.0. Washwater will flow from the truck wash area into Detention Basin I or K.

Prior to transition from Basins H and I to Basins J and K, the basin liners will be perforated or removed. The new Detention Basin J will be constructed as part of the elimination of the existing Detention Basin H. By placing waste in the existing detention basin with approximately a 2H:1V slope gradient towards the interior of the landfill, the newly placed waste will form a depression against the existing waste mass. Pumps will be maintained in the depression to manage stormwater during the transition. Eventually, this depression will form Detention Basin J. The new Detention Basin K will be similarly constructed by continuing waste placement with an inward slope gradient to control the size of the drainage area to the downgradient Detention Basin J.

Detention Basins J and K will be lined and equipped with submersible pumps having automated level controls. The pump in Detention Basin J is designed to discharge approximately 67 gpm to Detention Basin K once the liquid elevation in Detention Basin J reaches elevation 347.75 feet (i.e., 1 foot above the basin low point). The pump(s) in Detention Basin K is/are designed to discharge approximately 1,032 gpm to tank T-165 once the liquid elevation in Detention Basin K reaches elevation 366.38 feet (i.e., 1.5 foot above the basin low point). To maintain compliance with permit conditions regarding detention basin liquid elevations, an additional 0.5 foot of liquid shall be removed from Detention Basin K with the pump(s) by manually overriding the automatic level control until 1 foot or less liquid remains in the basin.

Piping used to transfer contact storm water (i.e. leachate) from within the landfill to Tank T-165 or the Primary Leachate Riser Vault which passes over landfill final cover areas, will be installed to meet the ancillary equipment requirements stipulated by 6NYCRR 373-2.10(d)(6) of the regulations. Piping installed over landfill final cover areas will be inspected for leaks daily.

The surveys of the waste mass shall also be used to evaluate the size of the detention basin drainage area in comparison to the respective acreage as depicted on Figure 1. If the detention basin drainage area is determined by a survey to be greater in acreage than depicted on Figure 1, CWM shall either grade the waste as necessary to reduce the acreage of the detention basin drainage area to a size at or below the acreage depicted on Figure 1, **or** submit with the waste mass survey, revised basin capacity calculations for Department approval. Such basin capacity calculations must be performed in accordance with the procedures and assumptions in the approved RMU-1 Leachate Level Compliance Plan, must reflect the as-built basin capacity and actual basin drainage area size, and must demonstrate that a minimum freeboard of 1.0 feet will be maintained. If CWM does not submit or the Department does not approve revised basin capacity calculations, the above indicated waste grading shall be completed prior to the next quarterly waste mass survey, unless adverse winter weather conditions prevent waste grading and an extension is approved by the Department.

The above inspections/surveys shall be submitted to the NYSDEC within thirty (30) days after completing the quarterly inspection/survey and within thirty (30) days of completing any RSHM Engineer requested inspection/survey.

<u>Post Phase IX Final Cover and Through Phase X Final Cover</u>

Anticipated final cover phasing (Phases X, XI, and XII) are shown on Figure 2 of the LLCP. To achieve waste grades at the middle and upper slopes on the south side of the landfill, final cover must be installed on the lower slope (Phase VIII) as described above. Additionally, temporary downchutes will be installed to manage non-contact water (stormwater) from the final cover area such that this stormwater does not drain into uncapped areas of the landfill. With the installation of Phase VIII final cover, the upgradient portions of the southern waste face will be built out to final waste grade in preparation for Phase X final cover. During this time, the drainage patterns are expected to remain as modeled in this LLCP.

Once the Phase X final cover is installed, the remaining uncapped area of the plateau to the west of the north-south ridgeline will be unable to gravity drain to the basins on the eastern side of the landfill. To allow this water to drain to the east where it can be contained in a basin and/or pumped to tank T-165, a ditch will be installed in an east-west orientation across the ridgeline of the landfill. This temporary feature will be excavated into the waste surface and will allow contact stormwater runoff to gravity drain to the east side of the landfill. Although the exact location of this feature will depend on waste grading conditions in place at the time, the required capacity of this ditch has been estimated and a minimum cross sectional geometry defined in Attachment 5 of Appendix A of the August 2011 (revised November 2011) LLCP . It may be necessary to move this ditch to accommodate waste placement but the minimum geometry will be utilized regardless of the ditch location. This ditch will remain in service until the installation of Phase XI final cover.

Several non-contact stormwater runoff features will be designed and constructed along with the Phase X final cover. Specifically, a diversion berm constructed of soil will be installed along the eastern edge of the cover on the landfill plateau. This temporary diversion feature will direct non-contact stormwater runoff to the south and into a temporary downchute pipe that will run down the south face of the landfill and carry the water out of the landfill. Additional temporary downchute pipes will be constructed at the same location to divert non-contact stormwater runoff in the two surface-water diversion berms away from the uncapped area and out of the landfill. Once these downchute pipes are installed, the temporary downchute pipes at the southwest corner of the landfill (Cell 14) may be dismantled so that the surface-water diversion berms flow continuously to the newly installed downchute pipes at the eastern edge of the Phase X final cover. Alternatively, the southwest downchute pipes may remain in service to reduce the flowrate to the new downchute pipes.

Fill progression beyond those shown on Figure 1 (August 2011, revised November 2011) shall not be performed until final cover is installed on Phase VIII, Phase IX, and Phase X areas. Upon installation of Phase VIII, Phase IX, and Phase X Final Covers, approximately 6.4 acres of waste area will be remaining to be closed with final cover (Phases XI and XII).

Based on previous engineering evaluations, tank T-165 provides storage capacity for approximately 11.1 acres of contact water from the active areas of the landfill. Therefore, significant detention basins will not be constructed for late stages of waste placement (i.e., following final capping of Phase VIII, IX, and X areas). Pumps within Basins J and K will be progressively moved to the low points within the basins during filling of the basins. Sumps will be constructed as necessary at the low points of the remaining portions of the basins or the low points on the waste benches so that adequate head can be maintained for pump operation. Lost storage capacity within the basins will be made up by the capacity of tank T-165.

Drainage to the basins and low points on the waste benches during fill progression will be verified quarterly and during the daily RCRA inspection. The RCRA inspector will note any low points containing water greater than 12-inches. Any drainage deficiencies noted during the daily RCRA inspections and/or the quarterly surveys related to drainage will be corrected within 7-days.

Post Phase X Final Cover and Through Landfill Closure

Construction of Phase X final cover is estimated to leave approximately 6.4 acres of the landfill uncapped. The majority of the non-contact stormwater runoff will be diverted away from the uncapped area, which will minimize the required size of contact stormwater runoff features. Consequently, Detention Basins J and K will be slowly filled once replacement features are constructed further to the north (see below for further discussion on the replacement features). The filling of the detention basins will allow buildout to final waste grade everywhere except in the alignment of the truck route and where the replacement contact water management features are located.

Upon filling the access road on the upper plateau reaching final waste grades in the Phase XI Final Cover area the final cover will be installed. A diversion berm constructed of soil will be installed along the eastern edge of the cover on the landfill plateau. This temporary diversion feature will direct non-contact stormwater runoff to the north to the upper surfacewater diversion berm completed in the Phase VII Final Cover area on the east slope.

Detention basins will be replaced with depressions along the alignment of the surface-water diversion berms on the eastern face of the landfill. The depths and widths of the depressions will be minimized to lessen their effect on achieving final waste grades in upgradient areas. These depressions will serve as collection points for contact stormwater runoff and will be equipped with pumps and float switches to allow automatic operation once the liquid depth exceeds 1 foot. The pumps in the depressions on the lower and upper surface-water diversion berms will discharge to the middle surface-water diversion berm at 67 gpm which, in turn, will discharge to tank T-165 at 1,032 gpm. Depressions constructed during late stage filling will be operated in accordance with the Detection Basin operating conditions with the exception that the depressions will not be lined.

The required size of these depressions will depend on the drainage area to each feature and the capacity of the pumps. Stormwater routing calculations, similar to those performed for Detention Basins J and K in the LLCP, have been performed to estimate the required sizes of the depressions. It is noted that these calculations are preliminary in nature because the sizes of the contributing watersheds have been estimated. These calculations will be performed during the quarterly waste surveys that are required by Module VI, Condition H.1 of the Sitewide Part 373 Permit to verify that the depressions are capable of managing the predicted runoff from the existing watersheds in place at those times. The depressions will be required to comply with the same Permit conditions as detention basins with the exception that the depressions will not be lined. The depressions will thus be sized to provide a minimum freeboard of 1 foot.

The existing lower truck route will be maintained throughout the filling of Detention Basins J and K and creation of the depressions discussed above. At that point, the majority of the remaining airspace (other than the amount that must be preserved for the depressions) will be within the truck route footprint. The truck route will be eliminated by placing waste near the upgradient end and progressing downslope to the edge of the Phase IX final cover. Once the truck route is eliminated, the remaining airspace will likely be filled using off-road dump trucks capable of climbing the steeper grades that will be necessary at that time.

Lastly, the depressions will be eliminated by controlled waste placement similar to what is planned for the south infiltration channel in the current fill progression design. However, because the surface-water diversions berms drain to the north, the depressions will need to be filled starting at the northern ends. As waste is placed in approximately 50- foot-long zones along the depressions, soil cover will be installed over the newly placed waste and the upgradient slope (to the next upgradient surface-water diversion berm) so that the runoff from that newly covered area may be allowed to drain out of the landfill. This allows the drainage areas to the depressions to be reduced in concert with the filling of the depressions. The waste filling and soil cover installation will continue to progress to the south until the eastern edge of Phase X final cover is reached.

At a minimum, Model City could place rock check dams at the exit of all channels discharging into the detention basins and place silt fence at the base of slopes that have shown erosion during rain events. Straw bale dikes will be placed in channels, as necessary, to reduce the runoff velocity and increase the deposition of the transported sediment load.

An 18-inch diameter perforated pipe will be installed along the invert of the Cell 9/10 intermediate channel adjacent to Cell 12/14 prior to waste placement across this channel, as shown on Figure 13 of this attachment. The perforated pipe will allow stormwater to continue to flow towards the western end of the channel where it can infiltrate into the operations layer and overflow into Cell 12/14 via the low point in the cell separation berm, as necessary. Sediment controls will be installed in the Cell 9/10 intermediate channel just upgradient of the entrance to the pipe. The controls shall be no higher than 1.0 feet below the crest of the primary liner on the adjacent Cell 9/10 and Cell 11/13 separation berm, so that any back up of stormwater will not overflow into Cell 11/13 prior to Cell 11/13 being approved for waste placement. Once Cell 11/13 is approved for waste placement, these sediment controls and the perforated pipe will no longer be required and the pipe will be left in place.

A collection vessel will be installed adjacent to the east exit road inside the landfill to manage truck wash waters and trap sediment. Water from this vessel will overflow to a stone area which will discharge through sediment controls, e.g., straw bale dike, to the perimeter infiltration channel or detection basin. Sediment which accumulates in the collection vessel and stone overflow area will be removed at least monthly, or at a frequency necessary to minimize sediment carryover into the infiltration channel.

An alternate location of the equipment/vehicle decontamination area will be provided if the permanent access road is constructed over Phase III, IV, and VII Final Cover as shown on Figure 1a of Attachment 4. This will allow for decontamination of exiting vehicles to occur before the vehicles cross onto the Phase III, IV, and VII Final Cover. Washwater from decontamination activities will drain to the eastern edge of the truck route and into a drainage ditch lined with sediment controls, e.g., straw bale dike. Washwater will flow from the truck wash area into Detention Basin I or K.

Upon observation of sediment on the operations stone within any infiltration channel which is considered by CWM personnel or NYSDEC On-site staff as adversely affecting the channel's ability to control surface water, CWM will remove the sediment from the identified infiltration channel as soon as practical. Such removal should include the excavation of any operations stone which appears to contain sediment from the waste. Operations stone should be removed with care so as to not damage the underlying liner system, and should be replaced with new operations stone to original channel grades.

ATTACHMENT #5
LANDFILL PLATEAU ACCESS ROAD DESIGN CALCULATIONS

WASTE MANAGEMENT

CWM CHEMICAL SERVICES, LLC
1550 Balmer Road
Model City, NY 14107
(716) 286-1550
(716) 286-0211 Fax

September 4, 2012

Mr. David Denk
Division of Environmental Permits
New York State Department of
Environmental Conservation
270 Michigan Avenue
Buffalo, New York 14203

Re: Part 373 Permit Modification Request Revision
RMU-1 Permanent Access Road

Dear Mr. Denk:

On August 15, 2012, CWM Chemical Services, LLC (CWM), Model City Facility submitted a permit modification request for the Sitewide Part 373 Permit No. 9-2934-00022/00097 to revise the design for the Residuals Management Unit No. 1 (RMU-1) landfill final cover system to include the construction of a permanent access road on the north side of the landfill. The New York State Department of Environmental Conservation (NYSDEC) issued comments for this request on August 23, 2012. Attached are revised pages for the application which address the NYSDEC's comments. The Short Environmental Assessment Form, submitted on August 15, 2012, does not require any revisions to address the NYSDEC's comments and is still applicable for this request.

The August 15, 2012, permit modification request included proposed modifications to one section of the CWM Sitewide Part 373 Permit No. 9-2934-00022/00097, plus proposed revisions to two reference documents, i.e., the RMU-1 Engineering Report and RMU-1 Operations and Maintenance (O&M) Manual. Since only a limited number of revisions are necessary to address the NYSDEC's August 23, 2012, comments, CWM is only providing the updated pages necessary to address the comments. These pages are intended to replace the corresponding pages of the August 15, 2012, submittal. Instructions for incorporating the revised pages into the applicable documents are provided in the attached flysheets and as described below:

Modifications to Part 373 Permit No. 9-2934-00022/00097

Attachment J, Appendix D-6 (RMU-1 Landfill Drawings)

New Drawing No. 23a has been revised to increase the size of the drainage pipe for the access road drainage ditch from 8-inches to 10-inches and is intended to replace the corresponding drawing from the August 15, 2012, submittal. All other drawings in this section submitted on August 15, 2012, have not been revised and are to be retained.

Reference Documents

RMU-1 Engineering Report Revisions

Appendix I (Surface Water Drainage and Erosion Calculations): Miscellaneous revisions submitted August 15, 2012 to reflect changes to drainage areas due to proposed access road have not been revised and are to be retained. A revised new calculation sheet (Section IX) has been prepared to increase the size of the drainage pipe for the access road drainage ditch from 8-inches to 10-inches and is intended to replace the corresponding calculations from the August 15, 2012, submittal.

RMU-1 O&M Manual Revisions

All pages of the RMU-1 O&M Manual submitted on August 15, 2012, have not been revised and are to be retained.

The August 15, 2012 permit modification request inadvertently did not include a revised Attachment O (Permit Modification Log) of the referenced permit. An updated Attachment O is attached.

If you have any questions or comments, please contact either myself at (716) 286-0246 or Mr. Jonathan Rizzo at (716) 286-0354.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to 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."

Sincerely,
CWM CHEMICAL SERVICES, LLC

Jill A. Banaszak

Jill A. Banaszak
Technical Manager
Model City Facility

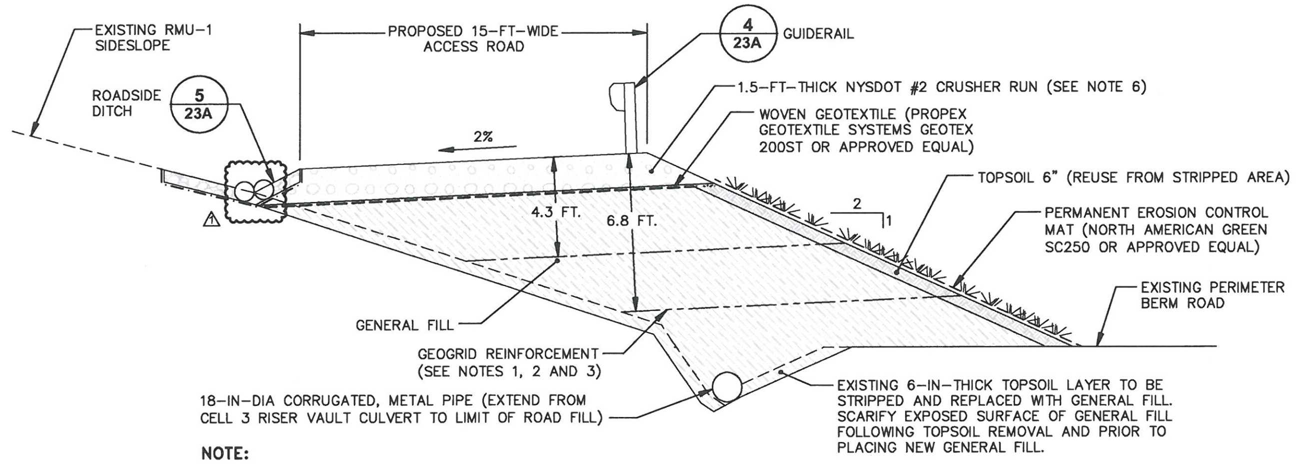
JPR/JAB/jpr
Attachment

cc: J. Strickland - NYSDEC/Region 9
D. Weiss - NYSDEC/Region 9
B. Rostami - NYSDEC/Region 9

On-site Monitors	- NYSDEC/ Model City, NY
M. Cruden	- NYSDEC/Albany, NY
T. Killeen	- NYSDEC/Albany, NY
G. Burke	- NYSDEC/Albany, NY
M. Mason	- NYSDEC/Albany, NY
M. Mortefolio	- NYSDEC/Albany, NY
P. Flax	- USEPA/Region II
J. Devald	- NCHD/Lockport, NY
M. Mahar	- CWM/Model City, NY
J. Rizzo	- CWM/Model City, NY
D. Darragh	- C&G/Pittsburgh, Pa
EMD Subject File	
Q & A	

Attachment J, Appendix D-6 (RMU-1 Landfill Drawings)

Use the attached pages to replace the corresponding pages of the previous submittal.

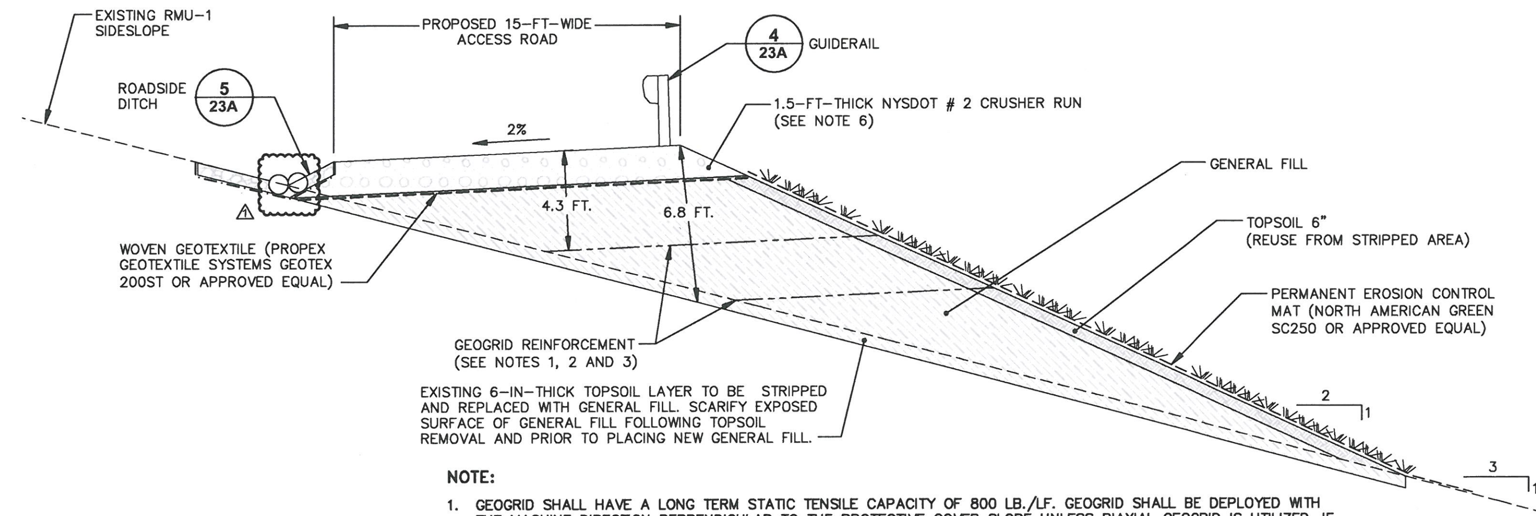


NOTE:

1. GEOGRID SHALL HAVE A LONG TERM STATIC TENSILE CAPACITY OF 800 LB./LF. GEOGRID SHALL BE DEPLOYED WITH THE MACHINE DIRECTION PERPENDICULAR TO THE PROTECTIVE COVER SLOPE UNLESS BIAXIAL GEOGRID IS UTILIZED. IF BIAXIAL GEOGRID IS USED AND DEPLOYED WITH THE MACHINE DIRECTION ALONG THE ROAD ALIGNMENT, THE CROSS MACHINE DIRECTION STRENGTH SHALL MEET THE INDICATED MINIMUM TENSILE CAPACITY AND ANY OVERLAP OF ADJACENT PANELS IN THE CROSS ROAD DIRECTION SHALL BE SUFFICIENT TO FULLY DEVELOP GRID STRENGTH.
2. GEOGRID SHALL EXTEND 17 FT. INTO ROAD GENERAL FILL FROM SIDESLOPE FACE OR 6 INCHES INTO EXISTING GENERAL FILL OF COVER SYSTEM, WHICHEVER IS LESS.
3. GEOGRID SHALL BE INSTALLED IN ACCORDANCE WITH SPECIFICATIONS CONTAINED IN APPENDIX D-11 OF THE RMU-1 ENGINEERING REPORT.
4. GENERAL FILL SHALL MEET THE REQUIREMENTS OF ITEM 2.04 OF SECTION 02210 OF THE RMU-1 TECHNICAL SPECIFICATIONS.
5. GENERAL FILL INSTALLATION SHALL BE IN ACCORDANCE WITH SECTION 02210 OF THE RMU-1 TECHNICAL SPECIFICATIONS EXCEPT THAT ONLY THE UPPER 2 FT. OF THE GENERAL FILL SHALL BE COMPACTED TO THE SPECIFIED MINIMUM DENSITY. DEEPER LIFTS SHALL ONLY BE COMPACTED BY TRACKING WITH A DOZER AND NO COMPACTION TESTING SHALL BE REQUIRED.
6. CRUSHER RUN SHALL BE PLACED, COMPACTED, AND TESTED IN ACCORDANCE WITH SECTION 02220 OF THE RMU-1 TECHNICAL SPECIFICATIONS. TESTING FREQUENCY SHALL BE ONE TEST PER 1,500 SQUARE FEET PER LIFT.

TYPICAL ROADWAY SECTION - PERIMETER BERM (1)

0 4' 8'
SCALE: 1"=4'



NOTE:

1. GEOGRID SHALL HAVE A LONG TERM STATIC TENSILE CAPACITY OF 800 LB./LF. GEOGRID SHALL BE DEPLOYED WITH THE MACHINE DIRECTION PERPENDICULAR TO THE PROTECTIVE COVER SLOPE UNLESS BIAXIAL GEOGRID IS UTILIZED. IF BIAXIAL GEOGRID IS USED AND DEPLOYED WITH THE MACHINE DIRECTION ALONG THE ROAD ALIGNMENT, THE CROSS MACHINE DIRECTION STRENGTH SHALL MEET THE INDICATED MINIMUM TENSILE CAPACITY AND ANY OVERLAP OF ADJACENT PANELS IN THE CROSS ROAD DIRECTION SHALL BE SUFFICIENT TO FULLY DEVELOP GRID STRENGTH.
2. GEOGRID SHALL EXTEND 17 FT. INTO ROAD GENERAL FILL FROM SIDESLOPE FACE OR 6 INCHES INTO EXISTING GENERAL FILL OF COVER SYSTEM, WHICHEVER IS LESS.
3. GEOGRID SHALL BE INSTALLED IN ACCORDANCE WITH SPECIFICATIONS CONTAINED IN APPENDIX D-11 OF THE RMU-1 ENGINEERING REPORT.
4. GENERAL FILL SHALL MEET THE REQUIREMENTS OF ITEM 2.04 OF SECTION 02210 OF THE RMU-1 TECHNICAL SPECIFICATIONS.
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6. CRUSHER RUN SHALL BE PLACED, COMPACTED, AND TESTED IN ACCORDANCE WITH SECTION 02220 OF THE RMU-1 TECHNICAL SPECIFICATIONS. TESTING FREQUENCY SHALL BE ONE TEST PER 1,500 SQUARE FEET PER LIFT.

TYPICAL ROADWAY SECTION - SIDESLOPE AREA (2)

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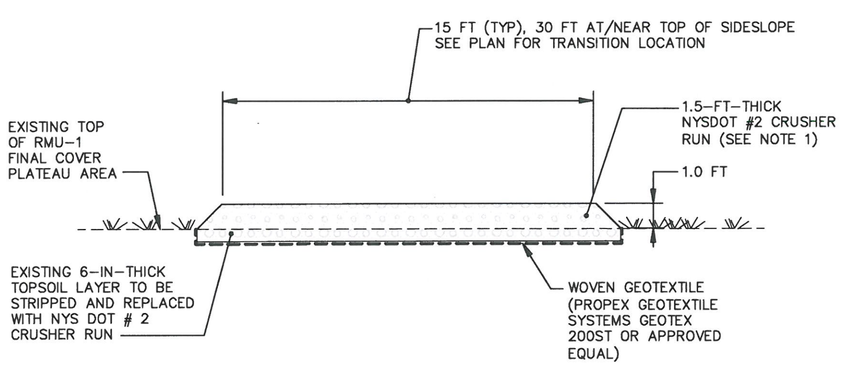
SCALE: 1"=4'

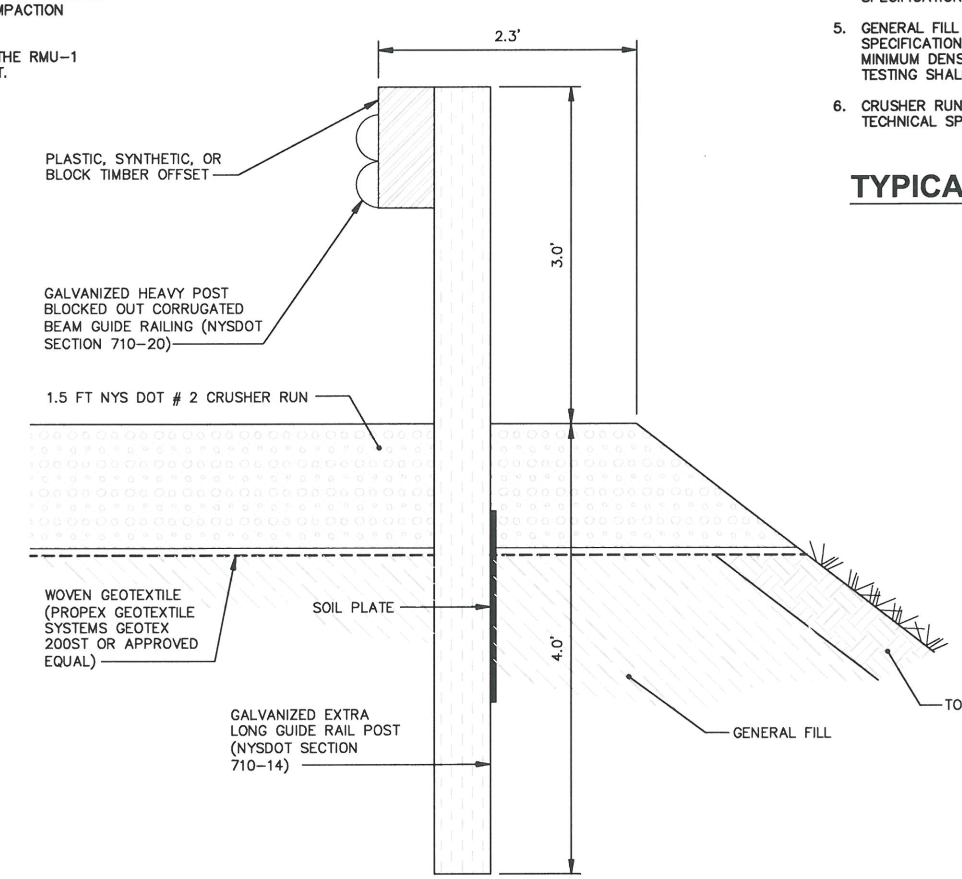


NOTE:

1. CRUSHER RUN SHALL BE PLACED, COMPACTED, AND TESTED IN ACCORDANCE WITH SECTION 02220 OF THE RMU-1 TECHNICAL SPECIFICATIONS. TESTING FREQUENCY SHALL BE ONE TEST PER 1,500 SQUARE FEET PER LIFT.

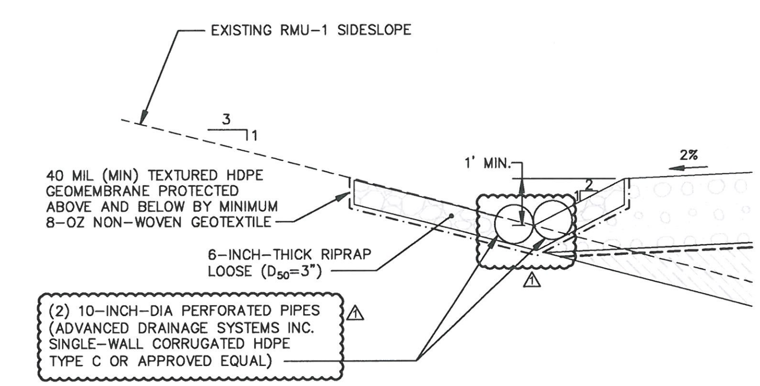
TYPICAL ROADWAY SECTION - PLATEAU AREAS (3)

NOT TO SCALE



TYPICAL GUIDERAIL DETAIL (4)

NOT TO SCALE



ROADSIDE DITCH DETAIL (5)

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SCALE: 1"=2'

CITY: SYRACUSE, NY DIV/GROUP: ENVCADD DB: K.SARTORI LD: K.SARTORI PIC: W. POPHAM PM: T. FARMEN TM: B. STONE LYR: (Opt)ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0023729\2012\00002\DWG\PERMIT\23729G23a.dwg LAYOUT: 23A SAVED: 8/29/2012 11:15 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 8/29/2012 11:15 AM BY: SARTORI, KATHERINE
XREFS: 23729X00 IMAGES: PROJECTNAME: ----

SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
1	8/2012	REVISED PERFORATED PIPE DIAMETER	NWF	BMS

Professional Engineer's Name: JOSEPH MOLINA III
Professional Engineer's No.: 072644
State: NY | Date Signed: 8/29/12 | Project Mgr.: BMS
Designed by: BMS/PTO | Drawn by: SLM/KLS | Checked by: BMS

STATE OF NEW YORK JOSEPH MOLINA III LICENSED PROFESSIONAL ENGINEER 072644

ARCADIS
ARCADIS U.S., INC.

CWM CHEMICAL SERVICES, LLC • MODEL CITY FACILITY
RESIDUALS MANAGEMENT UNIT 1

LANDFILL PLATEAU ACCESS ROAD DETAILS

ARCADIS Project No. B0023729.2012.00002
Date AUGUST 2012
ARCADIS 6723 TOWPATH ROAD SYRACUSE, NY 13214.0066 TEL: 315.446.9120

23A

RMU-1 Engineering Report

Insert the Following revised New Calculation Sheet (IX. RMU-1 Plateau Access Road Drainage Calculations) at the End of Existing Appendix I.

IX. RMU-1 PLATEAU ACCESS ROAD DRAINAGE CALCULATIONS

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Calculation Sheet

Client: CWM Chemical Services, LLC

Project Location: Model City, New York

Project: RMU-1 Plateau Access Road Design **Project No.: B0023729.2012**

Subject: Drainage Calculations

Prepared By: NWF/BMS **Date: August 2012**

Reviewed By: PTO/BMS **Date: August 2012**

Checked By: BMS **Date: August 2012**

OBJECTIVE:

Demonstrate that the drainage ditch along the inside edge of the proposed landfill plateau access road provides adequate hydraulic capacity to convey the estimated peak discharge from the 25-year, 24-hour design storm. Demonstrate that the proposed culvert beneath the landfill plateau access road provides adequate hydraulic capacity to convey the estimated peak discharge from the 25-year, 24-hour design storm.

REFERENCES:

1. RMU-1 Permit Drawing No. 12-a entitled “Top of Vegetated Cover Grades,” ARCADIS, August 2012.

2. RMU-1 Permit Drawing No. 23A entitled “Landfill Plateau Access Road Details,” ARCADIS, August 2012.

3. Technical Release 55 “Urban Hydrology for Small Watersheds,” Soil Conservation Service, June 1986.

4. HydroCAD Software Solutions, LLC, HydroCAD. Version 8.5. Computer Software, 2006. (Output attached).

5. Manufacturer’s Literature, www.ads-pipe.com, Advanced Drainage Systems, Inc. (attached).

ASSUMPTIONS:

1. A new permanent road is proposed along the northern face of RMU-1 to allow waste hauling trucks and other vehicles access to the landfill’s plateau. The road design is shown on Reference 1. The road design includes two new drainage features. A roadside ditch will be installed along the inside edge of the road to convey concentrated runoff down the landfill sideslope and into the existing surface water diversion berms (SWDBs) and perimeter channel. A culvert will be installed beneath the road fill along the perimeter berm to maintain flow within the existing perimeter channel.

2. The proposed roadside ditch has a v-notch geometry with a minimum depth of 1 ft, sideslopes of 3H:1V and 2H:1V, and a variable longitudinal slope. The roadside ditch will be lined with a geomembrane to limit percolation into the existing cover soil. The geomembrane will be covered with a 6-inch-thick layer of loose riprap having a D50 of 3 inches. Two 10-inch-diameter perforated and corrugated high density polyethylene (HDPE) pipes will be installed along the invert of the roadside ditch and buried within the loose riprap. The pipes are provided as a means to convey the majority of

Calculation Sheet

the ditch flow in a non-erosive manner and to limit the required size of the ditch riprap.

3. The invert slope of the roadside ditch matches the longitudinal slope of the access road and varies from 8% to 12%. The ditch is divided into three segments as follows:

    - Upper Ditch Segment – 12% slope draining to upper SWDB.
    - Middle Ditch Segment – 8% slope draining to lower SWDB.
    - Lower Ditch Segment – 12% slope draining to perimeter channel.

4. The capacity of the roadside ditch includes the pipe-full flowrate at the indicated ditch slope, and any open channel flowrate that would occur above the riprap layer. The depth of open channel flow above the riprap considers both the required head to admit water into the perforated pipes as well as the additional flow capacity needed beyond that provided by the perforated pipes.

5. The proposed culvert is necessary to maintain drainage within the perimeter channel at the top of the perimeter berm that would otherwise be blocked by fill placement necessary for the access road construction. A culvert is currently in place in this channel in front of the riser vaults for Cell 3. Because the road fill extends to this existing culvert location, the proposed culvert is essentially an extension of the existing culvert. The extension of the existing culvert pipe is assumed to utilize the same material, diameter, and construction (i.e., 18-inch-diameter corrugated metal pipe). The culvert pipe is assumed to have a Manning “n” of 0.025. The culvert is assumed to have a slope of 0.5%.

6. Both proposed stormwater features (ditches and culvert), are based on the 25-year, 24-hour event, storm event which produces 4.0 inches of rainfall.

7. The runoff curve number for the tributary watershed to each roadside ditch segment and the proposed culvert varies according to surface conditions. The runoff curve number for gravel access roads is 89 based on Reference 3. The roadside ditch is riprap lined with a runoff curve number of 89 also based on Reference 3. The runoff curve number for capped areas is assumed to be 86 to remain consistent with original RMU-1 drainage design calculations (based on the value presented in Table 2-2a of Reference 3 for <50% grass cover, fair, Hydrologic Soil Group “C”).

8. The culvert configuration is deemed acceptable if the design can convey the 25-year, 24-hour estimated peak discharge without causing a headwater depth that exceeds the depth of the perimeter channel in which the culvert is installed. The flow capacity of the culvert is estimated using Reference 4, which accounts for both pipe friction losses and energy losses at the culvert entrance and exit.

Calculation Sheet

CALCULATIONS:

1. Estimated Peak Discharge to the Roadside Ditch

Table 1 summarizes the runoff characteristics for the tributary watersheds draining to each roadside ditch segment and the resulting 25-year, 24-hour peak discharges.

Table 1 – Runoff Characteristics of Tributary Areas Draining to Roadside Ditch Segments

Ditch Segment	Cumulative Watershed Area (acres)	Composite Runoff Curve Number	Time of Concentration (min)	25-yr, 24-hr Estimated Peak Discharge (cfs)
Upper (12% Slope)	1.26	87	10.4	4.87
Middle (8% Slope)	0.36	87	6.0	1.59
Lower (12% Slope)	0.25	87	6.0	1.11

The watersheds are included as Attachment 1 to this calculation sheet. Supporting output from HydroCAD is included as Attachment 2 to this calculation sheet.

2. Roadside Ditch Capacity

As discussed in Assumption 4, the capacity of the roadside ditch includes the capacity of the perforated pipes buried in the riprap and the open channel flow that occurs above the riprap (if any). The pipe-full flow capacity of the perforated pipes is based on the Manning equation:

$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$$

where,
- Q = pipe-full flowrate, cfs (unknown)
- A = cross sectional area of pipe flowing full = $\pi D^2/4$
- n = Manning "n" for corrugated HDPE pipe = 0.017 (Reference 5)
- R = hydraulic radius = A/P
- P = wetted perimeter of pipe flowing full = πD
- S = minimum longitudinal slope of pipe = varies, either 0.08 or 0.12

Solving for Q for each longitudinal ditch slope,

Q = 5.76 cfs x 2 pipes = 11.52 cfs total (12% Slopes)
= 4.70 cfs x 2 pipes = 9.40 cfs total (8% Slopes)

Thus, for all ditch segments, the pipe-full capacity exceeds the peak discharge to each segment, meaning the pipes alone can convey the peak flow and there is no need for excessive flow to be conveyed above the riprap layer.

However, in order for the flow to enter the perforated pipes, a certain head outside the pipes is needed. This head is estimated from laboratory testing by the pipe manufacturer (Reference 5), the results of

Calculation Sheet

which are included as Attachment 3 to this calculation sheet. An inflow rate per foot of pipe for each ditch segment is determined using the above-calculated peak discharges. The corresponding head (measured with respect to the pipe invert) is then determined. As indicated in Attachment 3, the head for the middle and lower ditch segments is approximately 1 inch and the head for the upper ditch segment is approximately 6.9 inches. Thus, the water level in the middle and lower roadside ditch segments should remain below the top of the riprap layer during the peak flow period of the design storm. The predicted water depth over the top of the riprap layer in the upper ditch segment is limited (approximately 0.9 inches) and is not sufficient to affect the stability of the riprap lining.

3. Estimated Peak Discharge to the Perimeter Channel Culvert

Table 2 summarizes the runoff characteristics for the tributary watershed draining to the perimeter channel culvert and the resulting 25-year, 24-hour peak discharge.

Table 2 – Contributing Watershed Characteristic and Peak Discharge

Watershed ID	Area (acres)	Runoff Curve Number	Time of Concentration (min)	Resulting Peak Discharge (cfs)
Perimeter Channel Culvert	0.60	87	6.0	2.65

Supporting output from HydroCAD is included as Attachment 4.

4. Perimeter Channel Culvert Capacity

Reference 4 is used to estimate the headwater at the inlet to the culvert to be installed beneath the access road fill. This predicted water surface elevation is compared with the lowest perimeter channel containment elevation to verify that the culvert will not cause the perimeter channel to overtop while conveying the peak flow from the design storm. The results from Reference 4 are summarized in Table 3.

Table 3 – Perimeter Channel Culvert Capacity Calculations

Required Flow Rate (cfs)	Culvert Composition	Pipe Slope	Max. Allowable Water Surface El. in Upstream Perimeter Channel (ft)	Predicted Peak Water Surface El. in Perimeter Channel[1] (ft)
2.65	18-inch CMP	0.5%	333.22	331.97

Notes:

1. Maximum water elevation is based on lowest surveyed elevation at edge of perimeter channel upstream of culvert.

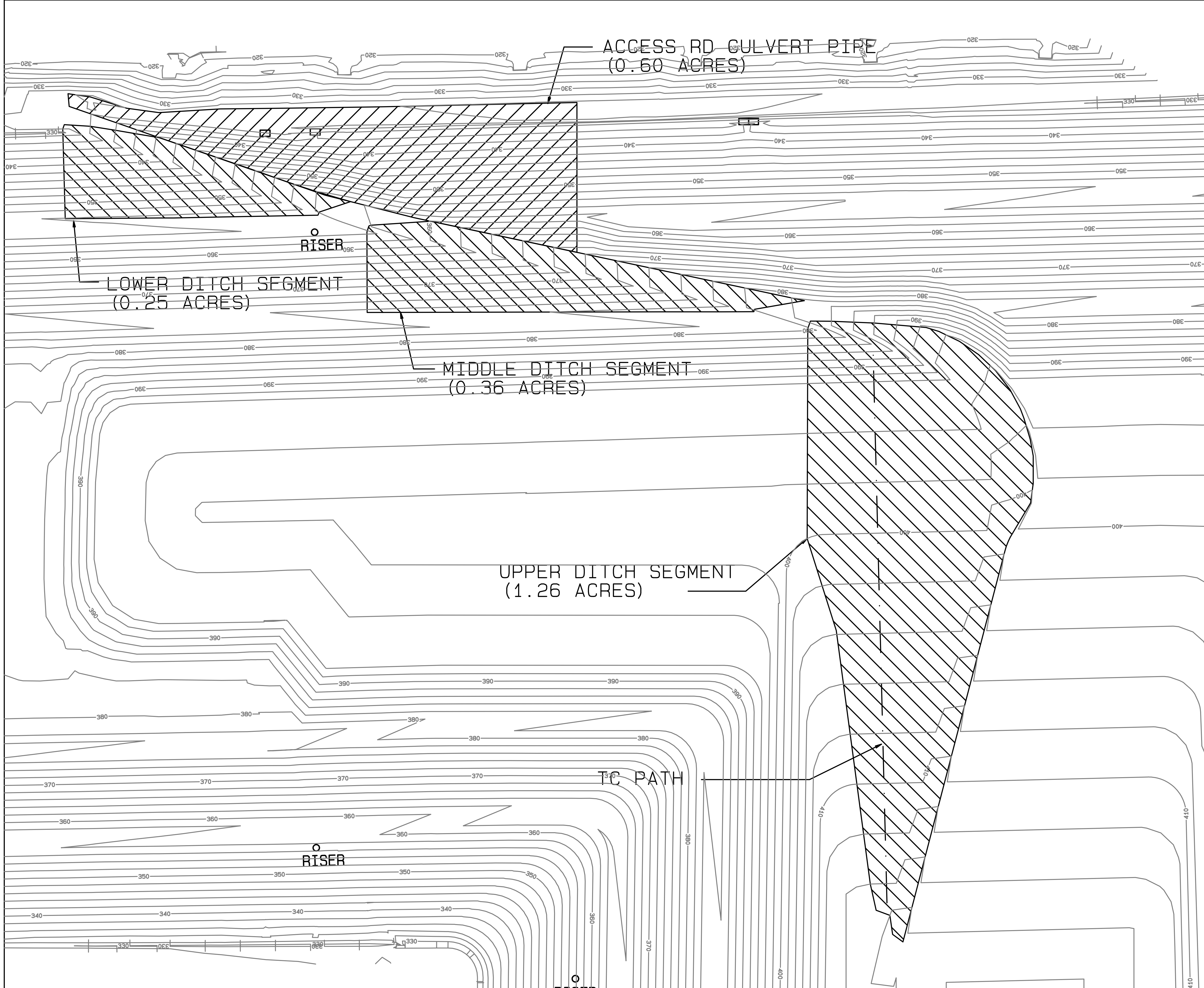
As indicated in Table 3, the predicted peak water surface elevation in the perimeter channel upstream of the culvert is less than the lowest surveyed elevation at the edge of the perimeter channel. Thus, the channel should not overflow while conveying the peak runoff from the design storm and the culvert capacity is therefore sufficient.

SUMMARY:

The proposed roadside ditch and culvert at the bottom of the access road provide adequate hydraulic capacity to convey the peak discharges from the 25-year, 24-hour design storm event.

Attachment 1

Watershed Area Map


ACCESS RD CULVERT PIPE
(0.60 ACRES)
LOWER DITCH SEGMENT
(0.25 ACRES)
MIDDLE DITCH SEGMENT
(0.36 ACRES)
UPPER DITCH SEGMENT
(1.26 ACRES)
TC PATH
RISER
RISER
RISER

ARCADIS

Attachment 2

HydroCAD Output for Roadside Ditches

Summary for Subcatchment 1S: Roadside Ditch (Upper Segment)

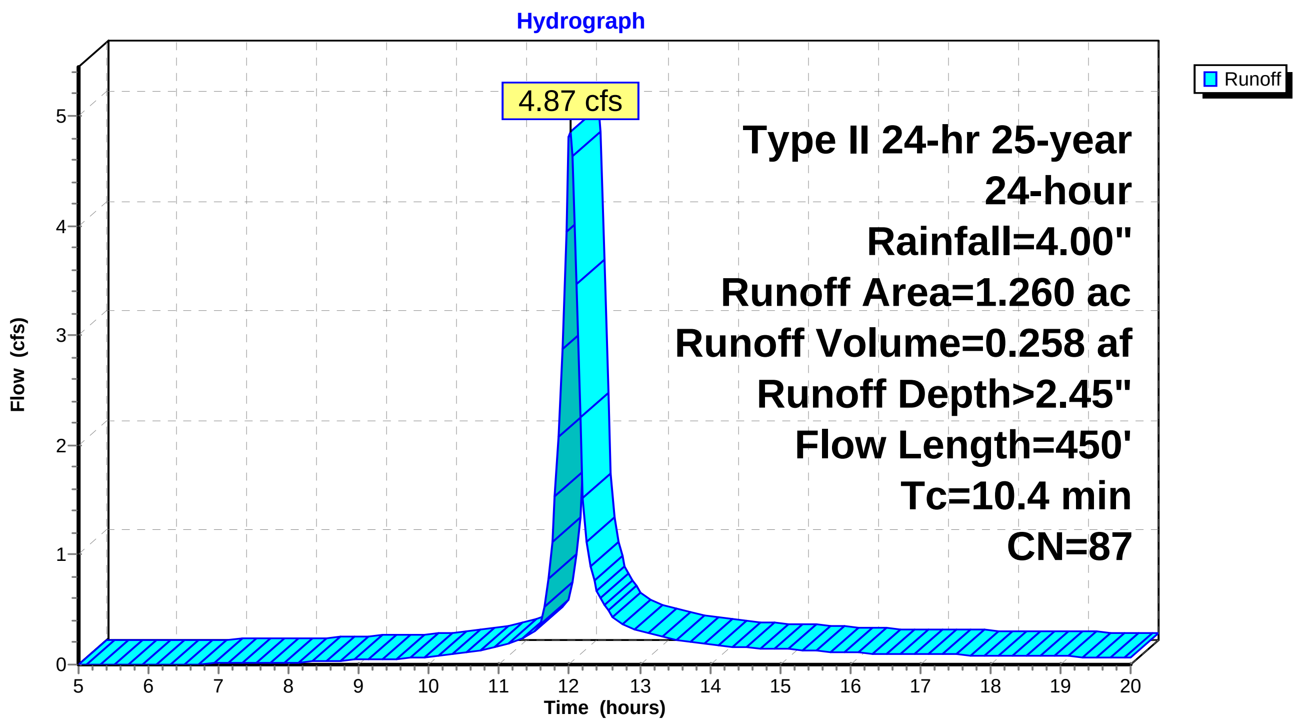
Runoff = 4.87 cfs @ 12.02 hrs, Volume= 0.258 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year, 24-hour Rainfall=4.00"

	Area (ac)	CN	Description
*	0.950	86	<50% Grass cover, Poor, HSG C
	0.310	89	Gravel roads, HSG C
	1.260	87	Weighted Average
	1.260		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0500	0.24		**Sheet Flow,** Range n= 0.130 P2= 2.50"
3.4	320	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.3333	4.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.4	450	Total			

Subcatchment 1S: Roadside Ditch (Upper Segment)



Summary for Subcatchment 3S: Roadside Ditch (Middle Section)

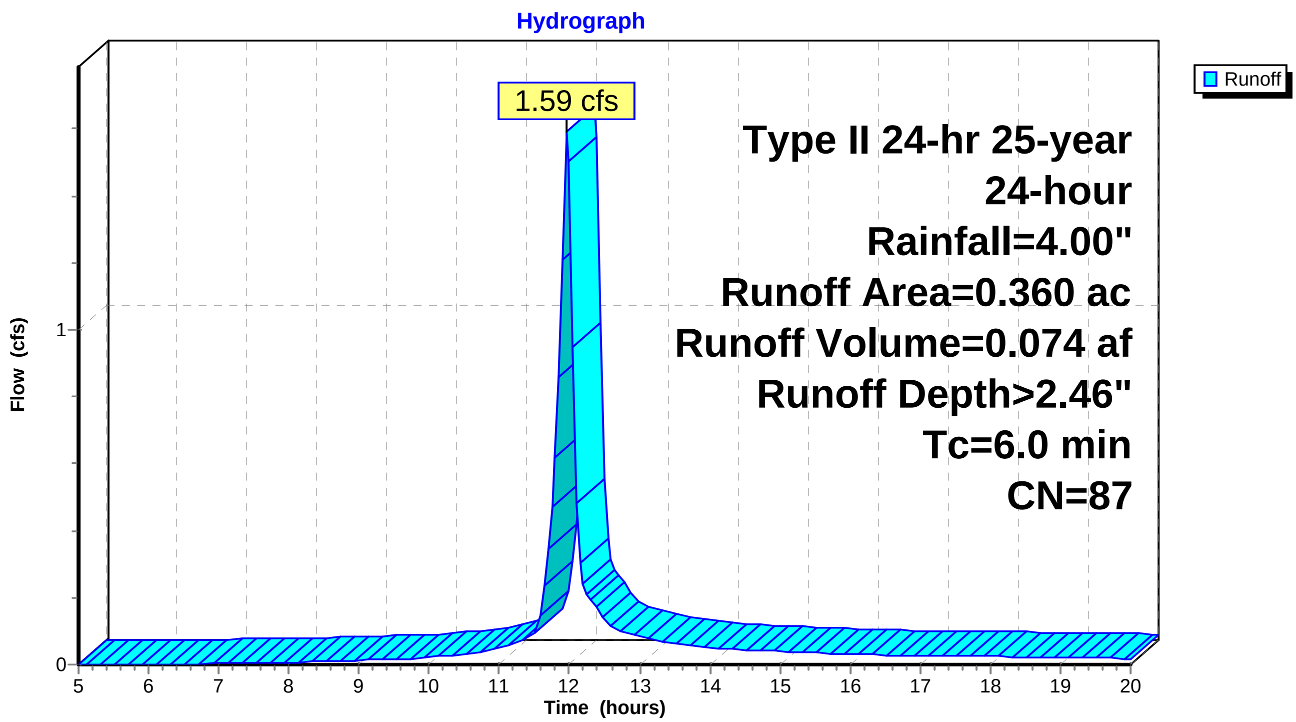
Runoff = 1.59 cfs @ 11.97 hrs, Volume= 0.074 af, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year, 24-hour Rainfall=4.00"

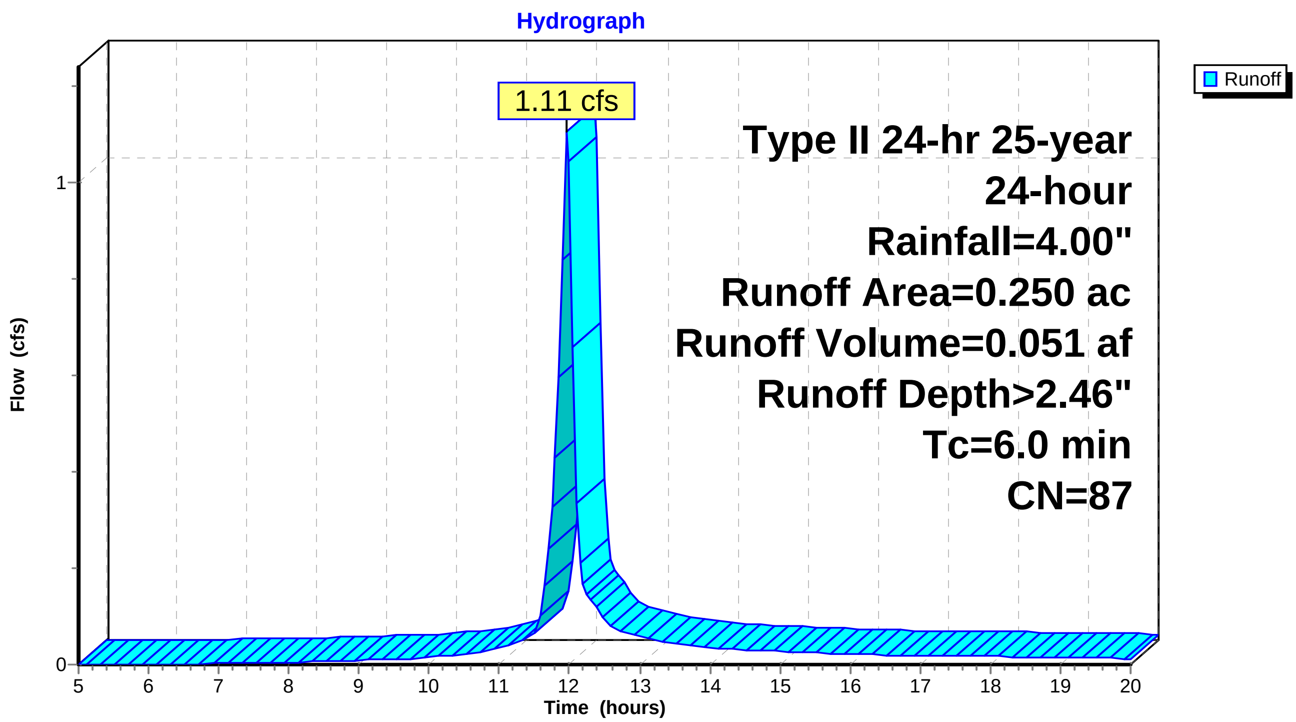
Area (ac)	CN	Description
0.210	86	<50% Grass cover, Poor, HSG C
0.150	89	Gravel roads, HSG C
0.360	87	Weighted Average
0.360		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 3S: Roadside Ditch (Middle Section)



Subcatchment 2S: Roadside Ditch (Lower Section)



Summary for Subcatchment 2S: Roadside Ditch (Lower Section)

Runoff = 1.11 cfs @ 11.97 hrs, Volume= 0.051 af, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year, 24-hour Rainfall=4.00"

Area (ac)	CN	Description
0.160	86	<50% Grass cover, Poor, HSG C
0.090	89	Gravel roads, HSG C
0.250	87	Weighted Average
0.250		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

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Attachment 3

Manufacturer's Literature
(Advanced Drainage
Systems, Inc.)

Technical Notes

Technical Note 2.109
Re: Flow Capacity
Date: March 1, 1995

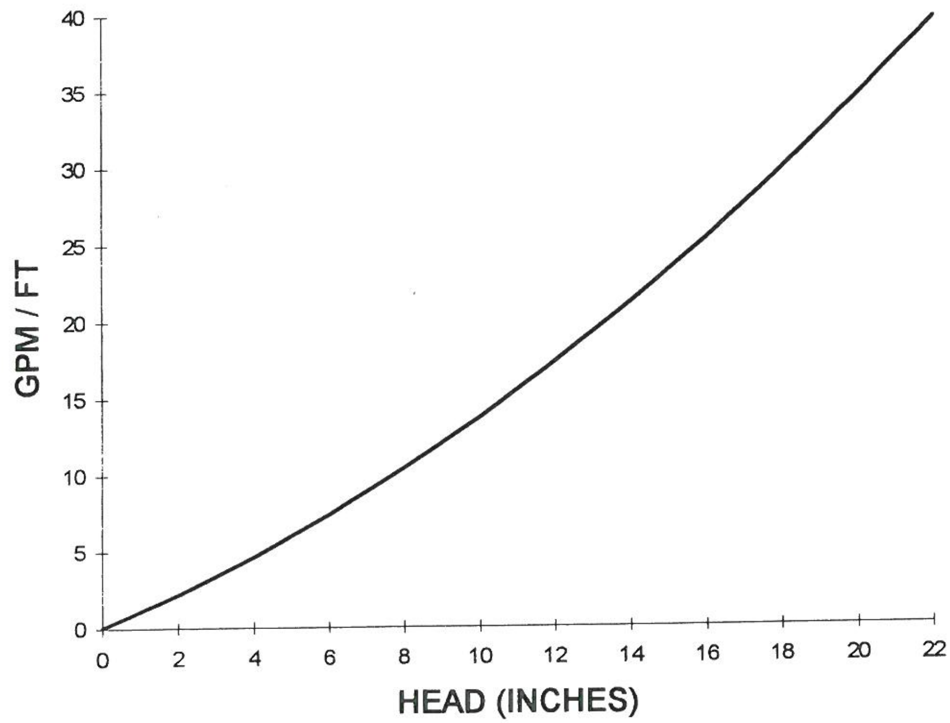
It is the intent of this Technical Note to provide current hydraulic performance data for use by the engineering community. A bibliography is included for the engineer's use if further information or guidance is needed.

Manning's "n" values are offered for design purposes based on the best available data assembled from a variety of sources as indicated. Table 1 presents the Manning's "n" values recommended by the A.D.S. engineering staff for use in design.

Table 1
Manning's "n" Value For Design
(Storm & Sanitary Sewer and Culverts)

Pipe Type	"n"
A.D.S. Corrugated Polyethylene Pipe	
3" - 6" Diameter	0.015
8" Diameter	0.016
10" Diameter	0.017
12" - 15" Diameter	0.018
18" - 36" Diameter	0.020
A.D.S. N-12	0.012
Concrete Pipe	0.013
Corrugated Metal Pipe (2 2/3" x 1/2" corrugation)	
Annular	
Plain	0.024
Paved Invert	0.020
Fully Paved (smooth lined)	0.013
Helical	
Plain 15" Diameter	0.013
Plain 18" Diameter	0.015
Plain 24" Diameter	0.018
Plain 36" Diameter	0.021
Spiral-Rib	0.012
Plastic Pipe (SDR, S&D, Etc.)	0.011
Vitrified Clay	0.013

OUTFLOWS - ADS PIPE
10" SINGLE WALL PIPE TYPE C



FACTORS FOR OUTFLOW CALCULATIONS
ADS 10" SINGLE WALL PIPE TYPE C

OPEN AREA	AO	A1	A2	H2	H	Q=GPM/FT
1.2	0.03997	0.99646	0.03616	0	0	0.04
1.2	0.03997	0.99646	0.03616	4	2	2.18
1.2	0.03997	0.99646	0.03616	16	4	4.60
1.2	0.03997	0.99646	0.03616	36	6	7.32
1.2	0.03997	0.99646	0.03616	64	8	10.33
1.2	0.03997	0.99646	0.03616	100	10	13.62
1.2	0.03997	0.99646	0.03616	144	12	17.20
1.2	0.03997	0.99646	0.03616	196	14	21.08
1.2	0.03997	0.99646	0.03616	256	16	25.24
1.2	0.03997	0.99646	0.03616	324	18	29.69
1.2	0.03997	0.99646	0.03616	400	20	34.43
1.2	0.03997	0.99646	0.03616	484	22	39.46

NOTE: Q = AO + (A1*H) + (A2*H2)

DITCH SEGMENT	CFS (PEAK)	DITCH LENGTH (FT)	GPM/FT ÷ 2 PIPES	HEAD (IN)
UPPER	4.87	125	8.7	6.9
MIDDLE	1.59	310	1.2	1.1
LOWER	1.11	185	1.3	1.2

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Attachment 4

HydroCAD Output for Culvert

Summary for Subcatchment 4S: Perimeter Channel Culvert

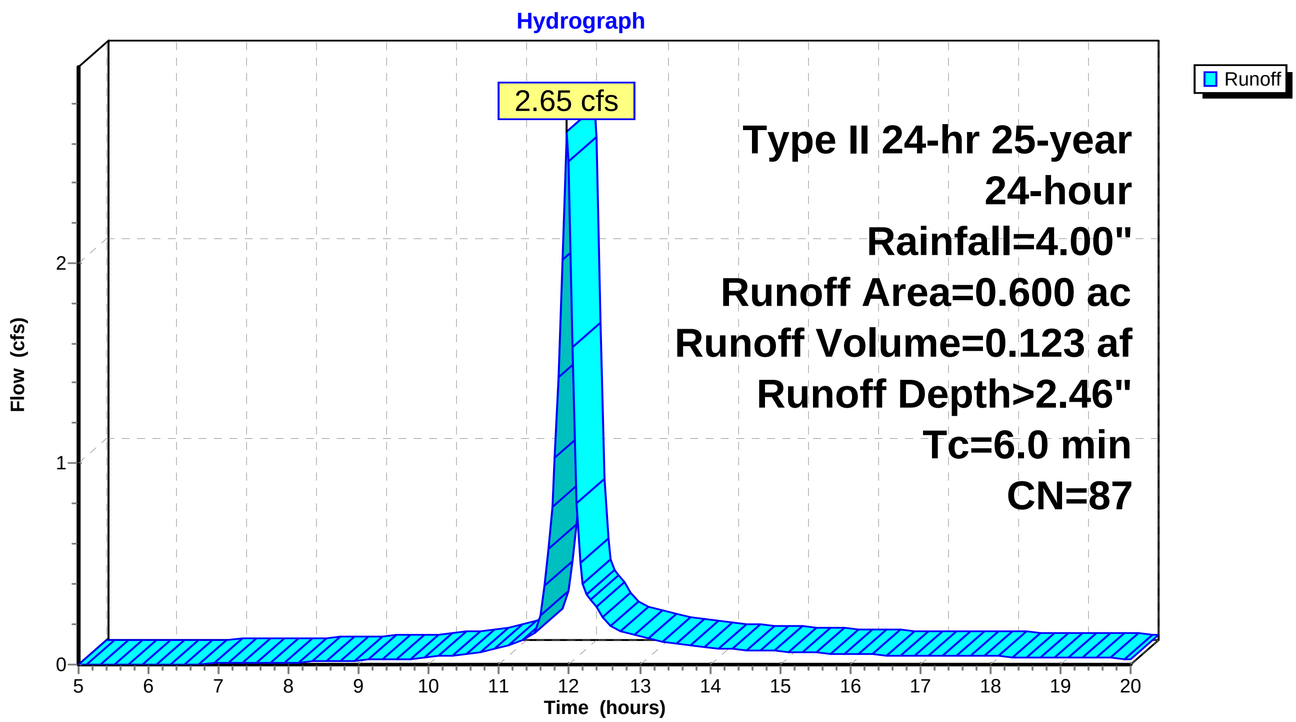
Runoff = 2.65 cfs @ 11.97 hrs, Volume= 0.123 af, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year, 24-hour Rainfall=4.00"

Area (ac)	CN	Description
0.470	86	<50% Grass cover, Poor, HSG C
0.130	89	Gravel roads, HSG C
0.600	87	Weighted Average
0.600		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 4S: Perimeter Channel Culvert



Summary for Pond 5P: 18" CMP (Cell 3 Riser Vault CV Extension)

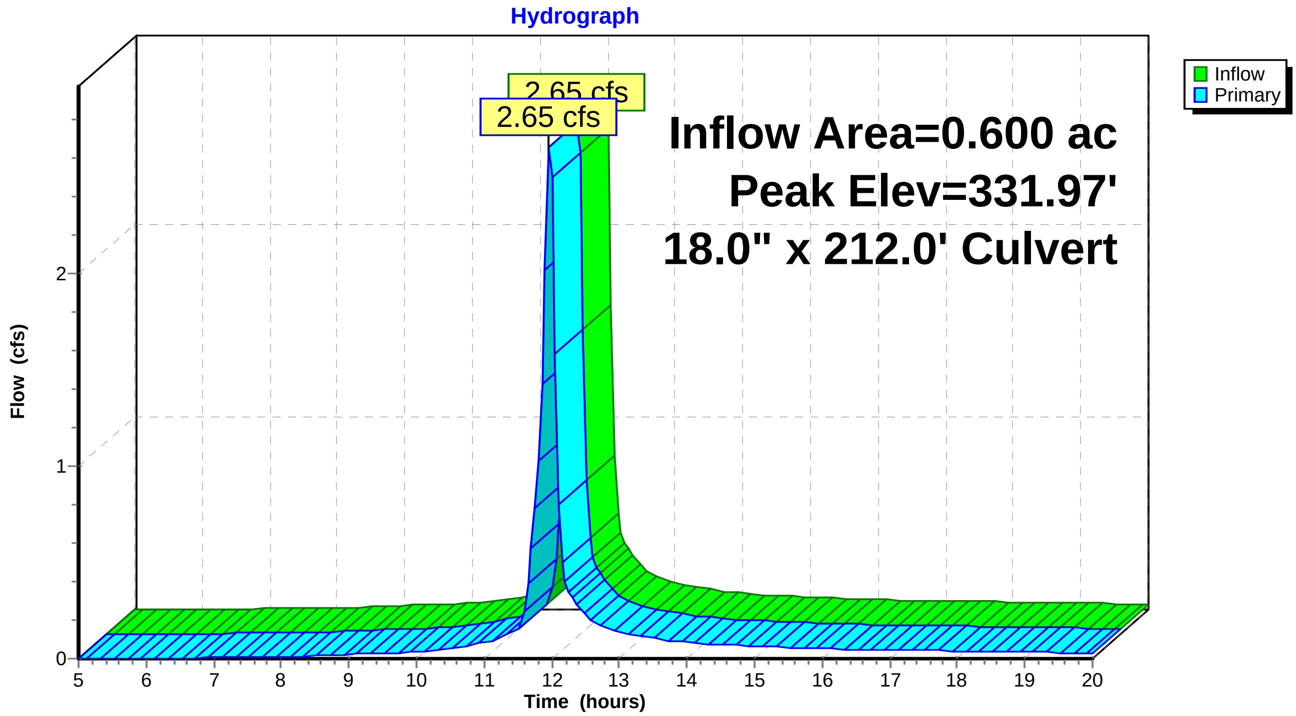
Inflow Area =	0.600 ac,	0.00% Impervious, Inflow Depth >	2.46"	for 25-year, 24-hour event
Inflow =	2.65 cfs @	11.97 hrs, Volume=	0.123 af	
Outflow =	2.65 cfs @	11.97 hrs, Volume=	0.123 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.65 cfs @	11.97 hrs, Volume=	0.123 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 331.97' @ 11.97 hrs
Flood Elev= 333.22'

Device	Routing	Invert	Outlet Devices
#1	Primary	330.79'	**18.0" x 212.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 329.73' S= 0.0050 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=2.57 cfs @ 11.97 hrs HW=331.95' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.57 cfs @ 2.43 fps)

Pond 5P: 18" CMP (Cell 3 Riser Vault CV Extension)



- **Attachment O – Permit Modification Log**

Use the attached page to replace the corresponding page of the current permit.

The name of the specific document being modified (sections, and/or attachments)	Modified page numbers		Date of Revised pages	The effective date of permit modification	The nature of the modifications
	Old	New			
Att. I, Sect. I.1, Site Closure Plan Att. I, Sect. I.1, Site Closure Plan Att. I, Sect. I.1, Site Closure Plan Att. J, App. D-6	Cover&5 3 6&7 Drawing No. 1-a	Cover&5 3 6&7 Drawing Nos. 1-a & 24-a	2/10/10 3/14/08 8/10/07 2/10/10	6/25/10 (continued)	
Module IV, Condition B.10 Att. J, App. D-6	10&11 Drawing No. 24-a	10&11 Drawing No. 24-a	7/16/10	7/26/10	Re-locate Tank T-165 and its secondary containment vault (prior to construction).
Module IV, Condition A, Table 1.0 Att. D, App. D-3	5&6 12, Fig.D-29, & Calc. Shts. 1-2	5&6 12, Fig.D-29, & Calc. Shts. 1-2	3/23/11	3/23/11	Department initiated Permit modification for additional sumps in the secondary containment of the Leachate Tank Farm to improve removal of accumulated liquids.
Att. J, App. D-6	Drawings 1a & 12-a	Drawings 1a & 12-a New Drawing 23a	8/15/12 8/29/12		Revised RMU-1 Final Cover for the installation of a permanent access road.

WASTE MANAGEMENT

CWM CHEMICAL SERVICES, LLC
1550 Balmer Road
Model City, NY 14107
(716) 286-1550
(716) 286-0211 Fax

October 15, 2012

Mr. Dennis Weiss, P.E.
Division of Environmental Permits
New York State Department of
Environmental Conservation
270 Michigan Avenue
Buffalo, New York 14203

Re: RMU-1 Permanent Access Road

Dear Mr. Weiss:

On August 15, 2012, CWM Chemical Services, LLC (CWM), Model City Facility submitted a permit modification request for the Sitewide Part 373 Permit No. 9-2934-00022/00097 to revise the design for the Residuals Management Unit No. 1 (RMU-1) landfill final cover system to include the construction of a permanent access road on the north side of the landfill. The New York State Department of Environmental Conservation (NYSDEC) issued comments for this request on August 23, 2012. On September 4, 2012, CWM submitted a revised permit modification request and on September 6, 2012 CWM submitted a temporary authorization request to construct the access road. On September 7, 2012, the NYSDEC issued conditional approval of CWM's temporary authorization request.

Construction of the access road began on September 10, 2012 and was substantially completed on September 25, 2012. During field testing the road it became apparent that the width of the road needs to be increased at the turn at the end of the north plateau in order for it to serve its intended purpose of safely providing a pull over location for trucks that could meet on the road. Attached please find a construction drawing which provides details for widening the road at the turn on the north plateau of the landfill.

If you have any questions or comments, please contact either myself at (716) 286-0246 or Mr. Jonathan Rizzo at (716) 286-0354.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to 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."

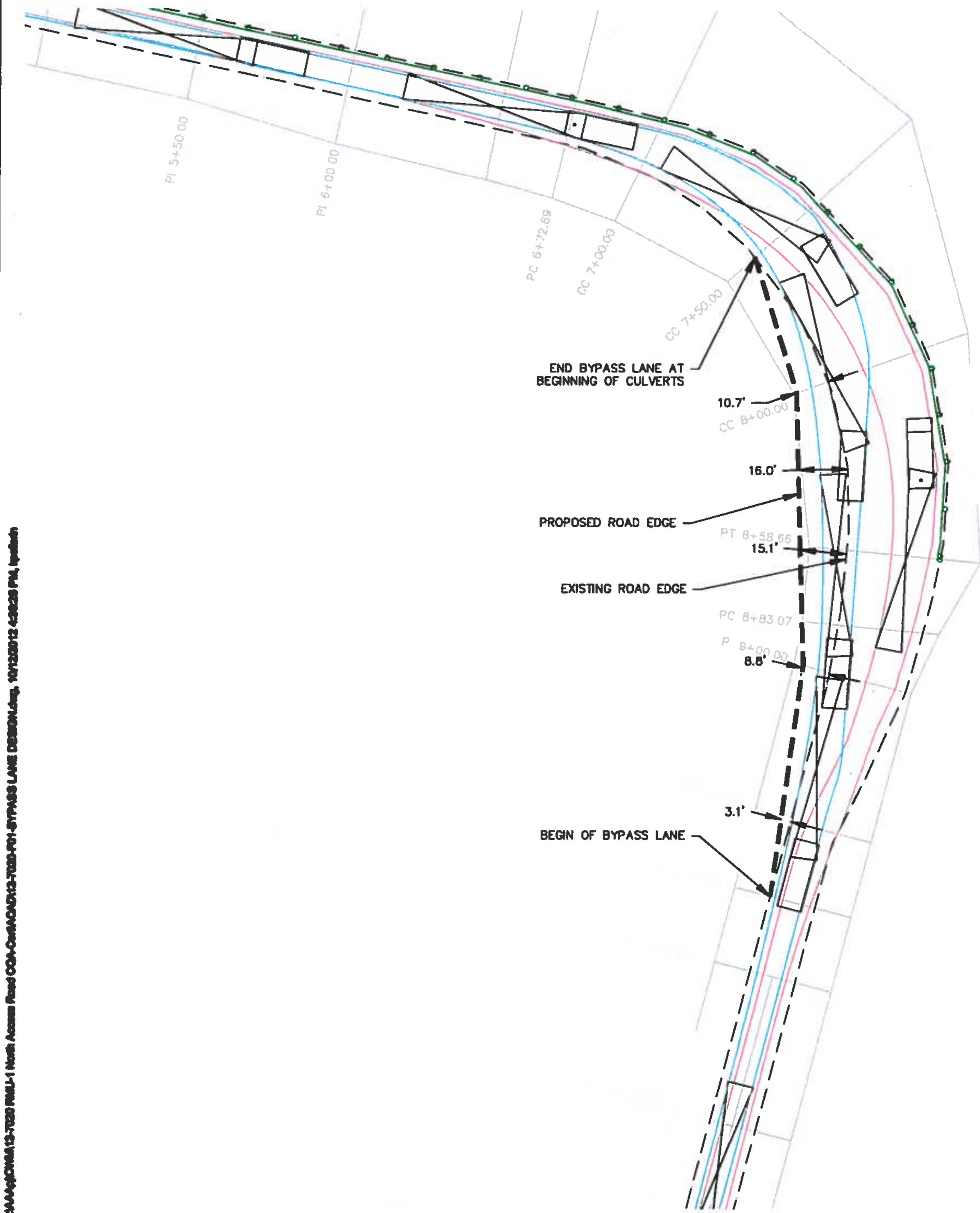
Sincerely,
CWM CHEMICAL SERVICES, LLC

Jill A. Banaszak

Jill A. Banaszak
Technical Manager
Model City Facility

JPR/JAB/jpr
Attachment

cc:	B. Rostami	- NYSDEC/Region 9
	On-site Monitors	- NYSDEC/ Model City, NY
	M. Cruden	- NYSDEC/Albany, NY
	T. Killeen	- NYSDEC/Albany, NY
	G. Burke	- NYSDEC/Albany, NY
	M. Mortefolio	- NYSDEC/Albany, NY
	P. Flax	- USEPA/Region II
	J. Devald	- NCHD/Lockport, NY
	M. Mahar	- CWM/Model City, NY
	J. Rizzo	- CWM/Model City, NY
	EMD Subject File	
	Q & A	



LEGEND:

INSERT TEXT

EXISTING ROAD EDGE

PROPOSED ROAD EDGE

EXISTING GUIDE-RAIL

IN-BOUND TRAFFIC ENVELOPE

OUT-BOUND TRAFFIC ENVELOPE

DESIGN VEHICLE PLOTTED ALONG PATH

NOTES:

1. BYPASS LANE REQUIRED TO ALLOW FOR IN-BOUND / OUT-BOUND TRUCK TRAFFIC BYPASS AT HILL CREST.
2. DESIGN VEHICLE IS WB-65 TRACTOR TRAILER WITH FOR 22.5-FT TRACTOR AND 53-FT TRAILER. TOTAL VEHICLE LENGTH 70-FT.

DESIGN VEHICLE

SCALE: 25' 0' 25' 50'

ACCESS ROAD CONSTRUCTION

CORNER SAFETY BY-PASS LANE

CWM CHEMICAL SERVICES

MODEL CITY, NY

EnSol, Inc.
Environmental Solutions
661 MAIN STREET
NIAGARA FALLS, NY 14301
PHONE (716) 285-3920
FAX (716) 285-3928

FIGURE 1

OCTOBER 2012

PN: 12-7020