LAFAYETTE
ENGINEERING COMPANY

Department of Civil and Environmental Engineering

Lafayette College

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CE473 – Senior Capstone Design II

Spring 2015

EROSION AND SEDIMENT CONTROL REPORT

Due Date: May 5, 2015

From: Julia Kripas, Michael Ryan

Group: Environmental Group

Title: Erosion and Sediment Control Report

Executive Summary:

The purpose of this report was to analyze existing and proposed conditions on designated site and their potential contributions to erosion that may occur over the course of construction. Best Management Practices and other control devices have been proposed to control any erosion that may occur during construction. These measures will remove sediment from runoff and help to stabilize the site post construction.

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1. Introduction

The following narrative and Erosion and Sediment Control Plan was prepared in accordance with the 2012 Erosion and Sediment Pollution Control Program Manual, prepared by the Pennsylvania Department of Environmental Protection. The narrative sections align with the requirements of a Standard E&S Control Plan and satisfy all items on the Technical Review Checklist.

PLAN PREPARER'S QUALIFICATIONS:

Plan Preparers: Julia Kripas, Michael Ryan

Formal Education: Lafayette College
BS Civil Engineering, 2015

Current Employer: Lafayette Engineering

2. Existing Topographic Features

All existing topographic features of the project sites and surrounding areas (including contours, 100-year flood plains, watercourses, roads, buildings, utilities, etc.) have been clearly depicted on the plan sheets provided with this narrative. A north arrow, graphic scale, and map legend are provided on the plans. A USGS 7.5-minute quadrangle Location Map, with the project area labeled, is included in Appendix A.

3. Type, Depth, Slope, Location and Limitations of the Soils

Onsite and surrounding soils were found on the Northampton County Web Soil Survey created by the United States Department of Agriculture, Natural Resources Conservation Services (NRCS). The predominant soils include:

RzF- Ryder-Rock outcrop complex 25-75 percent slopes, 65 percent Ryder and similar soils, 20 percent rock outcrop (Rickenbach Dolomite of the Beekmantown Group)

Location: On the hillslope

Limitations: moderate potential for sinkholes due to exposed dolomite, steep slopes

Ukb- Urban land, occasionally flooded 0-3 percent slopes

Location: South of the hill underlying Bushkill Drive and The Spot

Limitations: Very high runoff potential, occasional flooding

UoB- Urban land-Duffield complex 0-8 percent slopes

Location: North of the hill, on campus

Limitations: moderate potential for sinkholes in Duffield (25 percent)

Refer to Appendix B for additional characteristics of these soils.

4. Historic Land Uses and Proposed Earth Disturbance Activity/Alterations

The buildings on-site, located at the foot of College Hill at the intersection of College Avenue and Bushkill Drive, have existed since as early as 1919, though their uses have changed over the years. Many if not all of them have undergone renovation since then. The area currently known as the Spot parking lot, which will now host a landing station for the elevator, was originally constructed sometime between the years 1976 and 2003.

5. Stormwater Volume and Rate of Runoff

Refer to Appendix C for Worksheets and relevant calculations related to stormwater runoff from the project site and upstream watershed areas.

6. Receiving Waters of the Commonwealth

Runoff from the site sheds to the Bushkill Creek which discharges into the Delaware River. The Bushkill Creek is classified as a High-Quality Cold Water Fishery (HQ-CWF), Migratory Fishery (MF), according to Title 25, Chapter 93 – Water Quality Standards of the Pennsylvania Code. This classification mean Antidegradation Best Available Combination of Technologies (ABACT) control devices must be utilized.

7. Written Description of Proposed BMPs

The BMPs proposed to be utilized on this project include:

7.1 Rock Construction Entrance

A rock construction entrance is necessary wherever it is anticipated that vehicles associated with construction will be exiting the project site onto any roadway and access should be limited to this entrance.

Rock construction entrances are proposed along the western side of Bushkill Drive as the main entrance to the side, as well as at the entrance to the staging area next to Ruef Hall on Lafayette College's Campus. This entrance is accessible only through a stone access road.

7.2 Compost Filter Socks

Compost filter socks are an ABACT sediment removal device that contain varied compost material, chosen for certain properties, within a biodegradeable or photodegradeable mesh tube.

Compost filter socks are proposed along the downslope perimeter of disturbed areas that are not otherwise treated by a different BMP. They will also surround any stockpile of soil. Socks should be installed along the contour in every case possible. Additional information on the design of the compost filter socks is provided in Appendix D.

7.3 Temporary Barriers

To protect pier foundation drill holes while soil is exposed, temporary flood barriers shall be installed to divert water away from construction areas and reduce contact with disturbed soil. HydroSnake sandless sandbags provide an environmentally-friendly alternative to conventional sandbag barrier diversion systems. They will be installed upslope of the drilling area on the hill slope. After use, bags can be slit

open and their contents can be released into the soil to enhance plant and vegetation growth. Additional information on Hydrosnake is provided in Appendix D.

7.4 Vegetative Stabilization

All disturbed areas that have significant potential for erosion should be stabilized with vegetation. Temporary erosion control BMPs will include temporary seed mixtures, predominantly annual grasses or erosion blankets. Critical erosion areas or those within 5 feet of a surface water should be blanketed with a basic erosion control blanket (DS 75) found in Appendix D. Temporary erosion control BMPs installed must remain in place and maintained until permanent stabilization is achieved. Once construction in an area is complete, permanent seed mixtures, such as perennial species should be planted, or the area should be mulched until planting can occur. An area will not be considered stabilized until the area has a minimum of 70% uniform vegetative cover. Additional information on vegetation and DS 75 is provided in Appendix D.

7.5 Steep Slope Stabilization

Disturbed areas where vegetative cover is difficult and are risk for long term erosion should be stabilized with long term biodegradable erosion control blanket. The main area requiring these mats are beneath the inclined elevator structure, which will is shaded and has steep slopes. Permanent vegetation specified for steep slopes should be planted under the matting. The mat should extend beyond the width of the structure to protect the soil from roof runoff. Biodegradable erosion control blanket specifications (S150 BN) is provided in Appendix D.

8. Sequence of Construction

All earth disturbance activities shall proceed in accordance with the following sequence. Each stage shall be completed before any following stage is initiated. Clearing and grubbing shall be limited only to those areas described in each stage.

At least seven days prior to starting any earth disturbance activities, the operator shall invite all contractors involved in those activities, the landowner, all appropriate municipal officials, the erosion and sediment control plan preparer, and the governing conservation district to an onsite preconstruction meeting.

1. Create stone access road to Marquis landing

2. Install rock construction entrances (RCE's) on stone access road and on western entrance of Bushkill Drive and temporary barriers to restrict access to the eastern entrance of Bushkill Drive. Establish temporary topsoil stockpile.

3. Demolish existing site features.

4. While maintaining perimeter BMP's and limiting disturbance to the greatest extent possible, perform site work and install onsite improvements to include building foundations, access ways and parking facilities, buildings, utility extensions, and storm sewer facilities. Storm sewer facilities shall be installed after matting is secured and soil is stabilized.

5. Before drilling column foundation on slopes, install temporary diversion BMP's. First a compost filter sock will be installed downslope of the work area. Then a Hydrosnake will be placed upslope of the work area.

6. After drilling and construction of column foundations had been completed, the Hydrosnake can be cut open. Permanent vegetation shall be planted utilizing the contents of the Hydrosnake and BN 150 Erosion Control Matting installed over top. Compost filter socks may be removed after matting is secured and soil is stabilized.

7. Upon stabilization of all disturbed areas, contact the governing conservation district prior to removing any sediment control devices. Temporary perimeter sediment control devices may be removed only after permanent stabilization of minimum 70% perennial vegetative cover with a density capable of resisting accelerated uniform and sedimentation has been achieved.

8. With Conservation District approval, remove REC's and clean stockpile/staging area. Areas disturbed as part of BMP removal shall be immediately stabilized upon removal.

9. Supporting Calculations and Measurements

Supporting Calculations and Measurements are provided and listed as part of Appendices C and D.

10. Plan Drawings

Plan drawings are provided with this report.

11. Maintenance Program

Until the site is stabilized, all E&S controls must be maintained properly by the permittee. Maintenance must include inspection of all E&S controls after each runoff event and on a weekly basis. All maintenance work, including clean-out of sediment, repair, replacement, reseeding, remulching and renetting must be performed immediately.

Access should be provided for sediment removal and other required maintenance activities. Any sediment removed from E&S controls shall be disposed of in proper areas as landscaping and shall be immediately stabilized or placed in topsoil stockpiles.
Upon completion or temporary interruption of the earth disturbance activities, the site shall be immediately stabilized.

Excess topsoil from the site shall be temporarily stockpiled at locations shown on the plans. Any topsoil not used on the site should be used elsewhere or properly disposed of. Transportation of the topsoil should be kept to a minimum. The sediment barrier around the stockpile shall remain intact with minimum opening for access as long as topsoil remains stockpiled.

Temporary controls may be removed only after permanent stabilization with a minimum uniform 70% perennial vegetative cover has been achieved across the upslope areas. The Northampton Conservation District must be contacted prior to removal.

12. Recycling and Disposal of Construction Wastes

Construction materials will be recycled when at all possible, or disposed of in areas suited for such wastes as outlined by PA DEP regulations. If approved by engineers, material such as fill and soil shall be re-used for grading on site where applicable; excess materials will be disposed. Removed materials shall be stored and disposed of in landscaped areas outside of steep slopes, wetlands, floodplains, and other areas which may adversely impact water quality.

13. Impacts of Naturally Occurring Geologic Formations

There are no known or documented naturally-occurring geologic formations at risk of being affected within the proposed areas of disturbance. However, it should be noted that the site lies in the Rickenbach Formation, whose beds consist mainly of laminated dolomite and impure limestone.

Carbonate geology is prone to sinkholes and solution-enhanced porosity, which can create subsurface conduits that speed up or otherwise route the movement of water.

14. Thermal Impacts

Little impact is anticipated to runoff on site to change it from current conditions. The majority of collected areas are under cover through the pipe under the proposed inclined elevator structure, so thermal impacts are anticipated to be minimal to non-existent.

15. E&S Plan and PCSM Plan Consistency

This E&S Plan is consistent with the proposed PCSM Plan.

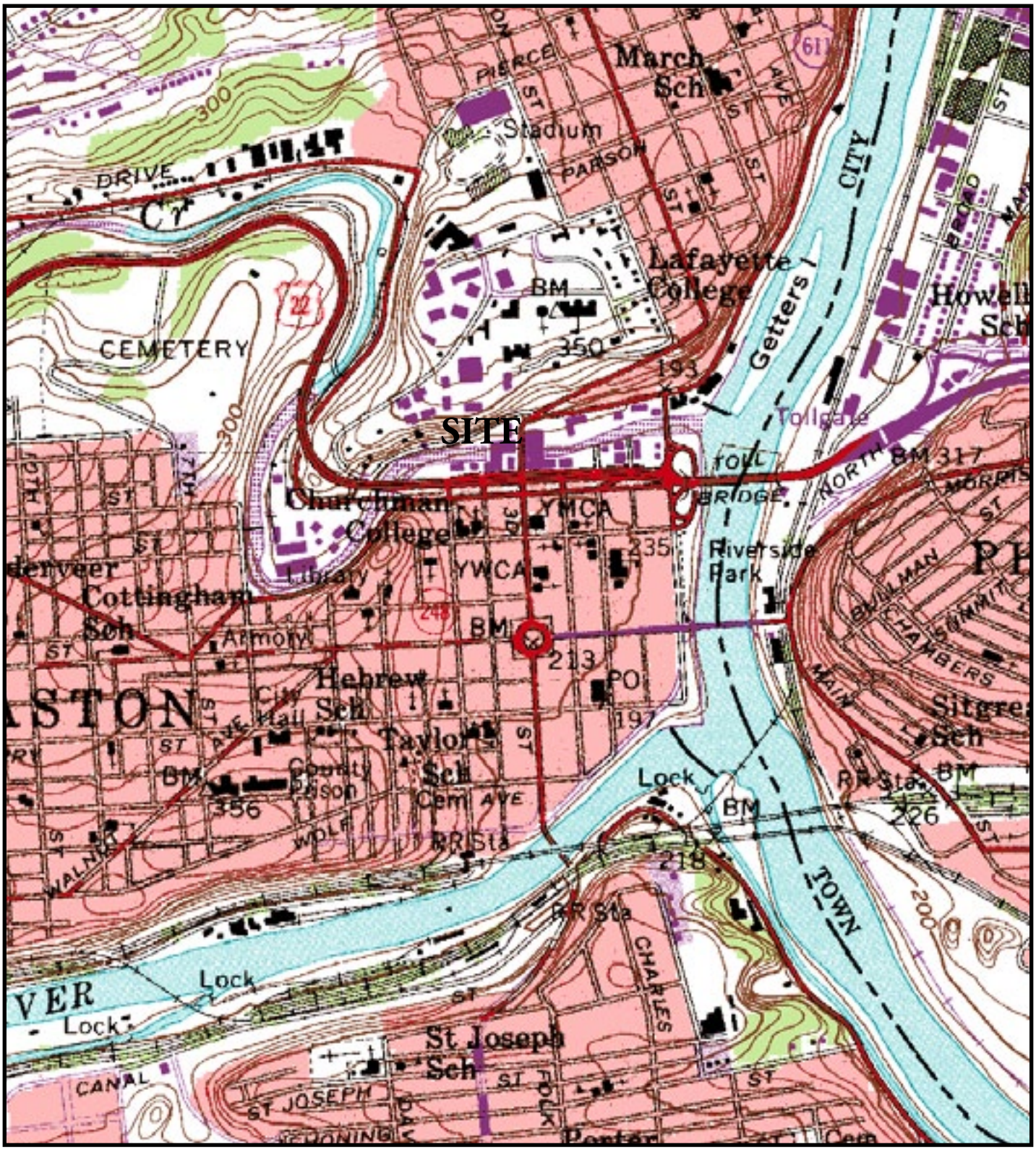
16. Existing and Proposed Riparian Forest Buffers

No riparian forest buffers have been found within the area of interest.

Appendix A

Maps

Current USGS Topographic Map

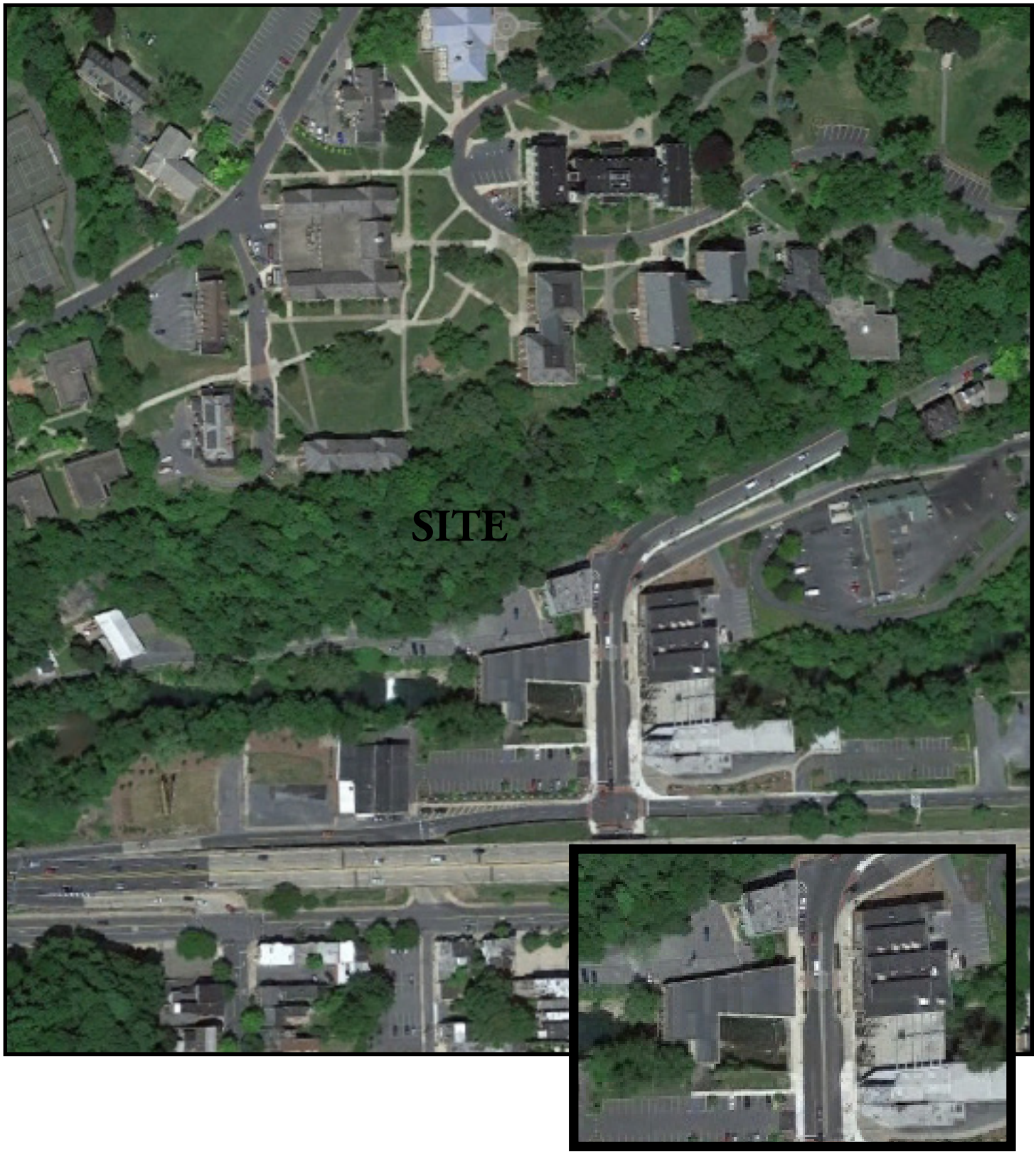


LAFAYETTE ENGINEERING COMPANY

Site Location: College Ave. & Bushkill Dr.
Site Owner: Lafayette College
City, St, ZIP: Easton, PA 18042
Date: October 8, 2014

N

Current Aerial Photograph of Easton, PA



LAFAYETTE
ENGINEERING COMPANY

Site Location: College Ave. & Bushkill Dr.
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Date: October 8, 2014

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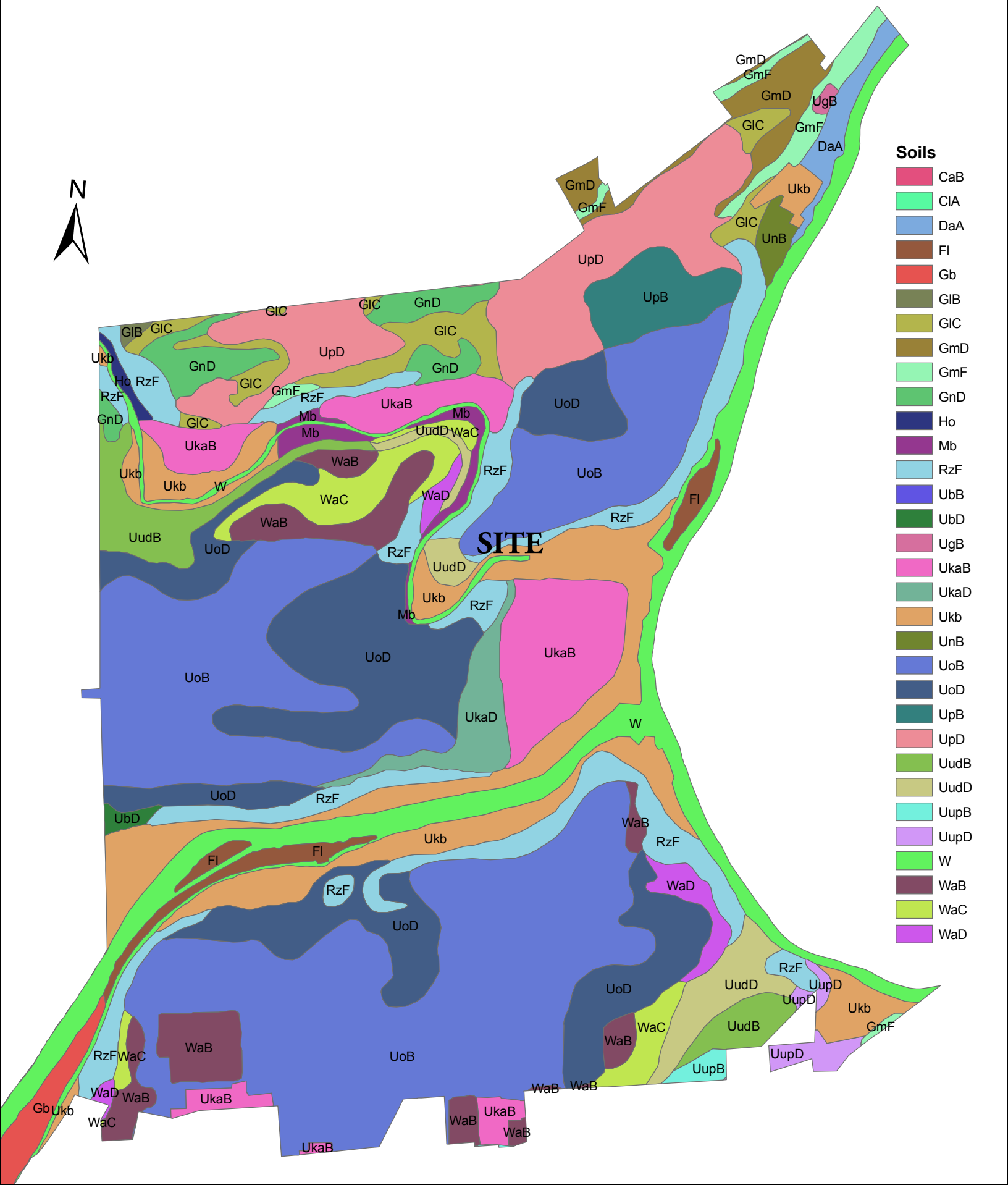
Soils in the City of Easton



City of Easton

NORTHAMPTON COUNTY, PENNSYLVANIA

BEDROCK

Legend

Streets

Waterways

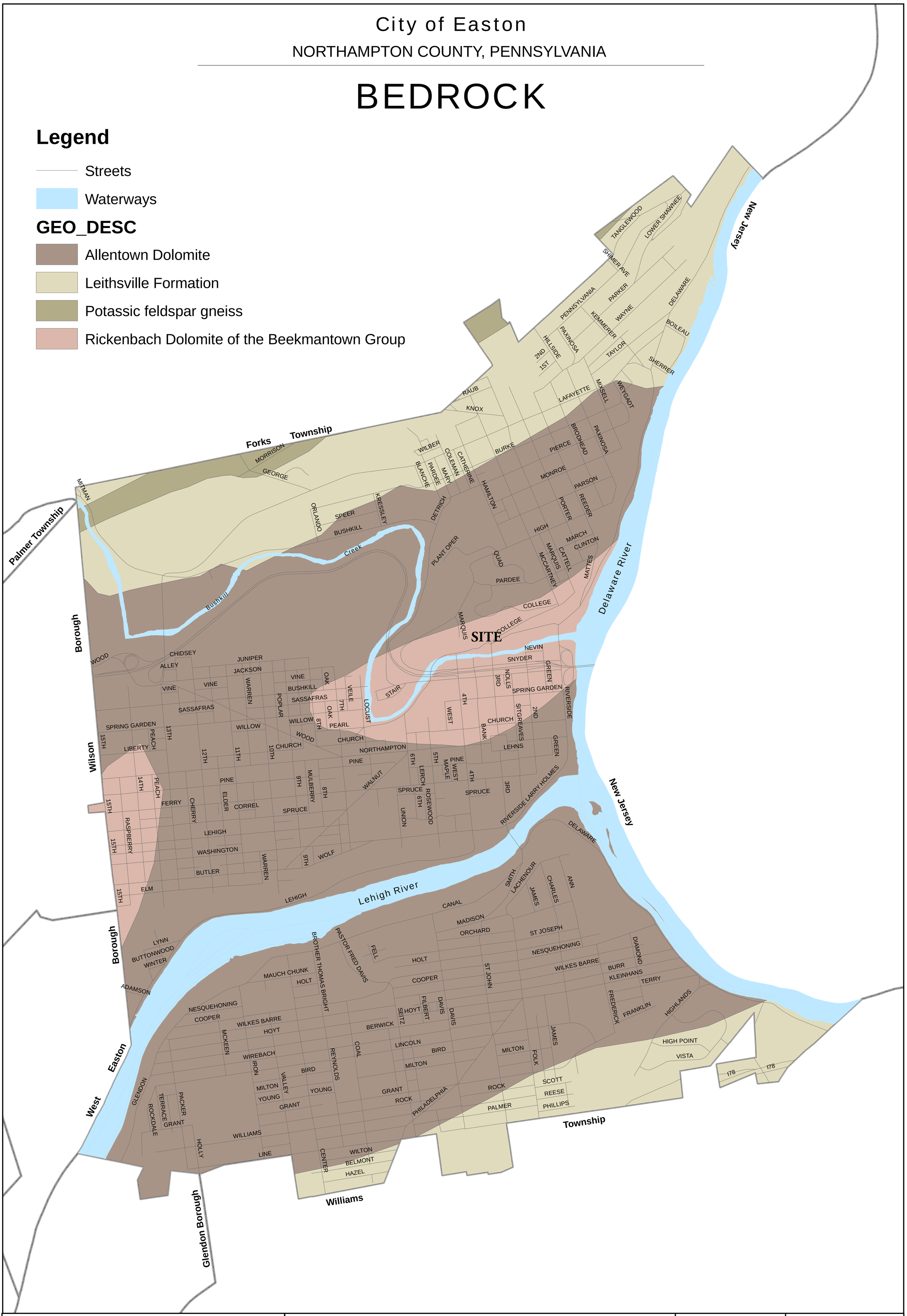
GEO_DESC

Allentown Dolomite

Leithsville Formation

Potassic feldspar gneiss

Rickenbach Dolomite of the Beekmantown Group



CITY OF EASTON

Alpha Building, One South Third Street
Easton, Pennsylvania 18042
Telephone: (610) 250-6600
Website: http://www.easton-pa.gov

0 650 1,300 2,600 3,900 5,200 Feet

1 inch equals 692.945754 feet

Map Date:
November 24, 2008

Map By:
Department of Planning & Codes
City of Easton

N
W E
S

Appendix B

NRCS Soil Information

Northampton County, Pennsylvania

RzF—Ryder-Rock outcrop complex, 25 to 75 percent slopes

Map Unit Setting

National map unit symbol: l7cn
Elevation: 300 to 1,000 feet
Mean annual precipitation: 36 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Ryder and similar soils: 65 percent
Rock outcrop: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ryder

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Residuum weathered from shaly limestone

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 24 inches: channery silt loam
C - 24 to 34 inches: very channery silt loam
R - 34 to 44 inches: bedrock

Properties and qualities

Slope: 25 to 75 percent
Depth to restrictive feature: 24 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.1 inches)

Description of Rock Outcrop

Setting

Landform: Valley sides
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Linear, convex

Across-slope shape: Linear, convex
Parent material: Bedrock exposures

Typical profile

R - 0 to 0 inches: bedrock

Properties and qualities

Slope: 25 to 75 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat):
Moderately low to high (0.06 to 6.00 in/hr)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Data Source Information

Soil Survey Area: Northampton County, Pennsylvania
Survey Area Data: Version 5, Sep 22, 2014

Northampton County, Pennsylvania

Ukb—Urban land, occasionally flooded

Map Unit Setting

National map unit symbol: 23f25
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 48 to 57 degrees F
Frost-free period: 161 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land, occasionally flooded: 99 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land, Occasionally Flooded

Setting

Landform: Flood plains
Parent material: Pavement, buildings and other artifically covered areas

Typical profile

C - 0 to 6 inches: variable

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 10 to 98 inches to lithic bedrock
Natural drainage class: Excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Frequency of flooding: Occasional
Available water storage in profile: Very low (about 0.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Data Source Information

Soil Survey Area: Northampton County, Pennsylvania
Survey Area Data: Version 5, Sep 22, 2014

Northampton County, Pennsylvania

UoB—Urban land-Duffield complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 23f21
Elevation: 200 to 1,500 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 44 to 57 degrees F
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 65 percent
Duffield and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Pavement, buildings and other artifically covered areas

Typical profile

C - 0 to 6 inches: variable

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 to 100 inches to lithic bedrock
Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Description of Duffield

Setting

Landform: Valleys
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from limestone

Typical profile

Ap - 0 to 10 inches: silt loam
Bt - 10 to 53 inches: silty clay loam

C - 53 to 72 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 48 to 120 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Minor Components

Clarksburg

Percent of map unit: 4 percent
Landform: Valley flats
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave

Penlaw

Percent of map unit: 4 percent
Landform: Swales
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

Thorndale

Percent of map unit: 2 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear, concave

Data Source Information

Soil Survey Area: Northampton County, Pennsylvania
Survey Area Data: Version 5, Sep 22, 2014

Appendix C

Runoff Calculations

STANDARD E&S WORKSHEET # 9

Time of Concentration

PROJECT NAME: Lafayette College Incline Elevator

LOCATION: Easton, Pa

PREPARED BY: Julia Kripas Date: 2/20/2015

CHECKED BY: Michael Ryan Date: 2/21/2015

OVERLAND FLOW:

PATH NUMBER	LENGTH L (FT)	"n" VALUE	AVERAGE SLOPE (S) (ft/ft)	TIME (minutes)
1	107.36	0.4	0.102	8.165
2	32.24	0.02	0.031	1.517

SHALLOW CONCENTRATED FLOW:

PATH NUMBER	LENGTH (FT)	TYPE OF COVER	SLOPE(S) (ft/ft)	V (ft/sec)	TIME (minutes)
1	143.29	0.14	0.105	2.5	0.016
2	45.66	0.14	0.307	3	0.004
3	165.76	0.14	0.724	10	0.005

STANDARD E&S WORKSHEET # 10

Time of Concentration

PROJECT NAME: Lafayette College Incline Elevator

LOCATION: Easton, Pa

PREPARED BY: Julia Kripas Date: 2/20/2015

CHECKED BY: Michael Ryan Date: 2/21/2015

DETERMINE WATERSHED "C" VALUE

CHANNEL NUMBER	DRAINAGE AREA NUMBER	TYPE OF COVER	C VALUE	AREA (acres)	C X A	Cw
1	1	Imp Area	0.72	0.134	0.097	0.237
	2	Grass Area	0.14	0.668	0.094	

DETERMINE RAINFALL INTENSITY

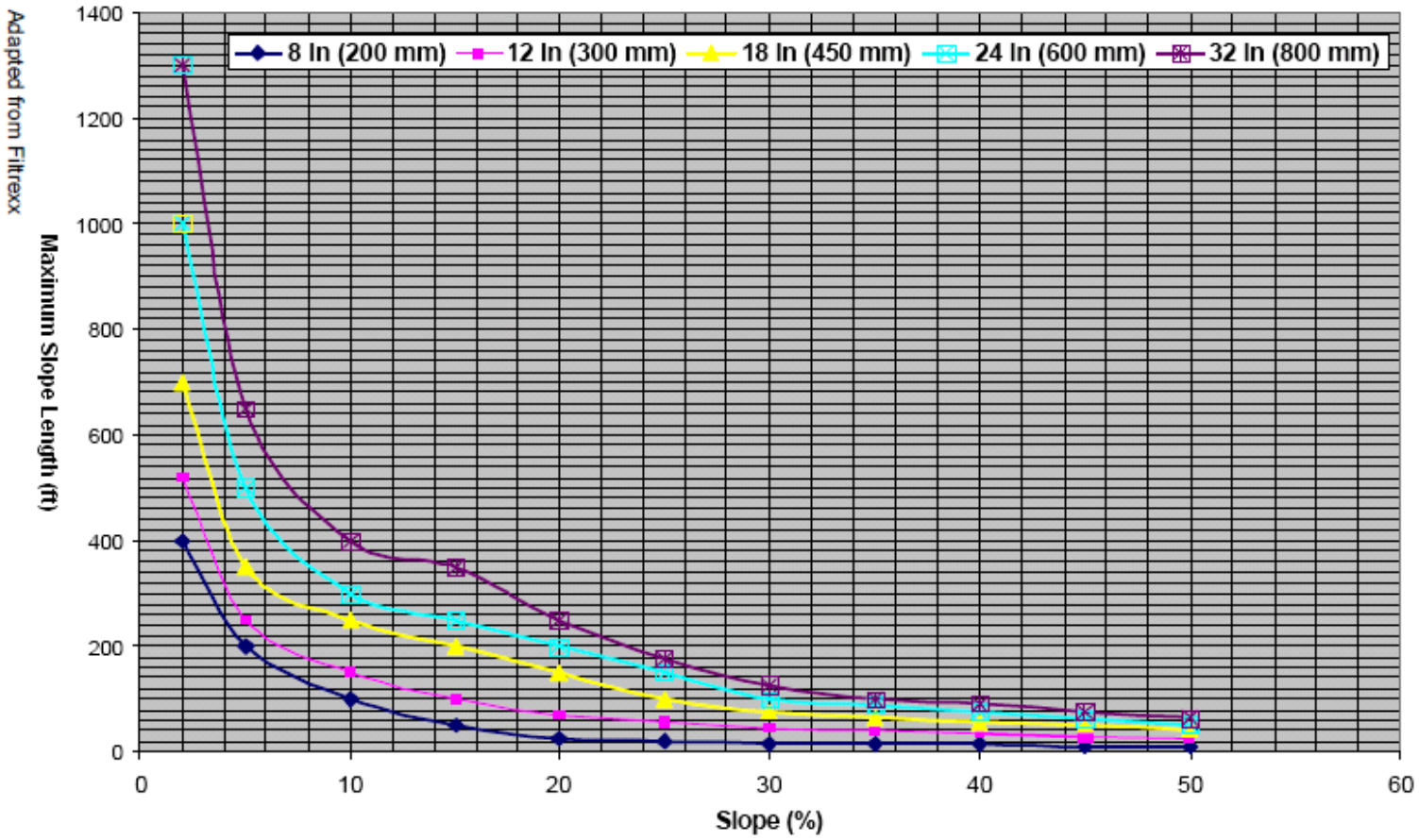
CHANNEL NUMBER	Tc	R2	R10	I2	I10
1	9.707	-	-	3.96898695	5.19765347

DETERMINE PEAK RUNOFF RATES (Q = C I A)

CHANNEL NUMBER	C VALUE	I (in/hr)	A (acres)	Q2 (cfs)	Q10 (cfs)
1	0.237		0.803	0.75450296	0.98807202
					`

Appendix D

BMP Details/Calculations



Adapted from Filtrexx

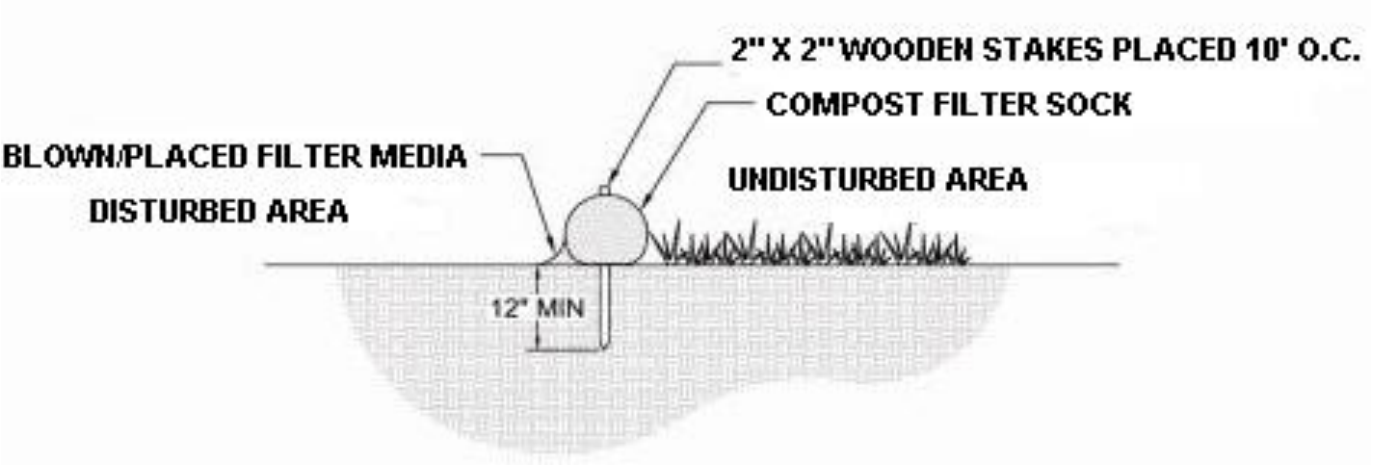
FIGURE 4.2
MAXIMUM PERMISSIBLE SLOPE LENGTH ABOVE COMPOST FILTER SOCKS

NOTE: 8" diameter socks should only be used to control small (≤ ¼ acre) disturbed areas on individual house lots).

From PA DEP's Erosion and Sediment Control Manual

STANDARD E&S WORKSHEET #1
Compost Filter Socks

PROJECT NAME: LAFAYETTE COLLEGE INCLINED ELEVATOR
LOCATION: LAFAYETTE COLLEGE, EASTON PA
PREPARED BY: JMK DATE: 4/19/2015
CHECKED BY: MR DATE: 4/19/2015



SOCK NO.	Dia. In.	LOCATION	SLOPE PERCENT	SLOPE LENGTH ABOVE BARRIER (FT)
12-1	12	SEE PLAN	10.0	50
12-2	12	SEE PLAN	11.0	105
12-3	12	SEE PLAN	50.0	20
18-1	18	SEE PLAN	15.0	180
18-2	18	SEE PLAN	15.0	200
18-3	18	SEE PLAN	5.5	350

HYDROSNAKE©

The HydroSnake© is the solution to the deficiencies of the sandbag that have frustrated users for hundreds of years.

The HydroSnake© is the new modern method to create a highly effective barrier to the threat of flood water in domestic and commercial properties. Before use the HydroSnake© is light, flat, simple to store and easy to handle.

Once in contact with water it quickly expands and miraculously absorbs up to 20 litres of water weighing approx 20 kilos. Placing the HydroSnake© in areas where there is water leakage will limit the danger of flooding. The HydroSnake© is ideal for door protection, warehouse and garage doors and machinery. HydroSnakes can be stacked or folded according to the protection required.

HydroSnakes are safe and eco friendly. They contain pulp and super absorbent polymer (SAP) as used in diapers. They will retain their bulk for up to three months.

HydroSnake© under test

To dispose of used HydroSnakes simply slit them and release the contents into the earth. (SAP is often used to enhance the growth of plants). HydroSnakes are produced in the UK by Gravitas International Ltd.

Sandbags were first developed by the Egyptians thousands of years ago and little development has been seen until now. The labour used to fill them was cheap and inexhaustible. The modern sandbag is labour intensive to produce and expensive to transport which is often not recognised as an extra cost. Furthermore sand does not resist water which will eventually penetrate through the hessian outer, leaving all the toxic elements that it has gathered within the bag. This cannot be released into the earth or landfill without causing contamination.

HydroSnakes absorbs, resist and can be released into the earth after use without any dangerous consequences.

The HydroSack© and HydroSnake© are an eco friendly solution.

Gravitas International Ltd

HydroSnake© is manufactured in the UK exclusively by:

Gravitas International Ltd
Wykeham House, Alan Drive, Hale,
Cheshire WA15 0LR

Tel: +44 (0)161 980 1016
Email : sallon@gravitasint.com

HydroSnake Technical Detail

Length:	145cm
Width:	25cm
Absorption:	15-20 litres
Inflation time:	2-3 minutes
Weight before:	0.5 kilos
Weight after:	15-20 kilos
Outer fabric:	Non Woven Polypropylene Hydrophilic finish
Internal Pads:	Pads x9 per/sack Super Absorbent Polymer (SAP) Pulp
Non Toxic, ECO friendly	
Flood Water Depth:	5cm of water per/snake
Flood Water Length:	140cm per/snake

ROLLMAX™
ROLLED EROSION CONTROL

Specification Sheet – BioNet® S150BN™ Erosion Control Blanket

DESCRIPTION

The short-term double net erosion control blanket shall be a machine-produced mat of 100% agricultural straw with a functional longevity of up to 12 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location and elevation). The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with a 100% biodegradable woven natural fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 0.50 x 1.0 in. (1.27 x 2.54 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The S150BN shall meet Type 2.D specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content		
Matrix	100% Straw Fiber	0.5 lbs/sq yd (0.27 kg/sm)
Netting	Top: Leno woven 100% biodegradable organic jute Bottom: 100% biodegradable organic jute	9.35 lb/1000 sq ft (4.5 kg/100 sm) 7.7 lb/1000 sq ft (3.76 kg/100 sm)
Thread	Degradable	

Standard Roll Sizes			
Width	6.67 ft (2.03 m)	8.0 ft (2.4 m)	15.5 ft (4.72 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	90 ft (27.43 m)
Weight ± 10%	52.22 lbs (23.69 kg)	65.28 lbs (29.61 kg)	101.2 lbs (45.9 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	155 sq yd (129.6 sm)
	Leno weave top only	Leno top and bottom	Leno top and bottom

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.23 in. (5.84 mm)
Resiliency	ECTC Guidelines	80.5%
Water Absorbency	ASTM D1117	428%
Mass/Unit Area	ASTM D6475	8.71 oz/sy (296 g/sm)
Swell	ECTC Guidelines	15%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	6.23 oz-in
Light Penetration	ASTM D6567	15.3%
Tensile Strength - MD	ASTM D6818	188.4 lbs/ft (2.79 kN/m)
Elongation - MD	ASTM D6818	11.2%
Tensile Strength - TD	ASTM D6818	157.2 lbs/ft (2.33 kN/m)
Elongation - TD	ASTM D6818	13.5%
Biomass Improvement	ASTM D7322	549%

Design Permissible Shear Stress	
Unvegetated Shear Stress	1.85 psf (88 Pa)
Unvegetated Velocity	6.00 fps (1.83 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.00014	0.039	N/A
20-50 ft	0.01	0.070	N/A
≥ 50 ft (15.2 m)	0.02	0.100	N/A

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.055
0.50 – 2.0 ft	0.055-0.021
≥ 2.0 ft (0.60 m)	0.021

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NORTH AMERICAN GREEN®

Tensar International Corporation
2500 Northwinds Parkway
Suite 500
Alpharetta, GA 30009
800-TENSAR-1
tensarcorp.com

Tensar International Corporation
5401 St. Wendel-Cynthiana Road
Poseyville, Indiana 47633
Tel. 800.772.2040
Fax 812.867.0247
www.nagreen.com

Erosion Control Materials Design Software
Version 5.0

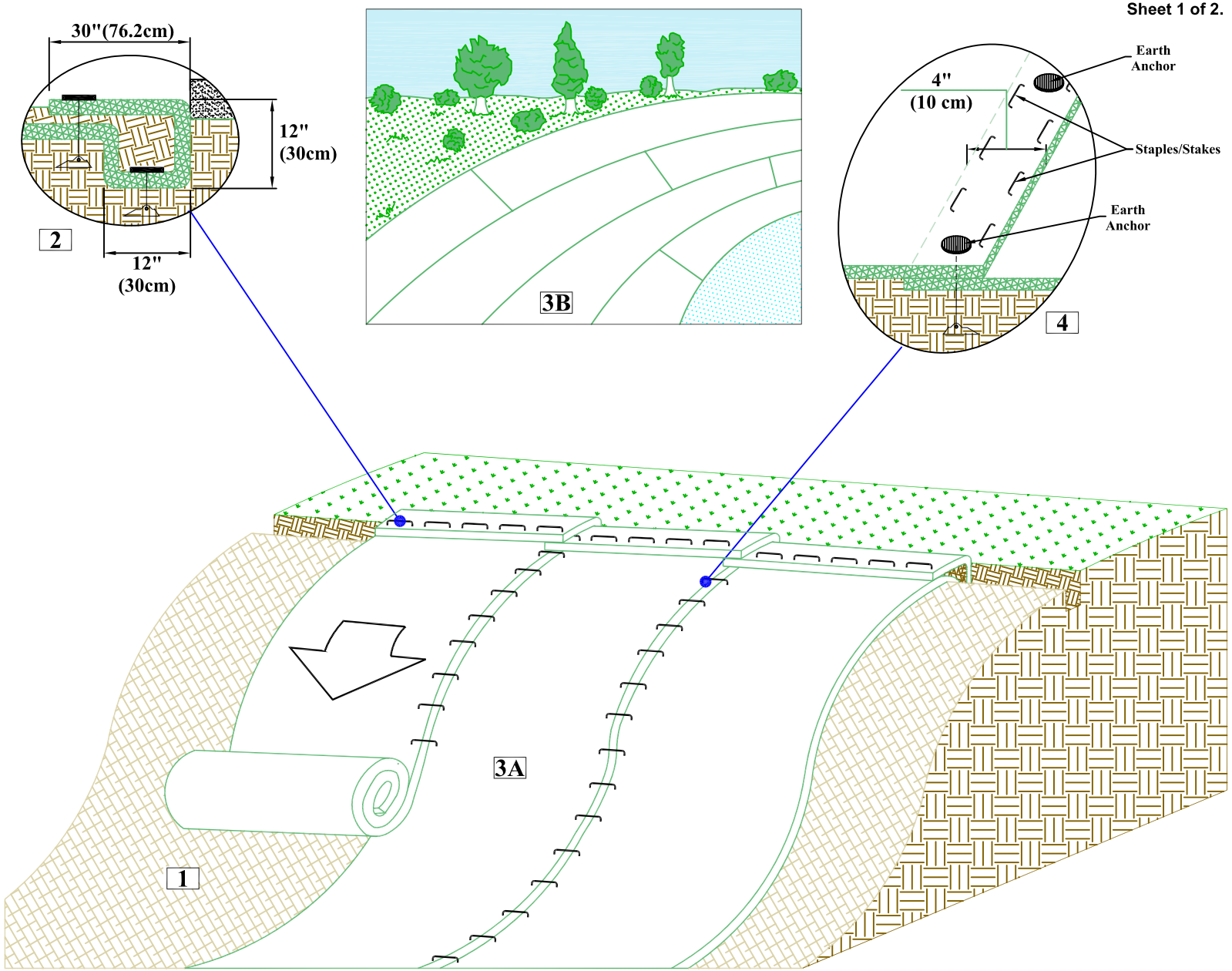
Project Name: Lafayette College Inclined Elevator
Project Number: 61393
Project Location: Easton, Pennsylvania
Slope Name: Hill

Country	United States
State/Region	Pennsylvania
City	Philadelphia
Annual R Factor	150
Adjusted R Factor	150
Total Slope Length	10
Protection Type	Permanent
Protection Period	12
Beginning Month	September
Slope Gradient (H:1)	1.56
Soil Type	Silt Loam
K Factor	0.330

Reach 1
Start: 0ft End: 10ft
Vegetation Type: Bunch Type(50-75%)

Material	ASL bare	ASL mat	MSL bare	MSL mat	Soil Loss Tolerance	SF	Remarks	Staple / App Rate
C125BN	0.677 in	0.034 in	0.735 in	0.037 in	0.25 in	6.803	STABLE	C
Estb. Veg.	1.048 in	0.105 in	0 in	0 in	0.03 in	0.286	UNSTABLE	--
S150BN	0.677 in	0.058 in	0.735 in	0.063 in	0.25 in	3.955	STABLE	C
S75BN	0.677 in	0.156 in	0.735 in	0.169 in	0.25 in	1.479	STABLE	C
SC150BN	0.677 in	0.043 in	0.735 in	0.046 in	0.25 in	5.399	STABLE	C

SLOPE INSTALLATION EARTH ANCHOR (EA) DETAIL



1. Prepare soil before installing high-performance turf reinforcement mats (HP-TRMs), including any necessary application of lime, fertilizer, and seed.
2. Begin at the top of the slope by anchoring the HP-TRMs in a 12” (30 cm) deep x 12” (30cm) wide trench with approximately 30” (76.2 cm) of HP-TRMs extended beyond the up-slope portion of the trench. Anchor the HP-TRMs with an alternating row of staples and anchors approximately 30” (76.2 cm) apart in the bottom of the trench. Backfill and compact the trench after stapling. Fold remaining 30” (76.2 cm) portion of HP-TRMs back over compacted soil. Secure HP-TRMs over compacted soil with an alternating row of staples/anchors spaced approximately 18" (45 cm) apart across the width of the HP-TRMs.
3. Roll the HP-TRMs (A) down or (B) horizontally across the slope. HP-TRMs will unroll with appropriate side against the soil surface. All HP-TRMs must be securely fastened to soil surface by placing staples/anchors in appropriate locations as shown in the staple pattern guide.
4. The edges of parallel HP-TRMs must be stapled between earth anchors with approximately 4" (10 cm) overlap depending on the HP-TRM type. For curved sections, adjust the overlap edges of parallel HP-TRMs accordingly with a minimum of 4" (10 cm) overlap to accommodate transitional segments.

Drawing Not To Scale

*NOTE:
In loose soil conditions, the use of staple or stake lengths greater than 6"(15cm) may be necessary to properly secure the HP-TRMs.

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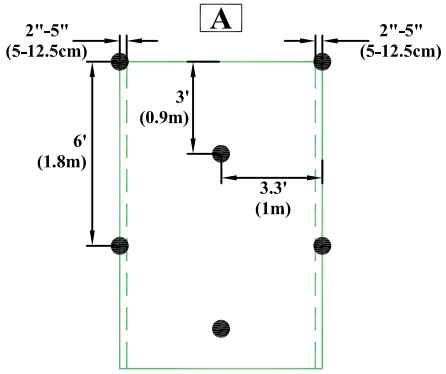
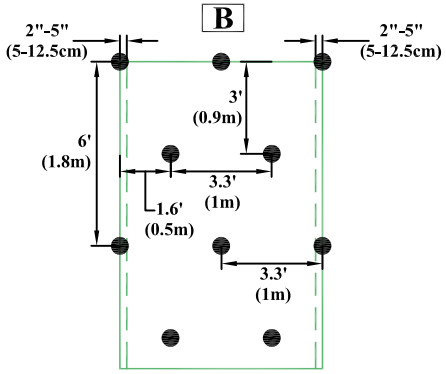
Drawn on: 01-28-13

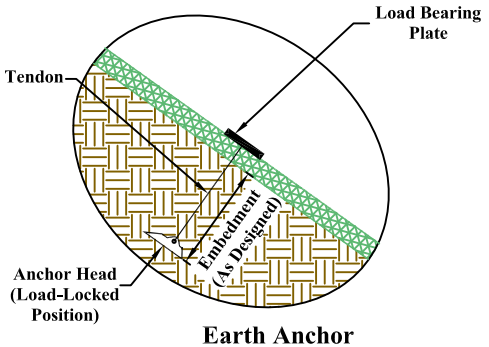
SLOPE INSTALLATION EARTH ANCHOR (EA) DETAIL



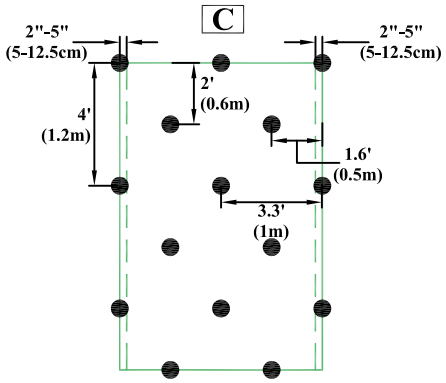
0.7 Anchors per SQ.YD.
(0.8 Anchors per SQ. M.)



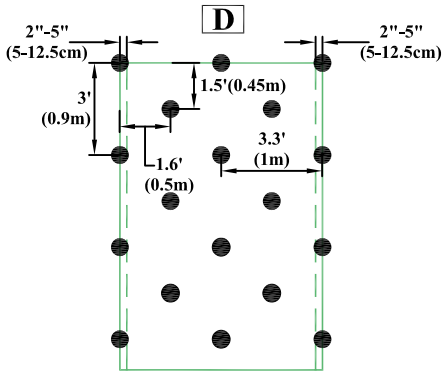
1.15 Anchors per SQ.YD.
(1.35 Anchors per SQ. M.)



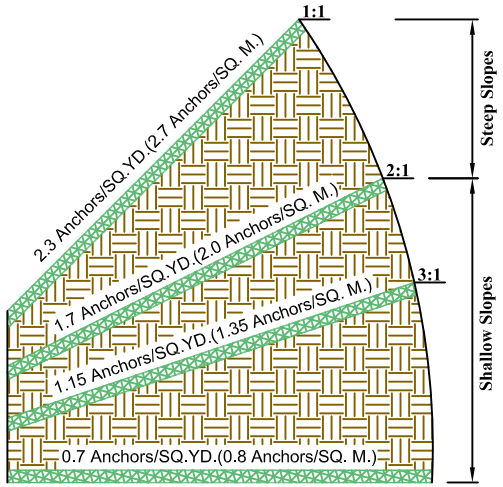
Earth Anchor Detail



1.7 Anchors per SQ.YD.
(2.0 Anchors per SQ. M.)



2.3 Anchors per SQ.YD.
(2.7 Anchors per SQ. M.)



Channel & Shoreline Slopes

NOTES:

* The performance of ground anchoring devices is highly dependent on numerous site/project specific variables. It is the sole responsibility of the project engineer and/or contractor to select the appropriate anchor type and length. Anchoring shall be selected to hold the mat in intimate contact with the soil subgrade and resist pullout in accordance with the project's design intent.
* Anchor Pattern Guide can vary based on earth anchor and blanket selection.
* If desired, the system can be soil-filled and sodded after TRM installation. Sod should be staples/staked according to plan specifications.

CRITICAL POINTS

A. Overlaps and Seams
B. Projected Water Line
C. Channel Bottom/Side Slope Vertices

Drawing Not To Scale

1. Prepare soil before installing high-performance turf reinforcement mats (HP-TRMs), including any necessary application of lime, fertilizer, and seed.
2. Begin at the top of the slope by anchoring the HP-TRMs in a 6" (15 cm) deep x 6" (15cm) wide trench with approximately 12" (30 cm) of HP-TRMs extended beyond the up-slope portion of the trench. Anchor the HP-TRMs with a row of staples and anchors approximately 12" (30 cm) apart in the bottom of the trench. Backfill and compact the trench after stapling. Apply seed to compacted soil and fold remaining 12" (30 cm) portion of HP-TRMs back over seed and compacted soil. Secure HP-TRMs over compacted soil with a row of staples/stakes spaced approximately 12" (30 cm) apart across the width of the HP-TRMs.
3. Roll the HP-TRMs (A) down or (B) horizontally across the slope. HP-TRMs will unroll with appropriate side against the soil surface. All HP-TRMs must be securely fastened to soil surface by placing staples/stakes in appropriate locations as shown in the staple pattern guide.
4. The edges of parallel HP-TRMs must be stapled with approximately 2" - 5" (5-12.5cm) overlap depending on the HP-TRM type.
5. Consecutive HP-TRMs spliced down the slope must be end over end (Shingle style) with an approximate 3"(7.5cm) overlap. Staple through overlapped area, approximately 12"(30cm) apart across entire HP-TRM width.

*NOTE:
In loose soil conditions, the use of staple or stake lengths greater than 6"(15cm) may be necessary to properly secure the HP-TRMs.

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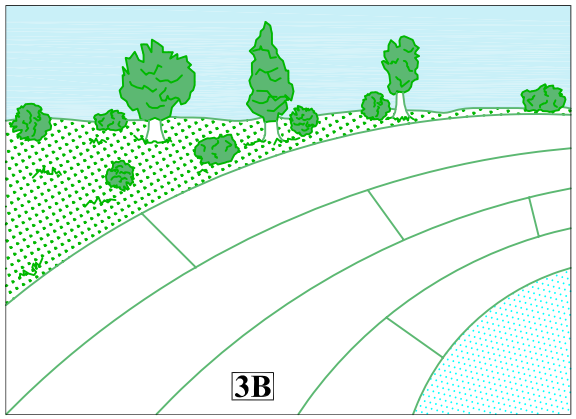
SLOPE INSTALLATION DETAIL



Drawing Not To Scale

1. Prepare soil before installing rolled erosion control products (RECPs), including any necessary application of lime, fertilizer, and seed.
2. Begin at the top of the slope by anchoring the RECPs in a 6"(15cm) deep X 6"(15cm) wide trench with approximately 12" (30cm) of RECPs extended beyond the up-slope portion of the trench. Anchor the RECPs with a row of staples/stakes approximately 12" (30cm) apart in the bottom of the trench. Backfill and compact the trench after stapling. Apply seed to the compacted soil and fold the remaining 12"(30cm) portion of RECPs back over the seed and compacted soil. Secure RECPs over compacted soil with a row of staples/stakes spaced approximately 12"(30cm) apart across the width of the RECPs.
3. Roll the RECPs (A) down or (B) horizontally across the slope. RECPs will unroll with appropriate side against the soil surface. All RECPs must be securely fastened to soil surface by placing staples/stakes in appropriate locations as shown in the staple pattern guide.
4. The edges of parallel RECPs must be stapled with approximately 2" - 5" (5-12.5cm) overlap depending on the RECPs type.
5. Consecutive RECPs spliced down the slope must be end over end (Shingle style) with an approximate 3"(7.5cm) overlap. Staple through overlapped area, approximately 12"(30cm) apart across entire RECPs width.

*NOTE:
In loose soil conditions, the use of staple or stake lengths greater than 6"(15cm) may be necessary to properly secure the RECP's.

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Drawn on: 3-16-11

STANDARD E&S WORKSHEET # 21
Temporary and Permanent Vegetative Stabilization Specifications

PROJECT NAME: **LAFAYETTE COLLEGE INCLINED ELEVATOR**
LOCATION: **LAFAYETTE COLLEGE EASTON PA**
PREPARED BY: **JMK** DATE: **4/19/2015**
CHECKED BY: **MR** DATE: **4/19/2015**

SPECIFICATIONS: The Department recommends the use of the Penn State publication, "Erosion Control and Conservation Plantings on Noncropland," as the standard to use for the selection of species, seed specifications, mixtures, liming and fertilizing, time of seeding, and seeding methods. Specifications for these items may also be obtained from PennDOT's Publication # 408, Section 804 or by contacting the applicable county conservation district. Upon selection of a reference, that reference should be used to provide all specifications for seeding, mulching, and soil amendments. The following specification will be used for this project:

(TEMPORARY)	*SPECIES:	**ANNUAL RYEGRASS**
	% PURE LIVE SEED:	**98** %
	APPLICATION RATE:	**40** LB./ACRE
	FERTILIZER TYPE:	**10-10-10** (X-X-X)
	FERTILIZER APPL. RATE:	**150** LB./ACRE
	LIMING RATE:	**1** T./ACRE
	MULCH TYPE:	**STRAW**
	MULCHING RATE:	**3** T./ACRE
(PERMANENT)	TOPSOIL PLACEMENT DEPTH:	**4** IN.
	*SPECIES:	**PENN LAWN FINE FESCUE, KENTUCKY BLUE, PERENNIAL RYE**
	% PURE LIVE SEED:	**95** %
	APPLICATION RATE	**109, 174, 65** LB./ACRE
	FERTILIZER TYPE:	**10-20-20** (X-X-X)
	FERTILIZER APPL. RATE:	**1000** LB./ACRE
	LIMING RATE:	**6** T./ACRE
	MULCH TYPE:	**STRAW**
	MULCHING RATE:	**3** T./ACRE
	ANCHOR MATERIAL:	**WOOD CELLULOSE**
	ANCHORING METHOD:	**BLOWN**
	RATE OF ANCHOR MATERIAL APPL.:	**1500** LB./ACRE
	SEEDING SEASON DATES:	**MAR 15-JUNE 1 & AUG 1-OCT 15**
(PERMANENT - STEEP SLOPE)		
	TOPSOIL PLACEMENT DEPTH:	**4** IN.
	*SPECIES:	**SEE ERNST SEED MIX 178 ON PLAN**
	% PURE LIVE SEED:	**100** %
	APPLICATION RATE:	**45** LB./ACRE
	FERTILIZER TYPE:	**10-20-20** (X-X-X)
	FERTILIZER APPL. RATE:	**1000** LB./ACRE
	LIMING RATE:	**6** T./ACRE
	MULCH TYPE:	**STRAW**
	MULCHING RATE:	**3** T./ACRE
	ANCHOR MATERIAL:	**S150BN TEMPORARY EROSION CONTROL BLANKET**
	ANCHORING METHOD:	**STAPLES AS DETAILED BY MANUFACTURER**
	RATE OF ANCHOR MATERIAL APPL.:	**ALL DISTURBED STEEP SLOPE** LB./ACRE
	SEEDING SEASON DATES:	**MAR 15-JUNE 1 & AUG 1-OCT 15**

*If more than one species is used, indicate application rate for each species.

Note: This worksheet should be added to the plan drawings.