GREEN INFRASTRUCTURE FEASIBILITY REPORT

DIETZ MEMORIAL STADIUM

Owner:
City of Kingston
420 Broadway, Kingston, NY 12401

Date:
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1.0 EXECUTIVE SUMMARY

The City of Kingston is located in Ulster County, New York within the Hudson River Valley. The City of Kingston consists of vibrant neighborhoods diverse in land use and in population. Kingston has been proactive in an effort to improve public infrastructure including City streets, water & wastewater infrastructure as well as enhanced park facilities and green infrastructure.

The City of Kingston and Kingston Central School District recently took ownership of the Dietz Memorial Stadium, a sports venue and community events complex. The City is currently advancing improvements to the facility buildings, traffic circulation, on-site parking as well as improvements to the neighboring Andretta Pool through the Downtown Revitalization Initiative program. These improvements will provide safe, convenient and accessible facilities and parking to the users of Dietz Memorial Stadium.

The City views the Dietz Memorial Stadium improvements as a great opportunity to incorporate green infrastructure while improving the buildings and parking, which aligns with the City's vision of providing a more livable, vibrant and sustainable community. Green infrastructure can be easily incorporated into the parking lot improvements.

The City of Kingston anticipates developing a green infrastructure plan which incorporates low-impact development practices including a number of less intrusive measures to allow precipitation to infiltrate into the ground instead of running off into stormwater system of the nearby Esopus Creek a B (T) standard waterway. These measures include permeable pavement and bioretention systems.

This plan sets forth goals and objectives for the City as a whole and places Kingston in alignment with a greener future for both the community and environment.

2.0 PROJECT OBJECTIVES

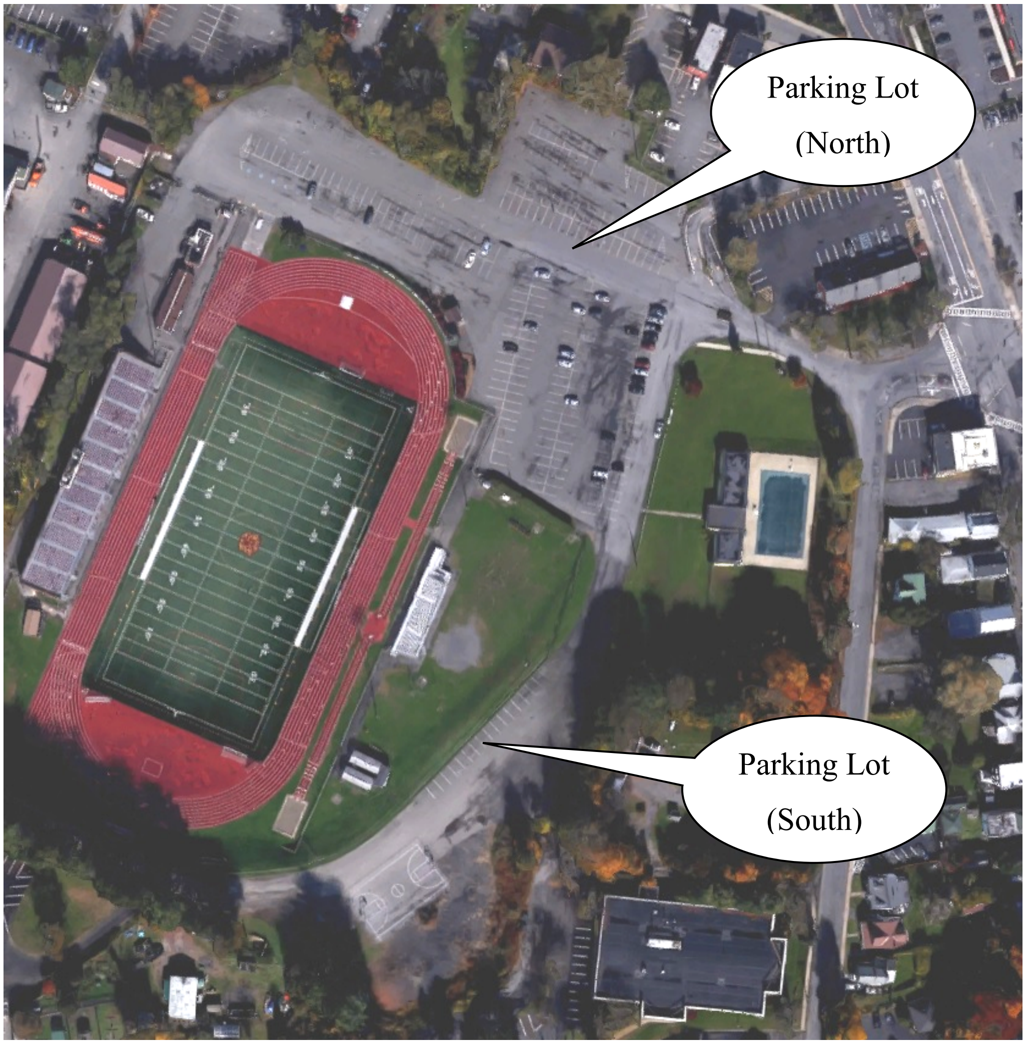
The City of Kingston is currently in the planning stages to reconstruct the parking lot of Dietz Memorial Stadium. The parking lot has been neglected over the years and does not include adequate drainage to accommodate the stormwater runoff generated within the parking lot. The stormwater runoff in many cases overwhelms the closed drainage system of the City and contributes to concerns of potential flooding along the Esopus Creek watershed and ultimately contribute pollutants to the Esopus Creek and Hudson River. The project objectives for the parking lot improvements are as follows:

1) Improve the poor or substandard condition of the parking lots which will provide safe, convenient and accessible parking and traffic circulation at Dietz Memorial Stadium.
2) Promote "green infrastructure" designs to reduce stormwater runoff, combat air pollution, reduce area temperatures, save money on maintenance and repair, and create greenspace where parking can be located
3) Reduce the volume of stormwater which enters the City's closed drainage system and discharges to the Esopus Creek watershed and ultimately the Hudson River through green infrastructure, low-impact development and best stormwater management practices.

The proposed green infrastructure will exceed the requirements of the SPDES General Permit for Stormwater Discharges from Construction Activity.

3.0 EXISTING CONDITIONS

The study includes the parking lot at Dietz Memorial Stadium as shown below:



The existing condition plan for the parking lot is located in Appendix A.

A. Land Use: The land use is commercial (existing sports complex with asphalt parking) located adjacent to commercial and some residential on multi-level structures. Impervious sidewalks are located between the road and building faces.

B. Depth to Bedrock: Based on review of the USDA Web Soil Survey, the predominate soil type is Plainfield-Rock outcrop complex. This classification indicates a depth to restrictive layer of more than 80 inches in the Plainfield soil type and bedrock at 0-60 inches in areas of rock outcrop. Areas of exposed bedrock were noted to the southwest of the existing basketball courts. Preliminary soil borings were progressed to 8 feet; bedrock was not encountered in any of the borings. Soil Boring Logs are included in Appendix B.

C. USGS Soil Classification: According to the USDA Web Soil Survey mapping tool the predominate soil type is Plainfield-Rock outcrop complex (PrC). These soils are classified as hydrologic soil group (HSG) 'A' well drained soils with a predicted infiltration rate of 5.95 to 19.98 inches per hour. Soil types encountered during soil borings differed from the classification consisting mostly of silty gravelly type soils. Preliminary infiltration tests revealed an infiltration rate of 0 to 2 inches per hour. More extensive soil borings and infiltration testing should be performed to verify the soils suitability for green infrastructure practice locations during the detail design phase. A copy of the USDA Web Soil Survey report is included in Appendix C. Preliminary infiltration test results are included in Appendix B.

D. Depth to Water Table: The USDA Web Soil Survey indicates the depth to water table is more than 80 inches. Preliminary soil borings were progressed to 8 feet; groundwater was not encountered in any of the borings. Therefore the water table depth at green infrastructure locations is not expected to present any significant design issues which would preclude the use of green infrastructure infiltration practices.

E. Other Considerations: The parking lot location is adjacent to the Dietz Memorial Stadium and is within an urban commercial corridor. The project includes the re-development of the existing impervious areas with minimal to no additional site clearing anticipated. The following site considerations are noted:

   a. According to the NYS DEC Environmental Resource Mapper, no wetlands are located on or adjacent to the site.

b. According to the NYS DEC Environmental Resource Mapper the site is located in the vicinity of animals and bats listed as endangered or threatened.

c. Based on FEMA Flood Insurance Rate Map Number 36111C0470F the project site is located outside of the 1% annual chance (100-year) floodplain boundary of the Esopus Creek. The northern portion of the site is in Zone X, defined as areas of 0.2% annual chance (500-year) flood. A copy of the FEMA mapping is included in Appendix D.

F. Additional Information: Based on available mapping, the average slope across the parking lot area is less than 5 percent which is the maximum slope for permeable pavement recommended in the NYSDEC Stormwater Management Design Manual.

Based on review of available data the parking lot location appears to be a feasible location to incorporate green infrastructure practices for water quality treatment. Additional survey, utility mapping and more extensive soil borings and infiltration testing should be performed to verify green infrastructure practice locations are suitable during detailed design. Existing Site photographs are included in Appendix G.

4.0 PROJECT DESCRIPTION

The City of Kingston has initiated a project to improve the Dietz Memorial Stadium facilities and parking lot. The goal of this project is to improve the poor or substandard condition of the parking lots which will provide safe, convenient and accessible facilities and parking to the users of Dietz Memorial Stadium. Conceptual Site Plans are included in Appendix E. The City of Kingston would like to use the parking lot improvements as additional demonstration projects for green infrastructure practices that fully align with the vision and goals of the adopted Kingston 2025 Comprehensive Plan by incorporating green infrastructure.

The first green infrastructure practice that the City will incorporate into the parking lot improvements is the use of porous pavement. The porous pavements will be constructed and utilized in the parking stalls while the circulation lanes will utilize traditional asphalt pavements. The porous asphalt pavement will allow stormwater runoff to permeate through the porous asphalt into a stone reservoir layer, which will allow infiltration into the soil and reduce the amount of stormwater runoff to the stormwater system.

The second green infrastructure practice that the City will incorporate into the parking lot improvements is the use of bioretention areas. The bioretention areas will be utilized throughout the site and within the proposed circulation islands which will delineate the parking stalls and promote improved traffic circulation. The bioretention areas will help reduce the amount of stormwater runoff and remove pollutants which is then used by vegetation in evapotranspiration and filtered through the soil.

Preliminary Water Quality Volume (WQv) and green infrastructure practice sizing calculations were performed to identify the potential benefit of the proposed practices using the NYSDEC Green Infrastructure Worksheets. The green infrastructure practices were sized to treat the WQv using the 90th percentile rainfall of 1.5 inches or less of stormwater runoff in a 24-hour period. The required water quality volume (WQv) for the porous pavement and bioretention practices was based on the size of the drainage areas of each subcatchment expected to contribute runoff to each practice. The calculation was performed utilizing procedures outlined in the NYSDEC Stormwater Management Design Manual. The project area was separated into twenty subcatchment areas for each proposed practice. The following table summarizes the contributing area and required and provided WQv.

Subcatchment	Contributing Drainage Area (acres)	Required WQv (Cu. Feet)	Provided WQv (Cu. Feet)	Proposed GI Practice
1	0.07	350	1,178	Porous Pvt
2	0.28	1,435	4,809	Porous Pvt
3	0.07	328	798	Porous Pvt
4	0.07	344	793	Porous Pvt
5	0.04	192	636	Porous Pvt
6	0.03	143	450	Porous Pvt
7	0.07	255	492	Porous Pvt
8	0.16	805	1,558	Porous Pvt
9	0.14	705	1,418	Porous Pvt
10	0.22	960	2,202	Porous Pvt
11	0.30	1,526	2,202	Porous Pvt
12	0.23	899	900	Bioretention
13	0.11	533	576	Bioretention
14	0.08	377	576	Bioretention
15	0.17	762	653	Bioretention
16	1.19	4,309	3,840	Bioretention
17	1.34	2,666	3,240	Bioretention
18	0.39	1,324	1,411	Bioretention
19	0.20	513	691	Bioretention
20	0.51	2,237	2,268	Bioretention

The total WQv expected to be reduced by using green infrastructure practices is **20,[illegible]3** cubic feet or **0.47** acre-feet. Both green infrastructure practices are effective at treating surface pollutants, specifically sediment, nitrogen and phosphorus. Pollutant loading and reduction calculations were performed for the proposed green infrastructure practices. A summary of the calculations is provided in Appendix H.

The water quality volume calculated for this study is an estimated quantity only based on a conceptual design that will be refined during the design development process. Subcatchment areas and conceptual green infrastructure practice locations are included in the mapping in Appendix F. Water quality volume requirements and green infrastructure sizing calculation worksheets are also included in the Appendix F.

5.0 PROJECT SCHEDULE

The schedule for construction of parking lot improvements including the green infrastructure practices is as follows:

GI Feasibility Study	**Completed July 2019**
Grant Awarded	**November/December 2019**
Contract Completed	**June 2020**
Design Consultant Selection	**July/October 2020**
Project Design	**October/November 2020**
Project Letting, Award	**November/December 2020**
Construction Begins	**Spring 2021**
Construction Complete	**Fall 2021**

6.0 ANTICIPATED REGULATORY APPROVAL AND PERMITS

The following regulatory approvals and permits are anticipated as part of the Dietz Memorial Stadium Parking Lot Green Infrastructure Upgrades:

- NYSDEC – State Pollutant Discharge Elimination System (SPDES) General Permit (GP-0-15-002)
- SHPO – Historic and Cultural Resources
- Kingston – State Environmental Quality Review Act (SEQRA)

A SPDES General Permit GP-0-15-002 will be required if the project involves more than one acre of soil disturbance. A Stormwater Pollution Prevention Plan (SWPPP) with the appropriate sediment and erosion control measures will be developed during the design development phase as necessary.

Soil erosion control plans and details will also be developed during the final design phase of the project in accordance with NYSDEC's Standards and Specifications for Erosion and Sediment Control manual. These plans and details will include both temporary and permanent measures to prevent soil erosion and provide fences, seeding, mulching, and stabilized construction access points. The project will employ effective erosion and sediment control practices during construction, as set forth in the final design plans.

7.0 PROJECT COST ESTIMATE

The conceptual opinion of costs to incorporate green infrastructure within the Dietz Memorial Stadium improvement project is as follows:

Item of Work	**Estimated Cost**
Demolition	$313,000
Drainage System Improvements	$231,000
New Bioretention Areas (11,800 sq, ft.)	$354,000
New Porous Pavement (41,400 sq. ft.)	$1,117,800
Other Parking Area Improvements (Temporary Erosion Control, Excavation, Subbase, Pavement, Striping, Curb, Signage, Lighting, Fencing, Landscaping)	$2,441,602
Contingency Allowance (15%)	$668,610
Total Estimated Green Infrastructure & Parking Improvements Cost:	**$5,126,012**

The City of Kingston is eager to incorporate green infrastructure practices into the Dietz Memorial Stadium improvement project which will complement the Downtown Revitalization Initiative program currently in development.

8.0 LONG TERM OPERATION AND MAINTENANCE

Long term operation and maintenance of the green infrastructure and parking facilities will be performed by the City of Kingston Department of Parks and Recreation with assistance from Department of Public Works Park Maintenance Division. A summary of the maintenance requirements is provided below.

Typical Maintenance Activities for Porous Pavement	
Activity	**Schedule**
Ensure that paving area is clean of debris	Monthly
Ensure that paving dewaters between storms	Monthly/after storms > 0.5 in.
Mow upland and adjacent areas, and seed bare areas	Monthly
Vacuum sweep frequently to keep surface free of sediments	As needed
Inspect the surface for deterioration or spalling	Annual

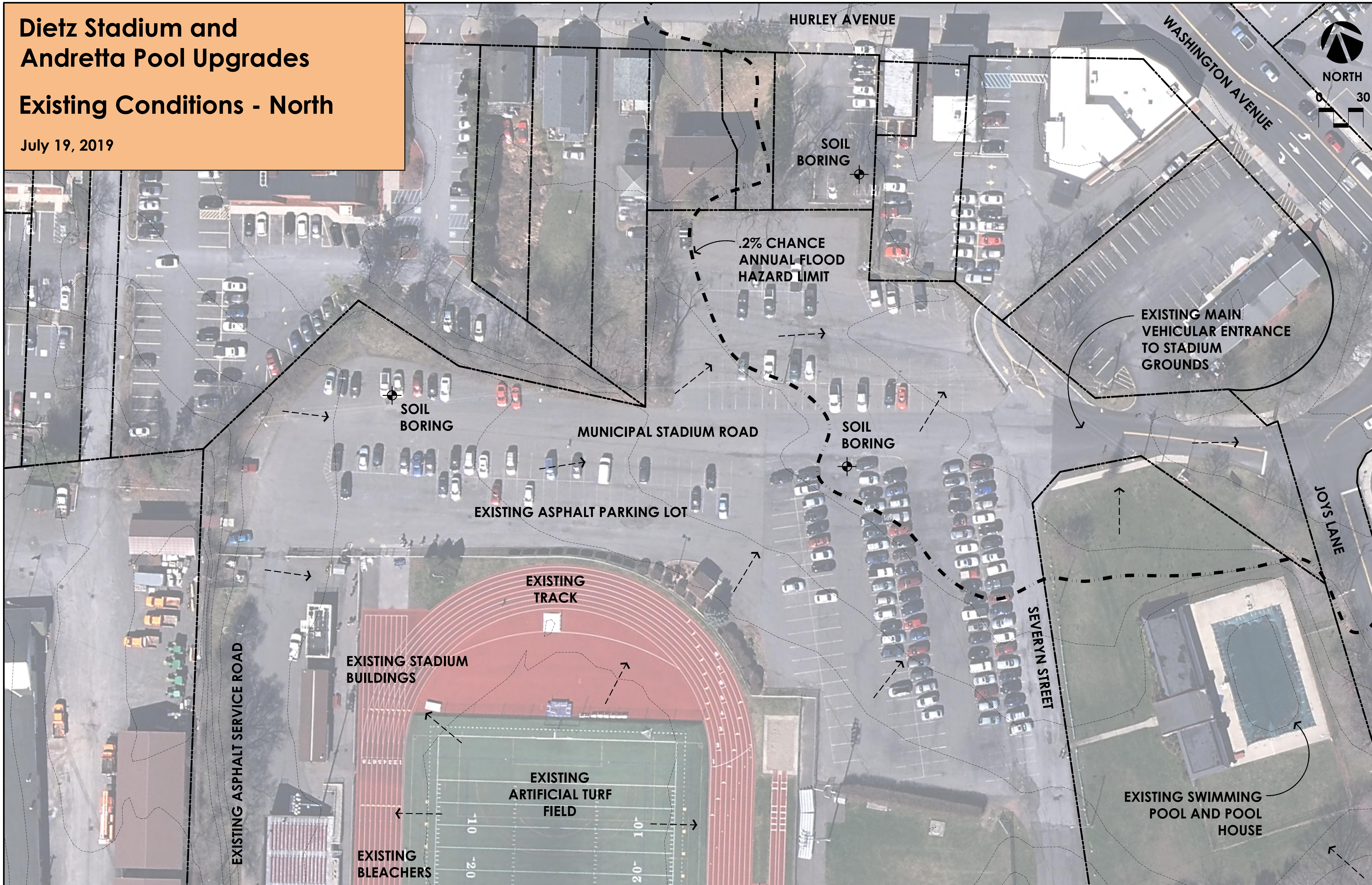
Typical Maintenance Activities for Bioretention	
Activity	**Schedule**
Prune and weed, remove litter and debris, renew mulch, mow upland and adjacent areas, water plant material	As needed
Inspect inflow points for clogging and remove sediment	Semi-annually, after major storms
Inspect inflow points for erosion and repair as needed	Semi-annually, after major storms
Inspect vegetation, trees and shrubs to evaluate health and replace as needed	Semi-annually
Inspect and remove debris build-up in pre-treatment areas	Annually in fall
Remove leaves and previous years plant material	Annually in spring

APPENDIX A
EXISTING CONDITIONS PLAN

Dietz Stadium and Andretta Pool Upgrades

Existing Conditions - North

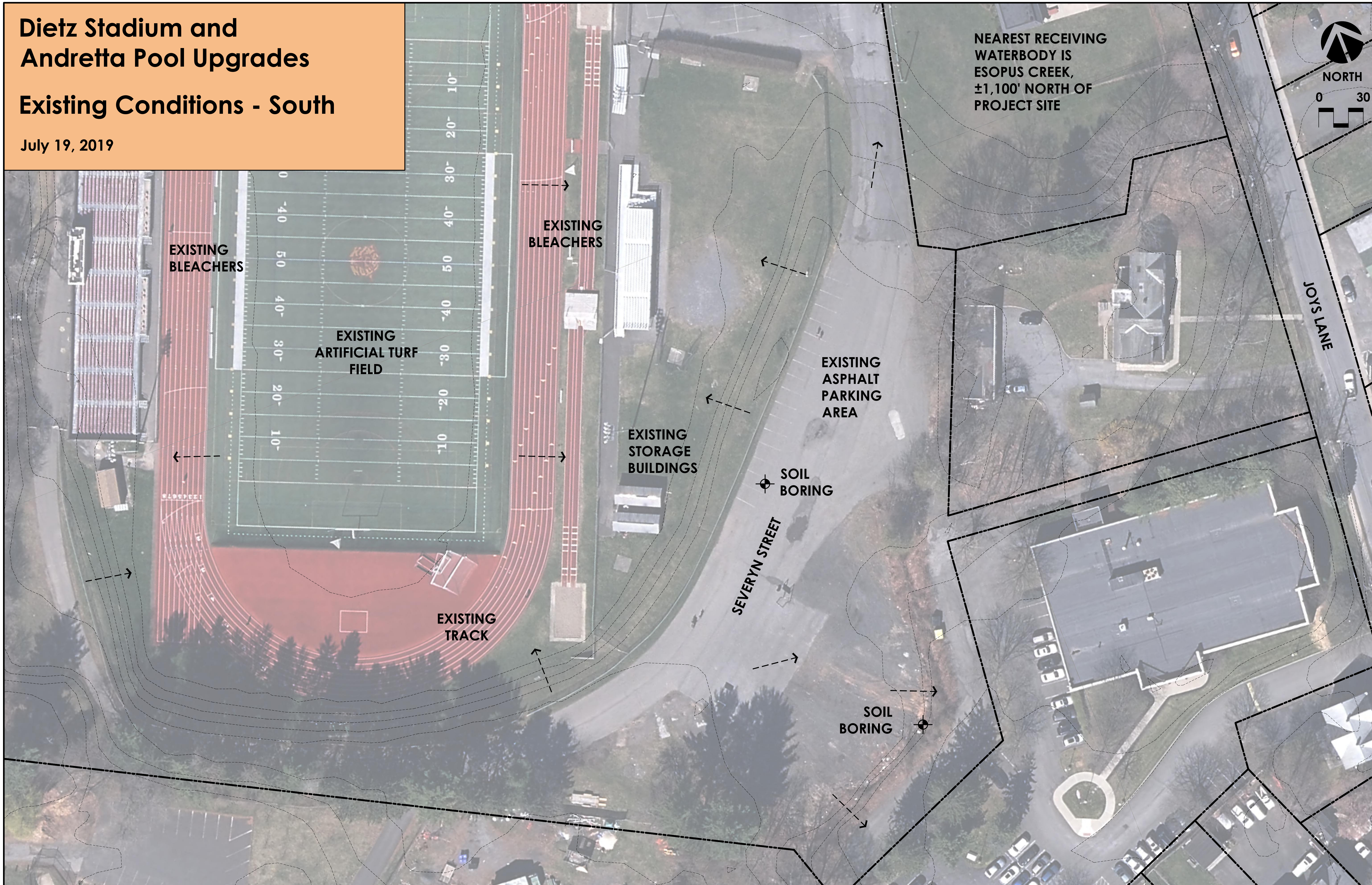
July 19, 2019



Dietz Stadium and Andretta Pool Upgrades

Existing Conditions - South

July 19, 2019



APPENDIX B

PRELIMINARY SOIL BORINGS & INFILTRATION TEST RESUTLS

DIETZ STADIUM – INFILTRATION TESTING 7/18/19

B-2	DROP	ELAPSED TIME	
RUN #1	0"	1 HR	⇒ ∅"/HR

B-3			
RUN #1	2"	1 HR	⇒ 2"/HR
RUN #2	1.75"	1 HR	⇒ 1.75"/HR
RUN #3	2"	1 HR	⇒ 2"/HR
RUN #4	2"	1 HR	⇒ 2"/HR

TODD KOZAK

QCQA LABS

APPENDIX C
WEB SOIL SURVEY REPORT

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for

Ulster County, New York

2019 Dietz Memorial Stadium Green Infrastructure

July 5, 2019

Preface

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

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

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

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

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

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

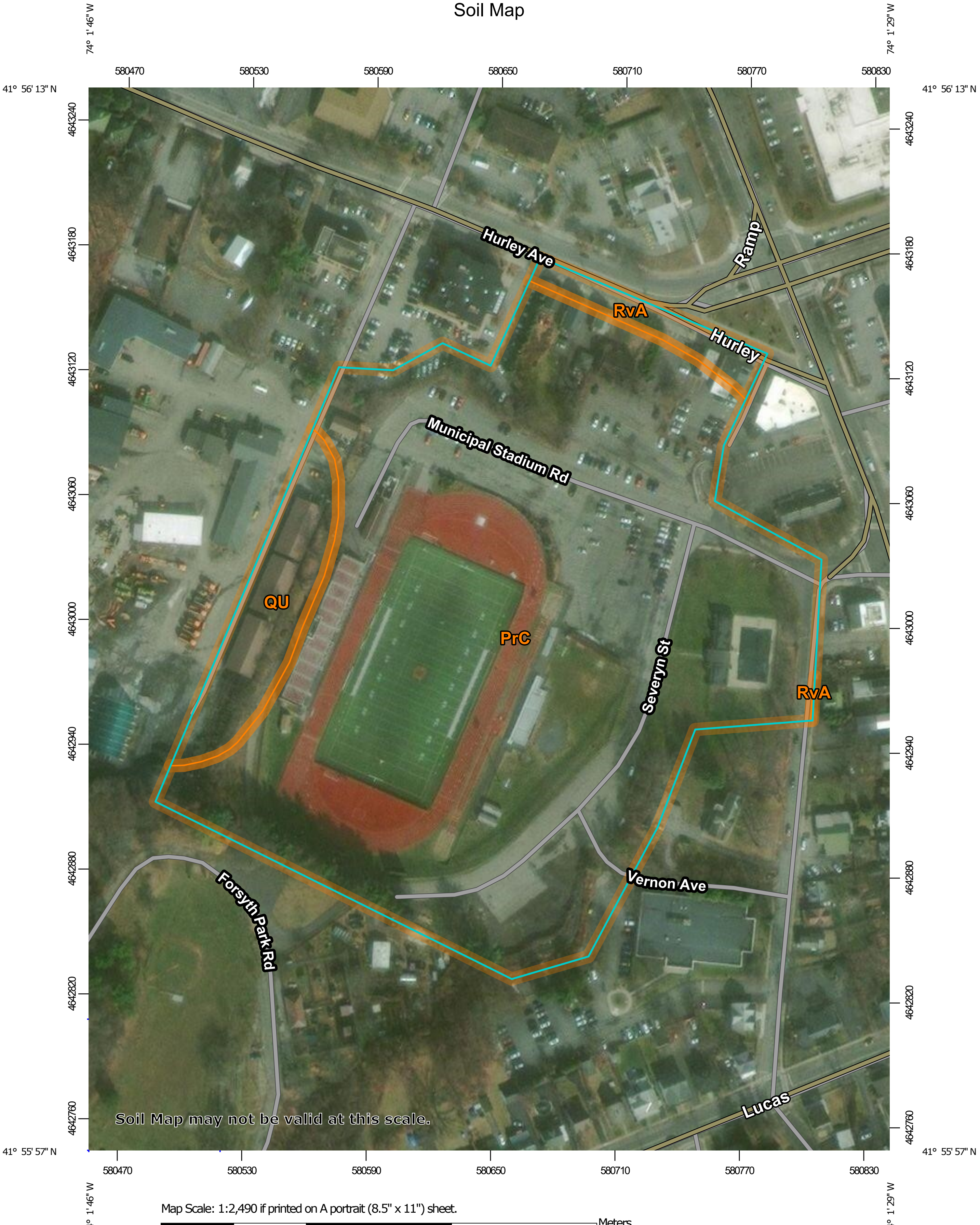
The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

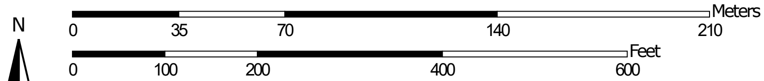
Soil Map

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

Soil Map



Map Scale: 1:2,490 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Ulster County, New York
Survey Area Data: Version 17, Sep 3, 2018

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

Date(s) aerial images were photographed: Oct 7, 2013—Sep 3, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
PrC	Plainfield-Rock outcrop complex, rolling	15.2	90.4%
QU	Quarry	1.2	7.0%
RvA	Riverhead fine sandy loam, 0 to 3 percent slopes	0.4	2.6%
Totals for Area of Interest		**16.8**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Ulster County, New York

PrC—Plainfield-Rock outcrop complex, rolling

Map Unit Setting

National map unit symbol: 9xj0
Elevation: 720 to 1,150 feet
Mean annual precipitation: 41 to 62 inches
Mean annual air temperature: 41 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Plainfield and similar soils: 65 percent
Rock outcrop: 15 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Plainfield

Setting

Landform: Terraces, deltas, outwash plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy glaciofluvial or deltaic deposits

Typical profile

H1 - 0 to 9 inches: loamy sand
H2 - 9 to 32 inches: loamy sand
H3 - 32 to 65 inches: coarse sand

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 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 3.8 inches)

Interpretive groups

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

Description of Rock Outcrop

Typical profile

H1 - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydric soil rating: Unranked

Minor Components

Pompton

Percent of map unit: 5 percent
Hydric soil rating: No

Riverhead

Percent of map unit: 5 percent
Hydric soil rating: No

Stockbridge

Percent of map unit: 5 percent
Hydric soil rating: No

Walpole

Percent of map unit: 5 percent
Hydric soil rating: No

QU—Quarry

Map Unit Setting

National map unit symbol: 9xj2
Mean annual precipitation: 41 to 62 inches
Mean annual air temperature: 41 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Quarry: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Quarry

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 to 40 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Minor Components

Arnot
Percent of map unit: 5 percent
Hydric soil rating: No

Lyons
Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Rock outcrop
Percent of map unit: 5 percent
Hydric soil rating: Unranked

Udorthents
Percent of map unit: 5 percent
Hydric soil rating: No

RvA—Riverhead fine sandy loam, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: 9xj7
Mean annual precipitation: 41 to 62 inches
Mean annual air temperature: 41 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Riverhead and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverhead

Setting
Landform: Deltas, terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits overlying stratified sand and gravel

Typical profile
H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 26 inches: sandy loam
H3 - 26 to 49 inches: loamy sand
H4 - 49 to 62 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 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 5.7 inches)

Interpretive groups

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

Minor Components

Hoosic

Percent of map unit: 5 percent
Hydric soil rating: No

Pompton

Percent of map unit: 5 percent
Hydric soil rating: No

Walpole

Percent of map unit: 5 percent
Hydric soil rating: No

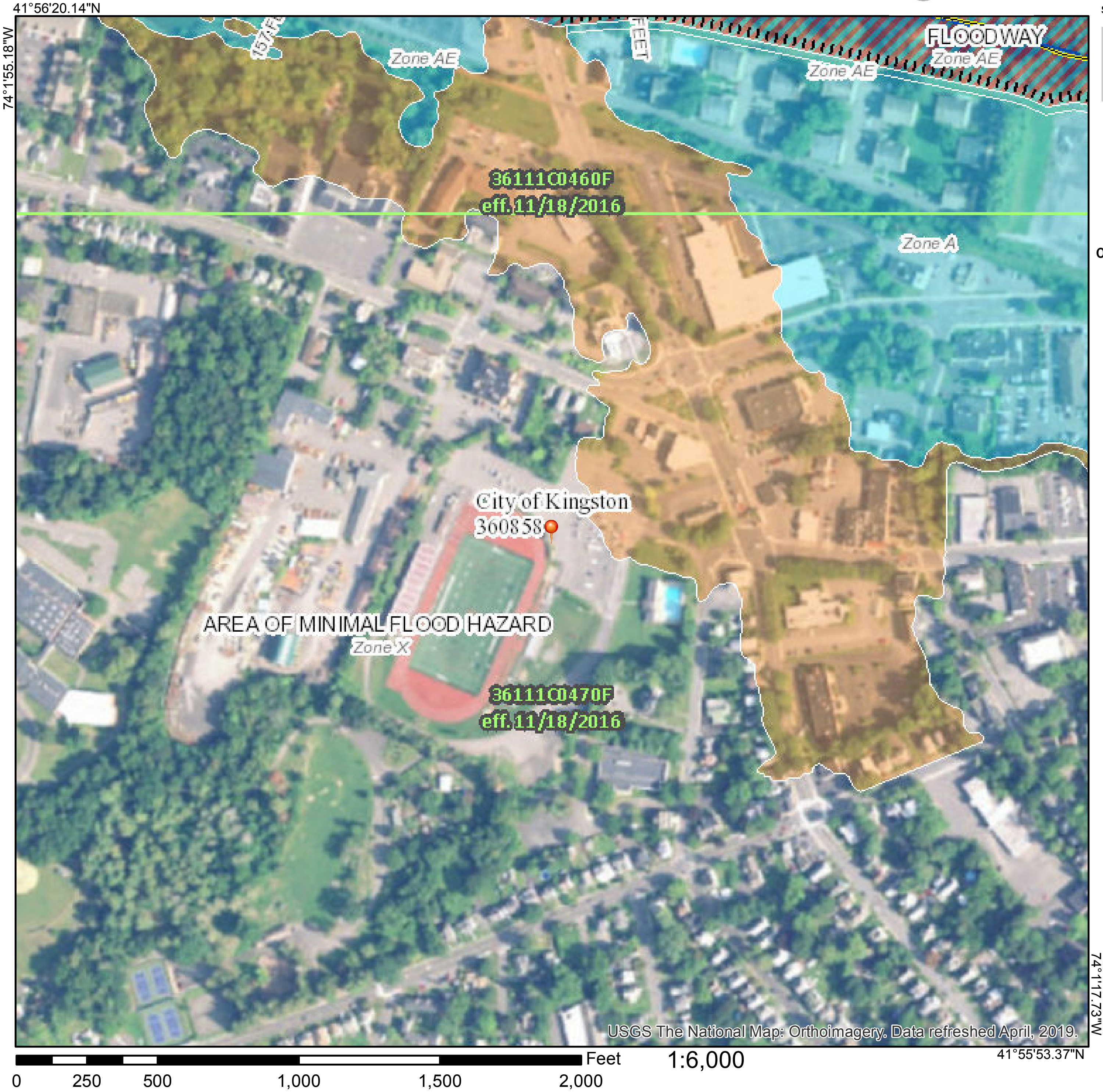
Plainfield

Percent of map unit: 5 percent
Hydric soil rating: No

APPENDIX D
FEMA FLOODPLAIN MAPPING

National Flood Hazard Layer FIRMette

FEMA



1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/5/2019 at 3:05:57 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX E
CONCEPTUAL SITE PLANS

Dietz Stadium and Andretta Pool Upgrades

Design Considerations - North

May 29, 2019

Dietz Stadium and Andretta Pool Upgrades

Design Considerations - South

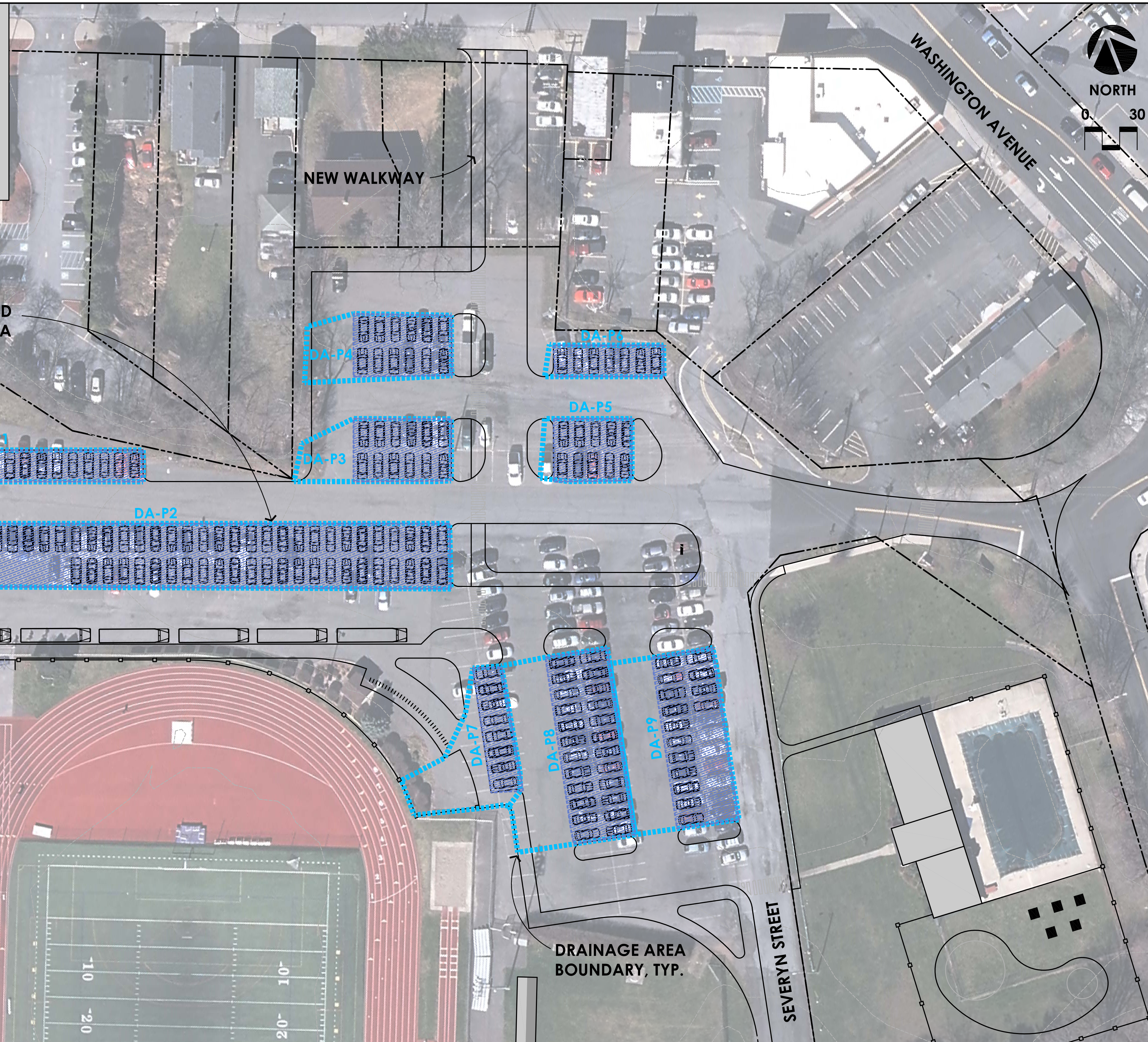
May 29, 2019

APPENDIX F
DRAINAGE AREA MAPPING & GI PRACTICE LOCATIONS
WQV REQUIREMENTS & GI SIZING

Dietz Stadium and Andretta Pool Upgrades

Porous Pavement Drainage Areas - North

July 19, 2019



Dietz Stadium and Andretta Pool Upgrades

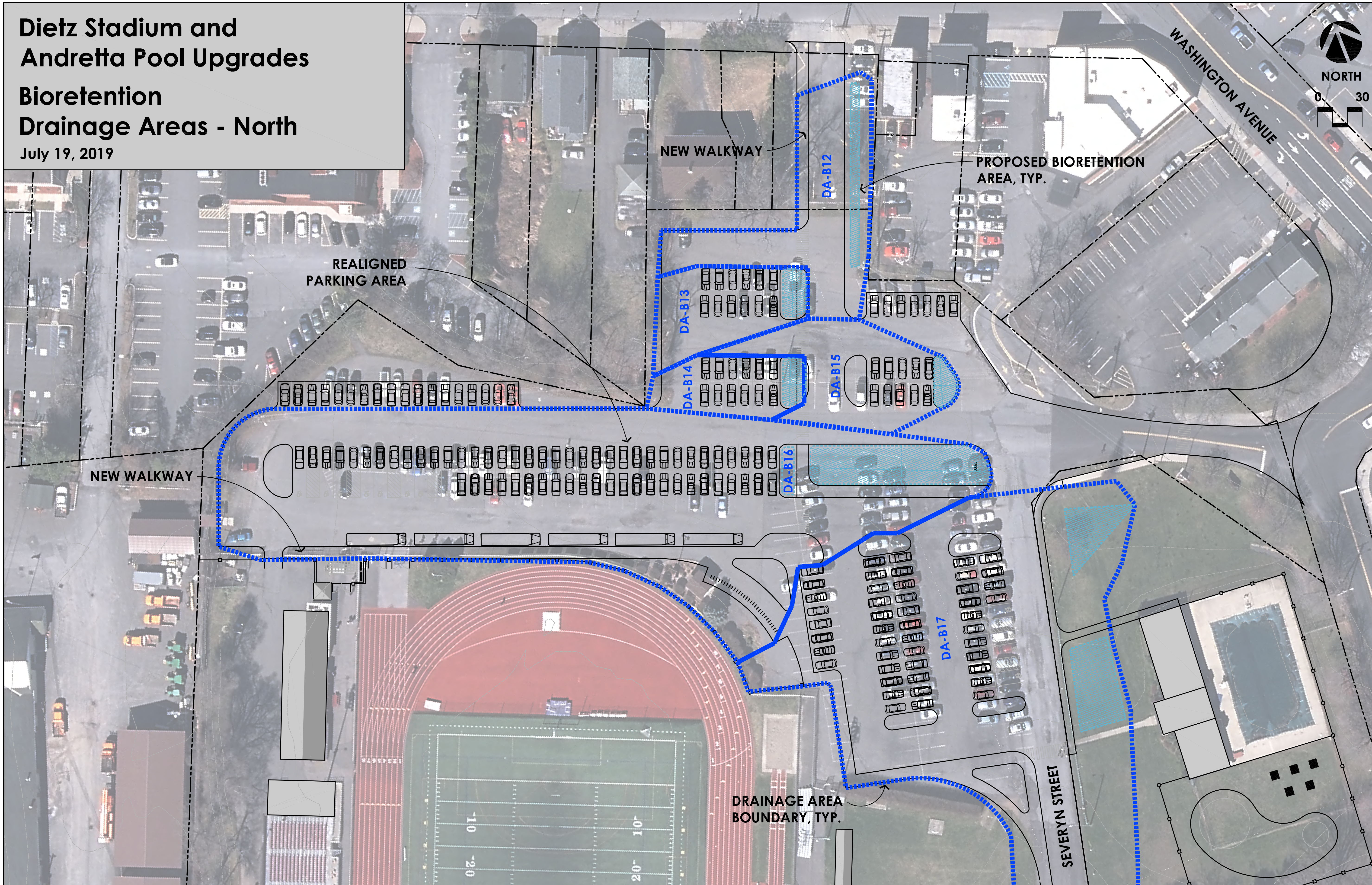
Porous Pavement Drainage Areas - South

July 19, 2019

Dietz Stadium and Andretta Pool Upgrades

Bioretention Drainage Areas - North

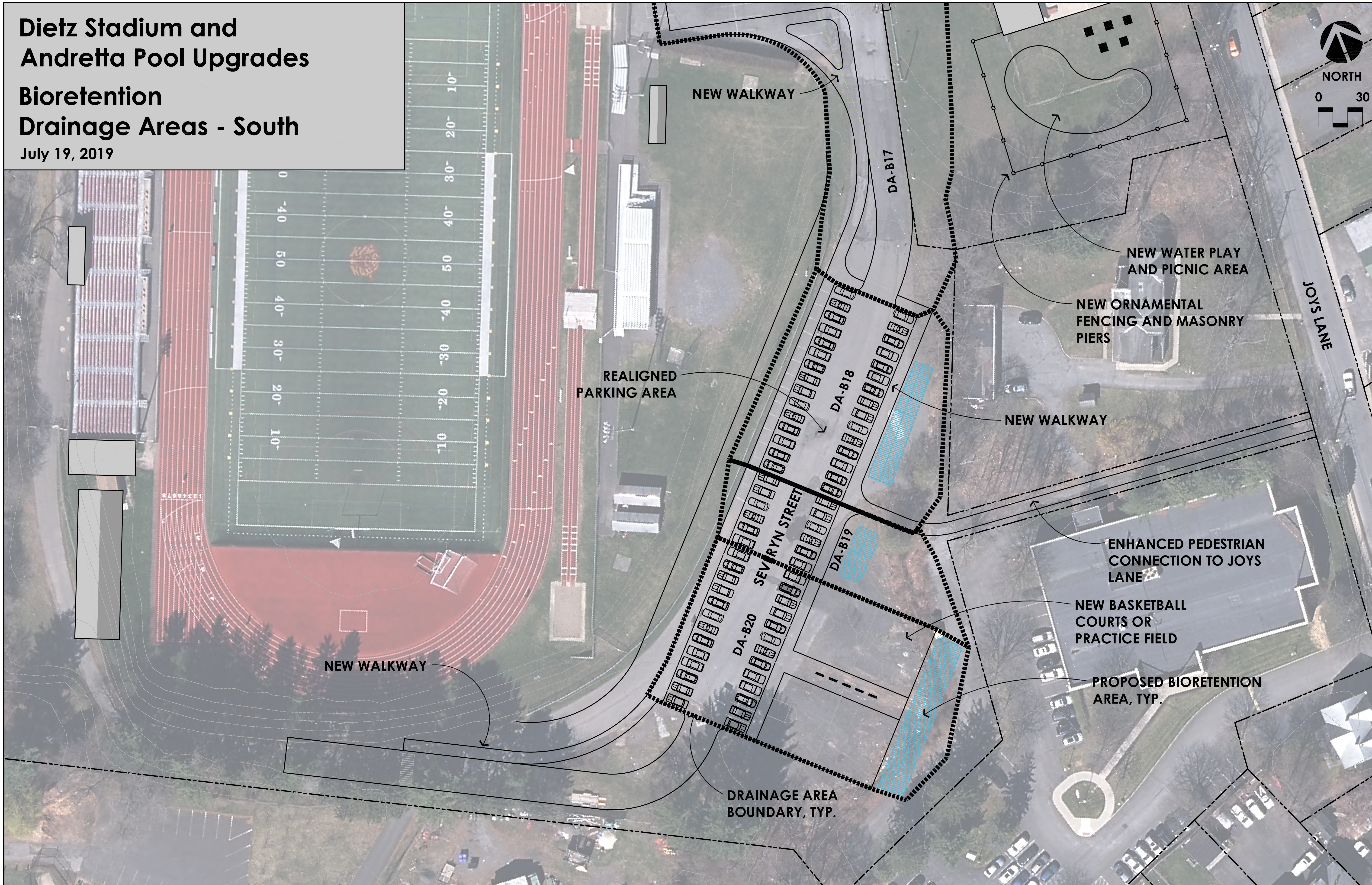
July 19, 2019



Dietz Stadium and Andretta Pool Upgrades

Bioretention Drainage Areas - South

July 19, 2019



Version 1.8
Last Updated: 11/09/2015

Total Water Quality Volume Calculation
WQv(acre-feet) = [(P)(Rv)(A)] /12

Is this project subject to Chapter 10 of the NYS Design Manual (i.e. WQv is equal to post-development 1 year runoff volume)?...	No

Design Point:	1	
P=	1.50	inch

Manually enter P, Total Area and Impervious Cover.

Breakdown of Subcatchments						
Catchment Number	Total Area *(Acres)*	Impervious Area *(Acres)*	Percent Impervious *%*	Rv	WQv *(ft^3)*	Description
1	0.07	0.07	100%	0.95	350	Porous Pavement
2	0.29	0.28	95%	0.91	1,435	Porous Pavement
3	0.07	0.06	95%	0.90	328	Porous Pavement
4	0.07	0.07	97%	0.92	344	Porous Pavement
5	0.04	0.04	88%	0.85	192	Porous Pavement
6	0.03	0.03	100%	0.95	143	Porous Pavement
7	0.07	0.05	66%	0.64	255	Porous Pavement
8	0.16	0.16	100%	0.95	805	Porous Pavement
9	0.14	0.14	100%	0.95	705	Porous Pavement
10	0.22	0.18	82%	0.79	960	Porous Pavement
Subtotal (1-30)	5.67	3.90	69%	0.67	**20,663**	**Subtotal 1**
Total	5.67	3.90	69%	0.67	**20,663**	**Initial WQv**

Identify Runoff Reduction Techniques By Area			
Technique	Total Contributing Area *(Acre)*	Contributing Impervious Area *(Acre)*	Notes
Conservation of Natural Areas	0.00	0.00	*minimum 10,000 sf*
Riparian Buffers	0.00	0.00	*maximum contributing length 75 feet to 150 feet*
Filter Strips	0.00	0.00	
Tree Planting	0.00	0.00	*Up to 100 sf directly connected impervious area may be subtracted per*
Total	**0.00**	**0.00**	

Recalculate WQv after application of Area Reduction Techniques					
	Total Area *(Acres)*	Impervious Area *(Acres)*	Percent Impervious *%*	Runoff Coefficient Rv	WQv *(ft^3)*
"<<Initial WQv"	5.67	3.90	69%	0.67	20,663
Subtract Area	0.00	0.00			
WQv adjusted after Area Reductions	**5.67**	**3.90**	69%	0.67	20,663
Disconnection of Rooftops		0.00			
Adjusted WQv after Area Reduction and Rooftop Disconnect	5.67	3.90	69%	0.67	**20,663**
WQv reduced by Area Reduction techniques					0

Total Water Quality Volume Calculation
WQv(acre-feet) = [(P)(Rv)(A)] /12

Additional Subcatchments						
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Description**
11	0.30	0.30	100%	0.95	1,526	Porous Pavement
12	0.23	0.17	74%	0.71	899	Bioretention
13	0.11	0.10	90%	0.86	533	Bioretention
14	0.08	0.07	85%	0.82	377	Bioretention
15	0.17	0.15	87%	0.84	762	Bioretention
16	1.19	0.81	68%	0.67	4,309	Bioretention
17	1.34	0.47	35%	0.37	2,666	Bioretention
18	0.39	0.25	64%	0.63	1,324	Bioretention
19	0.20	0.09	46%	0.47	513	Bioretention
20	0.51	0.43	84%	0.80	2,237	Bioretention
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
Subtotal	4.52	2.84	63%	0.62	**15,146**	**Subtotal**

Total Water Quality Volume Calculation

WQv(acre-feet) = [(P)(Rv)(A)] /12

All Subcatchments						
Catchment	**Total Area** *(Acres)*	**Impervious Cover** *(Acres)*	**Percent Impervious** *%*	**Runoff Coefficient** *Rv*	**WQv** *(ft ^{3})*	**Description**
1	0.07	0.07	1.00	0.95	349.60	Porous Pavement
2	0.29	0.28	0.95	0.91	1,435	Porous Pavement
3	0.07	0.06	0.95	0.90	328.12	Porous Pavement
4	0.07	0.07	0.97	0.92	343.72	Porous Pavement
5	0.04	0.04	0.88	0.85	192.16	Porous Pavement
6	0.03	0.03	1.00	0.95	142.74	Porous Pavement
7	0.07	0.05	0.66	0.64	255.07	Porous Pavement
8	0.16	0.16	1.00	0.95	805.36	Porous Pavement
9	0.14	0.14	1.00	0.95	705.02	Porous Pavement
10	0.22	0.18	0.82	0.79	959.76	Porous Pavement
11	0.30	0.30	1.00	0.95	1526.41	Porous Pavement
12	0.23	0.17	0.74	0.71	899.38	Bioretention
13	0.11	0.10	0.90	0.86	532.71	Bioretention
14	0.08	0.07	0.85	0.82	377.23	Bioretention
15	0.17	0.15	0.87	0.84	761.77	Bioretention
16	1.19	0.81	0.68	0.67	4309.13	Bioretention
17	1.34	0.47	0.35	0.37	2665.80	Bioretention
18	0.39	0.25	0.64	0.63	1323.73	Bioretention
19	0.20	0.09	0.46	0.47	512.84	Bioretention
20	0.51	0.43	0.84	0.80	2237.26	Bioretention
21						
22						
23						

Runoff Reduction Volume and Treated volumes						
	Runoff Reduction Techiques/Standard SMPs		**Total Contributing Area**	**Total Contributing Impervious Area**	**WQv Reduced (RRv)**	**WQv Treated**
			(acres)	**(acres)**	**cf**	**cf**
Area/Volume Reduction	Conservation of Natural Areas	RR-1	0.00	0.00		
	Sheetflow to Riparian Buffers/Filter Strips	RR-2	0.00	0.00		
	Tree Planting/Tree Pit	RR-3	0.00	0.00		
	Disconnection of Rooftop Runoff	RR-4		0.00		
	Vegetated Swale	RR-5	0.00	0.00	0	
	Rain Garden	RR-6	0.00	0.00	0	
	Stormwater Planter	RR-7	0.00	0.00	0	
	Rain Barrel/Cistern	RR-8	0.00	0.00	0	
	Porous Pavement	RR-9	1.45	1.36	7043	
	Green Roof (Intensive & Extensive)	RR-10	0.00	0.00	0	
Standard SMPs w/RRv Capacity	Infiltration Trench	I-1	0.00	0.00	0	0
	Infiltration Basin	I-2	0.00	0.00	0	0
	Dry Well	I-3	0.00	0.00	0	0
	Underground Infiltration System	I-4				
	Bioretention & Infiltration Bioretention	F-5	4.22	2.54	5662	7958
	Dry swale	O-1	0.00	0.00	0	0
Standard SMPs	Micropool Extended Detention (P-1)	P-1				
	Wet Pond (P-2)	P-2				
	Wet Extended Detention (P-3)	P-3				
	Multiple Pond system (P-4)	P-4				
	Pocket Pond (p-5)	P-5				
	Surface Sand filter (F-1)	F-1				
	Underground Sand filter (F-2)	F-2				
	Perimeter Sand Filter (F-3)	F-3				
	Organic Filter (F-4	F-4				
	Shallow Wetland (W-1)	W-1				
	Extended Detention Wetland (W-2	W-2				
	Pond/Wetland System (W-3)	W-3				
	Pocket Wetland (W-4)	W-4				
	Wet Swale (O-2)	O-2				
Totals by Area Reduction		→	0.00	0.00	0	
Totals by Volume Reduction		→	1.45	1.36	7043	
Totals by Standard SMP w/RRV		→	4.22	2.54	5662	7958
Totals by Standard SMP		→	0.00	0.00		0
Totals (Area + Volume + all SMPs)		→	5.67	3.90	12,705	7,958
	Impervious Cover √	okay				
	Total Area √	okay				

Minimum RRv

Enter the Soils Data for the site		
Soil Group	Acres	S
A	3.91	55%
B		40%
C		30%
D		20%
Total Area	3.91	
Calculate the Minimum RRv		
S =	**0.55**	
Impervious =	3.90	*acre*
Precipitation	1.5	*in*
Rv	0.95	
Minimum RRv	**11,100**	***ft3***
	0.25	af

NOI QUESTIONS

#	NOI Question	Reported Value	
		cf	af
28	Total Water Quality Volume (WQv) Required	20663	*0.474*
30	Total RRV Provided	12705	*0.292*
31	Is RRv Provided ≥WQv Required?	No	
32	Minimum RRv	11100	*0.255*
32a	Is RRv Provided ≥ Minimum RRv Required?	Yes	
33a	Total WQv Treated	7958	*0.183*
34	Sum of Volume Reduced & Treated	20663	*0.474*
34	Sum of Volume Reduced and Treated	20663	*0.474*
35	Is Sum RRv Provided and WQv Provided ≥WQv Required?	Yes	

Apply Peak Flow Attenuation			
36	Channel Protection	*Cpv*	
37	Overbank	*Qp*	
37	Extreme Flood Control	*Qf*	
	Are Quantity Control requirements met?		

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)

k The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
12	0.23	0.17	0.74	0.71	899.38	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops	0.00	74%	0.71	899	<<WQv after adjusting for Disconnected Rooftops		
Enter the portion of the WQv that is not reduced for all practices routed to this practice.				0	*ft^3*		
Soil Information							
Soil Group	D						
Soil Infiltration Rate	0.00	*in/hour*	*Okay*				
Using Underdrains?	Yes	*Okay*					
Calculate the Minimum Filter Area							
			Value		Units	Notes	
WQv			899		*ft^3*		
Enter Depth of Soil Media		*df*	2.5		*ft*	*2.5-4 ft*	
Enter Hydraulic Conductivity		*k*	0.5		*ft/day*		
Enter Average Height of Ponding		*hf*	0.5		*ft*	*6 inches max.*	
Enter Filter Time		*tf*	2		*days*		
Required Filter Area		***Af***	**749**		***ft^2***		
Determine Actual Bio-Retention Area							
Filter Width	6	*ft*					
Filter Length	125	*ft*					
Filter Area	750	*ft^2*					
Actual Volume Provided	900	*ft^3*					
Determine Runoff Reduction							
Is the Bioretention contributing flow to another practice?		No	Select Practice				
RRv	360						
RRv applied	**360**	***ft^3***	***This is 40% of the storage provided or WQv whichever is less.***				
Volume Treated	539	*ft^3*	*This is the portion of the WQv that is not reduced in the practice.*				
Volume Directed	0	*ft^3*	This volume is directed another practice				
Sizing √	OK		*Check to be sure Area provided ≥ Af*				

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)
k	The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor & Schueler, 1996)

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
13	0.11	0.10	0.90	0.86	532.71	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	90%	0.86	533	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	*ft^3*	
Soil Information							
Soil Group		C					
Soil Infiltration Rate		1.00	*in/hour*	*Design as an infiltration bioretention practice*			
Using Underdrains?		Yes	*Okay*				
Calculate the Minimum Filter Area							
				Value		Units	Notes
WQv				533		*ft^3*	
Enter Depth of Soil Media			*df*	2.5		*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity			*k*	0.5		*ft/day*	
Enter Average Height of Ponding			*hf*	0.5		*ft*	*6 inches max.*
Enter Filter Time			*tf*	2		*days*	
Required Filter Area			***Af***	**444**		***ft^2***	
Determine Actual Bio-Retention Area							
Filter Width		15	*ft*				
Filter Length		32	*ft*				
Filter Area		480	*ft^2*				
Actual Volume Provided		576	*ft^3*				
Determine Runoff Reduction							
Is the Bioretention contributing flow to another practice?			No	Select Practice			
RRv		230					
RRv applied		**230**	***ft^3***	***This is 40% of the storage provided or WQv whichever is less.***			
Volume Treated		302	*ft^3*	*This is the portion of the WQv that is not reduced in the practice.*			
Volume Directed		0	*ft^3*	This volume is directed another practice			
Sizing √		OK		*Check to be sure Area provided ≥ Af*			

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)

k — The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
14	0.08	0.07	0.85	0.82	377.23	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	85%	0.82	377	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	*ft^3*	
Soil Information							
Soil Group		C					
Soil Infiltration Rate		1.00	*in/hour*	*Design as an infiltration bioretention practice*			
Using Underdrains?		Yes	*Okay*				
Calculate the Minimum Filter Area							
				Value		Units	Notes
WQv				377		*ft^3*	
Enter Depth of Soil Media			*df*	2.5		*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity			*k*	0.5		*ft/day*	
Enter Average Height of Ponding			*hf*	0.5		*ft*	*6 inches max.*
Enter Filter Time			*tf*	2		*days*	
Required Filter Area			***Af***	**314**		***ft^2***	
Determine Actual Bio-Retention Area							
Filter Width		15	*ft*				
Filter Length		32	*ft*				
Filter Area		480	*ft^2*				
Actual Volume Provided		576	*ft^3*				
Determine Runoff Reduction							
Is the Bioretention contributing flow to another practice?			No	Select Practice			
RRv		230					
RRv applied		**230**	***ft^3***	***This is 40% of the storage provided or WQv whichever is less.***			
Volume Treated		147	*ft^3*	*This is the portion of the WQv that is not reduced in the practice.*			
Volume Directed		0	*ft^3*	This volume is directed another practice			
Sizing √		OK		*Check to be sure Area provided ≥ Af*			

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)

k The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point: **1**

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
15	0.17	0.15	0.87	0.84	761.77	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	87%	0.84	762	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	*ft^3*	
Soil Information							
Soil Group		C					
Soil Infiltration Rate		1.00	*in/hour*	*Design as an infiltration bioretention practice*			
Using Underdrains?		Yes	*Okay*				
Calculate the Minimum Filter Area							
				Value		Units	Notes
WQv				762		*ft^3*	
Enter Depth of Soil Media			*df*	2.5		*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity			*k*	0.5		*ft/day*	
Enter Average Height of Ponding			*hf*	0.5		*ft*	*6 inches max.*
Enter Filter Time			*tf*	2		*days*	
Required Filter Area			***Af***	**635**		***ft^2***	
Determine Actual Bio-Retention Area							
Filter Width		16	*ft*				
Filter Length		34	*ft*				
Filter Area		544	*ft^2*				
Actual Volume Provided		653	*ft^3*				
Determine Runoff Reduction							
Is the Bioretention contributing flow to another practice?			No	Select Practice			
RRv		261					
RRv applied		**261**	***ft^3***	***This is 40% of the storage provided or WQv whichever is less.***			
Volume Treated		501	*ft^3*	*This is the portion of the WQv that is not reduced in the practice.*			
Volume Directed		0	*ft^3*	This volume is directed another practice			
Sizing √		Error		*Check to be sure Area provided ≥ Af*			

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)

k — The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point:	**1**

Enter Site Data For Drainage Area to be Treated by Practice

Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft³)*	**Precipitation** *(in)*	**Description**
16	1.19	0.81	0.68	0.67	4309.13	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	68%	0.67	4,309	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	*ft³*	

Soil Information

Soil Group	C		
Soil Infiltration Rate	1.00	*in/hour*	*Design as an infiltration bioretention practice*
Using Underdrains?	Yes	*Okay*	

Calculate the Minimum Filter Area

		Value	Units	Notes
WQv		4,309	*ft³*	
Enter Depth of Soil Media	*df*	2.5	*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity	*k*	0.5	*ft/day*	
Enter Average Height of Ponding	*hf*	0.5	*ft*	*6 inches max.*
Enter Filter Time	*tf*	2	*days*	
Required Filter Area	***Af***	**3591**	***ft²***	

Determine Actual Bio-Retention Area

Filter Width	25	*ft*	
Filter Length	128	*ft*	
Filter Area	3200	*ft²*	
Actual Volume Provided	3840	*ft³*	

Determine Runoff Reduction

Is the Bioretention contributing flow to another practice?		No	Select Practice
RRv	1,536		
RRv applied	**1,536**	***ft³***	***This is 40% of the storage provided or WQv whichever is less.***
Volume Treated	2,773	*ft³*	*This is the portion of the WQv that is not reduced in the practice.*
Volume Directed	0	*ft³*	This volume is directed another practice
Sizing √	Error		*Check to be sure Area provided ≥ Af*

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)
k	The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor & Schueler, 1996)

Design Point:	**1**

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft ^{3})*	**Precipitation** *(in)*	**Description**
17	1.34	0.47	0.35	0.37	2665.80	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	35%	0.37	2,666	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	*ft ^{3}*	
Soil Information							
Soil Group		C					
Soil Infiltration Rate		1.00	*in/hour*	*Design as an infiltration bioretention practice*			
Using Underdrains?		Yes	*Okay*				
Calculate the Minimum Filter Area							
				Value		Units	Notes
WQv				2,666		*ft ^{3}*	
Enter Depth of Soil Media			*df*	2.5		*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity			*k*	0.5		*ft/day*	
Enter Average Height of Ponding			*hf*	0.5		*ft*	*6 inches max.*
Enter Filter Time			*tf*	2		*days*	
Required Filter Area			***Af***	**2222**		***ft ^{2}***	
Determine Actual Bio-Retention Area							
Filter Width		90	*ft*				
Filter Length		30	*ft*				
Filter Area		2700	*ft ^{2}*				
Actual Volume Provided		3240	*ft ^{3}*				
Determine Runoff Reduction							
Is the Bioretention contributing flow to another practice?			No	Select Practice			
RRv		1,296					
RRv applied		**1,296**	***ft ^{3}***	***This is 40% of the storage provided or WQv whichever is less.***			
Volume Treated		1,370	*ft ^{3}*	*This is the portion of the WQv that is not reduced in the practice.*			
Volume Directed		0	*ft ^{3}*	This volume is directed another practice			
Sizing √		OK		*Check to be sure Area provided ≥ Af*			

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)

k The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft³)*	**Precipitation** *(in)*	**Description**
18	0.39	0.25	0.64	0.63	1323.73	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	64%	0.63	1,324	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	*ft³*	
Soil Information							
Soil Group		C					
Soil Infiltration Rate		1.00	*in/hour*	*Design as an infiltration bioretention practice*			
Using Underdrains?		Yes	*Okay*				
Calculate the Minimum Filter Area							
				Value		Units	Notes
WQv				1,324		*ft³*	
Enter Depth of Soil Media			*df*	2.5		*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity			*k*	0.5		*ft/day*	
Enter Average Height of Ponding			*hf*	0.5		*ft*	*6 inches max.*
Enter Filter Time			*tf*	2		*days*	
Required Filter Area			***Af***	**1103**		***ft²***	
Determine Actual Bio-Retention Area							
Filter Width		14	*ft*				
Filter Length		84	*ft*				
Filter Area		1176	*ft²*				
Actual Volume Provided		1411	*ft³*				
Determine Runoff Reduction							
Is the Bioretention contributing flow to another practice?			No	Select Practice			
RRv		564					
RRv applied		**564**	***ft³***	***This is 40% of the storage provided or WQv whichever is less.***			
Volume Treated		759	*ft³*	*This is the portion of the WQv that is not reduced in the practice.*			
Volume Directed		0	*ft³*	This volume is directed another practice			
Sizing √		OK		*Check to be sure Area provided ≥ Af*			

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)
k	The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
19	0.20	0.09	0.46	0.47	512.84	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	46%	0.47	513	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	*ft^3*	
Soil Information							
Soil Group		C					
Soil Infiltration Rate		1.00	*in/hour*	*Design as an infiltration bioretention practice*			
Using Underdrains?		Yes	*Okay*				
Calculate the Minimum Filter Area							
				Value		Units	Notes
WQv				513		*ft^3*	
Enter Depth of Soil Media			*df*	2.5		*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity			*k*	0.5		*ft/day*	
Enter Average Height of Ponding			*hf*	0.5		*ft*	*6 inches max.*
Enter Filter Time			*tf*	2		*days*	
Required Filter Area			***Af***	**427**		***ft^2***	
Determine Actual Bio-Retention Area							
Filter Width		16	*ft*				
Filter Length		36	*ft*				
Filter Area		576	*ft^2*				
Actual Volume Provided		691	*ft^3*				
Determine Runoff Reduction							
Is the Bioretention contributing flow to another practice?			No	Select Practice			
RRv		276					
RRv applied		**276**	***ft^3***	***This is 40% of the storage provided or WQv whichever is less.***			
Volume Treated		236	*ft^3*	*This is the portion of the WQv that is not reduced in the practice.*			
Volume Directed		0	*ft^3*	This volume is directed another practice			
Sizing √		OK		*Check to be sure Area provided ≥ Af*			

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)
k	The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
20	0.51	0.43	0.84	0.80	2237.26	1.50	Bioretention
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	84%	0.80	2,237	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	*ft^3*	
Soil Information							
Soil Group		C					
Soil Infiltration Rate		1.00	*in/hour*	*Design as an infiltration bioretention practice*			
Using Underdrains?		Yes	*Okay*				
Calculate the Minimum Filter Area							
				Value		Units	Notes
WQv				2,237		*ft^3*	
Enter Depth of Soil Media			*df*	2.5		*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity			*k*	0.5		*ft/day*	
Enter Average Height of Ponding			*hf*	0.5		*ft*	*6 inches max.*
Enter Filter Time			*tf*	2		*days*	
Required Filter Area			***Af***	**1864**		***ft^2***	
Determine Actual Bio-Retention Area							
Filter Width		17.5	*ft*				
Filter Length		108	*ft*				
Filter Area		1890	*ft^2*				
Actual Volume Provided		2268	*ft^3*				
Determine Runoff Reduction							
Is the Bioretention contributing flow to another practice?			No	Select Practice			
RRv		907					
RRv applied		**907**	***ft^3***	***This is 40% of the storage provided or WQv whichever is less.***			
Volume Treated		1,330	*ft^3*	*This is the portion of the WQv that is not reduced in the practice.*			
Volume Directed		0	*ft^3*	This volume is directed another practice			
Sizing √		OK		*Check to be sure Area provided ≥ Af*			

Porous Pavement Worksheet

$$Ap = Vw / (n \times dt)$$

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
1	0.07	0.07	1.00	0.95	349.60	1.50	Porous Pavement
Enter Soil Infiltration Rate							
Soil Inflitration Rate	1.00	*in/hour*					
Calculate Required Surface Area							
Design Volume	Vw	350	*ft^3*				
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.			
Porosity of Gravel Bed	*n*	0.40	-				
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.			
Required Surface Area	Ap	874	*sf*				
Surface Area Provided		2,944	*sf*	*Dimensions of pavement can be provided here*			
Storage Volume Provided		1,178	*ft^3*				
Determine the Runoff Reduction							
RRv	**350**	***ft^3***					

Porous Pavement Worksheet

$Ap = Vw / (n \times dt)$

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**

Enter Site Data For Drainage Area to be Treated by Practice

Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
2	0.29	0.28	0.95	0.91	1434.72	1.50	Porous Pavement

Enter Soil Infiltration Rate

Soil Inflitration Rate	1.00	*in/hour*	

Calculate Required Surface Area

Design Volume	Vw	1,435	*ft^3*	
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.
Porosity of Gravel Bed	*n*	0.40	-	
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.
Required Surface Area	Ap	3,587	*sf*	
Surface Area Provided		12,022	*sf*	*Dimensions of pavement can be provided here*
Storage Volume Provided		4,809	*ft^3*	

Determine the Runoff Reduction

RRv	**1,435**	***ft^3***	

Porous Pavement Worksheet

$$Ap = Vw / (n \times dt)$$

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
3	0.07	0.06	0.95	0.90	328.12	1.50	Porous Pavement
Enter Soil Infiltration Rate							
Soil Inflitration Rate	1.00	*in/hour*					
Calculate Required Surface Area							
Design Volume	Vw	328	*ft^3*				
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.			
Porosity of Gravel Bed	*n*	0.40	-				
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.			
Required Surface Area	Ap	820	*sf*				
Surface Area Provided		1,994	*sf*	*Dimensions of pavement can be provided here*			
Storage Volume Provided		798	*ft^3*				
Determine the Runoff Reduction							
RRv	**328**	***ft^3***					

Porous Pavement Worksheet

$Ap = Vw / (n \times dt)$

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	1

Enter Site Data For Drainage Area to be Treated by Practice

Catchment Number	Total Area *(Acres)*	Impervious Area *(Acres)*	Percent Impervious *%*	Rv	WQv *(ft^3)*	Precipitation *(in)*	Description
4	0.07	0.07	0.97	0.92	343.72	1.50	Porous Pavement

Enter Soil Infiltration Rate

Soil Inflitration Rate	1.00	*in/hour*	

Calculate Required Surface Area

Design Volume	Vw	344	*ft^3*	
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.
Porosity of Gravel Bed	*n*	0.40	-	
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.
Required Surface Area	Ap	859	*sf*	
Surface Area Provided		1,983	*sf*	*Dimensions of pavement can be provided here*
Storage Volume Provided		793	*ft^3*	

Determine the Runoff Reduction

RRv	**344**	***ft^3***	

Porous Pavement Worksheet

Ap = Vw / (n x dt)

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
5	0.04	0.04	0.88	0.85	192.16	1.50	Porous Pavement

Enter Soil Infiltration Rate				
Soil Inflitration Rate	1.00	*in/hour*		
Calculate Required Surface Area				
Design Volume	Vw	192	*ft^3*	
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.
Porosity of Gravel Bed	*n*	0.40	-	
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.
Required Surface Area	Ap	480	*sf*	
Surface Area Provided		1,590	*sf*	*Dimensions of pavement can be provided here*
Storage Volume Provided		636	*ft^3*	
Determine the Runoff Reduction				
RRv	**192**	***ft^3***		

Porous Pavement Worksheet

$$Ap = Vw / (n \times dt)$$

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
6	0.03	0.03	1.00	0.95	142.74	1.50	Porous Pavement
Enter Soil Infiltration Rate							
Soil Inflitration Rate	1.00	*in/hour*					
Calculate Required Surface Area							
Design Volume	Vw	143	*ft^3*				
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.			
Porosity of Gravel Bed	*n*	0.40	-				
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.			
Required Surface Area	Ap	357	*sf*				
Surface Area Provided		1,124	*sf*	*Dimensions of pavement can be provided here*			
Storage Volume Provided		450	*ft^3*				
Determine the Runoff Reduction							
RRv	**143**	***ft^3***					

Porous Pavement Worksheet

Ap = Vw / (n x dt)

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
7	0.07	0.05	0.66	0.64	255.07	1.50	Porous Pavement
Enter Soil Infiltration Rate							
Soil Inflitration Rate	1.00	*in/hour*					
Calculate Required Surface Area							
Design Volume	Vw	255	*ft^3*				
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.			
Porosity of Gravel Bed	*n*	0.40	-				
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.			
Required Surface Area	Ap	638	*sf*				
Surface Area Provided		1,230	*sf*	*Dimensions of pavement can be provided here*			
Storage Volume Provided		492	*ft^3*				
Determine the Runoff Reduction							
RRv	**255**	***ft^3***					

Porous Pavement Worksheet

$$Ap = Vw / (n \times dt)$$

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**

Enter Site Data For Drainage Area to be Treated by Practice

Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
8	0.16	0.16	1.00	0.95	805.36	1.50	Porous Pavement

Enter Soil Infiltration Rate

Soil Inflitration Rate	1.00	*in/hour*	

Calculate Required Surface Area

Design Volume	Vw	805	*ft^3*	
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.
Porosity of Gravel Bed	*n*	0.40	-	
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.
Required Surface Area	Ap	2,013	*sf*	
Surface Area Provided		3,894	*sf*	*Dimensions of pavement can be provided here*
Storage Volume Provided		1,558	*ft^3*	

Determine the Runoff Reduction

RRv	**805**	***ft^3***	

Porous Pavement Worksheet

$$Ap = Vw / (n \times dt)$$

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
9	0.14	0.14	1.00	0.95	705.02	1.50	Porous Pavement
Enter Soil Infiltration Rate							
Soil Inflitration Rate	1.00	*in/hour*					
Calculate Required Surface Area							
Design Volume	Vw	705	*ft^3*				
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.			
Porosity of Gravel Bed	*n*	0.40	-				
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.			
Required Surface Area	Ap	1,763	*sf*				
Surface Area Provided		3,545	*sf*	*Dimensions of pavement can be provided here*			
Storage Volume Provided		1,418	*ft^3*				
Determine the Runoff Reduction							
RRv	**705**	***ft^3***					

Porous Pavement Worksheet

$Ap = Vw / (n \times dt)$

Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
10	0.22	0.18	0.82	0.79	959.76	1.50	Porous Pavement
Enter Soil Infiltration Rate							
Soil Inflitration Rate		1.00	*in/hour*				
Calculate Required Surface Area							
Design Volume	Vw	960	*ft^3*				
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.			
Porosity of Gravel Bed	*n*	0.40	-				
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.			
Required Surface Area	Ap	2,399	*sf*				
Surface Area Provided		5,504	*sf*	*Dimensions of pavement can be provided here*			
Storage Volume Provided		2,202	*ft^3*				
Determine the Runoff Reduction							
RRv	**960**	***ft^3***					

Porous Pavement Worksheet

$Ap = Vw / (n \times dt)$

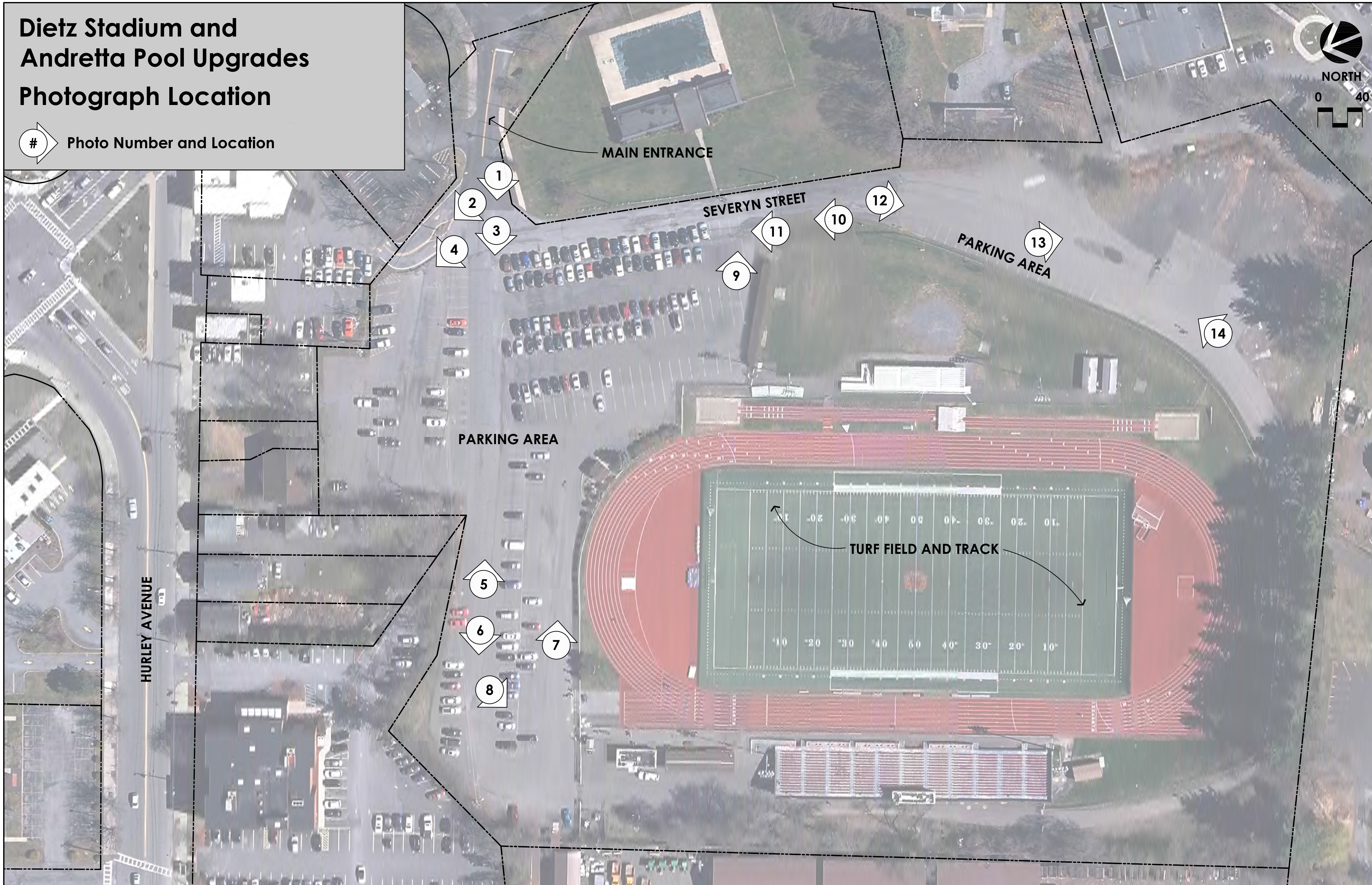
Ap	Required porous pavement surface area	*ft2*	
Vw	Design Volume	*ft3*	
n	porosity of gravel bed/resevoir		*Assume .4 for gravel*
dt	depth of gravel bed/resevoir		

Design Point:	**1**

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
11	0.30	0.30	1.00	0.95	1526.41	1.50	Porous Pavement
Enter Soil Infiltration Rate							
Soil Inflitration Rate		1.00	*in/hour*				
Calculate Required Surface Area							
Design Volume	Vw	1,526	*ft^3*				
Are underdrains being used?		Yes	-	Only Gravel Bed Depth below underdrain can be considered.			
Porosity of Gravel Bed	*n*	0.40	-				
Gravel Bed Depth	dt	1.00	*ft*	Must be the depth below the underdrain.			
Required Surface Area	Ap	3,816	*sf*				
Surface Area Provided		5,506	*sf*	*Dimensions of pavement can be provided here*			
Storage Volume Provided		2,202	*ft^3*				
Determine the Runoff Reduction							
RRv	**1,526**	***ft^3***					

APPENDIX G
SITE PHOTOGRAPHS

Dietz Stadium and Andretta Pool Upgrades Photograph Location



DIETZ MEMORIAL STADIUM

Existing Conditions Photos
(photos taken July 9, 2019)

Photo 1

Overall picture taken from entrance

Photo 2

Overall picture taken from entrance

Photo 3

Drainage structure located adjacent to drive isle

Photo 4

Drainage structure located along edge of parking lot

Photo 5

Overall picture of parking lot showing cracking and patches

Photo 6

Picture of asphalt at drive isle showing cracking

Photo 7

Picture of asphalt at drive isle showing cracking

Photo 8

Overall picture of parking area

Photo 9

Picture looking at Severyn Street showing pavement cracking

Photo 10

Picture from Severyn Street looking at parking area

Photo 11

Picture of drainage structure in parking lot along Severyn Street

Photo 12

Overall picture of parking area from Severyn Street

Photo 13

Overall picture of parking area near basketball court

Photo 14

Overall picture of parking area near basketball court

APPENDIX H
POLLUTANT REMOVAL

Pollutant Load Reduction

Excessive amounts of nutrients such as nitrogen, phosphorus and total suspended solids can harm waterbodies. The goal for this plan is to identify which green infrastructure practices (GIP's), applicable to the project site, will result in the greatest reduction of pollutants . The Simple Method was used estimate pollutant loads from the site or drainage area based on runoff coefficients. The load includes: annual rainfall, percent impervious surface, pollutant event concentration, and area of a particular land use. The method used to estimate load reductions does not account for soil information, slope, or other site specific factors that may influence potential pollution reductions for a practice. Removal efficiencies for each selected BMP were based on accepted efficiencies in accordance with NYS DEC's Stormwater Management Design Manual.

This project proposes the use of porous pavement and bioretention as green infrastructure practices. Porous pavement collects stormwater runoff where it meets the surface and allows infiltration into the native soils below. The bioretention practice captures stormwater runoff and allows infiltration through the filter medium. Both practices are effective at treating surface pollutants, specifically sediment, nitrogen, and phosphorus.

In summary, the project proposes removal of approximately:

0.79 tons of sediment (Total suspended solids (TSS)),
28.98 lbs. of nitrogen, and
4.93 lbs. of phosphorus per year

References

- Total Phosphorus Loading Calculations and Comparisons, the LA Group, August 24, 2004
- NYS Stormwater Management Design Manual, NYS DEC , January 2015

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Pollutant Load Reduction Calculations
City of Kingston - Dietz Memorial Stadium
Jul-19

Simple Method $L = 0.226 * R * C * A$

Where:
L = Annual Load (lbs.)
R = Annual Runoff (inches)
C = Pollutant Concentration (mg/L)
A = Contributing Area (acres)

$R = P * P_j * R_v$

Where:
R = Annual Runoff (inches)
P = Annual Rainfall (inches)
P_j = Fraction of Rainfall Producing Runoff
R_v = Runoff Coefficient; $R_v = 0.05 + 0.009 * (\text{Percent Impervious})$

Description	Variable	Bioretention	Porous Pavement	
Runoff Coefficient	R_v	0.59	0.90	
Annual Rainfall (in)	P	47	47	
Fraction of Rainfall Producing Runoff	P_j	0.90	0.90	
Annual Runoff (in)	R	24.96	37.90	
Area (ac)	A	4.22	1.45	
Phosphorus Pollutant Concentration (mg/L)	C_P	0.34	0.34	
Nitrogen Pollutant Concentration (mg/L)	C_N	2	2	
TSS Concentration (mg/L)	C_{TSS}	54.5	54.5	
Phosphorus Annual Load (lbs.)	L_P	8.09	4.22	
Nitrogen Annual Load (lbs.)	L_N	47.60	24.84	
TSS Annual Load (lbs.)	L_{TSS}	1297.21	676.90	
Phosphorus Removal Efficiency		40%	40%	
Nitrogen Removal Efficiency		40%	40%	
TSS Removal Efficiency		80%	80%	TOTALS
Phosphorus Removed (lbs.)		3.24	1.69	4.93
Nitrogen Removed (lbs.)		19.04	9.94	28.98
TSS Removed (lbs.)		1037.77	541.52	1579.28