

# STORMWATER MANAGEMENT REPORT

*for*

**The Pennington School**

**Proposed Master Plan  
Block 701, Lot 4, Block 502 Lot 4,  
Block 206 Lot 10 & Block 205 Lot 1**

**Pennington Borough  
Mercer County, New Jersey**

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## **I. INTRODUCTION**

This project was designed to accommodate the stormwater runoff conditions that occur as a result of the proposed development at the Pennington School (Block 701, Lot 4; Block 502 Lot 4; Block 206, Lot 10 and Block 205 Lot 1) in Pennington Borough, Mercer County, New Jersey. This report will focus on the improvements on Block 502, Lot 4, as the remaining lots have no proposed development or minor improvements that do not warrant stormwater management measures be implemented.

The development will consist of the construction of two (2) building additions, perimeter landscaping improvements, improvements to existing athletic facilities, and vehicular/pedestrian circulation improvements. The proposed plan also shows a bridge and mulch walking paths which were previously permitted by the New Jersey Department of Environmental Protection (NJDEP) and improvements to the turf football field area that were approved under a separate application. The subject site is located at 112 West Delaware Avenue in the Borough of Pennington, Mercer County, New Jersey. The subject site is operating as a Middle School and High School and will continue to operate as it does today.

The scope of this study focuses on the overall drainage conditions resulting from the proposed site improvements. The proposed development will disturb over an acre of land and result in an increase of 1.028 acres of impervious surface. The increase of impervious coverage is mainly a result of additional pedestrian circulation and roof areas. The total motor vehicle surfaces are decreased by 0.447 acres.

The primary design constraints for this project are based on requirements established in the Pennington Borough Design Standards, Mercer County Design Standards, New Jersey Soil Erosion and Sediment Control Standards, and N.J.A.C 7:8. More specifically, the stormwater management design will serve to maintain existing drainage patterns to the maximum extent practical and reduce proposed runoff rates when compared to pre-development runoff rates. The proposed project will disturb over 1 acre and proposed impervious coverage will be

increased by more than ¼ acre; therefore, the project meets the definition of a “major development” under N.J.A.C. 7:8.

**II. EXISTING SITE CONDITIONS**

The subject site consists of approximately 50.244 acres over the entire campus consisting of 4 lots. The area is currently developed with school buildings and typical school accessories and site improvements. The proposed improvements will be limited to an area of 8.8 acres on Block 502, Lot 4, which is the area of study this report will focus on.

Based on the Mercer County Soil Survey, the soil types native to the site include:

SOIL TYPE	SOIL TYPE NAME	HYDRAULIC SOIL GROUP
BucB	Bucks Silt Loam, 2-6% Slopes	C
PeoB2	Bucks Silt Loam, 2-6% Slopes, eroded	B
PeoB	Penn Channery Silt Loam, 2-6% Slopes	C
PeoD	Penn Channery Silt Loam, 12-18% Slopes	C
RorAt	Rowland Silt Loam, 0-2% Slopes	C
UdbB	Udorthents, bedrock substratum	D
Water	Water	

The site has been evaluated using the TR-55 ‘Urban Hydrology for Small Watersheds’ standards. The disturbed area on this site has two main drainage sheds; the majority of the property drains to the lake and ultimately to the western property line and smaller section drains to West Delaware Avenue into the existing storm sewer and conveyed to the north and west. For purposed of this study we analyzed flow to two (2) existing underground basins which discharge to the pond, one underground basin that discharges to the north, existing flow from the baseball field to the pond, existing overland flow to West Delaware Avenue and flow to the existing storm sewer adjacent to the dining Hall. Below is a description of the drainage sub-watershed areas as depicted on the Existing Drainage Area Map:

Existing underground basin West Parking Lot (to north of turf field): This study point represents the location where all runoff from drainage area contributes to the existing

underground basin under the west parking lot. This study point has been analyzed to show a runoff reduction in the post developed condition when compared to the existing condition.

Existing underground basin south parking lot (to south of gym): This study point represents the location where all runoff from drainage area contributes to the existing underground basin in the south parking lot. This study point has been analyzed to show a runoff reduction in the post developed condition when compared to the existing condition.

Existing underground basin to north of Humanities Building: This study point represents the location where all runoff from drainage area contributes to the existing underground basin adjacent to the Humanities Building. This study point has been analyzed to show a runoff reduction in the post developed condition when compared to the existing condition.

Existing overland to West Delaware Avenue (west): This study point represents the location where all runoff from drainage area contributes to the existing inlet in West Delaware Avenue in front of the Humanities Building. This study point has been analyzed to show the overall drainage area and impervious coverage in the drainage area have been reduced, therefore no SWM controls are necessary.

Existing overland to West Delaware Avenue (east): This study point represents the location where all runoff from drainage area contributes to the existing inlet in West Delaware Avenue. This study point has been analyzed to show peak reductions from the addition proposed visitor parking loop in front of Old Main Building.

Existing baseball field overland flow to pond: This study point represents the location where all runoff from drainage at the proposed underground basin discharge point. This study point has been analyzed to show peak reductions from the addition of the turf field with underground storage.

Existing overland to storm sewer adjacent to dining hall: This study point represents the location where all runoff from drainage area contributes to the existing inlet adjacent to the dining hall. This study point has been analyzed to show the overall drainage area and impervious coverage in the drainage area have been reduced, therefore no SWM controls are necessary.

### **III. PROPOSED SITE CONDITIONS**

The proposed site improvements will result in an overall increase in impervious coverage of 0.764 acre. The proposed design serves to match the existing drainage patterns to the maximum extent practical. The site has been evaluated using the TR-55 'Urban Hydrology for Small Watersheds' standards and with the following proposed drainage sub-watershed areas as depicted on the Proposed Drainage Area Map.

All proposed study points listed in the existing conditions section above were also analyzed under the proposed conditions. The proposed analysis shows that the design is compliant with all applicable rules and regulations. While the design does increase impervious coverage, motor vehicle surfaces has been reduced by 19,465 square feet (0.447 acre).

This analysis shows that the drainage area and peak flows to the three existing underground infiltration basins has been maintained or reduced. All runoff from motor vehicle surfaces that enter these basins is pretreated with existing and proposed porous pavement. These drainage areas will continue to function per the original approval. While these BMP's were installed before the new regulations went into effect, the porous pavement meets all G.I. BMP requirements and the contributing areas to the underground infiltration basins meet the G.I. requirements for small scale infiltration basins, thus this design is still compliant with the regulations currently in place.

The analysis also shows that flows to the existing inlet in West Delaware adjacent to the Humanities Building and the on-site inlet adjacent to the dining hall receive overland flows that

have both reduced areas, reduced motor vehicle surfaces and reduced peak runoff rates, thus demonstrating the adjacent existing stormwater infrastructure will have no negative impacts and will function as it does currently. No additional SWM controls are necessary in this location.

There are rain gardens proposed adjacent to Stainton Hall. These are for aesthetics and landscaping features. They are not modeled as BMP's and do not account for the additional storage volume they provide, thus making the design more conservative.

Finally, we have analyzed the proposed underground basin adjacent to Old Main Building, proposed underground basin north of the gymnasium and a turf baseball field with underground storage. The proposed basin at Old Main collects no motor vehicles surfaces and the gymnasium pretreats motor vehicle surfaces with porous pavement which is an approved G.I. BMP. No motor vehicle surfaces contribute to the baseball field and the storage under the field is for water quantity purposes only.

#### **IV. DESIGN METHODOLOGY**

The design intention of the proposed stormwater management facilities for this project is to provide measures as required to address applicable aspects of the Pennington Borough Design Standards, Mercer County Design Standards, New Jersey Soil Erosion and Sediment Control Standards, and N.J.A.C 7:8. In order to prepare the stormwater management design for the subject project, an initial investigation of the property was performed. On-site review of the tract was performed by Van Cleef Engineering Associates to verify existing site conditions and land cover characteristics.

Based upon our review of the existing site conditions and the Boundary & Topographic Survey prepared by Van Cleef Engineering Associate, the Drainage Area Maps for the existing and proposed site conditions as defined within this report were established. A Grading Plan was developed for the proposed site improvements with consideration to the existing drainage

patterns to the maximum extent practicable. The site was designed to ensure that the runoff to the existing stormwater management facilities did not exceed current conditions with regards to both peak flow and volume to ensure they would continue to operate per their previous approved design. The project was designed to ensure runoff from the proposed development would meet the required peak flow rate reductions of 50%, 75% and 80% for the 2-year, 10-year, and 100-year storm events respectively. Anticipating new rule changes from NJDEP, the 2-year, 10-year, and 100-year storm events were modeled using the Mercer County Precipitation Factors in NJDEP Draft rules. The 2-year, 10-year, and 100-year storm events were modeled with 3.84 inch, 5.86 inch and 11.33 inch rainfalls, respectively.

Stormwater runoff generated by the proposed improvements will be collected via a series of inlets and underground pipes and conveyed into detention basins and then discharged to the Study Points discussed above. The storm sewer design accommodates the 25-yr design storm utilizing the Rational Method under free flowing conditions. Associated calculations are included in the Appendix of this report.

Based upon the scope of the project, the development is classified as a major development; and therefore, the project has been designed to meet the stormwater runoff quantity set forth by the Pennington Borough Design Standards, Mercer County Design Standards, and NJAC 7:8.

The following items are addressed within this report:

- Erosion control and runoff quantity standards
- Stormwater runoff quality standards
- Calculation of stormwater runoff
- Green Infrastructure Techniques

Runoff volumes for the site were modeled utilizing HydroCAD computer software using the Urban Hydrology for Small Watershed TR55 method for the applicable design storms. The 2-, 10- and 100-year quantity design storms are based upon the New Jersey 24-Hour Rainfall Frequency Data for Mercer County as published by the USDA NRCS utilizing a Type C rainfall distribution. Curve number calculations have been included within the Appendix and are based upon The Hydrologic Soil Groups as identified by the Mercer County Soil Survey. Pervious and



impervious areas were modeled separately as suggested in the NJDEP Stormwater Management Best Management Practices Manual. All porous paving and porous pavers were modeled as an impervious surface to be conservative.

Stormwater Quality standards were met with the use of Porous Pavement or Porous Pavers for 80% TSS removal. The NJDEP BMP manual lists porous pavement as an acceptable Green Infrastructure BMP for water quality purposes. Additionally, the underground basin under old main meets the criteria for a small scale infiltration basin. The underground basin north of the gymnasium is designed as an underdrain system and will not infiltrate.

## **V. RUNOFF RATE REDUCTION PERFORMANCE**

This project proposes to meet peak runoff reduction rates by either demonstrating that the size of the drainage area has been reduced (pre vs. post construction) or runoff to existing stormwater management facilities were reduced by proposing the construction of new BMP's to demonstrate that the required peak reduction rates are met for the 2-yr, 10-yr and 100-yr storms (50%, 75% and 80%, respectively).

Three of the study areas focus on the existing underground basins. All motor vehicle surfaces are treated with existing and or proposed porous pavement prior to entering the basins. The following is a comparison of drainage areas and runoff comparisons for each to demonstrate the proposed development will not impact the performance of existing BMP's:

### **Existing underground basin West Parking Lot (to north of turf field)**

Ex. Drainage Area = 10,155 sf

Prop. Drainage Area = 7,600 sf

	Existing (Disturbed Area) Runoff (cfs)	Proposed Runoff (cfs)
<b>2 Year</b>	0.5	0.5
<b>10 Year</b>	0.9	0.8
<b>100 Year</b>	2.2	1.8

**Existing underground basin south parking lot (to south of gym)**

Ex. Drainage Area = 94,220 sf

Prop. Drainage Area = 90,474 sf

	Existing (Disturbed Area) Runoff (cfs)	Proposed Runoff (cfs)
<b>2 Year</b>	6.9	6.2
<b>10 Year</b>	11.7	10.2
<b>100 Year</b>	23.4	21.7

**Existing underground basin to north of Humanities Building**

Ex. Drainage Area = 27,426 sf

Prop. Drainage Area = 22,429 sf

	Existing (Disturbed Area) Runoff (cfs)	Proposed Runoff (cfs)
<b>2 Year</b>	1.3	1.1
<b>10 Year</b>	2.3	2.0
<b>100 Year</b>	5.3	4.6

**Existing overland to West Delaware Avenue (west)**

Ex. Drainage Area = 42,404 sf

Prop. Drainage Area = 34,552 sf

	Existing (Disturbed Area) Runoff (cfs)	Proposed Runoff (cfs)
<b>2 Year</b>	2.0	1.5
<b>10 Year</b>	3.7	2.9
<b>100 Year</b>	8.8	6.9

The following is a comparison of overall pre- and post- development runoff rates for the proposed BMPs within project disturbance area as required by N.J.A.C. 7:8:

**Proposed underground basin to West Delaware Avenue (east)**

	Existing (Disturbed Area) Runoff (cfs)	Allowable Runoff (cfs)	Proposed Runoff (cfs)
<b>2 Year</b>	2.1	1.05	0.8
<b>10 Year</b>	3.8	2.85	2.6
<b>100 Year</b>	8.4	6.72	6.7

**Existing baseball field overland flow to pond**

	Existing (Disturbed Area) Runoff (cfs)	Allowable Runoff (cfs)	Proposed Runoff (cfs)
<b>2 Year</b>	2.6	1.3	1.3
<b>10 Year</b>	5.1	4.28	2.9
<b>100 Year</b>	11.9	9.52	8.7

## **VI. GROUNDWATER RECHARGE**

Ground water recharge is met by utilizing the proposed porous pavers and underground small scale infiltration basin on the north side of the Old Main Building. The ground water analysis spreadsheet shows the proposed site coverage has an annual recharge deficit of 4,412 cubic feet and the infiltration basin will provide 42,014 cubic feet of recharge, thus groundwater recharge is met utilizing a Green Infrastructure BMP.

## **VII. STABILITY ANALYSIS**

Per the NJ Soil Erosion and Sediment Control Standards, Section 21, “Standard for Off-Site Stability,” compliance has been met for the proposed study point. A rip rap apron has been designed pursuant to the NJ SESC Standards at the basin outfall. Downstream flows during every storm event have also been analyzed to the Study Point and have been determined to meet the 50%, 75%, and 80% reductions for the 2-year, 10-year and 100-year storm events respectively (including bypass areas), therefore meeting the conditions of the NJ SESC Standards Section 21-1 at the study point. Additionally, we have analyzed existing site discharges to demonstrate that all flows are reduced from the current conditions, where previous approvals for stability have been obtained.

## **VIII. WATER QUALITY ANALYSIS**

Runoff to all existing stormwater management features pretreats motor vehicle surfaces with existing porous pavement. As indicated in the “Rate Runoff Reduction Performance” section above, all existing BMPs have smaller contributing drainage areas and less contributing runoff than the existing condition.

New motor vehicle surfaces on campus are treated for water quality with porous pavement before it enters the proposed basin north of the gym. The flow area to the porous pavement is 18,860 sf and the area of the porous pavement is 6565 sf, thus the ratio is less than the maximum of 3:1 allowed by the NJDEP BMP Manual.

The proposed infiltration basin in front of the Old Main Building collects no motor vehicle surfaces and pre-treatment is not required. The total contributing area is 1.26 acres.

The systems described above treat all motor vehicle surfaces with porous pavement to remove 80% of T.S.S. in accordance with the NJDEP BMP Manual.

## **VIII. CONCLUSION**

The proposed project has been designed in a manner that will not adversely impact the existing drainage patterns, adjacent roadways or adjacent parcels. The stormwater runoff rates for the 2, 10, and 100-year design storms have been designed to meet the required reduction rates. The stormwater runoff rates for the project disturbance area for the 2, 10, and 100-year design storms meet or exceed the reduction criteria set forth by N.J.A.C. 7:8 under free flow conditions. With that stated, it is evident that the proposed development meets all regulatory requirements and will not have a negative impact on any existing stormwater management systems within the vicinity of the subject parcel.