Stormwater Drainage Report

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for

North Street Condominiums

Northampton, MA

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I. Introduction

The following report presents an analysis of the stormwater management system for the proposed development of 23 housing units located off of Northern Avenue in zoning district URB in Northampton, Massachusetts. The proposed development includes 23 new housing units and associated parking areas, driveways (approximately 1009 LF), and sidewalks, utilities, landscape features and stormwater management system. The total site area is approximately 6 acres of which approximately 2.48 acres will be disturbed by construction activities. The impervious area on site will increase by approximately 1.04 acres due to the new development and the stormwater management system has been designed to minimize proposed peak flows to reduce or match existing flows off the site. Mechanisms to reduce runoff and treat water quality include rain gardens, a proprietary treatment chamber, snow melt trenches, dry wells, deep sump hooded catch basins, and a detention basin.

II. Site Terrain and Soils

The project site is comprised of gradual sloping terrain, which generally drains toward the wetlands on the west part of the site.

The USDA Soil Survey of Hampshire County, Massachusetts, Central Part report classifies the site soils as (see attached soil map):

- **(Ra) Raynham Silt Loam**

  Hydrologic Group: C
  Flood Risk: None
  Depth to Water Table: 0.5'-2.0'
  Depth to Bedrock: >60"

- **(Au) Amostown-Windsor Silty Substratum**

  Hydrologic Group: C
  Flood Risk: None
  Depth to Water Table: 1.5'-3.0'
  Depth to Bedrock: >60"

- **(Ud) Udorthents Smooth**

  Soil formed by cutting or filling developed area**.**
  Reference pedon not given.
  Assumed Hydrologic Group: C

A series of test pits were conducted on site to determine subsurface conditions. The purpose of the test pits was to evaluate the site for the existence of ledge, the ability of the site to support stormwater drainage components, and for groundwater information. In general, the test pits confirmed the USDA Soil Survey findings for the site as ground water is generally very high throughout the site, thereby reducing the potential areas where infiltration would be feasible. The test pit logs are attached in Appendix B.

III. Existing Conditions

The existing site includes one drainage area: E-1. The existing drainage area boundary is depicted on the Pre-Development Drainage Area Plan (Figure 1). The overall curve number (CN) in existing conditions is 74. The control point to determine peak flow in existing conditions is the stream located on the property line west of the site shown on Figure 1 as E-CP. The following is a brief description of the drainage area:

E-1
E-1 is approximately 7.84 acres in size (approximately 0.14 acres of impervious area) and contains existing houses, pavement, grass, wooded areas, and a large wetland area on the west part of the site. Runoff flows overland in a southwestern direction through the wetlands and to the stream located southwest of the site.

IV. Proposed Conditions

The stormwater management system in proposed conditions has been designed to treat and reduce runoff on site. The proposed site contains four drainage areas: P-1, P-2, P-3, and P-4 (See Figure 2) and the overall curve number (CN) in proposed conditions is 78. The control point to determine peak flow in proposed conditions is the stream located on the property line located west of the site shown on Figure 2 as P-CP. The following is a brief description of each drainage area:

P-1
P-1 is approximately 5.68 acres in size and contains the northwestern area of the site consisting of all of the wetland area, grass and wooded areas, and new roof and pavement, as well as new sidewalks and retaining walls. The drainage follows a similar pattern as in existing conditions. It flows overland in a southwestern direction through the wetlands and to the stream located southwest of the site. The runoff from the new roof areas located within P-1 is directed to dry wells where the water is infiltrated into the ground. These dry wells are designed to be very shallow (approximately one foot in depth) due to high groundwater throughout the site. The dry wells are designed with an overflow

outlet that allows roof water to sheet flow overland toward the wetlands as it does in existing conditions in larger storms.

P-2
P-2 is approximately 0.48 acres in size and is located in the central eastern portion of the site. It contains the front portion of the roof areas from units 15-20 as well as a portion of the new road and grassed areas. The runoff from this area is directed to a rain garden which has been sized to clean and remove pollutants from the stormwater as well as infiltrate it into the ground prior to discharging toward the wetlands.

P-3
P-3 is approximately 0.57 acres in size and is located in the eastern part of the site. It contains new pavement, sidewalks, grass, roof areas from units 1-4, and existing wooded areas. Runoff from this area is directed to a catch basin or stone/sod system which pretreats the stormwater prior to entering a rain garden sized to clean and remove pollutants from the stormwater as well as infiltrate it into the ground prior to discharging toward the wetlands.

P-4
P-4 is approximately 1.10 acres in size and is located in the southern part of the site. It contains the majority of the new pavement and the front roof areas from units 5-14 as well as detention basin and walkways. It also contains existing grass and wooded areas along the property line. Roof runoff is directed into dry wells to be infiltrated and the new paved areas are directed into deep sump hooded catch basins, which flow into a stormwater treatment chamber (STC 900) which removes pollutants prior to discharging into the detention basin located adjacent to unit 14.

V. Calculations and Design

Drainage calculations were performed on Hydrocad Stormwater Modeling System version 8.0 using Soil Conservation Service (SCS) TR-20 methodology. The SCS method is based on rainfall observations, which were used to develop the Intensity-Duration-Frequency relationship, or IDF curve. The mass curve is a dimensionless distribution of rainfall over time, which indicates the fraction of the rainfall event that occurs at a given time within a 24-hour precipitation event. This synthetic distribution develops peak rates for storms of varying duration and intensities. The SCS distribution provides a cumulative rainfall at any point in time and allows volume dependent routing runoff calculations to occur. These calculations are included in the appendices.

The watershed boundaries for calculation purposes are divided according to the proposed site grading and the natural limits of the drainage areas. The curve

numbers (CNs) and times of concentration for the existing and proposed subcatchment areas are based on the soil type and the existing and proposed cover conditions at the site. The soil hydrologic group assumed for the site is noted in Figure 3. Watershed subcatchment areas, runoff coefficients and watercourse slopes are based on survey information.

Calculations were performed for the 2-, 10-, and 100-year frequency storms under existing and proposed conditions. The results of the calculations are presented in Table 1 on the following page. Appendix A presents the Hydrocad calculations.

Flow Rates & Water Quantity

In the post development conditions the runoff from the proposed site will be routed to a detention basin located in the south area of the site. The proposed detention basin is composed of both surface and underground storage. There is a pipe and header system connected to the surface detention basin which provides additional storage. The basin will attenuate peak flows up to the 100-Year Storm in proposed conditions through the use of an outlet control structure. Stormwater will be discharged to the wetlands as runoff does in existing conditions. In addition to the detention basin, 8 infiltration systems are proposed (2 rain gardens and 6 dry wells) which will provide a significant reduction in peak flows (through exfiltration); however these systems were not included in the Hydrocad calculations in order to provide a more conservative runoff quantity calculation. Table 1 on the following page presents the comparison of flow rates and water quantity at both existing and proposed control points based solely on the detention basin's attenuation capacity.

Table 1 Peak Flow and Volume Summary

Condition & Point of Analysis	2-Year Storm 3.00"		10-Year Storm 4.50"		100-Year Storm 6.50"	
	Peak Flow Rate(cfs)	Volume (acre-ft)	Peak Flow Rate(cfs)	Volume (acre-ft)	Peak Flow Rate(cfs)	Volume (acre-ft)
Existing – Control Pt. (E-CP)*	*4.71*	*0.569*	*11.07*	*1.256*	*21.00*	*2.346*
Proposed – Control Pt. (P-CP)*	*4. 71*	*0.705*	*11.06*	*1.446*	*20.85*	*2.586*

**Names in parentheses refer to HydroCad model and calculations.*

VI. MADEP Stormwater Standards Compliance

The following section details how the project will meet DEP Stormwater Management Policy's ten stormwater management standards.

Standard 1 - Untreated Stormwater

The proposed stormwater system is designed to treat the new point source discharge prior to flowing to the resource area. All new outlets are outfitted with flared ends and erosion protection to prevent any erosion from occurring in the area. See Appendix C for TSS removal summary.

Standard 2 - Post-Development Peak Discharge Rates

The stormwater system is designed so that post-development peak discharge rates *are less than* pre-development peak discharge rates leaving the site. In order to reduce runoff rates in proposed conditions a detention basin with an outlet control structures is proposed. Note that although 8 infiltration systems are proposed, they are not included in the runoff calculations in order to maintain a more conservative peak discharge rate. Refer to Table 1 Peak Flow and Volume Summary and Appendix A for HydroCAD calculations.

Standard 3 - Recharge to Groundwater

The proposed site has designed to recharge groundwater to the maximum extent practicable in proposed conditions. The entire site consists of hydrologic group "C" soils and there is very high groundwater throughout most of the site (see Appendix B for test pit logs). The soil conditions caused limitations for infiltration on many areas of the site because the required 2 feet separation from groundwater could not be met. Wherever possible, infiltration has been proposed and approximately 66.4% of the new impervious area will be directed to an infiltration system. The rain garden located between units 19 and 20/21 has been designed to infiltrate the impervious areas located within subcatchment P-2, and the rain garden adjacent to unit 4 has been designed to infiltrate the impervious areas located within subcatchment P-3. In addition to the rain gardens, the new roof areas that are not discharging to a rain garden are connected to a shallow dry well system designed to recharge roof runoff into the ground. Due to restrictions of the site terrain and soil conditions, not all of the impervious area could be directed to an infiltration system, therefore all 8 of the infiltration systems are oversized to maximize the amount of infiltration on site. They are designed to hold at least twice the required recharge volume directed to it and still drawdown within 72 hours in order to fully comply with Standard 3 requirements (see Appendix D for recharge calculations).

Standard 4 – Water Quality

The proposed stormwater management system has been designed to remove the average annual Total Suspended Solids (TSS) load equal to or in excess of 80%

for the proposed site conditions (see Appendix C for calculations). There are 3 treatment chains proposed:

Treatment Train 1(total of 90% TSS removed)
The first treatment chain treats the roof areas and paved impervious areas within P-2. The runoff is directed through a pre-treatment system consisting of a stone diaphragm and grassed area which discharges into a rain garden which achieves a total annual TSS removal rate of approximately 90%. The water quality basin has been designed to hold a larger volume of water (706cf) than the water quality volume required (463cf) for the impervious area directed to it.

Treatment Train 2(total of 90% TSS removed)
The first treatment chain treats the roof areas and paved impervious areas within P-3. The runoff is directed through a pre-treatment system consisting of a stone diaphragm and grassed area which discharges into a rain garden which achieves a total annual TSS removal rate of approximately 90%. The water quality basin has been designed to hold a larger volume of water (317cf) than the water quality volume required (278cf) for the impervious area directed to it.

Treatment Train 3(total of 80% TSS removed)
The third treatment chain treats all of the roof areas from the new units. The roof areas are directed into a shallow dry well sized to hold the water quality volume and achieve a total annual TSS removal rate of approximately 80%. Although each of the roof areas are not hydraulically connected, they are considered to be within the same treatment chain as they all utilize the same BMP (dry well). See Appendix C for water quality and BMP sizing calculations.

Treatment Train 4(total of 83% TSS removed)
The second treatment chain treats the impervious areas from P-4. The runoff is directed into deep sump hooded catch basins (25% TSS removal) and then to a proprietary treatment chamber (*Stormceptor STC 900, 77% TSS removal) which achieves a total TSS removal rate of approximately 83%.

**Note: The stormwater treatment chamber has been sized based on MASTEP test evaluations. The attached table in appendix C displays MASTEP evaluated TSS removal rates based on the impervious area directed to the system.*

In addition to removal of TSS, a Long Term Pollution Prevention Plan has been created to maintain a clean site and ensure that all BMPs are functioning to their maximum potential. See Appendix F for Long Term Pollution Prevention Plan.

Standard 5 - Higher Potential Pollutant Loads
The proposed project is not expected to yield high potential pollutant loads.

Standard 6 - Protection of Critical Areas
The project site does not discharge to critical areas as defined in MA DEP Stormwater Policy Handbook.

Standard 7 - Redevelopment Projects
The redevelopment of previously developed site standard is not applicable for this project.

Standard 8 - Erosion/Sediment Control
Erosion and sediment controls have been incorporated into the project design to prevent erosion, control sediments, and stabilized exposed soils during construction and land disturbance. See Appendix G for Construction Period Pollution Prevention and Erosion Sedimentation Control.

Standard 9 - Operation/Maintenance Plan
An Operation and Maintenance Plan for the proposed project is included in Appendix E. It includes general controls for construction and long term maintenance of the stormwater management system.

Standard 10 – Prohibition of Illicit Discharges
No Illicit Discharge Compliance Statement is included with this report however one will be submitted prior to the discharge of any stormwater to post-construction BMPs.

VII. Summary

The impervious area from existing to proposed conditions will increase by approximately 1.04 acres from the new roadway, walks, walls, and housing units. The proposed stormwater management system is designed to maintain or reduce the peak flow rates in proposed conditions for the 2-, 10-, and 100-year storm frequencies. Special care has been taken to treat runoff with a series of best management practices to ensure water quality and annual TSS removal rates equal to or in excess of 80%. These methods include deep sump hooded catch basins, rain gardens, dry wells, and a stormwater treatment chamber.

VIII. References

United States Department of Agriculture. 1998. Soil Survey of Hampshire County (Central Part), Massachusetts.