Rip Rap Sizing Calculations

Millbury Jr/Sr HS Track and Field Renovations
Gale JN: 716383

Designed by: MJL

Q (CFS)	0.83
D (ft)	0.50
TW (ft)	0.20
D_{50} (ft)	0.19
D_{50} (in)	2.33

Q: Design Discharge (must insert this value)
D: Diameter of discharge pipe (must insert this value)
TW: tailwater, depth of receiving water. If unknown, us 0.4*

$$D_{50} = 0.2\,D\left(\frac{Q}{\sqrt{g}\,D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

where,
- D_{50} = riprap size, m (ft)
- Q = design discharge, m^3/s (ft^3/s)
- D = culvert diameter (circular), m (ft)
- TW = tailwater depth, m (ft)
- g = acceleration due to gravity, 9.81 m/s^2 (32.2 ft/s^2)

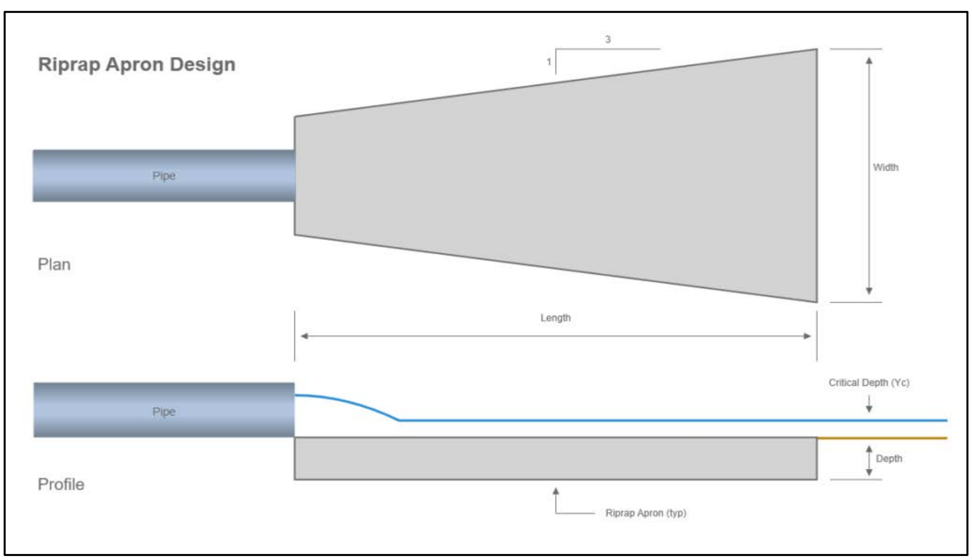
D50 is the diameter of the particle where 50% of a sample's mass is smaller than that sieve size, and 50% of a sample's mass is larger than

Use the calculated D50 to determine the RipRap Class in the table below.

Use the RipRap Class to determine the necessarry riprap apron length, depth and

Rip Rap Class	D_{50} (in)
1	5
2	6
3	10
4	14
5	20
6	22

Minimum Rip Rap Apron Dimensions			
	Apron Length (ft)	Apron Depth (in)	Apron Width (ft)
Class 1	2.00	8.16	2.83
Class 2	2.00	7.69	2.83
Class 3	2.50	5.59	3.17
Class 4	3.00	5.13	3.50
Class 5	3.50	4.66	3.83
Class 6	4.00	4.66	4.17



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OPERATION & MAINTENANCE PLAN
MILLBURY JR/SR HS TRACK AND FIELDS RENOVATIONS PROJECT

SECTION IV – ILLICIT DISCHARGE STATEMENT

Standard 10 of the Massachusetts Stormwater Regulations prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating and infiltrating stormwater on site, including stormwater best management practices and any pipes intended to transport stormwater to the ground water, a surface water, or municipal separate storm sewer system.

Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing, and water used to clean residential buildings without detergents.

I, Richard G. Bedard, JR. (print name), certify that I have conducted a proper site investigation and verify that to the best of my knowledge there are no illicit discharges located at the MILLBURY JR/SR HIGH SCHOOL ATHLETIC FACILITIES.

Signature R. Bedard Jr.

Date 3/11/2020

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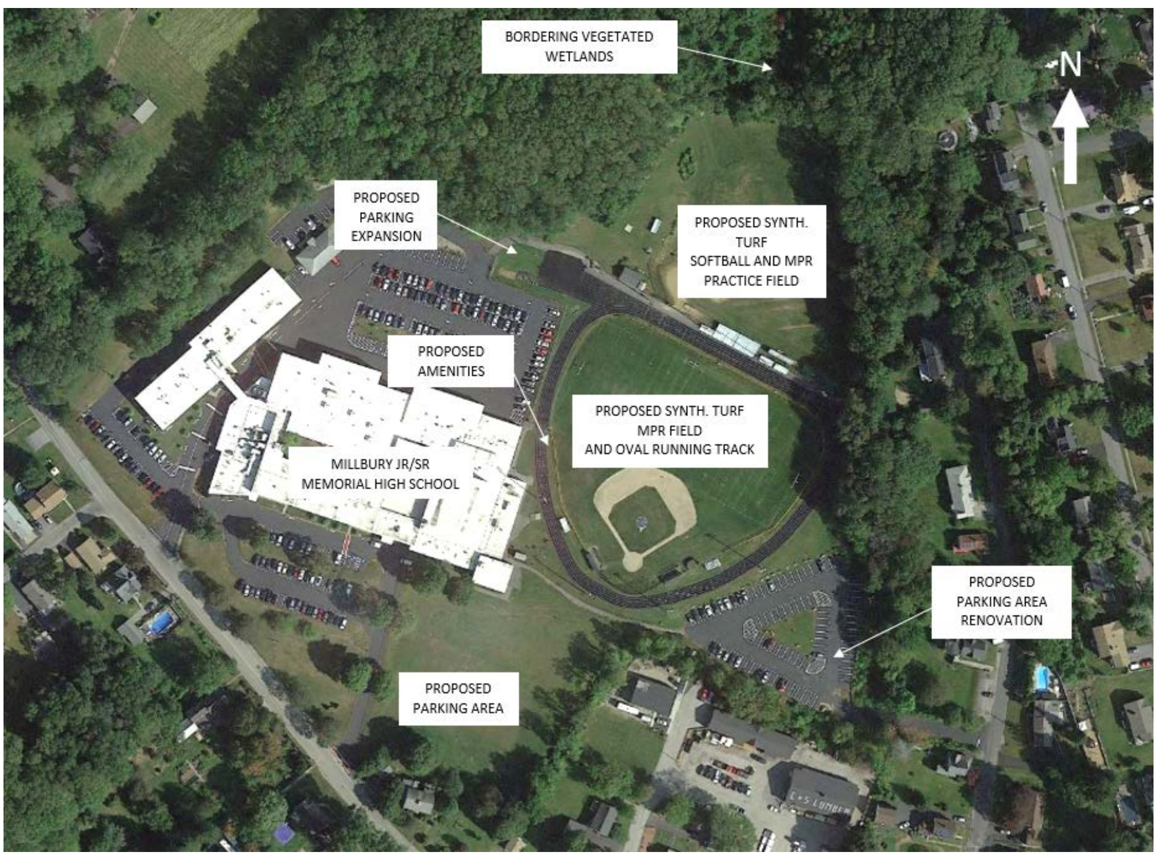
Millbury Public Schools
Richard G. Bedard, Jr.
12 Martin Street
Millbury, MA 01527

2.0 PROJECT DESCRIPTION

Millbury Public Schools (MPS) is proposing to improve the existing athletic campus located to the east of Millbury Jr/Sr High School at 12 Martin Street, Millbury, Massachusetts. The part of the athletic campus that is being renovated consists of a multipurpose rectangular (MPR) natural turf field, a natural turf baseball field, synthetic running track, and a natural turf softball field, all of which are used by the Middle and High School students and athletes for football, soccer, lacrosse, field hockey, track and field, cheerleading and physical education. The project also consists of parking improvements including renovations to the parking lot to the southeast, expansion of the parking lot to the northwest, and a new parking lot to the southwest of the athletic complex.

The athletic complex is located east of the High School, west of single-family residential homes, north of mixed single-family residential homes and commercial buildings, and south of a bordering vegetated wetland (BVW).



Renovations to the athletic campus include:

- Converting the existing natural turf MPR field into a durable, multipurpose, all-weather synthetic turf field that can sustain all the Millbury Jr/Sr High School's athletics programs including football, soccer, lacrosse, field hockey and cheerleading.
- Reconstructing the existing running track into an eight-lane straightaway and six-lane oval running track.
- Converting the existing natural turf softball field into a durable, all-weather synthetic turf softball and multipurpose practice field that can sustain all the Millbury High School's athletics programs including football, soccer, and cheerleading.
- 750 seat aluminum grandstand that includes a press box, with ADA access.
- 1,200 SF amenities building that includes restrooms, equipment storage, concessions and a ticket sales room.

Other site improvements include:

- New walkways throughout the site.
- Parking improvements including removing the southeastern parking lot off of Orchard Street and converting this area into an emergency vehicle access point, expansion of the parking area to the northwest of the complex, and a new parking area to the southwest of the campus.
- Site security/safety lighting.

A Notice of Intent (NOI) is being filed with the Town of Millbury Conservation Commission and the Massachusetts Department of Environmental Protection (MA DEP) for the proposed work. This Stormwater Report is also being filed with the Millbury Planning Board as part of the Site Plan Review permit submission. The Town of Millbury does not have any Town by-laws for wetland protection. However, the proposed renovations to the softball field are within the 100' Bordering Vegetated Wetland (BVW) buffer protected under the MA DEP Wetland Protection Act. The buffer zone is discussed in more detail below and is depicted within the accompanying plan set and supporting information.

2.1 Existing Conditions

The athletic complex property in which the renovations are being proposed on totals approximately 30 acres of land consisting of public schools, athletic facilities, parking lots, wetlands, and woodlands.

The site is a single parcel and is zoned within the "Residential I (R-1)" District.

3.0 WETLANDS AND ENVIRONMENTAL RESOURCE AREAS ANALYSIS

Gale Associates, Inc. (Gale) engaged LEC Environmental Consultants, Inc. (LEC) who conducted a site evaluation and Wetland Resource Area Analysis at Millbury Memorial Jr/Sr High School parcel in Millbury, Massachusetts on November 15, 2019. LEC's site evaluation was conducted in accordance with the Massachusetts Wetlands Protection Act (M.G.L. c. 131, s.40) and its implementing Regulations (310 CMR 10.00). The following report provides a general site description, wetland delineation methodology and a description of the Wetland Resource Areas and potential regulatory implications.

Wetland Boundary Determination Methodology

The wetland delineation was focused on areas located within 200 feet of the proposed athletic playing fields and adjacent parking lot as depicted on the *Millbury Jr/Sr High School Track and Field Renovations Project Plans*, prepared by Gale, dated January 24, 2020. The project is adjacent to woodlands to the north of the softball field where a bordering vegetated wetland (BVW) was identified. *BVW* is defined at 310 CMR 10.55 (2) (a) *as freshwater wetland which border on creeks, rivers, streams, ponds, and lakes. In these areas' soils are saturated and/or inundated such that they support a predominance of wetland indicator plants. The boundary of BVW is the line within which 50% or more of the vegetational community consist of wetland indicator plants and saturated or inundated conditions exist.*

LEC Environmental Consultants, Inc. (LEC) identified and demarcated the boundary of the BVW system that runs adjacent to the northern softball field at the Millbury Jr/Sr High School athletic facility predominantly by the dominance test of hydrophytic vegetation and other wetland indicators. The boundary of the BVW was demarcated in the field with blaze orange, surveyors flagging tape embossed with the words "BVW-1" in bold, black print. Wetland flags are numbered BVW-1 to BVW-15. The flags were surveyed on November 19, 2019. The BVW line is shown on the attached plans dated January 24, 2020. It should be noted that MassGIS identifies a drainage connection along the Eastern property line. LEC does not believe this area is jurisdictional based on the topographic gradient of the swale, and the lack of a predominantly wetland plant community and hydric soil indicators.

Regulatory Implications

Due to its adjacency to a BVW, the project falls within MassDEP state and local buffer and protection zones. The following is a summary of the buffer and protection zones that portions of the project are proposed within:

1) <u>100' Bordering Vegetated Wetland (BVW) Buffer (310 CMR 10.55).</u>

   Portions of the proposed improvements, including, but not limited to improved drainage, replacement of the existing natural grass softball field to synthetic turf, and installation of chain link fencing are proposed within the 100' BVW buffer zone. The amount of disturbed or improved areas within the buffer zone is equal to approximately 0.24 acres. As discussed in the section above, the proposed improvements will improve the quality and the peak flows of the runoff into the BVW from within the 100' BVW buffer.

In summary, the only work proposed that is within the environmental area of concern is the replacement of the existing natural grass softball field to synthetic turf. A crushed stone base for the synthetic turf field will be constructed to detain the stormwater and promote infiltration into the ground, instead of stormwater sheet flowing into the wetland as it does in its existing condition. This is discussed further in Section 6.0.

4.0 <u>SOILS INVESTIGATION</u>

A Soils Report is provided as Attachment 4. Information was taken from the USDA Natural Resources Conservation Service (NRCS) Soil Survey Report, as well as onsite investigations, including borings and test pits. The NRCS soils mapping indicates that the majority of the project site is defined as "651 Udorthents – smooth". The eastern portion of the athletic facility is defined as "260A – Sudbury fine sandy loam" and "420-B – Canton fine sandy loam." The southern section of the site, adjacent to Martin Street, is defined as "245B – Hinckley loamy sand." The northern portion of the site where the existing softball outfield is located is defined as "52A – Freetown muck."

A site soil evaluation was performed by Gale and has also been included within Attachment 4. A total of six (6) borings and seven (7) test pits were performed throughout the athletic facility. Refer to Attachment 4 for boring and test pit locations. The results of the test pits indicate that the soils on site generally consists of sandy loam fill and gravelly sand. A sandy-loam topsoil is present in the surface layer of the field to approximately 14-18" deep. The topsoil is underlain in the majority of areas by a gravelly sandy loam and/or loamy sand fill to depths of approximately 19-56". Curve number (CN) values for infiltration computations for most of the site were based on Hydrologic Soil Group B (HSG B), based on the high amount of sandy loam and loamy sand material discovered in the surficial layers. The HSG B classification is conservative for the amount of medium to fine sand materials discovered throughout the test pits. HSG B is considered to be a "sandy loam" or "loam" material with an infiltration rate (Rawl's Rate) between 0.52 – 1.02 inches per hour. We have used this rate of 1.02 inches per hour in all recharge calculations. The breakdown of curve numbers can be seen in the Hydrology Report, which are included in Attachment 6 and 7.

5.0 <u>STORMWATER MANAGEMENT CONCEPT</u>

To gain an understanding of the site hydrology in its current condition, Gale completed an on-site assessment and reviewed as built and design plans for the School campus. The following section describes the watershed analysis and current hydrologic condition of the site.

5.1 Pre-Development Condition

The project site, and surrounding areas have been broken down into five (5) existing sub-watersheds that reflect the contributing areas of runoff to the design points. Existing topography was used to determine the watershed areas. Refer to Sheet EWS under Attachment 5 for the Existing Watershed Map.

The five (5) existing watershed areas are described in more detail below.

5.1.1 Pre-Development Watershed Areas

<u>Existing Watershed Area 1 (EWS-1):</u>

EWS-1 generally includes runoff from the northeastern parking lot which consists of asphalt surfacing and grass islands. The runoff from this watershed flows into a closed drainage system which flows offsite at Martin Street, or Design Point 1 (DP-1).

Sub-Watershed	EWS-1
Total Contributary Area (ac)	1.38
Curve Number (CN)	91
Time of Concentration (min)	6.0
Hydrologic Soil Group	B

<u>Sub-Watershed Area 2 (EWS-2):</u>

EWS-2 includes runoff from the existing track and baseball field. The runoff from this watershed flows a close pipe drainage system which flows offsite at Martin Street, or Design Point 1 (DP-1).

Sub-Watershed	EWS-2
Total Contributary Area (ac)	4.44
Curve Number (CN)	76
Time of Concentration (min)	19.8
Hydrologic Soil Group	B

<u>Sub-Watershed Area 3 (EWS-3):</u>

EWS-3 includes runoff from a portion of the athletic complex, a grass field to the southwest of the existing athletic complex, and a portion of the access drive that intersects with Martin Street. The upper portion of the athletic complex flows through a rip rap swale, and then a grass swale, and finally into a detention pond where it then flows into a closed drainage system that exists the site at Martin Street (DP-1). The field sheet flows into the detention pond/swale, and the access drive runoff flows offsite into the closed drainage system at Martin Street (DP-1).

Sub-Watershed	EWS-3
Total Contributary Area (ac)	2.78
Curve Number (CN)	72
Time of Concentration (min)	9.0
Hydrologic Soil Group	B

Sub-Watershed Area 4 (EWS-4):

EWS-4 includes runoff from the upper eastern portion of the site and the southeastern parking lot. The eastern portion of the property flows to a grass swale that includes a series of check dams and eventually into a detention pond. The detention pond was constructed to handle stormwater from the parking area, which is being removed. Overflow from the detention pond enters a closed drainage system which then flows off the property (DP-2). A portion of the southeastern parking lot flows into the detention basin and is routed under the driveway via culvert to DP-2, while the remainder sheet flows overland to DP-2.

Sub-Watershed	EWS-4
Total Contributary Area (ac)	2.60
Curve Number (CN)	77
Time of Concentration (min)	13.0
Hydrologic Soil Group	B

Sub-Watershed Area 5 (EWS-5):

EWS-5 includes runoff from the northern softball field. The runoff from this watershed sheet flows to the BVW (DP-3). No existing closed drainage system or outfalls to the wetlands presently exist.

Sub-Watershed	EWS-5
Total Contributary Area (ac)	2.23
Curve Number (CN)	71
Time of Concentration (min)	18.8
Hydrologic Soil Group	B

5.2 Post-Development Condition

The Track and Field Renovations Project generally includes the following scope as it relates to stormwater management:

- Installation of a two (2) synthetic turf MPR fields with engineered base stone and subsurface drainage system (flat panel drains and collector pipes). The fields are comprised of a permeable carpet that is designed to be installed on top of a permeable shock pad, which goes directly on top of engineered stone base with an 8-inch average depth, and 33% void space for stormwater storage. Stormwater that enters the synthetic turf carpet will drain vertically into the stone base and will be provided the opportunity to recharge into the existing subsurface soils. In the event of a significant storm, the stormwater that does not infiltrate immediately into subsurface soils is stored within the void space of the stone base. The stormwater is also collected via flat panel drains which are installed within the stone base. These flat panel drains convey water away from the field of play towards the perimeter collector pipe which provides additional storage of stormwater.

- The southwestern parking lot's runoff will flow to a permeable paver system that will provide the required water quality treatment and reduce peak flows.

- The existing swale and detention ponds are to remain and be protected.

5.2.1 Post-Development Watershed Areas

The proposed development results in a watershed analysis that differs from the pre-development condition based on revised grading and drainage patterns as well as runoff characteristics of the proposed improvement areas. The post-development condition has been analyzed to determine the watershed areas and hydrology as it relates to the Design Points which is consistent with the design point analysis completed for the pre-development condition. Refer to Sheet PWS under Attachment 5 for the Post-Development Watershed Map.

Sub-Watershed Area 1 (PWS-1):

PWS-1 consists of the entire reconfigured northwest parking lot, and the entrance plaza to the athletic complex. The majority of this watershed is impervious stormwater is graded to flow into the existing closed drainage system.

Sub-Watershed	**PWS-1**
Total Contributary Area (ac)	2.31
Curve Number (CN)	85
Time of Concentration (min)	6.0
Hydrologic Soil Group	B

Sub-Watershed Area 2 (PWS-2):

PWS-2 is comprised of the track and the multi-purpose rectangular synthetic turf field. Although synthetic turf is highly permeable, the synthetic turf field area is given a CN of 98 to model the area as a pond. Runoff from the turf field area and surrounding walkways enters the turf base stone directly. The voids in the turf base stone act as storage area while allowing infiltration into the subsurface soils. The track is graded to shed water to the synthetic turf.

Sub-Watershed	PWS-2
Total Contributary Area (ac)	3.26
Curve Number (CN)	98
Time of Concentration (min)	6.0
Hydrologic Soil Group	B

Sub-Watershed Area 3A (PWS-3A):

PWS-3A is comprised of the existing access road in front of the school, and a portion of the grass field adjacent to it. The access road drainage remains unchanged, but the grass portion will now flow through a conveyance swale and a culvert beneath the parking lot entrance before entering the closed drainage system (DP-1).

Sub-Watershed	PWS-3A
Total Contributary Area (ac)	0.42
Curve Number (CN)	80
Time of Concentration (min)	6.0
Hydrologic Soil Group	B

Sub-Watershed Area 3B (PWS-3B):

PWS-3B consists of the grass field to the north of the proposed parking lot, the shotput area and a stone trench. Stormwater flows down the slope like it did in the existing condition, but then is intercepted by the proposed stone trench. The stone trench will have an embedded 8” perforated HDPE pipe that will connect to the existing drain line that connects Martin Street at DP-1.

Sub-Watershed	PWS-3B
Total Contributary Area (ac)	1.717
Curve Number (CN)	65
Time of Concentration (min)	9.7
Hydrologic Soil Group	B

Sub-Watershed Area 3C (PWS-3C):

PWS-3C is comprised of a new 80± space parking lot comprised of pavement and permeable concrete pavers, and also pervious landscaped islands. The stormwater is designed to flow to the permeable concrete pavers where it will be treated and either infiltrate or drain into a 6-inch perforated pipe with three (3) overflows to the existing detention pond to the south of the parking lot. The base stone of the permeable pavers is designed to treat the required water quality volume.

Sub-Watershed	PWS-3C
Total Contributary Area (ac)	0.65
Curve Number (CN)	95
Time of Concentration (min)	6.0
Hydrologic Soil Group	B

Sub-Watershed Area 3D (PWS-3D):

PWS-3D consists of the existing grass/stone swale to the East of the proposed parking lot, the existing detention pond, and the existing grass area surrounding these stormwater devises. The drainage patterns in this area remain unchanged. The stormwater flows through the existing grass/stone swale, and into the detention pond. The stormwater then enters the existing catchbasin which enters the closed drainage system in Martin Street (DP-1).

Sub-Watershed	PWS-3D
Total Contributary Area (ac)	0.77
Curve Number (CN)	66
Time of Concentration (min)	6.4
Hydrologic Soil Group	B

Sub-Watershed Area 4 (PWS-4):

PWS-4 includes the southern entrance off of Orchard Street, and the areas to the west of the proposed track and field. There is an existing conveyance swale with rip rap check dams and a detention pond. The parking lot is being removed and replaced with an emergency access driveway, which has less impervious area than the parking lot. The smaller northern basin will be removed, as there will no longer be a paved parking area flowing towards it, but the large, more southern basin will remain unchanged. The emergency access area will be graded similar to existing conditions where a portion flows to the basin and is conveyed to DP-2 via a culvert and a portion sheet flows to DP-2.

Sub-Watershed	PWS-4
Total Contributary Area (ac)	2.15
Curve Number (CN)	65
Time of Concentration (min)	13.5
Hydrologic Soil Group	B

Sub-Watershed Area 5A (PWS-5A):

PWS-5A includes the entire synthetic turf softball field, as well as the impervious walkway to the south, and the grass hill to the west. Although the synthetic turf softball field is highly permeable, the synthetic turf field area is given a CN of 98 to model the area as a pond. Runoff from the turf field area and surrounding walkways enters the turf base stone directly. The voids in the turf base stone act as storage area while allowing infiltration into the subsurface soils. The stormwater runoff from the grass hill enters a stone trench with an HDPE perforated pipe that connects to the header pipe within the turf field. The synthetic turf field is designed to infiltrate the 2-, 10- and 25- year storm. A catch basin will be installed as an outlet overflow structure for stormwater that is not infiltrated. Overflow from the catch basin will overland flow to DP-3.

Sub-Watershed	PWS-5A
Total Contributary Area (ac)	1.37
Curve Number (CN)	93
Time of Concentration (min)	6.0
Hydrologic Soil Group	B

Sub-Watershed Area 5B (PWS-5B):

PWS-5B includes the grass area to the north of the synthetic turf softball field, and a portion of the BVW. Stormwater runoff from this area has not changed from the existing condition and overland flows into the wetlands.

Sub-Watershed	PWS-5A
Total Contributary Area (ac)	0.789
Curve Number (CN)	68
Time of Concentration (min)	13.6
Hydrologic Soil Group	B

6.0 COMPLIANCE WITH STORMWATER STANDARDS (MASWMS)

6.1 Untreated Stormwater (Standard 1)

The project is designed so that stormwater conveyances (outfalls/discharges) do not discharge untreated stormwater into or cause erosion to wetlands, to the maximum extent practicable by providing the turf field that acts as an infiltration basin, and stone trench dissipates flow and that detains stormwater runoff for infiltration. These BMP's will reduce the runoff into the wetlands and prevent erosion.

6.2 Post-Development Peak Rates (Standard 2)

A Hydrologic Study was performed to determine the rate of runoff for the 2-, 10-, 25- and 100-year storm events under pre-development (existing) conditions. Post-development rates were then computed in a similar manner. The design points where the peak rates were compared were taken as amount sheet flowing into the wetland area, representing the most downstream point within the limit of disturbance. From these analyses, it was determined that the proposed project and its Stormwater Management System would not increase the peak runoff rates above existing levels. It is the intent of the Stormwater Management System to minimize impacts to drainage patterns, downstream property and wetlands, while simultaneously providing water quality treatment to runoff prior to its release from the site or its discharge to wetlands.

The U.S.D.A. Soil Conservation Service (SCS) Technical Release 55 (TR-55), 1986, was used as the procedure for estimating runoff. A HydroCAD SCS TR-20-based computer program was used for estimating peak discharges. TR-55 is a generally accepted model for use on small sites and begins with a rainfall amount uniformly imposed on the watershed over a specified time distribution. Mass rainfall is converted to mass runoff by using a runoff curve number (CN). The CN is based on soils, plant cover, impervious areas, interception and surface storage. Runoff is then transformed into a hydrograph that depends on runoff travel time through segments of the watershed.

Stormwater management computations for the full-build were performed using SCS-based HydroCAD, as well as for existing and proposed conditions curve numbers, times of concentrations and unit hydrograph computations.

6.2.1 Proposed Conditions

As described under Section 6.2, the post-development curve numbers are greater than pre-development, which generally increases the runoff potential of the site. In the Hydro-CAD software, synthetic turf is modeled with a CN of 98, to model the direct contribution of stormwater into the dynamic base stone beneath the synthetic turf fields. The dynamic base stone serves to collect, detain and control the release of the majority of the stormwater runoff, to not increase the peak rates of runoff. The stone base will allow recharge and will promote infiltration to the maximum extent feasible.

6.2.2 Peak Rate Summary

Table 6.2.3 shows the peak rate of runoff for the existing site as well as for the developed site at 2, 10 and 100-year design storms.

TABLE 6.2.3

Analysis Point	Design Storm	Existing Runoff (CFS)	Proposed Runoff (CFS)
DP-1	2-yr	7.06	**6.55**
	10-yr	14.90	**13.51**
	25-yr	19.43	**17.35**
	100-yr	26.47	**22.89**
DP-2	2-yr	2.48	0.72
	10-yr	5.31	2.42
	25-yr	6.93	3.5
	100-yr	9.44	5.27
DP-3	2-yr	1.21	0.37
	10-yr	3.07	1.05
	25-yr	4.19	1.47
	100-yr	5.96	2.15

6.3 Recharge to Groundwater (Standard 3)

The project controls the stormwater runoff from the site by attenuating and treating the runoff by the use of proposed synthetic turf base stone. After permeating through the engineered dynamic base stone, the runoff will have the opportunity to infiltrate into the soils beneath the fields, with minimal stormwater draining through perforated flat panel under drains and perforated collector pipes. The flow from the dynamic base stone is constrained by the outlet control structure that allows the storage to stage prior to releasing in the wetland. Also, the flat panel drains are spaced at 30' on-center, which leaves ample opportunity for groundwater recharge, rather than downstream conveyance.

Required Recharge Volume for the site was calculated in accordance with the Standard 3:

Rv = F * new impervious area (acres)
Rv = (0.35/12) * 1.122 ac = 0.033 Ac-ft = 1,426 CF

Rv = Required Recharge Volume
F = Target Depth Factor (0.35 inches for soils of Hydrologic Soil Group B)
New impervious area = sidewalks, walkways, parking lot, roads, bleacher pads (48,874 SF or 1.122 Ac.)

Required minimum surface area of the bottom of the infiltration structure was calculated in accordance with the Simple Dynamic Method, as outlined in the Massachusetts Stormwater Management Standards:

A = Rv / (D + KT)
A = 1,426 CF / (0.67 ft + 0.085 ft/h * 2h) = 1,197 SF

A = Minimum required surface area of the bottom of the infiltration structure
Rv = Required Recharge Volume = 1,426 CF
D = Depth of the Infiltration Facility = 8 inches = 0.83 ft
K = Saturated Hydraulic Conductivity = 1.02 in/h = 0.085 ft/h
T = Allowable drawdown during the peak of the storm (2h)

The synthetic turf field base stone is used to meet this standard, as it is separated by a minimum of two feet (2') from the Estimated Seasonal High Groundwater (ESHGW) table and therefore will provide infiltration capabilities. The synthetic turf fields are approximately 135,297 SF in surface area. This amount of infiltrative surface area allows for the vertical transport of stormwater into the underlying base stone, which contains 33% voids equivalent to storage area.

The drawdown time from the dynamic base stone for the required recharge volume is calculated as follows:

$$\mathbf{Time_{drawdown} = Rv / [(K)*(Bottom\ Area)]}$$
$$\mathbf{= (1{,}197\ ft^3) / [(0.085\ ft/hr)*(135{,}297\ ft^2)]}$$
$$\mathbf{= 0.104\ hours\ or\ 6.26\ minutes}$$

Rv = Storage Volume (ft^3)
K = Saturated Hydraulic Conductivity (ft/hr)
Bottom Area = Bottom Area of Recharge Structure (ft^2)

The drawdown time for the infiltration areas was calculated to be 0.46 hours, or 28 minutes, well below the required drawdown time of 72 hours.

6.4 Water Quality (Standard 4)

The proposed synthetic turf athletic fields have low potential for accumulation of total suspended solids (TSS). The turf is not subject to fertilization, sedimentation, irrigation or rigorous maintenance, thus lessening the ability to acquire TSS. Runoff generated by the synthetic turf field will travel vertically, through approximately eight inches (8") of engineered stone base, where it will infiltrate into the soils below. All of the runoff directed into the synthetic turf field is "clean" because the impervious surfaces will not be subjected to sanding or salting, and therefore do not need to be treated for TSS removal. The perforated pipes are embedded within stone trenches.

The only pavement subject to TSS loading is the new southwestern parking lot, and the expanded parking lot to the northwest. The parking lots are the only areas subject to TSS loading. All other impervious area runoff is considered clean (i.e. they will not be sanded or salted and will not have any vehicle traffic).

VWQ = (DQW / 12 in/ft) * Aimp
VWQ = (0.5 in / 12 in/ft) * 30,395 SF = 1,266 CF

VWQ = Required Water Quality Volume
DWQ = Water Quality Depth (0.5 inches)
Aimp = Impervious Area of Parking Lots= 30,395 SF

The volume of the void space within the base stone of the permeable pavers is 2,722CF which exceeds the water quality requirement. Runoff from the south western parking lot is designed to flow through permeable pavers and provide treatment prior to entering the closed drainage system at Martin Street.

6.5 Land Uses with Higher Potential Pollutant Loads (Standard 5)

The proposed project does not qualify for a LUHPPL. No untreated runoff will leave the site or discharge into the adjacent wetlands.

6.6 Critical Areas (Standard 6)

The site does not lie within a critical area and is not listed in the DEP ACEC's List, Latest Edition.

6.7 Redevelopment (Standard 7)

This project is not a redevelopment project.

6.8 Erosion and Sedimentation Controls (Standard 8)

An Erosion and Sedimentation Control Plan is provided as part of the Notice of Intent Application to the Conservation Commission.

Also, the project will be covered by a NPDES Construction General Permit and SWPPP Plan. The contractor will provide these items prior to the start of construction.

6.9 Operation and Maintenance Plan (Standard 9)

An Operation and Maintenance Plan is provided as part of the Notice of Intent Application to the Conservation Commission. See Attachment 9 for the Operation and Maintenance & Erosion and Sediment Control Plan.

6.10 Prohibition of Illicit Discharges (Standard 10)

There are no illicit discharges to the proposed Stormwater Management System. A template for an illicit discharge compliance statement has been provided as part of the Notice of Intent Application to the Conservation Commission. A completed statement will be submitted prior to the discharge of stormwater to the post-construction Stormwater Management System. Refer to Attachment 10.

7.0 PRESERVATION OF WETLANDS

An important component to any project near environmentally sensitive areas is the demonstration of impact mitigation or preservation. Mitigation measures may include the use of best management practices and low-impact development techniques.

Mitigation measures associated with the proposed project include:

a) Increased groundwater recharge opportunities presented by the engineered base stone of the proposed synthetic turf field.

b) Elimination of the fertilization, sedimentation, irrigation or rigorous maintenance of natural turf fields.

c) Reducing the impervious footprint adjacent to the resource area to reduce runoff and providing water quality treatment for existing pavements.

d) Rain garden and stone trenches promote infiltration and reduce sheet flow of untreated stormflow into the wetlands.

8.0 SUMMARY

The Track and Field Renovations Project is intended to improve the quality of athletic and recreational surfaces for the students of Millbury Jr/Sr High School. The project takes the opportunity to provide water quality and peak flow improvements within the watersheds, and the proposed synthetic turf fields eliminate the need for routine maintenance of the existing natural grass field, which tends to negatively impact the quality of runoff from natural grass sedimentation from compaction, and aquifer drawdown through irrigation. The proposed stone trenches engineered base stone storage capacity and permeable pavers has provided significant peak runoff control and water quality improvements.

The project, as proposed, is the “best fit” for this site, and an improvement to the adjacent resource areas. The project proves to be a betterment to the environment by exceeding all the Massachusetts Stormwater Management Standards.

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