NOTICE OF INTENT PERMIT APPLICATION

Multi-Family Development
580 Main Street Bolton, MA

Prepared: September 1, 2022

Site Locus

OWNER:
Bolton Office Park LLC
100 Grandview Road, Suite 312
Braintree, Massachusetts 02184

APPLICANT:
Limited Dividend Affiliate of
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, Massachusetts 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

allenmajor.com

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ISSUED:
September 1, 2022

REVISED:
-

A&M PROJECT NO.:
1670-15

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SECTION 1.0 PROJECT SUMMARY/COVER LETTER

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allenmajor.com

ALLEN & MAJOR
ASSOCIATES, INC.

September 1, 2022

Brian Berube, Chairman	RE:	A&M Project # 1670-15
Bolton Conservation Commission		Portion of Map 4.C Lot 24
c/o Rebecca Longvall, Conservation Agent		Notice of Intent
Town of Bolton		
663 Main Street		
Bolton, MA 01740		

Dear Chairman Berube, Agent Longvall, and Members of the Conservation Commission:

On behalf of our client, A limited dividend affiliate of WP East Acquisitions LLC (WP), Allen & Major Associates, Inc. (A&M) would like to submit this Notice of Intent application (NOI) for work associated with the construction of Alta Nashoba Valley, a 229-unit residential development located on a portion of the land identified as Assessor Map 4.C, Lot 24 at 580 Main Street. The land has been divided through an Approval Not Required process through the Bolton Planning Board. Site addressing is currently underway through the Bolton Fire Department. The ANR is recorded in the Worcester County Registry of Deeds in Book 964 Page 50. The resultant parcel is 38.91 acres in size.

Alta Nashoba Valley has received a Comprehensive Permit from the Bolton Zoning Board of Appeals in accordance with the Massachusetts Chapter 40B Application requirements. The Permit was issued on August 4, 2022. The Permit relies upon adherence to State regulations for development and has been granted waivers from all local bylaws enacted by the Town of Bolton where conformance could not be achieved. Exhibit B of the permit has granted waivers from the Bolton Wetlands Bylaw, sections 1.18, 1.18.2, and 1.18.4 and the Wetlands Bylaw Regulations. The Zoning Board of Appeals has acted on behalf of all local Bolton Boards and issued a permit that would otherwise be reviewed by the Conservation Commission. Review of the attached Notice of Intent is requested only under the State Wetlands Protection Act (310 CMR 10.00) only. As part of the rigorous town review process in accordance with the statutes, the Town engaged the professional engineering services of Horsley and Witten to review the technical engineering aspects of the project as well as commentary regarding proposed project waivers. A copy of the technical letters issued by Horsley and Witten and the responses provided by A&M indicating changes to the plans are contained within the appendix to this report. They are provided to assist the Commission in understanding the history that has occurred to date to the extent the professional opinions of Horsley and Witten can be applied to the interests held by the Conservation Commission. Additional data on the Zoning Board of Appeals process is available on the Town's website or can be provided through A&M and/or the ZBA if required during the Notice of Intent review process.

The applicant has received an Order of Resource Area Delineation (ORAD) from the Commission to identify wetland resource areas onsite that create jurisdictional review. A copy of the ORAD is contained at the rear of this report based on discussion held at the regularly scheduled meetings on July 19 and August 16, 2022. The resource areas are illustrated on the attached site development drawings but are more particularly shown on the record ANRAD plan dated February 14, 2022, as revised through July 27, 2022. The project site has the following resource areas:

1. 200 riverfront area associated with Great Brook (an inland waterway) on the easterly portion of the site;
2. Bordering Land Subject to Flooding as depicted on the most recent FEMA flood plain maps for flooding associated with Great Brook;
3. Isolated wetland areas (flagged series B and C) located on the westerly side of the existing office building;
4. Bordering Vegetated wetlands adjacent to an existing stormwater/fire pond along the southerly parking lot boundary; and
5. Bordering Vegetated Wetlands at the southwest corner of the property denoted by flag series A and GC 100.

All resource areas were delineated by a professional wetland scientist from Goddard Consulting Inc. and reviewed in the field by wetland scientists by BSC Group. Additional site walks occurred with members of the Conservation Commission or their agent.

Application is hereby made to affect the property as shown on the site development plans and as outlined below.

Riverfront Area

Great Brook runs along the eastern portion of the property flowing in an south to north direction. The mean annual high-water boundary of Great Brook has been accepted under the ORAD and provides a 100 foot inner riparian zone and a 200 foot outer riparian zone as described under 310 CMR 10.58. There is approximately 403,983 square feet of total river front area onsite. The Act provides that "the issuing authority may allow the alteration of up to 5,000 square feet or 10% of the riverfront area within the lot, whichever is greater" 310 CMR 10.58(4)(d)(1). 10% is 40,398 square feet of alteration. A portion of the area contained onsite is located on the easterly side of Great Brook and will remain undisturbed. For impact purposes, only the westerly riverfront area is analyzed. This equates to an area of 106,539 square feet of inner riparian and 96,651 of outer riparian.

Under existing conditions, a significant portion of the 100- and 200-foot riparian zones (106,549 s.f.) have been altered or degraded as defined by 310 CMR 10.58(5) for redevelopment within previously developed Riverfront Areas; Restoration and Mitigation. "Degraded" refers to previously developed riverfront area covered by impervious surfaces or absence of topsoil prior to August 7, 1996. 16,871 square feet of impervious parking surface for the Bolton Office Park was constructed in the 1980's and remains in place today. Fundamental shifts in office workplace habits have left the parking area under utilized for several years. This alteration occurs wholly within the outer riparian zone. 45,358 square feet of the riverfront area has been "previously developed". This area has been significantly altered topographically and all native vegetation has been removed. The area is currently landscaped with lawn area that receives regular maintenance including application of growth and treatment fertilizers. 44,320 square feet remains in its natural state with tree cover and light underbrush. The limit of clearing is approximately 10 feet from the mean annual high-water line at its closest and approximately 75 feet at its greatest but averages a 25-foot distance to the Brook. A large portion of the riverfront area is also occupied by a body of water that serves as stormwater management and fire water for the office park.

Under proposed conditions, the applicant seeks to redevelop within the riverfront for utilization of previously degraded and previously disturbed land. Work within riverfront area will include the construction of a parking field, a detached amenity garage, a subsurface stormwater recharge field with two flared end outlets, and associated grading and construction of a retaining wall. In addition, the aforementioned 16,871 square feet of impervious parking will be removed and renovated to green space as depicted on the site development drawings with the application of areas of erosion seed mixture and tree plantings. The development requires a private onsite water treatment system. In order to meet the MassDEP regulated demands, three wells will be located onsite; two have been newly installed and were the subject of approved Requests for Determination of Applicability through the Commission. Each well requires a Zone 1 radius of protection to adhere to MassDEP drinking water supply regulations. Within these Zones, no structures, impervious surfaces, or stormwater management are allowed. A proposed well is located adjacent to wetland flags GC46/47 and within the riverfront. This well has a 314.5-foot Zone 1 radius. This zone will dictate the removal of 52,500 square feet of impervious parking area inclusive of the 16,871 s.f. noted above while not all located within the riverfront, the conversion provides an improvement over the existing condition. This area will also be utilized for replication and mitigation to the compensatory flood storage requirements of the Bordering Land Subject to Flooding and replication to isolated wetland areas to be filled.

Alternatives to the proposed work have been analyzed and none generate less adverse effects on the interests identified in M.G.L. c. 131 § 40 or are considered practicable under the Act. The development of an affordable project requires minimum density standards for the developer. This project requests 229 units as the minimum density necessary to support a project within the Town of Bolton. This position has been substantiated by the Zoning Board of Appeals through issuance of a Comprehensive Permit. The lack of public infrastructure also plays a key role in the utilization of the land. Though significant in size at nearly 39 acres, the useable area quickly diminishes due to the presence of onsite resource areas as noted above and the requirements from three (3) Public Water Supply Zone 1's. Each Zone prohibits construction within them while being wholly contained on lands owned and controlled by the applicant. Further, sewer infrastructure maintained entirely private has forced a separation of the systems where an onsite wastewater treatment facility and recharge fields located at the main entrance are adequately separated from resource areas, Zone 1's adjacent property and onsite structures. Four buildings are proposed onsite with each being limited to three stories to meet firefighting requirements of the Town of Bolton fire department based on apparatus limitations. Whereas higher stories could result in fewer buildings and less overall footprint area, this was not an option for this project. The property also has a significant amount of area dedicated to a southerly stormwater management and fire pond that provides a developmental and life safety restriction. The pond is part of a regional fire management plan utilized by the Bolton Fire Department for emergencies that may occur not only onsite but on Route 495 or Route 117. It should be noted that upon approval of this project, the use of the pond as stormwater management will be decommissioned. The pond will remain in place for the use of the fire department but will be allowed to naturalize and become a "pond" under criteria of the Act.

The southwesterly portion of the site had limited area available for development and placement of residential structures. However, the site provides common use access to the existing community garden and recreational sports fields. Under proposed conditions, this access will be restricted to emergency personnel only as the entirety of this area falls within a Zone. Water storage buildings and treatment works as shown are allowed within the Zone 1.

Parking surfaces have been analyzed and limited to the minimum necessary to support a project of this size based on the applicant's experience in development. 380 spaces are provided (1.6 spaces per unit) whereas strict adherence to the Town of Bolton Zoning Bylaw would require 458 (2 spaces per unit) and 20% additional land coverage area that has been avoided.

Where avoidance is not possible, the layout maintains major building elements outside of the riverfront area. The parking field proposed is approximately 22,711 s.f. (6,306 within inner riparian zone; 16,405 within outer riparian zone) of coverage within the riverfront. Below is a stormwater recharge system to maintain runoff rate and volume control. The parking field is located entirely within a previously disturbed area. No vegetation removal is necessary for its construction. Further, it is located at a minimal distance away from the river than present conditions. A retaining wall is proposed to minimize grading work and meet the standards of the local bylaw preference for a 25 foot no-disturb buffer. 2,.013 square feet of detached garage c is located within this area. This construction exceeds the currently degraded area of 16,871 s.f. The Act allows for reuse of previously degraded area in full. However, if the degraded area is less than the 10% alteration allowed, the 10% may be used (310 CMR 10.58 (5)(e). 10% of the available area onsite is 40,398 s.f. The proposed project thereby meets this standard.

Any alternate layout of the proposed work within the riverfront area result in the reduction of residential units and parking spaces and is not practicable. Additional land area is not available to the applicant in order to allow a portion of the Bolton Office Park to remain. The proposed work within the riverfront zone is the most practicable and economical solution. Alterations to the site plans may result in rotational changes to the buildings and or parking areas, but would hold largely the same impact footprint.

In seeking approval, the applicant asserts that the proposed project will

a. Result in an improvement over existing conditions;

   Development within the riverfront will restore a previously degraded area and previously altered areas. Presently no stormwater controls exist beyond sheet flow runoff and a weir controlled collection pond. The proposed project will employ a stormwater management program in full compliance with the MassDEP stormwater regulations including subsurface recharge, proprietary treatment, and deep sump and hooded catch basins.

b. Stormwater management is provided according to standards established by the Department;

   See condition a described above.

c. Within 200 foot riverfront area, proposed work shall not be located closer to the river than existing conditions or 100 feet, whichever is less;

   Current conditions have resulted in clearing to within 10 feet of Great Brook. Proposed conditions are no closer than 35 feet to the mean annual high water line. A retaining wall is utilized to meet the local regulation for a 25 foot no disturb buffer.

d. Proposed work, including expansion of existing structures, shall be located outside the riverfront area or toward the riverfront area boundary and away from the river except in accordance with 310 CMR 10.58(5)(f) or (g);

Work has been located as far away from the riverfront as possible with only parking, a portion of a detached garage, and stormwater management located within.

e. The area of proposed work shall not exceed the amount of degraded area, provided that the proposed work may alter up to 10% if the degraded area is less than 10% of the riverfront area, except in accordance with 310 CMR 10.58(5)(f) or (g);

   The total area of disturbance within the riverfront is approximately 34,746 s.f. with 22,711 s.f. of permanent impervious surfaces. This is below the 10% allowed under the Act. Area used for BLSF and replication is not reflected in the 34,746 s.f. as outlined in 310 CMR 10.58 3(d)(1).

f. Restoration of on-site degraded riverfront area may be allowed notwithstanding the criteria of 310 CMR 10.58 (5)(c), (d) and (e) at a rate of 1:1.

   Restoration of the existing degraded area is proposed at the minimum ratio required.

Bordering Land Subject to Flooding

The easterly portion of the property contains a Bordering Land Subject to Flooding (BLSF) adjacent to Great Brook. This area is described on the Flood Insurance Rate Map for Community 25027 Panel C0486F with an effective date of July 16, 2014. The area is described as a Special Flood Hazard Area with a calculated base flood elevation of 340.40 in the vicinity of the proposed work. The FEMA map illustrates several flood elevations as affected by controls within Great Brook. The area adjacent to the proposed work was constructed by twin 36-inch culvert pipes. The pipes become routinely clogged by beaver dam activity. One of the pipes has been removed from the Brook occurring prior to the applicant's interest in the property.

The proposed work will include the filling of approximately 42,851 square feet (footprint area) of BLSF for the installation of the parking field, garage building, underground infrastructure associated with the proposed project and grading. According to 310 CMR 10.57(4)(a), "compensatory storage shall be provided for all flood storage volume that will be lost as the result of a proposed project within Bordering Land Subject to Flooding". Replacement of flood storage area lost shall be replaced in kind and shall be incrementally equal to the theoretical volume of flood water at each elevation up to and including the 100-year flood elevation. The flood elevation onsite based on the FEMA mapping occurs at elevation 340.50. Displacement affects elevations from 338 to 340.50 as noted in the table below. Replication is proposed due south of the filling area and will be located within the Zone 1 of the drinking water supply well. Elevations and volumes are as follows:

Existing incremental volume						Proposed incremental volume replication					
Contour Elevation (ft)	Contour Area (ft^2)	Average Surface Area (ft^2)	Depth (ft)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)	Contour Elevation (ft)	Contour Area (ft^2)	Average Surface Area (ft^2)	Depth (ft)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)
338.00	6,750	0	0.0	0	0	338.00	6,792	0	0.0	0	0
339.00	31,596	19,173	1.0	19,173	19,173	339.00	31,820	19,306	1.0	19,306	19,306
340.00	41,357	36,477	1.0	36,477	55,650	340.00	41,679	36,750	1.0	36,750	56,056
340.50	44,175	42,766	0.5	21,383	77,033	340.50	44,592	43,136	0.5	21,568	77,623

*Existing Contours taken from Existing Conditions plan V-101

*Proposed Contour areas taken from Grading Sheet C-105-C-108

**All proposed calculations assume closed contours using "footprint" area created by assuming a hypothetical "prism" or column of water with vertical sides defined by the "footprint" and extending from the ground up to the elevation of the 100-yeard flood elevation.

Replacement of flood storage remains directly adjacent to Great Brook to ensure water management within the watershed is maintained. (310 CMR 10.57 (4)(a).)

Isolated Wetlands

Two isolated wetland areas have been identified on the ORAD. These areas are located west of the existing office building and are noted as flagged series 'B' with a footprint area of 3,170 square feet and 'C' with an area of 4,080 square feet for a total of 7,250 square feet. They have developed over time from the areas of surface ledge and natural water runoff. Area B has been partially manicured over the years and is equipped with stormwater piping at higher elevations. The areas during the ORAD process were determined to not border on any resource area that is defined as jurisdictional under the Act (310 CMR 10). However, MassDEP exerts jurisdiction over isolated wetland areas under water quality certification (310 CMR 9) if a cumulative area of greater than 5,000 square feet is proposed to be filling. The application before the Commission seeks to fill both areas as illustrated on the site development drawings. Subsequent to review by the Bolton Conservation Commission, the applicant will prepare and file a BRP WW 10 Major Fill/Excavation Project Certification to provide notification and detail to MassDEP of the filling. Additionally, the Army Corps. Of Engineers (ACOE) may exert jurisdiction over the filling operation. A Pre-Construction Notification (PCN) application has been prepared and will be submitted upon conclusion of the NOI process. Copies of each permit and rendered decisions shall be copied to the Bolton Conservation Commission for record. It is reasonable to assume that either MassDEP or ACOE may require replication of the lost isolated vegetated wetlands. A&M has identified an area located within the Bordering Land Subject to Flooding that provides for replication at a 1:1 ratio.

Replacement of the IVW is intended within the area denoted by the 338-elevation contour. 338 is directly adjacent to the existing tree line and will provide compatible elevations to act as part of the natural hydrologic cycle to Great Brook. That is, the area will provide opportunity for surface water runoff or direct precipitation to pond within the area to saturate the soils and provide water support to a planted species of wetland tolerant plants. Prior to work within the replication area, tubular barriers are erected on both upstream and downstream areas under fully established. Construction of the replication area requires at least 12" of the existing soils to be removed and replaced with 12" of "wetland loam". The material can be used from native onsite soils if available or augmented loam import in accordance with design details provided by A&M. The soils would be placed in a loose fashion to avoid compaction and allow for natural aerial and biological activity. The loose placement also allows for increased water retention within void spaces. Plant groupings shall be as designated on the final construction plans. The entirety of the area shall be sprayed with New England Wet mix and Erosion Control/Restoration Mix for Moist sites. Placement of the IVW replication occurs within the area designated for BLSF compensatory flood storage replication. The Act does not restrict replication with the BLSF flood plain for IVW replacement.

Additional conditions as may be imposed by MassDEP or ACOE shall be considered and implemented in the final construction plans.

The Town of Bolton maintains a local wetland bylaw. Under Section 3.05 Lands Subject to Flooding or Inundation by Ground Water or Surface Water, it notes that "Lands subject to flooding or inundation by groundwater or surface water can be either bordering a water body or isolated." The NOI application is provided for adherence to state regulations under the Act only. The Comprehensive Permit issued by the Zoning Board of Appeals has subsumed all local permits, including the Bolton Wetland Bylaw, and by issuance of the permit, the application as presumed to meet any local performance standards. No buffer zones, replication standards, or other considerations present within the Bolton Bylaw are reflected on the site plans.

Bordering Vegetated Wetlands (Buffer Zone Only)

The ORAD has certified the presence of Bordering Vegetated Wetlands on the south and southwest portion of the site as abutting stream channels. These are flag series A1 through A48 and GC 1 through GC 100-6. These boundaries are illustrated on the approved ANRAD resource area plan and as illustrated in the site design plans. Portions of each flagged boundary occurs offsite to the subject area.

The wetlands protection act exerts jurisdiction of activities performed within buffer zones as outlined under 310 CMR 10.02 (b) and subject to review through a Notice of Intent process. For buffer zone projects, the requirements and considerations by the approving authority (Bolton Conservation Commission) are enumerated in 310 CMR 53 (1):

> *(1) If the Issuing Authority determines that a Resource Area is significant to an interest identified in M.G.L. c. 131, § 40 for which no presumption is stated in the Preamble to the applicable section, the Issuing Authority shall impose such conditions as are necessary to contribute to the protection of such interests. For work in the Buffer Zone subject to review under 310 CMR 10.02(2)(b)3., the Issuing Authority shall impose conditions to protect the interests of the Act identified for the adjacent Resource Area. The potential for adverse impacts to Resource Areas from work in the Buffer Zone may increase with the extent of the work and the proximity to the Resource Area. The Issuing Authority may consider the characteristics of the Buffer Zone, such as the presence of steep slopes, that may increase the potential for adverse impacts on Resource Areas. Conditions may include limitations on the scope and location of work in the Buffer Zone as necessary to avoid alteration of Resource Areas. The Issuing Authority may require erosion and sedimentation controls during construction, a clear limit of work, and the preservation of natural vegetation adjacent to the Resource Area and/or other measures commensurate with the scope and location of the work within the Buffer Zone to protect the interests of M.G.L. c. 131, § 40. Where a Buffer Zone has already been developed, the Issuing Authority may consider the extent of existing development in its review of subsequent proposed work and, where prior development is extensive, may consider measures such as the restoration of natural vegetation adjacent to a Resource Area to protect the interest of M.G.L. c. 131, § 40. The purpose of preconstruction review of work in the Buffer Zone is to ensure that adjacent Resource Areas are not adversely affected during or after completion of the work.*

In requesting approval for the work located within the buffer zone, the applicant and A&M have only sought the minimum necessary to support the development. There is no excess clearing of vegetation for the mining on onsite soils or other extraneous activity. Proposed activities are occurring in areas previously disturbed during the construction of the Bolton Office Park.

The areas of work are outlined as the following:

1. Construction of the easterly parking lot, subsurface drainage, and garage building C. This work also occurs within the Riverfront area as described above. The riverfront buffers exceed the 100 foot buffer zone from the identified Bordering Vegetated Wetland boundaries. The area of proposed work lies in a zone that has previously been cleared of all vegetation, graded and currently maintained as lawn. All work is located within the existing limits of the tree line. The work can be constructed with adequate erosion control precautions with the installation of siltation and tubular barriers. This area will be filled to the grades as shown on the site development drawings and stabilized with a perimeter slope with applied erosion seed mix. A segmental block retaining wall is provided to maintain a minimum separation of at least 25 feet from the bordering vegetated wetland boundary. This has been done voluntarily to adhere with the interests of the Bolton Wetlands Bylaw on recommendation by the Zoning Board of Appeals peer review consultants. A waiver of the Bolton Wetland Bylaw was approved by the Zoning Board of Appeals.
2. Reclamation of the existing parking field at the southeast corner of the site as wholly located within the proposed Zone 1 public drinking water supply boundary and work associated with the installation of IVW replication and compensatory flood storage. Portions of this work also occur within the riverfront buffers. Work includes the required wetland mitigation as discussed prior but the removal of asphalt and gravel subbase. Where possible, the existing trees located within the parking field will be saved. Removal of earth is to the minimum necessary to achieve the transition slopes from the proposed travelled ways and the BLSF flood storage replacement. This area will remain subject to the provisions of the MassDEP drinking water supply regulations. It shall not be used for stormwater management, future construction, vehicular access (other than well maintenance vehicles), or snow storage. It will receive and application of wildflower meadow seed and allowed to naturalize with limited maintenance performed for a vehicular access road to the well.
3. Construction of the southerly parking field adjacent to the onsite fire pond. After removal of the asphalt, subbase, and unsuitable soil, a subsurface infiltration field shall be provided as designated on the site development drawings. The adjacent grade to the BVW shall be raised approximately 6-7 feet to allow for installation of drainage while maintaining necessary separation to groundwater. The existing rip-rap spillways and guardrail will be removed and reset as shown on the drawings. Two flared end sections equipped with rip-rap splash pads to mitigate erosion and discharge velocities are provided. These have been located generally where the existing rip-rap pads installed by Bolton Office Park in 2021 are found. The existing stormwater/fire pond located within this area will remain in place solely for fire protection use. It will no longer receive untreated stormwater runoff. It will act as a conveyance for stormwater from the proposed systems to the natural watercourse onsite. Construction of a playground will occur within the buffer zone. Vegetation removal will occur in the vicinity of the playground and grading. There is an existing drinking water supply well located in this area northeasterly of wetland flag GC79. This well will remain in use. However, the source line requires replacement to address age concerns. Maintenance of infrastructure would be considered exempt from a Notice of Intent (310 CMR 10.02 (i) and (j). Provisions of a Request for Determination of Applicability might apply.

Construction within this area requires work within 25 feet to the BVW delineation. The work occurs within previously disturbed and degraded areas and does not encroach further into the buffer zone. A waiver to the local wetlands bylaw was approved by the Zoning Board of Appeals to permit the work as shown.

4. Installation of new water wells on the westerly portion of the site was permitted under prior application to the Commission. Each well has been tested and is currently awaiting certification by MassDEP for use. The westerly portion of the site, including areas within the buffer and through the delineated boundaries of the BVW (see flags GC 100-6 and GC 100-5) are currently used by Town of Bolton residents to access the community garden and recreation sports field. Access is via gravel paths constructed by the current owner. Passenger vehicles routinely used this roadway. Septic hauler trucks use the roadways semi-regularly to access the septic tanks located at the Florence Sawyer School wastewater treatment plant. The installation of a well creates a Zone 1 radius that will prohibit these activities from continuing. The access road to the recreation field and community garden will be gated, signed, and regulated for emergency vehicles only or accessible on foot only. Septic trucks will continue to access the school through a reconstructed gravel roadway that is outside the jurisdictional buffer zone.

   In support of the drinking water supply, new water and electric lines are required to be installed within the buffer zone. These lines shall be installed underground in appropriately sized trenches. Upon completion of construction, the area will match existing grade and vegetative cover. No tree removal is anticipated to facilitate this work; however underbrush may be removed to provide machine access. Above ground domestic and fire storage tanks, water supply houses and appurtenant water works will be in this vicinity but will occur outside of the buffer zone.

All work described herein is subject to adequate erosion control protection. The limits of work shall be established in the field and lined with siltation barriers and tubular barriers to prevent sediment or untreated runoff into adjacent wetland resource areas. Installation of barriers, and inspection by the Commission's agent shall be required prior to any groundbreaking activity.

Development of the Alta Nashoba Valley is subject to coverage under the Construction General Permit of the National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Program (SWPPP) during construction. The SWPPP shall be prepared at least 14 days prior to ground break and filed with the EPA. A copy to the Bolton Conservation Commission can be provided if required. A copy to the ZBA is prescribed under the Comprehensive Permit. The SWPPP will outline in detail additional construction measures to prevent inadvertent effect of adjacent areas, wetland or otherwise. The report will not temporary measures that will be required of the contractor to protect against runoff, wind blow dust, slope destabilization among others.

The stormwater materials provided within the application contain a long-term pollution prevention plan and a stormwater management operation and maintenance report. These describe in detail pre- and post-construction measures that must be followed to prevent adverse conditions. Requirements to ensure construction vehicles are not stored or staged and do not routinely idle within wetland resource area buffers will be a requirement of the construction team. Spilling of fuels and hydraulic oils require immediate cleanup through hazardous material handling protocols. Mitigation of such an event will be provided as required. Trucks shall not utilize areas adjacent to wetland resource areas for washdown of wheels or concrete shoots. This shall occur in areas designated as part of pre-construction consultation with the applicant.

Ancillary to the proposed project, the applicant has been requested to replace the existing timber bridge span over a perennial stream easterly of Florence Sawyer School. Replacement of the bridge will allow for improved access to the recreation field, community garden, and the school's wastewater treatment plant. This work will require a separate Notice of Intent once the final scope has been determined.

A&M and the applicant appreciate the opportunity to work with the Commission on the review and discussion of this project. Attached hereto is a printed copy of the Notice of Intent. An electronic copy has been made available through the Commission's Agent for distribution to the members. A copy has also been filed with the Central Region MassDEP office. A check for the proposed filing has been issued directly to the Commission and will arrive under separate cover. Similarly, a check has been mailed to the MassDEP PO Box.

Upon review of this application for completeness, please notify this office of the required advertisement fees and the date and time of the hearing so abutters may be notified in advance.

If you require any additional information on this NOI application package, please feel free to contact me.

Very truly yours,

ALLEN & MAJOR ASSOCIATES, INC.

Philip Cordeiro, P.E.
Branch Manager
pcordeiro@allenmajor.com

cc: WP East Acquisitions LLC
Bolton Office Park LLC
MassDEP Central Regional Office
File

SECTION 2.0 NOI APPLICATION

WPA FORM 3 – NOTICE OF INTENT

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 3 – Notice of Intent

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

Bolton
City/Town

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

Note: Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

A. General Information

1. Project Location (**Note:** electronic filers will click on button to locate project site):

580 Main Street	Bolton	01740
a. Street Address	b. City/Town	c. Zip Code

Latitude and Longitude:	42.429487	-71.599761
	d. Latitude	e. Longitude

Map 4C	Lot 24
f. Assessors Map/Plat Number	g. Parcel /Lot Number

2. Applicant:

Jim	Lambert
a. First Name	b. Last Name

Limited Dividend Affiliate of WP East Acquisitions, LLC.
c. Organization

91 Hartwell Ave, 3rd floor
d. Street Address

Lexington	MA	02421
e. City/Town	f. State	g. Zip Code
(978) 369-8111		Jim.Lambert@woodpartners.com
h. Phone Number	i. Fax Number	j. Email Address

3. Property owner (required if different from applicant): ☐ Check if more than one owner

Jeffrey	O'Neill
a. First Name	b. Last Name

Bolton Office Park LLC
c. Organization

100 Grandview Road, Suite 312
d. Street Address

Braintree	MA	02184
e. City/Town	f. State	g. Zip Code
(781) 552-4202		joneill@condyne.com
h. Phone Number	i. Fax Number	j. Email address

4. Representative (if any):

Phil	Cordeiro
a. First Name	b. Last Name

Allen & Major Associates, Inc.
c. Company

10 Main Street
d. Street Address

Lakeville	MA	02347
e. City/Town	f. State	g. Zip Code
(508) 923-1010	(508) 923-6309	pcordeiro@allenmajor.com
h. Phone Number	i. Fax Number	j. Email address

5. Total WPA Fee Paid (from NOI Wetland Fee Transmittal Form):

$5,650.00	$2,81250	$2,837.50
a. Total Fee Paid	b. State Fee Paid	c. City/Town Fee Paid

A. General Information (continued)

6. General Project Description:

The proposed project is a multi-family residential development located off Main Street in the Town of Bolton, Massachusetts consisting of a total of 229 residential units on 32.4 acres (proposed Lot 2 as shown on the Site Development Drawings). The proposed project will include the construction of four (4) three (3) story residential buildings, a clubhouse, a mail center, an access road, parking areas, amenities and all supporting site features and infrastructure required to support the proposed development. The project will be serviced by private drinking water supply wells, a private on-site wastewater treatment system, and private underground utilities consisting of electrical service and underground tele-communication/cable services from various utility companies. Portions of the site development fall within jurisdictional resource areas

7a. Project Type Checklist: (Limited Project Types see Section A. 7b.)

1. ☐ Single Family Home
2. ☐ Residential Subdivision
3. ☐ Commercial/Industrial
4. ☐ Dock/Pier
5. ☐ Utilities
6. ☐ Coastal engineering Structure
7. ☐ Agriculture (e.g., cranberries, forestry)
8. ☐ Transportation
9. ☑ Other

7b. Is any portion of the proposed activity eligible to be treated as a limited project (including Ecological Restoration Limited Project) subject to 310 CMR 10.24 (coastal) or 310 CMR 10.53 (inland)?

1. ☐ Yes ☑ No If yes, describe which limited project applies to this project. (See 310 CMR 10.24 and 10.53 for a complete list and description of limited project types)

2. Limited Project Type

If the proposed activity is eligible to be treated as an Ecological Restoration Limited Project (310 CMR10.24(8), 310 CMR 10.53(4)), complete and attach Appendix A: Ecological Restoration Limited Project Checklist and Signed Certification.

8. Property recorded at the Registry of Deeds for:

Worcester	
a. County	b. Certificate # (if registered land)
49223	19
c. Book	d. Page Number

B. Buffer Zone & Resource Area Impacts (temporary & permanent)

1. ☐ Buffer Zone Only – Check if the project is located only in the Buffer Zone of a Bordering Vegetated Wetland, Inland Bank, or Coastal Resource Area.
2. ☑ Inland Resource Areas (see 310 CMR 10.54-10.58; if not applicable, go to Section B.3, Coastal Resource Areas).

Check all that apply below. Attach narrative and any supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

For all projects affecting other Resource Areas, please attach a narrative explaining how the resource area was delineated.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Bank	1. linear feet	2. linear feet
b. ☐ Bordering Vegetated Wetland	1. square feet	2. square feet
c. ☐ Land Under Waterbodies and Waterways	1. square feet 3. cubic yards dredged	2. square feet

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
d. ☐ Bordering Land Subject to Flooding	42,817 1. square feet 36,299 3. cubic feet of flood storage lost	45,000 2. square feet 67,500 4. cubic feet replaced
e. ☐ Isolated Land Subject to Flooding	1. square feet 2. cubic feet of flood storage lost	3. cubic feet replaced
f. ☐ Riverfront Area	Great Brook (Inland) 1. Name of Waterway (if available) - **specify coastal or inland**	

2. Width of Riverfront Area (check one):

☐ 25 ft. - Designated Densely Developed Areas only

☐ 100 ft. - New agricultural projects only

☑ 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project: 403,983 square feet

4. Proposed alteration of the Riverfront Area:

52,268	12,247	40,021
a. total square feet	b. square feet within 100 ft.	c. square feet between 100 ft. and 200 ft.

5. Has an alternatives analysis been done and is it attached to this NOI? ☑ Yes ☐ No

6. Was the lot where the activity is proposed created prior to August 1, 1996? ☑ Yes ☐ No

3. ☐ Coastal Resource Areas: (See 310 CMR 10.25-10.35)

Note: for coastal riverfront areas, please complete **Section B.2.f**. above.

B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

Check all that apply below. Attach narrative and supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below	
b. ☐ Land Under the Ocean	1. square feet 2. cubic yards dredged	
c. ☐ Barrier Beach	Indicate size under Coastal Beaches and/or Coastal Dunes below	
d. ☐ Coastal Beaches	1. square feet	2. cubic yards beach nourishment
e. ☐ Coastal Dunes	1. square feet	2. cubic yards dune nourishment

	Size of Proposed Alteration	Proposed Replacement (if any)
f. ☐ Coastal Banks	1. linear feet	
g. ☐ Rocky Intertidal Shores	1. square feet	
h. ☐ Salt Marshes	1. square feet	2. sq ft restoration, rehab., creation
i. ☐ Land Under Salt Ponds	1. square feet 2. cubic yards dredged	
j. ☐ Land Containing Shellfish	1. square feet	
k. ☐ Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above 1. cubic yards dredged	
l. ☐ Land Subject to Coastal Storm Flowage	1. square feet	

4. ☐ Restoration/Enhancement

If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.2.b or B.3.h above, please enter the additional amount here.

a. square feet of BVW

b. square feet of Salt Marsh

5. ☐ Project Involves Stream Crossings

a. number of new stream crossings

b. number of replacement stream crossings

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

Bolton
City/Town

C. Other Applicable Standards and Requirements

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section C and complete Appendix A: Ecological Restoration Limited Project Checklists – Required Actions (310 CMR 10.11).

Streamlined Massachusetts Endangered Species Act/Wetlands Protection Act Review

1. Is any portion of the proposed project located in **Estimated Habitat of Rare Wildlife** as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP)? To view habitat maps, see the *Massachusetts Natural Heritage Atlas* or go to http://maps.massgis.state.ma.us/PRI_EST_HAB/viewer.htm.

a. ☐ Yes ☑ No **If yes, include proof of mailing or hand delivery of NOI to:**

Natural Heritage and Endangered Species Program
Division of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581

August 1, 2021
b. Date of map

If *yes*, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18). To qualify for a streamlined, 30-day, MESA/Wetlands Protection Act review, please complete Section C.1.c, and include requested materials with this Notice of Intent (NOI); *OR* complete Section C.2.f, if applicable. *If MESA supplemental information is not included with the NOI, by completing Section 1 of this form, the NHESP will require a separate MESA filing which may take up to 90 days to review (unless noted exceptions in Section 2 apply, see below).*

c. Submit Supplemental Information for Endangered Species Review*

1. ☐ Percentage/acreage of property to be altered:

(a) within wetland Resource Area ______
percentage/acreage

(b) outside Resource Area ______
percentage/acreage

2. ☐ Assessor's Map or right-of-way plan of site

2. ☐ Project plans for entire project site, including wetland resource areas and areas outside of wetlands jurisdiction, showing existing and proposed conditions, existing and proposed tree/vegetation clearing line, and clearly demarcated limits of work **

(a) ☑ Project description (including description of impacts outside of wetland resource area & buffer zone)

(b) ☐ Photographs representative of the site

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* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review (see https://www.mass.gov/ma-endangered-species-act-mesa-regulatory-review).
Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.

** MESA projects may not be segmented (321 CMR 10.16). The applicant must disclose full development plans even if such plans are not required as part of the Notice of Intent process.

C. Other Applicable Standards and Requirements (cont'd)

(c) ☐ MESA filing fee (fee information available at https://www.mass.gov/how-to/how-to-file-for-a-mesa-project-review).
Make check payable to "Commonwealth of Massachusetts - NHESP" and ***mail to NHESP*** at above address

*Projects altering **10 or more acres** of land, also submit:*

(d) ☐ Vegetation cover type map of site

(e) ☑ Project plans showing Priority & Estimated Habitat boundaries

(f) OR Check One of the Following

1. ☐ Project is exempt from MESA review.
Attach applicant letter indicating which MESA exemption applies. (See 321 CMR 10.14, https://www.mass.gov/service-details/exemptions-from-review-for-projectsactivities-in-priority-habitat; the NOI must still be sent to NHESP if the project is within estimated habitat pursuant to 310 CMR 10.37 and 10.59.)

2. ☐ Separate MESA review ongoing.

a. NHESP Tracking #

b. Date submitted to NHESP

3. ☐ Separate MESA review completed.
Include copy of NHESP "no Take" determination or valid Conservation & Management Permit with approved plan.

3. For coastal projects only, is any portion of the proposed project located below the mean high water line or in a fish run?

a. ☑ Not applicable – project is in inland resource area only b. ☐ Yes ☐ No

If yes, include proof of mailing, hand delivery, or electronic delivery of NOI to either:

South Shore - Cohasset to Rhode Island border, and the Cape & Islands:

Division of Marine Fisheries -
Southeast Marine Fisheries Station
Attn: Environmental Reviewer
836 South Rodney French Blvd.
New Bedford, MA 02744
Email: dmf.envreview-south@mass.gov

North Shore - Hull to New Hampshire border:

Division of Marine Fisheries -
North Shore Office
Attn: Environmental Reviewer
30 Emerson Avenue
Gloucester, MA 01930
Email: dmf.envreview-north@mass.gov

Also if yes, the project may require a Chapter 91 license. For coastal towns in the Northeast Region, please contact MassDEP's Boston Office. For coastal towns in the Southeast Region, please contact MassDEP's Southeast Regional Office.

c. ☐ Is this an aquaculture project? d. ☐ Yes ☑ No

If yes, include a copy of the Division of Marine Fisheries Certification Letter (M.G.L. c. 130, § 57).

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

Bolton
City/Town

C. Other Applicable Standards and Requirements (cont'd)

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

4. Is any portion of the proposed project within an Area of Critical Environmental Concern (ACEC)?

a. ☐ Yes ☑ No If yes, provide name of ACEC (see instructions to WPA Form 3 or MassDEP Website for ACEC locations). **Note:** electronic filers click on Website.

b. ACEC

5. Is any portion of the proposed project within an area designated as an Outstanding Resource Water (ORW) as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00?

a. ☐ Yes ☑ No

6. Is any portion of the site subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L. c. 131, § 40A) or the Coastal Wetlands Restriction Act (M.G.L. c. 130, § 105)?

a. ☐ Yes ☑ No

7. Is this project subject to provisions of the MassDEP Stormwater Management Standards?

a. ☑ Yes. Attach a copy of the Stormwater Report as required by the Stormwater Management Standards per 310 CMR 10.05(6)(k)-(q) and check if:

   1. ☐ Applying for Low Impact Development (LID) site design credits (as described in Stormwater Management Handbook Vol. 2, Chapter 3)
   2. ☑ A portion of the site constitutes redevelopment
   3. ☑ Proprietary BMPs are included in the Stormwater Management System.

b. ☐ No. Check why the project is exempt:

   1. ☐ Single-family house
   2. ☐ Emergency road repair
   3. ☐ Small Residential Subdivision (less than or equal to 4 single-family houses or less than or equal to 4 units in multi-family housing project) with no discharge to Critical Areas.

D. Additional Information

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section D and complete Appendix A: Ecological Restoration Notice of Intent – Minimum Required Documents (310 CMR 10.12).

Applicants must include the following with this Notice of Intent (NOI). See instructions for details.

Online Users: Attach the document transaction number (provided on your receipt page) for any of the following information you submit to the Department.

1. ☑ USGS or other map of the area (along with a narrative description, if necessary) containing sufficient information for the Conservation Commission and the Department to locate the site. (Electronic filers may omit this item.)

2. ☑ Plans identifying the location of proposed activities (including activities proposed to serve as a Bordering Vegetated Wetland [BVW] replication area or other mitigating measure) relative to the boundaries of each affected resource area.

D. Additional Information (cont'd)

3. ☑ Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s), Determination of Applicability, Order of Resource Area Delineation, etc.), and attach documentation of the methodology.

4. ☐ List the titles and dates for all plans and other materials submitted with this NOI.

Application for Comprehensive Permit ALTA Nashoba Valley
a. Plan Title

Allen & Major Associates, Inc.
b. Prepared By

Phil Cordeiro
c. Signed and Stamped by

April 12, 2022
d. Final Revision Date

1" = 30'
e. Scale

Project Narrative & Drainage Report
f. Additional Plan or Document Title

September 10, 2021
g. Date

5. ☐ If there is more than one property owner, please attach a list of these property owners not listed on this form.

6. ☐ Attach proof of mailing for Natural Heritage and Endangered Species Program, if needed.

7. ☐ Attach proof of mailing for Massachusetts Division of Marine Fisheries, if needed.

8. ☑ Attach NOI Wetland Fee Transmittal Form

9. ☑ Attach Stormwater Report, if needed.

E. Fees

1. ☐ Fee Exempt: No filing fee shall be assessed for projects of any city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority, municipal housing authority, or the Massachusetts Bay Transportation Authority.

Applicants must submit the following information (in addition to pages 1 and 2 of the NOI Wetland Fee Transmittal Form) to confirm fee payment:

2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payor name on check: First Name

7. Payor name on check: Last Name

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands
WPA Form 3 – Notice of Intent
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

Bolton
City/Town

F. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

1. Signature of Applicant

8/31/22
2. Date

3. Signature of Property Owner (if different)

4. Date

5. Signature of Representative (if any)

6. Date

For Conservation Commission:
Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

For MassDEP:
One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a **copy** of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

Other:
If the applicant has checked the "yes" box in any part of Section C, Item 3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.

F. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

mgr. Bolton Office Park LLC
1. Signature of Applicant

8/31/22
2. Date

3. Signature of Property Owner (if different)

4. Date

5. Signature of Representative (if any)

6. Date

For Conservation Commission:
Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

For MassDEP:
One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a **copy** of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

Other:
If the applicant has checked the "yes" box in any part of Section C, Item 3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.

MASSDEP NOI WETLAND FEE TRANSMITTAL FORM

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

NOI Wetland Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Applicant Information

1. Location of Project:

580 Main Street
a. Street Address

Bolton
b. City/Town

c. Check number

$2,892.50
d. Fee amount

2. Applicant Mailing Address:

Jimi
a. First Name

Lambert
b. Last Name

Limited Dividend Affiliate of WP East Acquisitions, LLC
c. Organization

91 Hartwell Ave, 3rd floor
d. Mailing Address

Lexington
e. City/Town

MA
f. State

02421
g. Zip Code

(978) 369-8111
h. Phone Number

i. Fax Number

Jim.Lambert@woodpartners.com
j. Email Address

3. Property Owner (if different):

Jeffrey
a. First Name

O'Neill
b. Last Name

Bolton Office Park LLC
c. Organization

100 Grandview Road, Suite 312
d. Mailing Address

Braintree
e. City/Town

MA
f. State

02184
g. Zip Code

(781) 552-4202
h. Phone Number

i. Fax Number

joneill@condyne.com
j. Email Address

B. Fees

To calculate filing fees, refer to the category fee list and examples in the instructions for filling out WPA Form 3 (Notice of Intent).

Fee should be calculated using the following process & worksheet. ***Please see Instructions before filling out worksheet.***

Step 1/Type of Activity: Describe each type of activity that will occur in wetland resource area and buffer zone.

Step 2/Number of Activities: Identify the number of each type of activity.

Step 3/Individual Activity Fee: Identify each activity fee from the six project categories listed in the instructions.

Step 4/Subtotal Activity Fee: Multiply the number of activities (identified in Step 2) times the fee per category (identified in Step 3) to reach a subtotal fee amount. Note: If any of these activities are in a Riverfront Area in addition to another Resource Area or the Buffer Zone, the fee per activity should be multiplied by 1.5 and then added to the subtotal amount.

Step 5/Total Project Fee: Determine the total project fee by adding the subtotal amounts from Step 4.

Step 6/Fee Payments: To calculate the state share of the fee, divide the total fee in half and subtract $12.50. To calculate the city/town share of the fee, divide the total fee in half and add $12.50.

B. Fees (continued)

Step 1/Type of Activity	Step 2/Number of Activities	Step 3/Individual Activity Fee	Step 4/Subtotal Activity Fee
3.B - Each building (RF)	1	$1,575	$1,575
2.G - Project source discharge (RF)	2	$750	$1,500
2.G - Project source discharge	2	$500	$1,000
3.A - Site prep beyond NOI (RF)	1	$1,575	$1,575
		Step 5/Total Project Fee:	$5,650

Step 6/Fee Payments:

Total Project Fee: $5,650
a. Total Fee from Step 5

State share of filing Fee: $2,812.50
b. 1/2 Total Fee **less $**12.50

City/Town share of filling Fee: $2,837.50
c. 1/2 Total Fee **plus** $12.50

C. Submittal Requirements

a.) Complete pages 1 and 2 and send with a check or money order for the state share of the fee, payable to the Commonwealth of Massachusetts.

Department of Environmental Protection
Box 4062
Boston, MA 02211

b.) **To the Conservation Commission:** Send the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and the city/town fee payment.

To MassDEP Regional Office (see Instructions): Send a copy of the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and a **copy** of the state fee payment. (E-filers of Notices of Intent may submit these electronically.)

COPY OF STATE FILING FEE CHECK

[redacted]

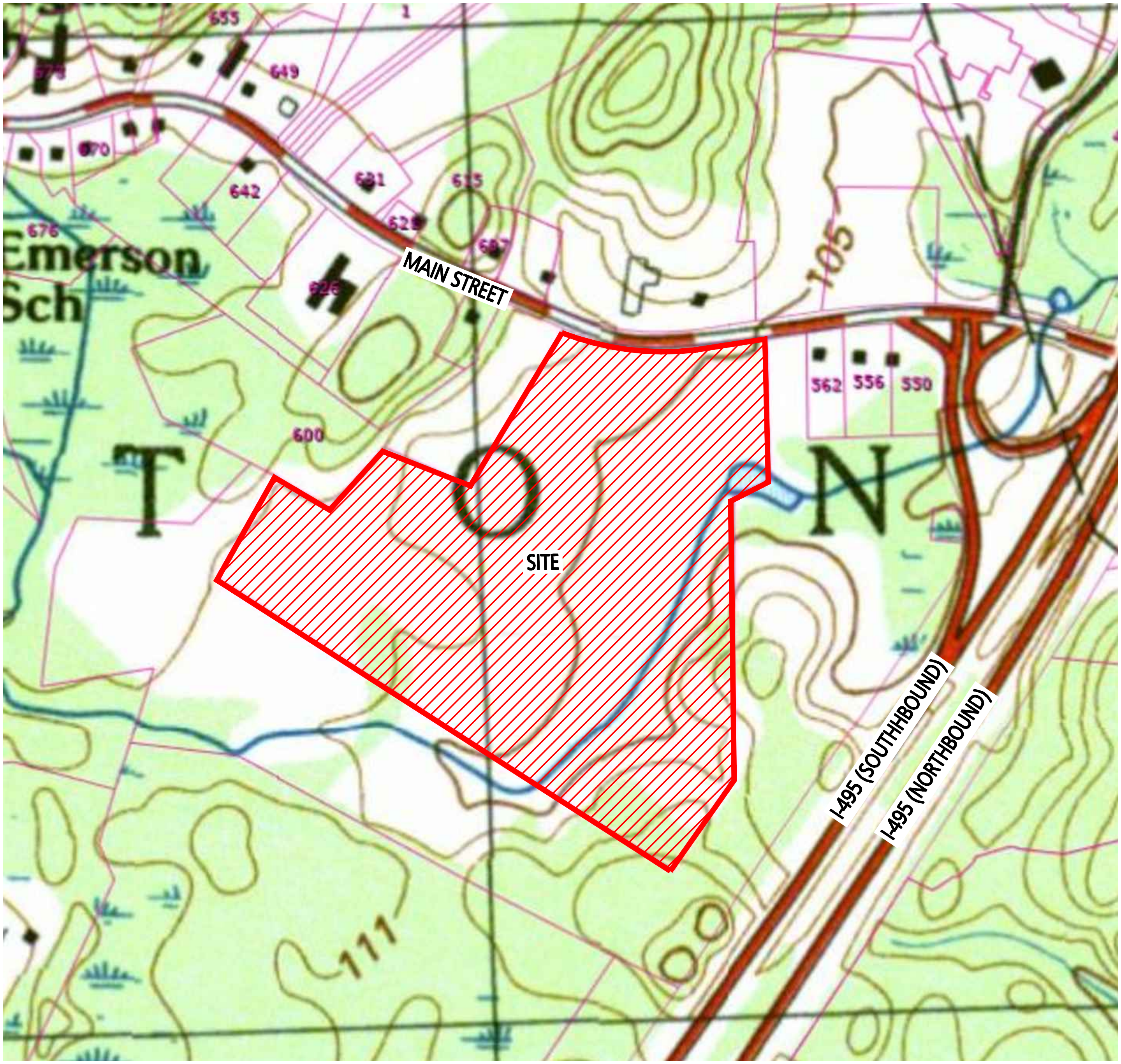
COPY OF LOCAL BY-LAW FILING FEE CHECK

[redacted]

SECTION 3.0

EXHIBITS

3.1 USGS LOCUS MAP



NOTE: IMAGE OBTAINED FROM OLIVER: MASSGIS ONLINE MAPPING TOOL ON 08/18/2022.

APPLICANT/OWNER:
LIMITED DIVIDEND AFFILIATE OF
WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE. 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:

ALTA NASHOBA VALLEY
580 MAIN STREET
BOLTON, MA

PROJECT NO.	1670-15	DATE:	08-18-2022
SCALE:	1"=500'	DWG. NAME:	C-1670-15C_
DESIGNED BY:	JPS	CHECKED BY:	PLC

PREPARED BY:

ALLEN & MAJOR
ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com

10 MAIN STREET
LAKEVILLE, MA 02347
TEL: (508) 923-1010
FAX: (508) 923-6309

WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

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DRAWING TITLE:	SHEET No.
USGS LOCUS MAP	1

3.2 AERIAL LOCUS MAP

NOTE: IMAGE OBTAINED FROM OLIVER: MASSGIS ONLINE MAPPING TOOL ON 08/18/2022.

APPLICANT/OWNER:

LIMITED DIVIDEND AFFILIATE OF
WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE. 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:

ALTA NASHOBA VALLEY
580 MAIN STREET
BOLTON, MA

PROJECT NO.	1670-15	DATE:	08-18-2022
SCALE:	1"=500'	DWG. NAME:	C-1670-15C_
DESIGNED BY:	JPS	CHECKED BY:	PLC

PREPARED BY:

ALLEN & MAJOR
ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com

10 MAIN STREET
LAKEVILLE, MA 02347
TEL: (508) 923-1010
FAX: (508) 923-6309

WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

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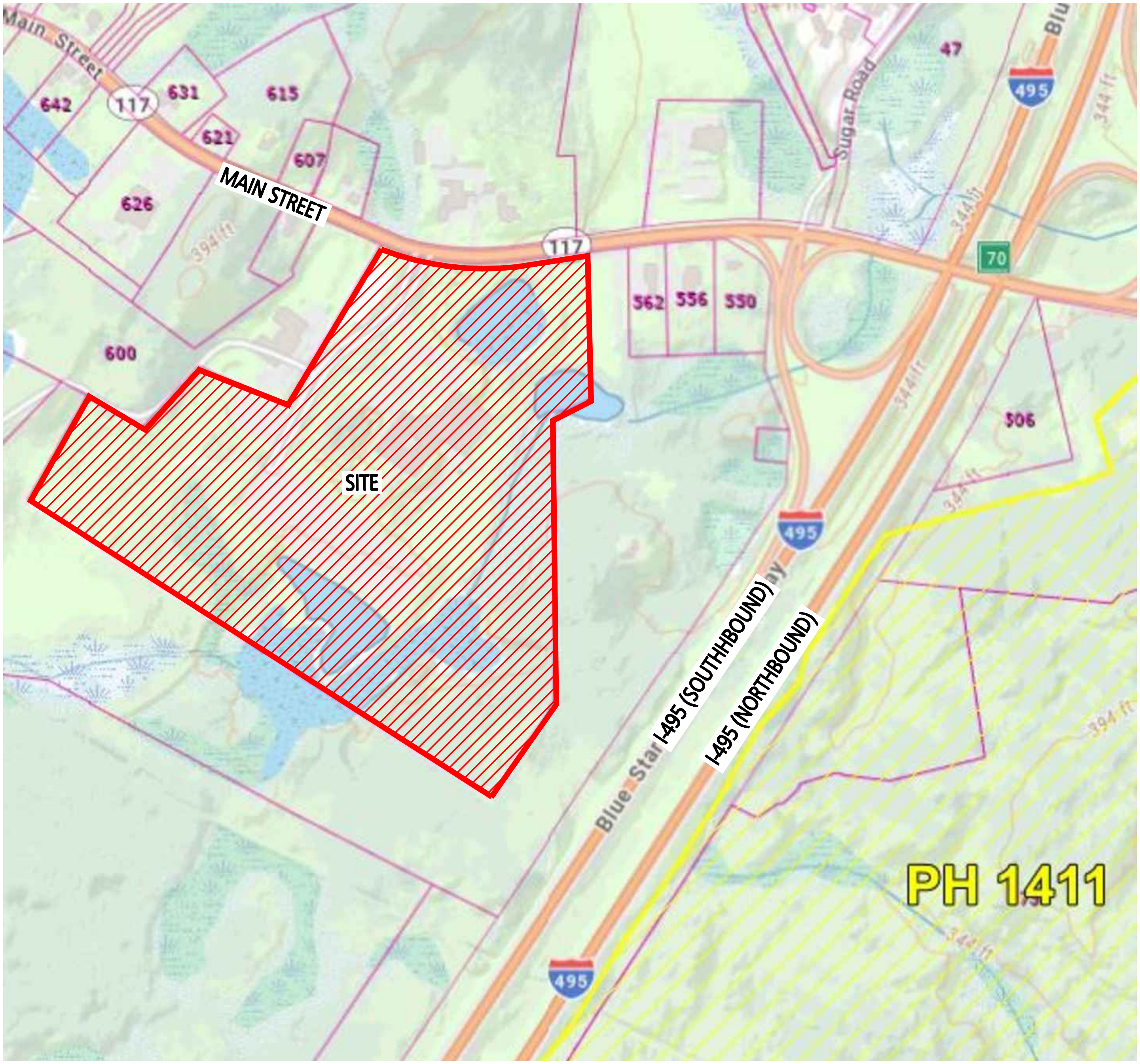
DRAWING TITLE:	SHEET No.
AERIAL LOCUS MAP	2

3.3 PRIORITY HABITAT MAP



NOTE: IMAGE OBTAINED FROM OLIVER: MASSGIS ONLINE MAPPING TOOL ON 08/18/2022.

APPLICANT/OWNER:
LIMITED DIVIDEND AFFILIATE OF
WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE. 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:
ALTA NASHOBA VALLEY
580 MAIN STREET
BOLTON, MA

PROJECT NO.	1670-15	DATE:	08-18-2022
SCALE:	1"=500'	DWG. NAME:	C-1670-15C_
DESIGNED BY:	JPS	CHECKED BY:	PLC

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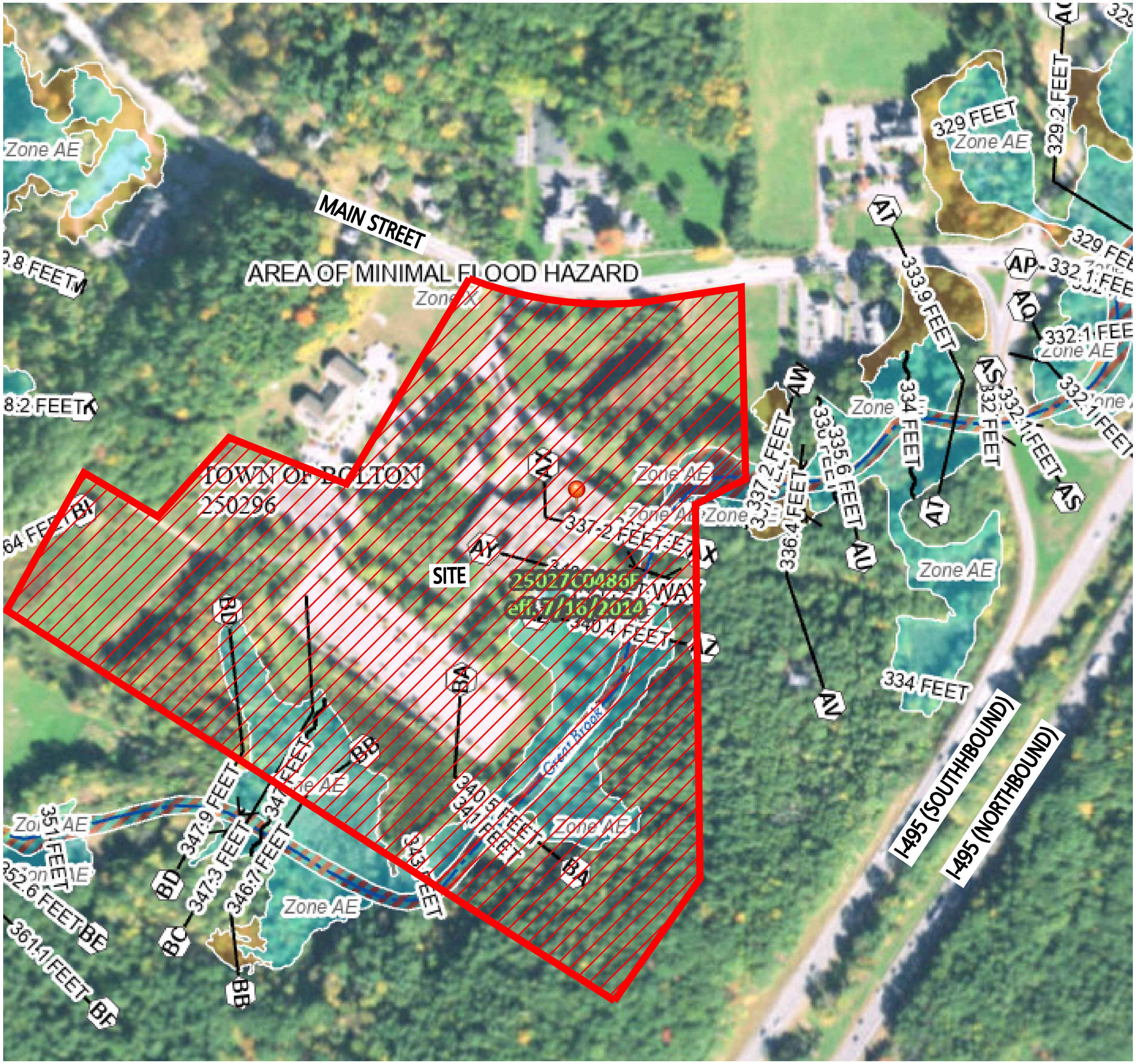
DRAWING TITLE:
PRIORITY HABITAT LOCUS MAP

SHEET No.
3

3.4 - FEMA FIRM (FIRMETTE) MAP



NOTE: IMAGE OBTAINED FROM FEMA ON 08/18/2022.

APPLICANT/OWNER:

LIMITED DIVIDEND AFFILIATE OF
WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE. 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:

ALTA NASHOBA VALLEY
580 MAIN STREET
BOLTON, MA

PROJECT NO.	1670-15	DATE:	08-18-2022
SCALE:	1"=500'	DWG. NAME:	C-1670-15C_
DESIGNED BY:	JPS	CHECKED BY:	PLC

PREPARED BY:

ALLEN & MAJOR
ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
w w w . a l l e n m a j o r . c o m

10 MAIN STREET
LAKEVILLE, MA 02347
TEL: (508) 923-1010
FAX: (508) 923-6309

WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

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DRAWING TITLE:

FEMA FIRMETTE
(MAP 25027C0486F)

SHEET No.

4

SECTION 4.0

NOTIFICATIONS

AFFIDAVIT OF SERVICE

AFFIDAVIT OF SERVICE

Under the Massachusetts Wetlands Protection Act

I, Phil Cordeiro hereby certify under the pains and penalties of perjury that on or before September 7, 2022 I gave notification to abutters in compliance with the second paragraph of the Massachusetts General Laws, Chapter 131, Section 40 and the DEP Guide to Abutter Notification in connection with the following matter:

A Notice of Intent (NOI) application was filed under the Massachusetts Wetlands Protection Act by a limited dividend of WP East Acquisitions, LLC with the Bolton Conservation Commission on September 7, 2022 for property located at (portion of) 580 Main Street, Bolton, MA.

The form of notification and the list of abutters to whom it was given and their addresses are attached to this Affidavit of Service.

Philip L Cordeiro
c=US, o=Allen and Major Associates Inc.,
ou=A01410C00000175798BB4FD00002012, cn=Philip L
Cordeiro
2022.09.07 13:46:36 -04'00'

Signature

September 7, 2022

date

NOTIFICATION TO ABUTTERS UNDER THE MASSACHUSETTS WETLAND PROTECTION ACT

Notification to Abutters

By Hand Delivery, Certified Mail (return receipt requested), or Certificates of Mailing

This is a notification required by law. You are receiving this notification because you have been identified as the owner of land abutting another parcel of land for which certain activities are proposed. Those activities require a permit under the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40).

In accordance with the second paragraph of the Massachusetts Wetlands Protection Act, and 310 CMR 10.05(4)(a) of the Wetlands Regulations, you are hereby notified that:

A. A Notice of Intent was filed with the Town of Bolton Conservation Commission on September 7, 2022 seeking permission to remove, fill, dredge, or alter an area subject to protection under M.G.L. c. 131 §40. The following is a description of the proposed activity/activities:

The proposed project is a multi-family residential development located off Main Street in the Town of Bolton, Massachusetts consisting of a total of 229 residential units on 32.4 acres (proposed Lot 2 as shown on the Site Development Drawings). The proposed project will include the construction of four (4) three (3) story residential buildings, a clubhouse, a mail center, an access road, parking areas, amenities and all supporting site features and infrastructure required to support the proposed development. The project will be serviced by private drinking water supply wells, a private on-site wastewater treatment system, and private underground utilities consisting of electrical service and underground tele-communication/cable services from various utility companies. Work in support of this development occurs within jurisdictional resource areas.

B. The name of the applicant is: Limited Dividend Affiliate of WP East Acquisitions, LLC.

C. The address of the land where the activity is proposed is: a portion of 580 Main Street (Map 4.C/Lot 24)

D. Copies of the Notice of Intent may be examined or obtained at the office of the Town of Bolton Conservation Commission, located at 663 Main Street, Bolton, MA 01740. The regular business hours of the Commission are 7:00 AM to 3:00 PM on Monday, Wednesday and Thursday, 7:00 AM to 4:00 PM on Tuesday and closed on Friday, and the Commission may be reached at (978) 779-3304.

E. Copies of the Notice of Intent may be obtained from the applicant or their representative by calling Allen & Major Associates, Inc. at (508) 923-1010. An administrative fee may be applied for providing copies of the NOI and plans.

F. Information regarding the date, time, and location of the public hearing regarding the Notice of Intent may be obtained from the Town of Bolton Conservation Commission. Notice of the public hearing will be published at least five business days in advance, in the Bolton Independent.

Notification provided pursuant to the above requirement does not automatically confer standing to the recipient to request Departmental Action for the underlying matter. See 310 CMR 10.05(7)(a)4.

CERTIFIED ABUTTER'S LIST

8/29/22
Pd ck# 925

TOWN OF BOLTON
ASSESSORS OFFICE
TOWN HALL
663 MAIN STREET
BOLTON, MASSACHUSETTS 01740
PHONE (978) 779-5556 FAX (978) 779-5461

Date of Application August 23, 2022

REQUEST FOR LIST OF ABUTTERS

Effective August 24, 2004, anyone requesting a list of abutters must give at least three (3) working days notice. This notice will allow the Assessors Office sufficient time necessary to prepare the list of Abutters.

Effective July 1, 2004, the fee schedule is $15 per certified abutters list.

**Please note that these fees apply to preparation of new list or verification or reverification of an existing list.*

Please indicate with a check

________ **Immediate Abutters (Board of Selectmen)**

________ **Board of Appeals, Planning Board, Site Plan review - within 300 feet**

x **Conservation Commission within 100 feet or distance =** 100 **feet**

________ **Planning Board for sub division – 500 feet**

________ **Abutter to Abutter within distance of**__________ **feet**

Map ____________________ **Parcel(s)** 004.C-000-0024.0

Applicant (please print): Allen & Major Associates, Inc. (on behalf of Bolton Office Park, LLC)

Location of Property: 580 Main Street

Signature of Applicant

Mailing Address of Applicant: (A&M) 10 Main St. Lakeville, MA 02347

Telephone Number: (508) 923-1010

FAX Number: ( )

PLEASE NOTE: THIS ABUTTERS LIST IS VALID FOR SIX MONTHS

100 foot Abutters List Report

Bolton, MA
August 23, 2022

Subject Property:

Parcel Number: 004.C-0000-0024.0
CAMA Number: 004.C-0000-0024.0
Property Address: 580 MAIN ST

Mailing Address: BOLTON OFFICE PARK LLC
100 GRANDVIEW RD, STE 312
BRAINTREE, MA 02184-

Abutters:

Parcel Number: 002.0-0000-0028.0
CAMA Number: 002.0-0000-0028.0
Property Address: 0 MAIN ST

Mailing Address: PATTERSON FRANK
284 LONG HILL RD
BOLTON, MA 01740-

Parcel Number: 004.C-0000-0004.0
CAMA Number: 004.C-0000-0004.0
Property Address: 0 BERLIN RD

Mailing Address: TOWN OF BOLTON DERBY PURCHASE
& SAWYER 1967
663 MAIN ST
BOLTON, MA 01740-

Parcel Number: 004.C-0000-0027.0
CAMA Number: 004.C-0000-0027.0
Property Address: 579 MAIN ST

Mailing Address: BOLTON PROPERTY MANAGEMENT LLC

579 MAIN ST
BOLTON, MA 01740-

Parcel Number: 004.C-0000-0035.0
CAMA Number: 004.C-0000-0035.0
Property Address: 0 MAIN ST

Mailing Address: FREIDUS FREDERIC J TR 563 MAIN
STREET RTY TR
138 WATTAQUADOCK HILL RD
BOLTON, MA 01740-

Parcel Number: 004.C-0000-0038.0
CAMA Number: 004.C-0000-0038.0
Property Address: 0 MAIN ST

Mailing Address: TOWN OF BOLTON
663 MAIN ST
BOLTON, MA 01740-

Parcel Number: 004.C-0000-0054.0
CAMA Number: 004.C-0000-0054.0
Property Address: 600 MAIN ST

Mailing Address: BOLTON SENIOR HOUSING CORP
663 MAIN ST
BOLTON, MA 01740-

As set forth in the Assessor's records as of January 1, 2022.

Kelly Garlock

Kelly Garlock
Assistant Assessor

CAI Technologies
www.cai-tech.com

August 23, 2022

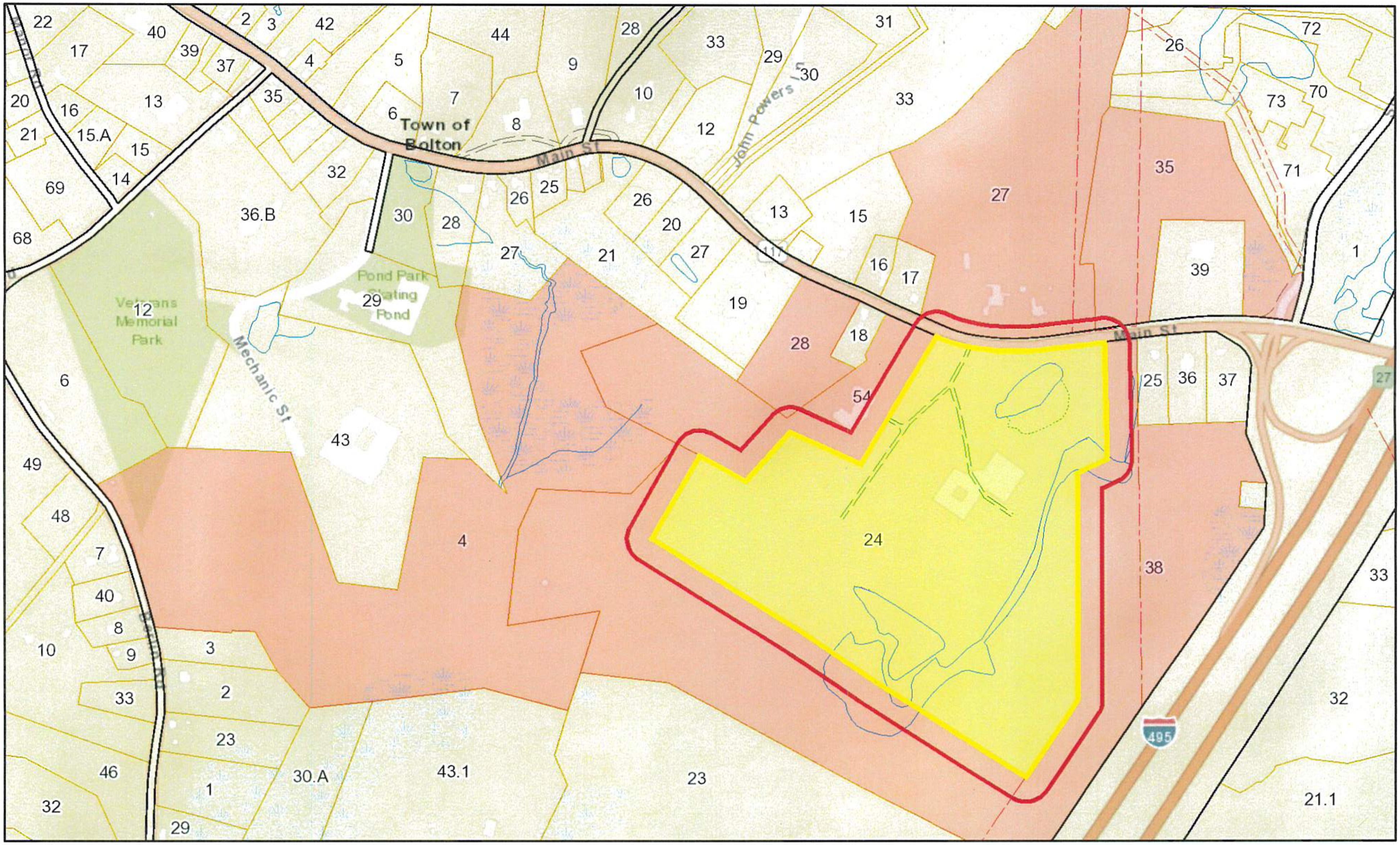
Bolton, MA

1 inch = 556 Feet

0 556 1112 1668

CAI Technologies
Precision Mapping. Geospatial Solutions.

www.cai-tech.com



BOLTON PROPERTY MANAGEMEN
579 MAIN ST
BOLTON, MA 01740-

BOLTON SENIOR HOUSING COR
663 MAIN ST
BOLTON, MA 01740-

FREIDUS FREDERIC J TR
563 MAIN STREET RTY TR
138 WATTAQUADOCK HILL RD
BOLTON, MA 01740-

PATTERSON FRANK
284 LONG HILL RD
BOLTON, MA 01740-

TOWN OF BOLTON
663 MAIN ST
BOLTON, MA 01740-

TOWN OF BOLTON
DERBY PURCHASE & SAWYER 1
663 MAIN ST
BOLTON, MA 01740-

TOWN OF BOLTON
DERBY PURCHASE & SAWYER 1
663 MAIN ST
BOLTON, MA 01740-

TOWN OF BOLTON
663 MAIN ST
BOLTON, MA 01740-

PATTERSON FRANK
284 LONG HILL RD
BOLTON, MA 01740-

FREIDUS FREDERIC J TR
563 MAIN STREET RTY TR
138 WATTAQUADOCK HILL RD
BOLTON, MA 01740-

BOLTON SENIOR HOUSING COR
663 MAIN ST
BOLTON, MA 01740-

BOLTON PROPERTY MANAGEMEN
579 MAIN ST
BOLTON, MA 01740-

APPENDIX A

SITE PLANS

APPENDIX B

OUTSTANDING ORDER OF RESOURCE AREA DELINEATION/MEETING MINUTES

Bolton Conservation Commission
Meeting Minutes

Date:	Tuesday, July 19th 2022
Time/Location	7:00 p.m. Zoom (remote participation)
Commissioners Present:	Chair Brian Berube, James Geraghty, Lori Stephenson, Gillian Glassanos (Conservation Agent, Rebecca Longvall)
Guests:	Tim Hess (Studio Insitu), Craig Bouvaird (711 Main), Kelly Durfee Cardoza (Avalon Consulting), Steve Brennan (Escalante International), Christopher Anderson, Ian Hazeton (Hannigan Engineering), Tom Schutz (Goddard Consulting), Ethan Sneesby (BSC Group), Nicki McGackey (Bolton Access),
Next Meeting:	Tuesday, August 2nd 2022 7:00pm via Zoom

1.	**Notice of Intent – 0 Main Street – DEPfile#112-0712 -** *Alphaterra Design, LLC for the proposed wetland crossing, shared driveway and single-family homes* *Ian Hazelton and Christopher Anderson were present to provide a summary of the project and address questions from the commission. They further expressed that 2,700 sq ft of wetland shall be altered as part of the crossing out of the 30-acre lot, remediation consists of a proposed planting plan inclusive of native shrubs, seed mix, and use of low impact development stormwater management systems components. Conservation Agent read DEP# and comments into the record, primarily regarding 401 WQC. Christopher provided an update to the commission, after reviewing relevant data it was found that the 401 WQC would not be required.* **Chair Brian made a motion to continue the public hearing specific to the Notice of Intent for 0 Main Street until August 2nd 2022 at 8:00pm. Gillian seconded; all AYE except Lori abstain.** **Roll call vote: BB, GG, WP, JG; LS abstain** **Site visit to be scheduled prior to next public meeting areas requested to be staked including but not limited to Limit of work, replication area, center line of driveway (refer to Bylaw for site visit requirements) **
2.	**Enforcement:** *112-0526 Century Mill Estates update* *Chair Brian made a motion to continue issuance of fines for ongoing work and work in violation of the wetlands protection act and local wetland bylaw under the expired OOC 112-0526. All AYE* **Roll call vote: BB, GG, LS, JG.** *Services have been contracted by Town for review of site regarding confirmation of all outstanding work and work in violation associated with OOC 112-0526.*
3.	**Minutes – Chair Brian made a motion to approve the minutes as amended this evening for the public meeting of July 5th 2022 of the Conservation Commission. Jim seconded, all AYE, except Gillian Abstain.** **Roll call vote: BB, LS, JG, AYE, GG Abstain**
4.	**Conservation Property Updates:** Maintenance and management items **Bowers Spring –** *Chair made a motion to hire Henderson Striker for FY23 Butternut & Bowers Maintenance all AYE.* **Roll Call: GG, LS, JG, BB** **Fyfeshire** – *Centrail Mass Goatscaping, commission voted contingent upon funding within budget, to contract as proposed and discussed this evening. All AYE.* **Roll Call: GG, LS, JG, BB** **MVP Program** **Current FY21-FY22: Nashua River Communities Resilient Lands Management Project** https://climateresilient.wixsite.com/nashuariver **Opportunity:** Volunteer Land Steward position, OSRP subcommittee member, Conservation Commission Member For all inquiries regarding these opportunities please contact the Conservation Agent, call 978-779-3304 or email rlongvall@townofbolton.com

5.	**Request for Determination of Applicability – Liv Tour Temporary Structures and Parking – International Escalante Ballville Road -** *Avalon Consulting Group, for the proposed temporary structures including a catering tent (30’x40’), concessions tent (100’x60’), first aid tent (10’x10’), portable restrooms and ADA accessible restroom trailer for a 3-day professional golf tournament. Kelly Durfee Cardoza, Steve Brennan, Art Allen, Paul McManus, and Mike Goggin, were present to provide a summary of the proposed project and address questions from the commission. Kelly walked through the project of tents, power, tables, and restrooms along with parking to be located throughout the various subject parcels. These areas specifically reference work located at Hole 1, Hole 13, Twin Springs and the Conservation Restriction located off of Sawyer and Ballville roads. The proposed fencing was stated to be placed at 105’ from the wetland resource area. Conservation Agent explicitly clarified that the commission is not reviewing or considering review of the wetland delineation at this time, rather reviewing the proposed limit of work. The applicant did not include the resource area delineation or location as part of the request for determination. The request is specific to the work itself only at this time. The applicant understood. She further clarified that there is no vegetation removal proposed at this time. She was presenting revised plans than what had been originally submitted and images that were not submitted to the commission by the required deadline prior to the meeting. She will submit revised plans within the required deadline before the next meeting of the conservation commission. No new information may be considered unless it is submitted by the bylaw required deadline. Chair Brian inquired about the parking areas located at Twin Springs and the Conservation Restriction-Farm property. The commission made a comment that the applicant seems to be working to remove activities from the jurisdictional areas and should be shown on the revised plans. Commission members inquired about the number of vehicles at Twin Springs and at the CR/Farm property. Mike Goggin clarified at the Northern Side of Twin Springs on plans, about 500 vehicles, then on the opposite side about 750 vehicles are anticipated. The CR/Farm property will not have parking aside from the bus depot/movement of buses itself. This area listed as parking on the current plans will be utilized for storing materials and staging. This should be noted/clarified on the revised plans. The applicant agreed to a site visit.* **Chair Brian made a motion to continue the public hearing for the proposed work located at international golf course off of Ballville Road. Gillian seconded, all unanimously AYE. Roll call vote: BB, GG, LS, JG** **Site visit to be scheduled prior to next public meeting (refer to Bylaw for site visit requirements) **

6.	**Abbreviated Notice of Resource Area Delineation – 580 Main Street – DEPfile# 112-0707** - *resource area delineation submitted by Goddard Consulting on behalf of Woodside partners. Ethan Sneesby of BSC group provided a report on the site. Ethan described to the commission and reviewed items in the July 12th 2022 Peer Review Report RE: Peer Review of Abbreviated Notice of Resource Area Delineation DEPfile#112-0707 located at 580 Main Street, Bolton, Ma Pages 1-4 from BSC Group. The Chair opened discussion to the applicant's representative Tom Schutz. Tom clarified areas agreed upon in the field, areas that were reflagged, and areas that were left to contention. The primary area left to contention was the Southerly wetland furthest from 117. The applicant's representative Tom Schutz, believed that this area was non jurisdictional. Conservation Agent asked clarifying questions about what their peer reviewer agreed with and what the applicant was relaying to the commission. The commission relayed the construction prior to 1996 and the distinct wetland characteristics that are still present today and relation to jurisdiction. The Commission established what areas they were in agreement with various locations described by the peer reviewer and comments by the applicant's representative. The following was stated by a quorum of the commission:* • Area 1: between flag series GC102 to GC-108 and A43 and A40 – *flags added in field as referenced in Peer review letter from BSC dated 7/12/2022. Commission agreed jurisdictional and additional revised flags necessary.* • Area 2: MAHW line south of flag MAHW22 - *flags added in field as referenced in Peer review letter from BSC dated 7/12/2022. Commission agreed jurisdictional and additional revised flags necessary.* • Area 1: the northerly isolated wetland - *as referenced in Peer review letter from BSC dated 7/12/2022. Commission determined jurisdictional as isolated wetland.* • Area 2: the southerly isolated wetland - *as referenced in Peer review letter from BSC dated 7/12/2022. Commission agreed jurisdictional as isolated wetland.* • Area 1: Located at the north of the site west of the mapped RFA and BVW: *as referenced in Peer review letter form BSC dated 7/12/2022. Commission agreed stormwater management infrastructure, fire pond (near route 117).* • Area 2: located at the south end of the property directly adjacent to the stream BVW: *as referenced in Peer review letter from BSC dated 7/12/2022. Commission determined this area as jurisdictional wetlands.* *The Conservation Commission requested the applicant and their representative submit revised plans reflecting the necessary revisions from the peer review letter and required at this evening's meeting and an associated narrative prior to the next meeting. Applicant was agreeable to a continuation.* **Chair Brian made a motion to continue the ANRAD under the Wetland Protection Act Chapter 131 Section 40 and associated regulations and under the Wetland Bylaw Chapter 233 for 580 Main Street until August 2nd 2022 at 8:30pm. Lori Seconded; all unanimously AYE. Roll Call: BB, GG, LS, JG**
7.	**Notice of Intent – 578 Sugar Road – DEPfile# 112-0 -** *submitted by Foresite Engineering on behalf of Terry Boots DAEMCO LLC, for the proposed construction of a single-family dwelling, driveway, and sewage disposal system including the installation of a well, installation of underground service utilities, site grading and landscaping.* *Applicant's representative has requested a continuation with no testimony due to their administrative error.* **Chair Brian made a motion to continue the public hearing for 578 Sugar Road under the Wetland Protection Act Chapter 131 Section 40 and associated regulations and under the Wetland Bylaw Chapter 233 until August 2nd 2022 at 8:45pm. Gillian Seconded; all unanimously AYE. Roll Call: BB, GG, LS, JG**
8.	**Notice of Intent – 711/713 Main Street – Demolition of existing barn** *Tim Hess of Studio Insitu and Craig Bovaird were present to address questions from the commission. Conservation Agent provided a summary of revised information submitted and relation to the draft OOC.* **Chair Brian made a motion to close the public hearing specific to the Notice of Intent for 711 713 Main st for the demolition of the existing barn. James seconded; all unanimously AYE. Roll call vote: BB, GG, LS, JG** **Chair Brian made a motion to issue an Order of Conditions as drafted for the public hearing specific to the Notice of Intent for 711 713 Main st for the demolition of the existing barn. Gillian seconded; all unanimously AYE. Roll call vote: BB, GG, LS, JG**
9.	**Chair Brian made a motion to adjourn the public meeting of the Conservation Commission Tuesday, July 19th 2022. At 8:39pm Gillian seconded; all unanimously AYE.** **Roll Call Vote: BB, GG, LS, JG, AYE**

Bolton Conservation Commission
Meeting Minutes

Date:	Tuesday, August 16th 2022
Time/Location	7:00 p.m. Zoom (remote participation)
Commissioners Present:	Chair Brian Berube, James Geraghty, Paal Brandvold, Conservation Agent, Rebecca Longvall)
Guests:	Kelly Durfee Cardoza (Avalon Consulting), Steve Brennan (Escalante International), Christopher Anderson (Hannigan Engineering), Tom Schutz (Goddard Consulting), Kyle Burchard, Pamela Duggan, Chuck Gordon, Scott Hayes (Foresite Engineering), Marco Avallone, Seth Donohoe (Dillis and Roy), Karen Maleski, Dan Gaffney, Shane Curcuru
Next Meeting:	Tuesday, September 6th 2022 7:00pm via Zoom

1.	**Request for Certificate of Compliance – DEPfile# 112-0404 Lot 12A Butternut –** *no work has been carried out on site* *Conservation Agent provided a summary noting the representative will be present for another item later on the agenda. Further review by both the representative and conservation agent realized the well which exists on site was originally constructed for the Lot 12A Butternut as part of this OOC. Therefore, work has been carried out on site and information has been requested from Board of Health and the Building Department to confirm compliance regarding the construction of the well. Therefore, the Chair tabled this discussion until next meeting and later in the agenda.*
2.	**Minutes –** *Chair Brian made a motion to approve the minutes as drafted for the public meeting of July 19th 2022 of the Conservation Commission. Jim seconded, all AYE, except Paal Abstain.* *Roll call vote: BB, JG, AYE, PB Abstain*
3.	**Conservation Property Updates:** *Bolton Trails Connectivity Improvement Project* – update to be provided expected in September Treatment of mowed poison Ivy – salt/vinegar/detergent mixture – *Chair Brian took a roll call vote to authorize the* **MVP Program** **Current FY21-FY22: Nashua River Communities Resilient Lands Management Project** https://climateresilient.wixsite.com/nashuariver **Opportunity:** Volunteer Land Steward position, OSRP subcommittee member, Conservation Commission Member For all inquiries regarding these opportunities please contact the Conservation Agent, call 978-779-3304 or email rlongvall@townofbolton.com
4.	**Enforcement: John Powers Lane** *The original deadline of July 21st 2022 has passed with no update. Violation has yet to be brought into compliance due to property owner's personal issues described via email. The Conservation Agent expressed the current drought conditions may leave fall as a beneficial planting time. The Conservation Commission requires the property owner to provide a timeline and plan for the final items to be brought into compliance. The Plan and Timeline shall be provided to the Conservation Department by the next meeting, [the bylaw regulations require all information to be submitted by 12pm on the Thursday prior. Therefore, the date for submittal of the plan and timeline is September 1st 2022 by 12pm]. The commission will then review the plan/timeline and deliberate on when the work shall be brought into compliance.*

5.	**Notice of Intent – 542 Sugar Road – DEPfile#112-0 - Map 6.E Parcel 28 -** *for North Gate Farm, Inc to address the collapse of one of two existing culvert and driveway on the subject site, and the subsequent enforcement order as issued on Sept 3rd 2021* *Kyle Burchard and Pamela Duggan were present to provide a summary of the existing infrastructure, the previous enforcement order issued administratively, and the proposed culvert that will meet stream crossing standards. DEP inquired about the use of pumping during construction vs the temporary bypass channel. The span is nearly 15' for the crossing. The applicant preferred the bypass channel. The commission inquired about the bypass location and duration, access to the lot during construction, and if there would be a net loss of resource area function. The applicant's representative relayed that technically quantitatively there will be an increase in resource area on site. The Access will be temporarily through the lot owned by the applicant off of Butternut Lane. The Conservation Agent expressed this is a benefit to the resources on site due to the failed culvert and undersized existing structure that does not meet stream crossing standards. She further expressed and clarified that the temporary access previously used is not permitted as it crosses town owned conservation land. The applicant expressed a survey was done and they will be removing the paddock fencing on their lot to accommodate temporary access through that lot, outside of the town owned land. Applicant is awaiting DEPfile# issuance as well.* *The Conservation Commission requested the agent draft conditions.* **Chair Brian made a motion to continue the public hearing specific to the Notice of Intent for 542 Sugar Road until September 6th 2022 at 7:00pm via Zoom. Paal seconded; all AYE** **Roll call vote: BB, GG, JG, PB, AYE**

6.	**Notice of Intent – 472 Sugar Road – DEPfile#112-0 - Map 6.D Parcel 77 –** *for Shane Curcuru for the construction of an indoor pool building on an existing developed lot. Landscape improvements to the buffer zone and riparian zone are incorporated in the proposed project* *Shane Curcuru property owner and Seth Donohoe of Dillis and Roy were present to provide a summary of the project to the commission and address any questions. Resource areas relevant to the site are the Riparian zone, and 100' buffer zone, adjacent upland resource area. The site is 4.8 acres with an extensive perennial stream totaling 141195 sq ft riverfront area, 3,185 sq. ft. of that is proposed alteration as part of this NOI. The alterations include the proposed grading and proposed building. No alterations are proposed within the inner riparian zone. The structure proposed within the outer riparian zone and buffer zone/AURA. Mitigation proposed is specific to pollinator gardens, infiltration gardens. Chair Brian requested a site visit. The property owner/applicant specified that they would prefer to reduce lawn and install native plantings to bring nature back closer to the building compared to what it is now. Seth highlighted the pervious pavement patio, filter strips and infiltration gardens, after Chair Brian inquired about infiltration on site. Commission inquired further about topography to establish flow on site specifically by the proposed building and outcrop. The Commission also requested an operation and maintenance plan specific to drainage or equipment. The Commission inquired about the resource area impacts from blasting vs. hammering ledge. Abutter Karen Maleski was present to express concerns about any blasting or hammering that may be required for the site. Seth addressed that hammering is a logical approach to the site however this has not been finalized. Karen further inquired about access to the Cart Path which the homeowner established as a deeded access to specific other properties with frontage along the pond. Conservation Agent noted all easements are required to be shown on the plans and therefore should be added. Access questions within the easement are a civil matter between the property and easement owner that is unrelated to the commission's jurisdiction and may not be discussed during this public meeting. Seth noted an existing building that will be removed and force main within the proposed work area. Conservation Agent inquired whether or not the 3,185 sq ft number includes existing alterations on site for example but not limited to lawn, single family home, outbuildings, or does that number only include the proposed alterations. Seth confirmed that is the total footprint of the proposed alteration as annotated in red on the submitted plans. He further notes the existing structures predate the riverfront act and any regulations. Conservation Agent states the project is relative to the Bylaw which does not have grandfathered considerations. She further requested the sq. ft. alterations on site including what the representative is considering the existing conditions. This should be broken out by resource area. She requested the age of the structures as well to confirm dates relative to the RFA.* **Chair Brian made a motion to continue the public hearing specific to the Notice of Intent for 542 Sugar Road until Tuesday, September 6th 2022 at 7:15pm via Zoom. Paal seconded; all AYE** **Roll call vote: BB, GG, JG, PB, AYE**
7.	**Notice of Intent – 357 Main Street– DEPfile#112-0 - Map 4.D Parcel 21 –** *for Andrew Everleigh of Environmental Pools for the redevelopment of the site, redevelopment within jurisdictional resource areas is limited to the improvement of an existing stormwater management basin and grading.* *Seth Donohoe of Dillis and Roy was present to provide a summary of the existing conditions, project, and resource areas. The project goal is to redevelop the property. Public Safety requires the ability to have clear vehicle circulation throughout the site. Therefore, gravel access ways will be improved to accommodate. Improvements to the stormwater management systems, constructing new stormwater basin on the western portion of the roadway and associated grading shall take place within jurisdictional areas. Seth totaled the alteration on site 13,000 sq.ft. limited to stormwater management improvements within the RFA inner and outer riparian areas. The commission inquired about calculations incorporated due to stormwater standards, parcel line, and requested a site visit. Conservation Agent noted to the commission and applicant that this property abuts the conservation property and trail. The Conservation Agent reminded the applicant and commission about an informal discussion with the property owner where it was requested that 1-2 parking spaces and connecting trail head be incorporated as part of this project. The Commission would like to review the area to provide better detail in such a request as part of this project.* **Chair Brian made a motion to continue the public hearing specific to the Notice of Intent for 357 Main Street until Tuesday, September 6th 2022 at 7:30pm via Zoom. Gillian seconded; all AYE** **Roll call vote: BB, GG, JG, PB, AYE**

8.	**Notice of Intent – 0 Main Street – DEPfile#112-0712 -** *Alphaterra Design, LLC for the proposed wetland crossing, shared driveway and single-family homes* *Christopher Anderson and Alex Duhani were present to provide a summary of the project and address questions from the commission. Conservation Agent and Vice chair Jim provided a summary of the site visit. The area has an intermittent stream and a box culvert will be constructed to accommodate the quantity of water. The culvert will meet stream crossing standards. The driveway will extend south into the property by a serpentine route. The crossing is necessary to access the backland upland portion of the lot. The crossing is also located at the narrowest point of the wetland. Stormwater management systems were incorporated into the plan incorporating stone line swales to capture and spread stormwater over the vegetated landscape. A secondary will have a small level spreader device. Wetland Restoration at a rate of 2.21 to assist in offsetting impacts. This restoration will occur within the buffer zone. Erosion controls proposed include hay bales and wire back fencing due to slope downgradient throughout the site and adjacent to any cut. Conservation and Wildflower seed mix will revegetate disturbed surfaces in the upland portion of the site. Well, septic and house shall be located outside of any resource areas on site. Chair Brian reiterated the use of native species for seed mix and any plantings on site. Conservation Agent inquired about proposed phasing on site, stating that this is something the commission may consider as a condition. Chris stated the site will be constructed in a controlled stabilization construction phasing; the project also requires a General Permit. The entire site will not be opened up at one time, with stabilization along the way. He noted there is an open OOC for the temporary crossing therefore he will be submitting the request for certificate of compliance for that DEPfile number.* **Chair Brian made a motion to continue the public hearing specific to the Notice of Intent for 0 Main Street until September 6th 2022 at 7:45pm. Paal seconded; all AYE** **Roll call vote: BB, GG, BB, PB, JG**
9.	**Request for Determination of Applicability – Liv Tour Temporary Structures and Parking – International Escalante Ballville Road -** *Avalon Consulting Group, for the proposed temporary structures including a catering tent (30'x40'), concessions tent (100'x60'), first aid tent (10'x10'), portable restrooms and ADA accessible restroom trailer for a 3-day professional golf tournament. Kelly Durfee Cardoza, Steve Brennan, and Paul McManus, were present. Conservation Agent and Vice Chair James Geraghty provided a summary of the site visit. The resource area delineation is not being considered for review at this time. The limit of work was not staked out as requested, the applicant's representatives staked out the LOW temporarily while in the field for the site visit. The Conservation agent suggested the commission require the LOW to be delineated with high visibility fencing and erosion controls at each site. She further suggested the commission may require the applicant to move concessions or rest rooms away from the treeline/resource area on site.* **Chair Brian made a motion to close the public hearing for the proposed work located at international golf course off of Ballville Road. James seconded, all unanimously AYE. Roll call vote: BB, GG, PB, JG** **Chair Brian made a motion to issue a Negative 3 Determination with the following conditions:** 1) High Visibility fencing and straw bale, haybale or straw wattle shall be installed 105' away from resource areas located at Twin Springs and the locally known Schultz farmed property along the limit of work. 2) High visibility fencing and straw bale, haybale, or straw wattle shall be placed at limit of work along concessions. 3) The Town's Conservation Agent shall inspect and approve the Limit of work and relative fencing and erosion controls upon completion of installation. 4) There shall be no scrub removal nor other vegetation removal as part of this project. **for the proposed work located at international golf course off of Ballville Road. James seconded, all unanimously AYE. Roll call vote: BB, GG, PB, JG**

10.	**Abbreviated Notice of Resource Area Delineation – 580 Main Street – DEPfile# 112-0707** - *resource area delineation submitted by Goddard Consulting on behalf of Woodside partners*. *Applicant's representative Tom Schutz of Goddard Consulting was present to address questions. The Conservation Agent provided a summary of the ANRAD peer review response and revised plans from the applicant. She brought attention to the BLSF on the plans that seems to be an error as the area continues and functions as BLSF following the contour vs what is annotated on the plans as BLSF. Applicant's representative stated the BLSF was overlayed directly from the FEMA National Flood Layer maps. Conservation commission inquired about the BLSF and how to establish the reference that it follows the contour vs. as annotated on plans.* **Chair Brian made a motion to close the ANRAD discussion under the Wetland Protection Act Chapter 131 Section 40 and associated regulations and under the Wetland Bylaw Chapter 233 for 580 Main Street and take no action on 112-0707 until September 6th 2022. James Seconded; all unanimously AYE. Roll Call: BB, GG, PB, JG**
11.	**Notice of Intent – 578 Sugar Road – DEPfile# 112-0 -** *submitted by Foresite Engineering on behalf of Terry Boots DAEMCO LLC, for the proposed construction of a single-family dwelling, driveway, and sewage disposal system including the installation of a well, installation of underground service utilities, site grading and landscaping.* *Applicant's representative Scott Hayes of Foresite Engineering provided a summary of the existing conditions, the well that has already been installed as part of the past OOC, and the proposed project. Scott also expressed 576 sugar road and 578 sugar road (12A) had been owned by the same property owner. 576 has been sold and therefore is under separate ownership. Easements for the shared driveway and waterline area already in place. Wetlands delineated by Chuck Caron Environmental. The site is being presented as an intermittent stream with BVW. The Chair noted the drought conditions and characteristics on site. He requested the memorialization of the 25' no touch by a semi-permanent marker by split rail fence or boulders or other method to be reviewed by the commission. Chuck Gordon was present from Butternut Lane to express concerns related to access Lot 12A from Butternut and sought confirmation that the proposed lot will be accessed from sugar road. The applicant's representative confirmed the access as proposed is a shared driveway from 276 Sugar Road. Terence Boots, property owner was present to inquire about the RCOC and sought confirmation of the receipt of the request. Conservation Agent stated everything was filed for the RCOC however, it was filed stating no work had been constructed on site. The site visit revealed that work had been conducted on site relative to but not limited to the construction of a well on lot 12A. The commission needs to review the old order and review files to confirm whether items carried out on site were conducted in compliance. The discussion for the RCOC has been tabled until next meeting for those reasons. Marco owner of 576 Sugar Road inquired about the definition of 25' no disturb. The first 25' is the no disturb no activity zone. He further inquired about access along the easement. The Conservation Agent stated access is a civil matter between the property owners. However, the memorialization is not intended to block access, rather suggest methods for memorialization that would be acceptable to the commission. Scott clarified the memorialization is not to prevent access rather, to demarcate and protect the resource areas.* **Chair Brian made a motion to continue the public hearing for 578 Sugar Road (lot 12A Butternut) under the Wetland Protection Act Chapter 131 Section 40 and associated regulations and under the Wetland Bylaw Chapter 233 until September 6th 2022 at 8:00pm. James Seconded; all unanimously AYE. Roll Call: BB, GG, PB, JG**
12.	**Request for Determination of Applicability – 84 Spectacle Hill Road –** *removal of 6 trees* *The property owner was present to provide a review of their proposed project. The commission requests a site visit. Chair Brian requested the property owner flag/mark what trees are proposed to be removed prior to the site visit.* **Chair Brian made a motion to continue the public hearing for 84 Spectacle Hill Road under the Wetland Protection Act Chapter 131 Section 40 and associated regulations and under the Wetland Bylaw Chapter 233 until September 6th 2022 at 8:15pm. Gillian Seconded; all unanimously AYE. Roll Call: BB, GG, PB, JG**
13.	**Chair Brian made a motion to adjourn the public meeting of the Conservation Commission Tuesday, August 18th 2022 at 9:30pm James seconded; all unanimously AYE.** **Roll Call Vote: BB, GG, PB, JG, AYE**

APPENDIX C

PROJECT NARRATIVE AND DRAINAGE REPORT (FROM COMPREHENSIVE PERMIT PROCESS)

PROJECT NARRATIVE & DRAINAGE REPORT TO ACCOMPANY COMPREHENSIVE PERMIT APPLICATION

Multi-Family Development

580 Main Street Bolton, MA

Prepared: September 10, 2021

Site Locus

CLIENT:
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

allenmajor.com

PROJECT NARRATIVE & DRAINAGE REPORT TO ACCOMPANY COMPREHENSIVE PERMIT APPLICATION

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PROPONENT:
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91 Hartwell Avenue
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Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

ISSUED:
September 10, 2021

REVISED:
-

A&M PROJECT NO.:
1670-15

PROJECT TEAM

OWNER Bolton Office Park LLC 100 Grandview Road, Suite 312 Braintree, MA 02184 Contact: Jeffrey O'Neill Tel: 781-552-4202 E-mail: joneill@condyne.com	**APPLICANT** WP East Acquisitions, LLC 91 Hartwell Avenue Lexington, MA 02421 Contact: Jim Lambert Tel: 781-541-5822 E-mail: jim.lambert@woodpartners.com
ATTORNEY Goulston & Storrs 400 Atlantic Avenue Boston, MA 02110 Contact: Deborah S. Horwitz Tel: 617-574-4123 E-mail: dhorwitz@goulstonstorrs.com	**CIVIL ENGINEER** Allen & Major Associates, Inc. 10 Main Street Lakeville, MA 02347 Contact: Phil Cordeiro, PE Tel: 508-923-1010 E-Mail: pcordeiro@allenmajor.com
LAND SURVEYOR Allen & Major Associates, Inc. 100 Commerce Way, Suite 5 Woburn, MA 01801 Contact: Norman Lipsitz, PLS Tel: 781-305-9416 E-mail: nlipsitz@allenmajor.com	**ARCHITECT** Market Square Architects, PLLC 104 Congress Street, Suite 203 Portsmouth, NH 03801 Contact: Jason Nieuweboer Tel: 603-501-0202 E-mail: jnieuweboer@marketsquarearchitects.com
LANDSCAPE ARCHITECT Grady Consulting, LLC 71 Evergreen Street, Suite 1 Kingston, MA 02364 Contact: Bart Lipinski, RLA Tel: 781-585-2300 E-mail: blipinski@gradyconsulting.com	**GEOTECHNICAL ENGINEER** Haley & Aldrich, Inc. 465 Medford Street, Suite 2200 Boston, MA 02129 Contact: Michael J. Weaver, PE Tel: 617-886-7400 E-mail: mweaver@haleyaldrich.com
TRAFFIC ENGINEER TEC, Inc. 146 Dascomb Road Andover, MA 01810 Contact: Elizabeth Oltman, PE Tel: 978-794-1792 x1031 E-mail: loltman@theengineeringcorp.com	**WETLAND CONSULTANT** Goddard Consulting, LLC 291 Main Street, Suite 8 Northborough, MA 01532 Contact: Nicole Hayes, PWS Tel: 508-393-3784 E-mail: nicole@goddardconsultingllc.com
WATER/WASTEWATER ENGINEER Onsite Engineering, Inc. 279 East Central Street, PMB 241 Franklin, MA 02038 Contact: David C. Formato, PE Tel: 508-530-0032 E-mail: dformato@onsite-eng.com	

The information presented herein this report has been a collaborative effort from the various members/personnel of the Project Team.

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SECTION 1.0 PROJECT SUMMARY

1.1 INTRODUCTION

The applicant, WP East Acquisitions, LLC, is submitting a comprehensive permit in accordance with Massachusetts General Law chapter 40B, Sections 20-23 for construction of a multi-family residential development located off Main Street in the Town of Bolton, Massachusetts consisting of a total of 229 residential units on 32.4 acres (proposed Lot 2 as shown on the Site Development Drawings). The proposed project will include the construction of four (4) three (3) story residential buildings, a clubhouse, a mail center, an access road, parking areas, amenities and all supporting site features and infrastructure required to support the proposed development. The project will be serviced by private drinking water supply wells, a private on-site wastewater treatment system, and private underground utilities consisting of electrical service and underground tele-communication/cable services from various utility companies. Gas service is not available at this location.

The existing office building and parking field will require modification to accommodate the proposed residential development. The proposed modifications are conceptually shown on the site plans, but all work associated with the office building on proposed Lot 1, will need to be designed and permitted by others.

The purpose of this project narrative and drainage report is to provide a detailed review of the locus, potential project impacts and stormwater as it pertains to the existing conditions and proposed redevelopment. The report will show by means of narrative, calculations and exhibits that appropriate best management practices have been used to mitigate the impacts from the proposed development. The report will demonstrate that the proposed site development reduces the peak stormwater discharge rates and the overall site runoff volume during all storm events at the existing design points. Further, the report will show that the proposed stormwater management system complies with the ten (10) stormwater standards as presented in the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Regulations and MA MS4 General Permit regulations.

1.2 SITE CATEGORIZATION FOR STORMWATER REGULATIONS

The proposed redevelopment at 580 Main Street is considered a mix of redevelopment and new development under the MassDEP Stormwater Management Standards. The main access road and the existing parking area associated with the office park along the front portion of the site will be considered redevelopment. Stormwater from a portion of the clubhouse, a small portion of the parking lot and the clubhouse amenity area which drain towards the front wet basin/fire pond will be improved through the use of Contech CDS 2015-4 water quality structure. The overall impervious area to the front wet basin/fire pond has been reduced.

The remaining area draining to either the rear wet basin/fire pond or Great Brook will be considered new development. Stormwater will be directed to deep sump hooded catch basins, piped through the Stormtech Isolator Row and eventually into a subsurface infiltration system consisting of Stormtech SC-740 chambers. Both subsurface infiltration systems have been designed with outlet control structures to meet pre-development conditions. Both subsurface infiltration systems have been designed to recharge the required volume for the entire site.

SECTION 2.0

EXISTING CONDITIONS

2.1 SITE LOCATION AND ACCESS

The subject property (the "Property") is located at 580 Main Street in the Town of Bolton which is located in central Massachusetts in the eastern edge of Worcester County. Bolton is located approximately 30 miles westerly of Boston and 13 miles northeast of Worcester. The property is located on the southerly side of Main Street and westerly of Interstate Route 495. The Property has legal frontage on Main Street (Route 117). Main Street runs east/west through the center of the town. Refer to Figure 1, which shows the entire Property, outlined in red.

Figure 1 – Locus Map (Bing Map)

The Property is identified on the Town of Bolton's tax map as Lot 24 on Map 4.C and is approximately 39 acres in size. The Property is located in the Limited Business (LB) Zone and adjacent to the Residential Zone. The property is also located within several overlays which include the Floodplain Overlay District and the Mixed Use Village Overlay District (MVOD). The property is currently being used as the Bolton Office Park. On the westerly side of the office park is a senior housing development, which shares the same access road as the office park. Adjacent to the property contains a mix of commercial, office and residential development which includes a bank, animal health center, medical offices and residential properties. The site is located within a ½ mile to the Bolton Town Hall, library, First Parish of Bolton and Trinity churches, fire station and the Florence Sawyer and Emerson Schools.

2.2 EXISTING SITE CONDITIONS

The site is bounded by Main Street to the north, vacant land owned by the Town to the east and south and senior housing to the west. An office building currently resides in the northeasterly portion of the site with a boulevard access road off Main Street. The office building is a two story brick and glass building with two exterior courtyards centrally located in the middle of the building. The easterly end of the office building contains a basement. The overall building footprint is approximately 48,000 sf in size. According to the assessor records the building was built in 1988 with a floor area of approximately 41,600 sf and a basement area of approximately 20,900 sf in size. The total gross floor area is approximately 104,200 sf. The driveway provides access to the office building as well as access to the senior housing building located at 600 Main Street. The driveway is currently paved with one lane entering and two lanes exiting. The driveway provides access to several parking areas located throughout the site. The width of travel lanes vary but are 16 feet at minimum. A small parking lot is currently located in the front of the office building, another small parking lot is located on the westerly side of the site driveway and a large parking area is located on the rear portion of the site.

The site topography is moderately sloped, with steeper slopes along the northerly and easterly side towards the wetland resource areas. A highpoint elevation of 353± exists along the north, south and west side of the building and slopes away from the building. The easterly side of the building is around elevation 341±. The site slopes to a low elevation of 338± along the easterly property line adjacent to the existing brook. Stormwater from the westerly and northerly portion of the site is collected in a series of catch basins and piped into the wet basin/fire pond. The pond is equipped with an outlet control structure which discharges treated stormwater to the wetlands. Stormwater from the southerly portion of the site sheet flows into the existing wet basin/fire pond adjacent to the existing parking lot. The pond is equipped with two outlet control structures which discharge treated stormwater to the wetlands. Stormwater from the easterly portion of the site sheet flows untreated directly to the wetlands. Eventually all stormwater drains to Great Brook.

2.3 WATERSHED

The property falls within the Concord Watershed with a drainage area of approximately 400 square miles. The Concord Watershed is part of a larger watershed identified as the Sudbury, Assabet and Concord (SuAsCo) Watershed. The Assabet and Sudbury Rivers start in Westborough and flows northerly until they merge at Egg Rock in Concord, MA. The Concord flows northerly to the Merrimack River in Lowell, MA and eventually into the ocean at Plum Island in Newburyport, MA.

2.4 EXISTING SOIL CONDITIONS

The underlying soils have been mapped by the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS) and consist of the following:

- 1 Water;
- 52A Freetown muck, 0 to 1% slopes;

- 102C Chatfield-Hollis-Rock outcrop complex, 0 to 15% slopes;
- 651 Udorthents, smoothed

Figure 2 – Soil's Map

Freetown muck consists of peat and muck with variable Hydrologic Soil Group (HSG) designation of B/D. Depth to water table is typically within six inches and are very poorly drained. Chatfield-Hollis-Rock outcrop complex consists of extremely stoney, gravelly fine sandy loams with variable Hydrologic Soil Group (HSG) designation of B/D. Depth to a restrictive feature (bedrock) can vary be between 16-40 inches, while other portions are well drained with a depth to the water table greater than 80 inches. Udorthents are lands that have been altered/developed.

Test pits and boring have been performed on-site by Haley Aldrich, Onsite Engineering and Allen & Major Associates. Test pits and boring were done for various portions of the project which include foundation design, septic design and drainage design. A&M conducted the test pits associated with the design of the subsurface infiltration system in August 2021. Soils consist of urban fill for a depth of 2-4 feet on natural soil. The existing soils along the easterly portion of the site were reasonably well drained gravelly sands. The soils located below the southerly parking field were dense till. The estimated seasonal high water table ranged from 24-36 inches below the existing surface. A copy of the soil mapping from the NRCS website is included in the Appendix of this report. Test pit locations and logs can also be found in the Appendix of this report.

2.5 FEMA FLOODPLAIN

The Flood Insurance Rate Map (FIRM) (Map Number 25027C0486F) for the Town of Bolton dated July 16, 2014 indicates the property lies within several flood zones which include a FEMA Zone X, Zone AE and a floodway associated with Great Brook, refer to Figure 8 below. A majority of the property and major improvements are located in the Zone X and the easterly and southerly portion of the property is located within the Flood Zone AE and the floodway.

The FEMA Zone X which is defined as “areas determined to be outside the 0.2% annual chance floodplain”. Zone AE is a special flood hazard areas subject to inundation by the 1% annual chance flood. The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The base flood elevation is the water-surface elevation of the 1% annual chance flood, which varies on the map, due to various structures located within the floodway. A floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

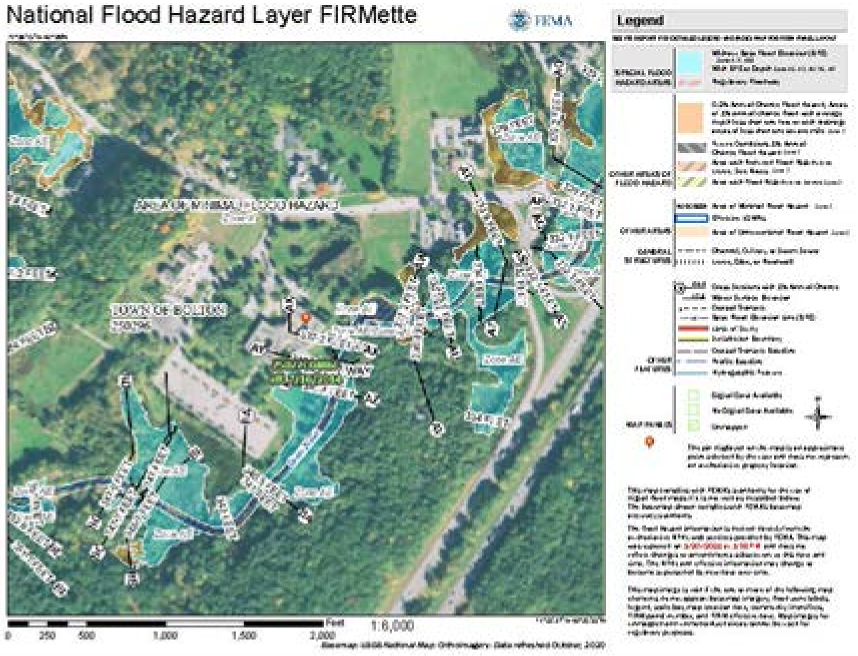

Figure 3 – FEMA FIRMette (Map 25027C0486F)

2.6 ENVIRONMENTALLY SENSITIVE ZONES

The Commonwealth of Massachusetts asserts control over numerous protected and regulated areas including: Areas of Critical Environmental Concern (ACEC); Outstanding Resource Waters (ORWs); areas protected under the Wetlands Protection Act and the

Rivers Protection Act, as well as Natural Heritage & Endangered Species Program (NHESP) Priority and Protected Habitat for rare and endangered species.

According to the MassDEP OLIVER website, the site has the following environmental sensitive zones on or adjacent to the property;

- Wetlands (open water, shrub swamp and deep marsh) are located on the property along the easterly and southerly portion of the property;
- Bordering Land Subject to Flooding (BLSF) is located on and adjacent to the property and are associated with the flood zones shown on the FIRM Map Number 25027C0486F for the Town of Bolton dated July 16, 2014;
- Great Brook is located on and adjacent to the property, therefore the property will have Riverfront Area;
- Two Public Water Supply (ID 2034019-01G and 2034019-02G) Wells are located on the southerly portion of the property which are associated with the existing office building;
- Wellhead Protection Area Zone I with a radius of 236 feet associated with the Public Water Supply Wells. Zone I is defined in 310 CMR 22.02 as "the protective radius required around a public water supply well or wellfield;
- Interim Wellhead Protection Area (IWPA) with a radius of 580 feet associated with the Public Water Supply Wells. Portions of the IWPA associated with the senior housing development encroaches on the property. IWPA is defined in 310 CMR 22.02 as "public water systems using wells or wellfields that lack a Department approved Zone II";
- The site is not located within, or adjacent to, an ACEC or ORW.

2.7 WETLANDS DELINEATION

Wetland resource areas were delineated by a Professional Wetland Scientist from Goddard Consultants, LLC on and adjacent to the property in January 2021. A copy of their wetland report is included in the back of this report. The report has identified the following resource area:

- Riverfront – The mean annual high water (MAHW) of the perennial stream (Great Brook) was delineated. Flags MAHW1-13 are on the west side and MAHW100-119 are located on the east side.
- Bordering Vegetative Wetlands (BVW)
  - BVW was delineated in the field along the edges of Great Brook. Wetland flags GC1-108 are on the west side and GC200-264 are on the east side;
  - BVW flags D1-D25 is a regulated, vegetated stormwater basin created prior to 1996 and is hydrologically connected to the BVW areas via several culverts.

  - Another BVW area was flagged with flags A1-A45 and is associated with an interior stream on the easterly end of the site.
  - A small BVW area was flagged with flags B1-14 and is located between the existing building and parking area.
- Isolated Vegetated Wetlands (IVW)
  - A small IVW area was flagged on the northwesterly side of the existing building with flags C1-11.
- Bordering Land Subject to Flooding

2.8 EXISTING STORMWATER PATTERNS

In order to compare the difference between pre- and post-development peak flows and run-off volumes, existing and proposed watersheds were developed. The design points for existing watersheds were picked based on the extent of development to ensure proper analysis from pre- and post-development conditions. All flow paths represent the longest time of concentration for stormwater runoff. The site topography is well defined, and runoff is directed towards the perimeter, into a wet basin/fire pond or a depression. A total of five (5) watersheds have been defined for the site and are as follows:

- Watershed E-1 is located on the northerly portion of the site and is 345,377 sf in size. Watershed E-1 consists of some woodlands, with good groundcover, grass with good groundcover, impervious surfaces (building, driveway, parking) and the existing wet basin/fire pond. Stormwater currently drains by either overland flow or is collected by a series of catch basins and eventually drains to the existing wet basin/fire pond. The wet basin/fire pond does have an outlet and eventually drains towards Great Brook;
- Watershed E-2A is located on the westerly portion of the site adjacent to the existing building and parking area and is 63,246 sf in size. Watershed E-2A consists of woodlands, with good groundcover, grass with good groundcover, impervious surface (sidewalk, ledge) and an isolated vegetated wetland pocket. Stormwater currently drains by overland flow to the isolated vegetated wetland and eventually overtops to a second isolated vegetated wetlands located within Watershed E-2B;
- Watershed E-2B is also located on the westerly portion of the site and is 62,941 sf in size. Watershed E-2B consists of woodlands, with good groundcover, grass with good groundcover, impervious surface (sidewalk, ledge) and an isolated vegetated wetland pocket. Stormwater currently drains by overland flow to the isolated vegetated wetland and eventually drains via an 18” culvert towards Great Brook;
- Watershed E-3 is located in the easterly, southerly and westerly portion of the site and is 423,611 sf in size. Watershed E-3 consists of woodlands, with good groundcover, grass with good groundcover and impervious surfaces (building,

pavement). Stormwater currently drains by overland flow to the wetlands and eventually towards Great Brook;

- Watershed E-4 is also located in the southerly portion of the site and is 226,166 sf in size. Watershed E-4 consists of some woodlands, with good groundcover, grass with good groundcover, impervious surfaces (building, driveway, parking) and the existing wet basin/fire pond. Stormwater currently drains by overland flow to the existing wet basin/fire pond. The wet basin/fire pond does have two outlet weir structures and eventually drains towards Great Brook.

See the rear of this report for a copy of the Existing Watershed Plan (EWS-1).

2.9 EXISTING SITE UTILITIES

The existing office park and surrounding properties all have private on-site wells and on-site sewage disposal systems. The office park currently has two public water supply wells located on the southerly portion of the site and regulated through MassDEP. These wells have protective zones around each well which limit development within these protective zones. A third well is currently located in the front portion of the lot, adjacent to Main Street, but does not appear to be registered with MassDEP and used for irrigation. A&M has not confirmed this usage through independent verification. There is no regulatory jurisdictional areas created by an onsite irrigation well.

The on-site sewage disposal system is located on the northwesterly corner of the property. Utility poles and overhead wires are located on the southerly side of Main Street. National Grid is the electrical service provider for the Town of Bolton. Verizon and Comcast supply the Town with communication lines that can be either through overhead cables or underground conduits.

Two fire ponds are located on the property. These ponds serve a dual purpose for stormwater control, but also provide water storage for firefighting. A pump house is located in the northerly portion of the site that charges the office complex internal sprinkler system.

SECTION 3.0

PROPOSED CONDITIONS

3.1 PROPOSED OVERVIEW

The applicant, WP East Acquisitions, LLC is submitting a comprehensive permit in accordance with Massachusetts General Law chapter 40B, Sections 20-23 for construction of a multi-family residential development located off Main Street in the Town of Bolton, Massachusetts consisting of a total of 229 residential units on 32.4 acres (proposed Lot 2). The proposed project will include the construction of four (4) three (3) story residential buildings, a clubhouse, a mail center, an access road, parking areas, amenities and all supporting site features and infrastructure required to support the proposed development. Building 1 is proposed to include 74 residential units with a footprint area of 27,924 square feet, Building 2 includes 71 residential units with an area of 27,567 s.f., Building 3 includes 36 residential units with an area of 13,512 s.f. and Building 4 includes 48 residential units with an area of 17,786 s.f. A clubhouse/amenity building will be constructed in front of Building 1 and a mail center will be provided to the west of the clubhouse.

The existing office building and parking field will require modification to accommodate the proposed residential development. The proposed modifications are conceptually shown on the site plans, but all work associated with the office building on proposed Lot 1, will need to be designed and permitted by others.

Figure 4 – Aerial Map with Proposed Overlay

Development of the site will maintain the existing roadway corridor off of Main Street for the first 150 feet and will modify the remainder of the road to accommodate the proposed development. The drive will continue to provide access to the existing office building, the senior housing development and will also provide access to the mail center, the clubhouse, the residential buildings and several parking areas. Internal drive aisles shall be provided around the buildings at a minimum width of 24 feet to accommodate two way traffic patterns. Accessibly compliant ramps are provided along the intended accessible site path to provide full accommodations for pedestrians. Connectivity to parking fields and across roadways are marked with pedestrian crosswalks in conformance with the Manual on Uniform Traffic Control Devices (MUTCD). A dumpster and recycling areas are provided for refuse. Direction signage will be included for internal navigation of the site. A 5-ft wide sidewalk will be installed along the frontage of Main Street.

Parking spaces are dispersed throughout the site and within reasonable distances to the various buildings. 386 total parking spaces are provided comprised of 358 surface spaces and 28 detached amenity garage space, or 1.68 spaces per unit. Standard parking spaces are designed at 9' by 18'. Parking spaces in compliance with the Americans with Disabilities Act (ADA) and the Massachusetts Architectural Access Board (MAAB) are distributed throughout the site adjacent to accessible entrances or amenities.

Other site improvements include landscape areas, underground utilities, private on-site wells, private on-site wastewater treatment system and new stormwater management systems. The proposed stormwater management plan calls for the use of appropriate best management practices, including swales, deep sump hooded catch basins, water quality structures, a Stormtech Isolator Row and two (2) subsurface infiltration systems. The subsurface infiltration systems will consist of Stormtech SC-740 chambers. The system has been designed with infiltration and an outlet control structure. The outlet control structure has been designed to match pre-development conditions for peak discharge rates and runoff volumes. The combination of these BMP's will remove greater than 80% of Total Suspended Solids, from the anticipated stormwater runoff.

3.2 PROPOSED STORMWATER PATTERNS

The drainage patterns under proposed conditions will maintain the same design points and designations under existing conditions. Some of the existing watershed areas have been modified due to grading of the proposed development. The study concluded that the proposed rates of runoff and runoff volumes at the design points is less than the existing conditions analysis. A total of five (5) watersheds have been defined for the site and are as follows:

- Watershed E-1 has been reduced in size to 312,214 sf. Portions of Watershed P-1 will be improved through the installation of water quality structure. Stormwater will continue to drain into the wet basin/fire pond and eventually into Great Brook;
- Watersheds E-2A & E-2B have been eliminated due to the proposed development;
- Watershed E-3 has been reduced in size to 339,925 sf. Watershed E-3 will continue to drain by overland flow to the wetlands and eventually into Great Brook;
- Watershed E-4 has been reduced in size to 121,952 sf. Watershed E-4 will continue to drain by overland flow to the existing wet basin/fire pond and eventually into Great Brook;
- Watershed P-5A is located on the southerly and westerly portion of the site and is 137,534 sf in size. Watershed P-5A consists of grass/landscape area with good groundcover and impervious surfaces (buildings, parking, drive aisle, sidewalk). Stormwater will be directed to deep sump hooded catch basins, through a water quality structure, into the Stormtech Isolator Row and into Subsurface Infiltration System No. 1. Subsurface Infiltration System No. 1 will be equipped with two (2) outlet control structures, directing treated runoff towards the existing wet basin/fire pond and eventually into Great Brook. The fire pond is not assumed to provide any treatment or mitigation for the proposed development;
- Watershed P-5B is located on the northerly and easterly portion of the site and is 207,813 sf in size. Watershed P-5B consists of grass/landscape area with good groundcover and impervious surfaces (buildings, parking, drive aisle, sidewalk). Stormwater will be directed to deep sump hooded catch basins, through a water quality structure, into the Stormtech Isolator Row and into the Subsurface Infiltration System No. 2. Subsurface Infiltration System No. 2 will be equipped with two (2) outlet control structures, directing treated runoff towards Great Brook;

See the rear of this report for a copy of the Proposed Watershed Plan (PWS-1).

Design Point #1 – Front Wet Basin/Fire Pond

Table 3.2.A – Design Point 1 Existing vs Proposed peak rate of runoff to Front Wet Basin/Fire Pond

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	11.54	10.44	-1.1 (9.5%)
10-year	23.34	21.10	-2.24 (9.6%)
25-year	31.02	28.04	-2.98 (9.6%)
100-year	42.99	38.87	-4.12 (9.6%)

Table 3.2.B – Design Point 1 Existing vs Proposed runoff volume to Front Wet Basin/Fire Pond

Design Storm	Existing (cf)	Proposed (cf)	Difference (cf)
2-year	41,807	37,793	-4,014 (9.6%)
10-year	83,594	75,567	-8,027 (9.6%)
25-year	111,477	100,773	-10,704 (9.6%)
100-year	155,956	140,981	-14,975 (9.6%)

Design Point #2 – Rear Wet Basin/Fire Pond

Table 3.2.C – Design Point 2 Existing vs Proposed peak rate of runoff to Rear Wet Basin/Fire Pond

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	12.44	3.56	-8.88 (71.4%)
10-year	21.50	9.68	-11.82 (54.92%)
25-year	27.13	17.44	-9.69 (35.7%)
100-year	35.73	35.13	-0.60 (1.7%)

Table 3.2.D – Design Point 2 Existing vs Proposed runoff volume to Rear Wet Basin/Fire Pond

Design Storm	Existing (cf)	Proposed (cf)	Difference (cf)
2-year	40,386	12,221	-28,165 (69.7%)
10-year	71,369	38,656	-32,713 (45.8%)
25-year	91,157	57,099	-34,058 (37.4%)
100-year	122,015	87,274	-34,741 (28.5%)

Design Point #3 – Great Brook

Table 3.2.E – Design Point 3 Existing vs Proposed peak rate of runoff at Great Brook

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	3.16	2.81	-0.35 (11.1%)
10-year	13.62	13.33	-0.29 (2.1%)
25-year	21.97	21.97	0.00 (0.0%)
100-year	36.04	35.58	-0.46 (1.3%)

Table 3.2.F – Design Point 3 Existing vs Proposed runoff volume at Great Brook

Design Storm	Existing (cf)	Proposed (cf)	Difference (cf)
2-year	18,728	13,552	-5,176 (27.6%)
10-year	57,912	50,427	-7,485 (12.9%)
25-year	89,965	78,904	-11,061 (12.3%)
100-year	145,278	128,405	-16,873 (11.6%)

3.3 DRAINAGE ANALYSIS METHODOLOGY

The peak rate of runoff was determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.

2. HydroCAD© Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.10. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the infiltration systems, to perform drainage routing and to combine the results of the runoff hydrographs.

3. Soil Survey of Worcester County, Massachusetts by United States Department of Agriculture, National Resource Conservation Service. Soil types and boundaries were obtained from this reference.

4. Rainfall Data for each of the storm events was based on data published by the NOAA Atlas 14. The extreme precipitation estimates for Bolton are shown in the following table:

Table 3.3.1 – Rainfall (NOAA Atlas 14)

2-year	10-year	25-year	100-year
3.27 inches	5.02 inches	6.11 inches	7.79 inches

3.4 CLOSED DRAINAGE SYSTEM COMPUTATIONAL METHODS

The closed drainage system calculations determine the rate of runoff, the time of concentration and the rainfall intensity for the drainage basin. The calculations were performed for a 25-year storm event. The closed drainage system has also been analyzed for the 100-year event. The following standards were used:

1. The Rational Formula (Q =CIA) was used to determine the flow to each structure.
    Q = Flow cubic feet per second (CFS)
    C = Runoff coefficients
    I = Rainfall Intensity (inches per hour)
    A = Drainage Area (acres)

2. The runoff coefficients used are as follows:
    Impervious (pavement and roofs) = 0.9
    Grassed = 0.40
    Bare Ground and gravel = 0.50
    Landscape = 0.3
    Wooded = 0.2

3. The intensity for each area was determined by the Steel Formula for a 25-year frequency storm. The Steel Formula is:
    I = k/(t+b)
    I = Intensity
    k = 230 (25 yr)
    t = Time of Concentration
    b = 30 (25 yr)

4. The times of concentration were calculated using a nomograph provided in "Design, Volume 1," by Seelye, 1960. A minimum time of concentration of six (6) minutes was utilized.

5. The Manning's formula was utilized to calculate the capacity of the individual pipes in the closed drainage system. The Manning's formula is:
    $Q = (Ap)\ (1.486/n)\ (s^{1/2})\ (h^{2/3})$
    Q = Flow in CFS
    Ap = Cross-sectional area of the pipe (square feet)
    n = Roughness coefficient
    s = slope of the pipe (ft/ft)
    h = hydraulic radius

The closed drainage system, as designed, is capable of handling the design flow as calculated, as well as maintaining a design velocity of between 2.0 feet per second (fps) (cleansing velocity at pipe half full conditions) and 12.0 fps.

3.5 EROSION AND SEDIMENT CONTROL

The site will be enclosed with a straw wattle and/or fiber roll barrier to prevent incidental conveyance of sediment from disturbed areas off-site or into the existing drainage system. All existing drainage inlets adjacent to the site that are to remain shall have silt sacks installed prior to any construction activities. Stabilized construction entrances shall be installed as part of the construction and will be maintained until site tracking potential has been eliminated. The erosion control measures will remain in place until all construction activities are complete and all disturbed areas have been stabilized. The contractor will be required to inspect all controls regularly to ensure that they are working properly and to see if they need to be cleaned and/or replaced on an as-needed basis. The proposed project will disturb greater than one (1) acre of land, therefore the project will require the filing of a National Pollutant Discharge Elimination System (NPDES) Stormwater Construction General Permit. A stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to any construction activity. The SWPPP will prescribe in detail the performance standards to which the contractor for the project will be responsible for. The SWPPP will be maintained at the construction trailer on-site throughout the duration of the project. The SWPPP shall outline acceptable temporary stabilization measures to prevent incidental transport of sediment to off-site areas.

3.6 SITE UTILITIES

Private On-Site Wastewater Treatment System

The project site is located in an area that is not serviced by a municipal sewer system, therefore the proposed development will rely on a new subsurface disposal system (SSDS) which will consist of an effluent pump chamber, pump station, and an underground leaching field located onsite. A wastewater control house is provided that will allow for the routine monitoring of the system, the influent and effluent, and the chemical injection systems for biological treatment. The system will need to be designed and permitted in accordance with MassDEP Guidelines for the Design, Construction, Operation and Maintenance of Small Treatment Facilities with Land Disposal revised July 2018. The system will be designed by Onsite Engineering, Inc. and approved through a MassDEP Groundwater Discharge Permit subsequent to a hydrogeological evaluation approval process.

The proposed residential development is anticipated to have 100 one-bedroom units, 105 two-bedroom units, and 28 three-bedroom units; totaling 394 bedrooms. The proposed sewer flows are estimated to be 43,752 gallons per day based on 314 CMR 7.00 and 310 CMR 15.00. The sewage flows were calculated as follows:

Calculated Sewage Flows per The State Environmental Code, Title V (Proposed Development)

Type of Establishment	Min. Flow	Size	Calculated Flow	Design Flow
Residential	110 gpd/bedroom	394 bedrooms	43,340 gpd	43,340 gpd
Office (Clubhouse)	75 gpd/1000 sf min of 200 gpd	5,491 sf	411.8 gpd	412 gpd
Total Residential Flow				**43,752 gpd**

Calculated Sewage Flows per The State Environmental Code, Title V (Existing)

Existing Office Building to remain	75 gpd/1000 sf min of 200 gpd	62,500 sf	4,687.5 gpd	**4,688 gpd**

The layout plan currently shows the new leaching fields to be located in the vicinity of the existing leaching field for the Office Park. Final layouts are subject to MassDEP approval.

Private Water (Wells)

The project site is located in an area that is not serviced by a municipal water system, therefore the proposed development will rely on private on-site wells or wellfields. Since the wells will be required to service at least 25 individuals daily at least 60 days of the year, the proposed wells will be considered a Public Water System (PWS) and will be permitted through MassDEP in accordance with 310 CMR 22. All work shall be done in accordance with MassDEP Guidelines for Public Water Systems. The well or wellfields will be required to provide the minimum flow based on the calculated sewage flows per The State Environmental Code, Title V, except for bedrock wells which must be 133.33% of the calculated flow. Use of actual water meter flow rates is at the discretion of the approving authority, MassDEP, and the presumption of environmental uplift.

Establishment of drinking water supply wells require the establishment of a Zone 1 radius of protection. The Zone 1 will be required to be entirely under the control of the proponent, and no hardscape development will be allowed within it. MassDEP may also require additional limitations based on the underlying aquifer water quality characteristics. Vehicular traffic shall also be regulated to minimize the introduction of uncontrolled pollutants that may affect drinking water stability.

The existing office park currently has two PWS wells which have been permitted through MassDEP. Each well currently has a Zone 1 with a protective radius of 236-ft, therefore each well is capable of producing approximately 8,100 gpd. In coordination with Onsite Engineering, Inc., it is the intent to decommission an existing onsite well, increase the yield of the remaining well, and provide two new well heads. One well will be a low yield supplemental well, while the second will be a high yield well. Each well will have a Zone I associated with it commensurate with its draw and will therefore restrict development on the property. The use of supplemental onsite storage water tanks for domestic water use and fire protection systems is being evaluated by separate consultant. The conceptual locations are shown on the site development drawings, but final layout is subject to MassDEP approvals. The applicant has coordinated the drilling and installation of the proposed onsite wells through the Bolton Conservation Commission and the Board of Health.

Electrical/Telephone/Data
The proposed development will be serviced by newly installed underground utilities. Transformers and underground conduit locations are shown on the proposed site plan, but the final location will be coordinated and determined by the various utility providers.

3.7 WETLAND RESOURCE ALTERATIONS

The proposed development will require the filling of the two (2) isolated vegetated wetlands (non-jurisdictional) and adding fill within the bordering land subject to flooding. Compensatory storage is being provided to mitigate for the proposed fill within the bordering land subject to flooding area. The compensatory storage is being done in accordance with Wetland Protection Act. It is the intent of all applications pursuant to the Project to be in accordance with the state regulations of the Wetlands Protection Act. The applicant has sought an exception to the Town of Bolton Wetlands

Bylaw Regulations as part of the Comprehensive Permit. The Applicant will be submitting a Notice of Intent with MassDEP and the Conservation Commission subject to State action only.

3.8 TRANSPORTATION

TEC, Inc. is the traffic engineer of record for the project and has conducted a Traffic and Impact Assessment Study (TIAS) in accordance with standard engineering practice. The TIAS report is included within the appendix to this report. The Executive summary from the TIAS is reproduced below.

TEC, Inc. (TEC) has been retained by Wood Partners, LLC (the "Applicant"), to prepare a Traffic Impact Assessment (TIA) associated with a proposed 229 multi-family unit development at 580 Main Street (Route 117) in Bolton, Massachusetts. The site is currently occupied by a 105,000 square foot (SF) office building, a portion of which will be demolished and approximately 50,000 SF will remain. Access/egress for the site will be provided via the existing Bolton Office Park Driveway onto Main Street (Route 117), which is under the jurisdiction of the Town of Bolton.

TEC has evaluated the traffic operations for the site driveway and study area intersections under existing and future conditions. The future year planning horizon examines traffic operations under existing conditions (2021), as well as a 7-year design horizon (2028) for traffic volume projections, which includes an evaluation of the No Build conditions (without the proposed project) and Build conditions (with site traffic added). These conditions are compared to determine what, if any, additional off-site mitigation is necessary to provide reasonable traffic operations in the area after.

The executive summary of their findings is reproduced below.

- *Access and egress from the proposed site will be provided via the existing full movement access/egress Bolton Office Park Driveway onto Main Street (Route 117);*
- *A total of 5 crashes were reported at the Bolton Office Park Driveway / Main Street (Route 117) intersection, 53 crashes at I-495 Southbound Ramps / Main Street (Route 117) intersection, and 17 crashes at I-495 Northbound Ramps / Main Street (Route 117) intersection during the six-year study period.*
- *The proposed 229 multi-family units and the 50,000 SF office building are anticipated to generate approximately 2,264 new vehicle trips during the average weekday, with 180 new vehicle trips (88 entering and 92 exiting) during the weekday morning peak hour and 184 new vehicle trips (88 entering and 96 exiting) during the weekday evening peak hour. No trip credit was applied for the existing office building on the site.*

- *The sight distance characteristics measured at the Bolton Office Park Driveway exceeds AASHTO's minimum recommendations for safe operations for vehicles exiting the site.*
- *The Driveway approach at its intersection Main Street (Route 117) experiences delays on the northbound left turn movement in the No Build and Build conditions. Minimal site generated traffic is distributed on this movement (24 vehicles in the morning peak hour and 25 vehicles in the evening peak hour, or one vehicle every 2.5 minutes) and the additional trips on the roadway system in this direction will not be noticeable. It is recommended that this approach be restriped to provide an exclusive left turn lane and an exclusive right turn lane to improve the safety and efficiency of the intersection.*
- *The existing queue length storage provided in the westbound left turn lane at the site Driveway remains sufficient to accommodate the projected queue length during the peak hours.*
- *The I-495 Southbound Ramps / Main Street (Route 117) intersection and the I-495 Northbound Ramps / Main Street (Route 117) intersection continue to operate with acceptable levels of service during both peak hours with the addition of site generated traffic.*
- *The proposed parking supply is adequate to meet the projected demand of the proposed residential development.*

In conclusion, the proposed residential development can be safely and efficiently accommodated within the study area corridors and intersections and does not warrant any additional project-specific transportation mitigation beyond the itemized mitigation listed above.

For background, analysis and more detail information, please refer to the Traffic Impact Assessment report prepared by TEC in Appendix B.

3.9 ARCHITECTURAL

Alta-Nashoba Valley is a 229-unit apartment community located behind an existing office building at 580 Main Street in Bolton, Massachusetts. The project consists of four (4) three-story residential buildings with a mix of one, two and three-bedroom apartments. A single-story amenity building and a mail & package building flank the entry drive to the site upon arrival.

The amenity building is a single-story farmhouse inspired social space for the residents to gather which contains a leasing office, fitness center, work from home spaces, game room, lounge and connects directly to the outdoor Amenity courtyard which includes a swimming pool, outdoor fire pits and grill stations. The parking areas are located at the perimeter of the buildings for easy parking access along with three (3) stand-alone garage structures.

The building facades utilize natural color palettes inspired by local New England farmhouse building materials and pitched roofs. Elements from the amenity building are incorporated into each of the residential buildings to highlight the entry points. The massing of Buildings 1 and 2 create a large passive courtyard with quiet seating areas and pathways around a central lawn area. Buildings 3 and 4 are located at the southern end of the site and take advantage of the scenic wetland views.

The buildings are designed with materials that reflect the farmhouse and colonial styles commonly found in Bolton and the surrounding Nashoba Valley towns. The exterior cladding will be a mix of fiber cement lap siding and fiber cement vertical panels with board and batten. Windows will be double-hung and include a mix of single and double windows to create a variety of openings along the facades of the buildings. The roof is a pitched asphalt shingle roof. Most of the apartments will have direct access to exterior balconies or patios. Detailing will be kept clean and simple, providing a contemporary approach to the traditional farmhouse style building.

SECTION 4.0

STORMWATER MANAGEMENT

4.1 MASSDEP STORMWATER PERFORMANCE STANDARDS

The MassDEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for storm water management. The following section outlines how the proposed Stormwater Management System meets the standards set forth by the Policy.

BMP's implemented in the design include –
- Deep Sump Hooded Catch Basins
- Stormtech Isolator Row
- Water Quality Structures/Hydrodynamic separators (CDS 2015-4)
- Subsurface Infiltration Systems (Stormtech SC-740 Chambers)
- Specific maintenance schedule

Stormwater Best Management Practices have been incorporated into the design of the project to mitigate the anticipated pollutant loading. An Operations and Maintenance Plan has been developed for the project, which addresses the long-term maintenance requirements of the proposed system.

Temporary erosion and sedimentation controls will be incorporated into the construction phase of the project. These temporary controls may include straw wattles and/or silt fence barriers, inlet sediment traps, slope stabilization, and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10) Stormwater Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The proposed redevelopment at 580 Main Street is considered a mix of redevelopment and new development under the MassDEP Stormwater Management Standards.

The Standards are enumerated below as well as descriptions and supporting calculations as to how the Project will comply with the Standards:

Standard 1

No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The proposed development will not introduce any new stormwater conveyances (e.g. outfalls) that discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. The proposed stormwater management system will consists of deep sump hooded catch basins, Stormtech Isolator Row, subsurface infiltration and a water quality structure. The new outfalls are associated with the two (2) new subsurface infiltration systems. All discharges from impervious surfaces (buildings, parking, drive aisles) will be treated prior to discharging.

Standard 2

Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

The proposed development will be designed so that the post-development peak discharge rates and volumes do not exceed the pre-development peak discharge rates and volumes. Calculations have been provided to show that the proposed development will not cause an increase in peak discharge rates. Refer to the HydroCAD calculations provided within Appendix D of this report for detailed breakdowns.

Standard 3

Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The existing annual recharge for the site will be exceeded in the developed condition. Subsurface infiltration chambers will be designed to meet this requirement. All Infiltration Systems were designed using the "Simple Dynamic" Method per the MassDEP Stormwater Management Standards, Volume 3, Chapter 1.

The USDA Soil Survey of Worcester County was used to determine soil types on site.

The required recharge rates for each soil classification are as follows:

Table 4.1 – Recharge Volume per Hydrologic Soil Group (HSG)

	HSG A	HSG B	HSG C	HSG D
Required Recharge	0.60 inches	0.35 inches	0.25 inches	0.10 inches

Table 4.2 – Proposed Impervious Surface

Site	Total Area	HSG A	HSG B	HSG C	HSG D
Building Roof	131,980 sf	-	131,980 sf	-	-
Pavement/sidewalk	245,688 sf	-	245,688 sf	-	-
Total Impervious Area	377,668 sf	-	377,668 sf	-	-

The project is considered a mix of redevelopment and new development. Under existing conditions, there is approximately 274,710 sf of existing impervious surfaces (pavement/roof). Under proposed conditions, the project will have a total of 377,668 sf of impervious surface area, therefore a net increase of 102,958 sf. Per the Massachusetts Stormwater Handbook, the project is only required to recharge the increase in impervious surface above existing conditions. The main access road, the parking area associated with the office building, a portion of the clubhouse, the clubhouse amenity area and a small portion of the parking lot is being considered the redevelopment portion for the property. The impervious area has been decreased to the existing front detention/fire pond. All runoff from the remaining impervious areas will be collected by the proposed closed drainage system and will be directed into one of two (2) sub-surface infiltration system. The proposed sub-surface infiltration systems have been designed to account for the impervious area from the front portion of the site. The required recharge volume is given by the following equation:

R_v = F x IA (Equation 1 Stormwater Handbook Volume 3)

where R_v = Required Recharge Volume, ft^3
F = Target Depth factor
IA = Impervious drainage area
R_v = F x IA
= (0.35 inches)(1 foot/12 inches)(377,668 sf)
=11,015 cubic feet

The infiltration BMP has been sized using the "Simple Dynamic" Method, refer to Appendix D for the HydroCAD report.

MA MS4 General Permit requires the project to retain and infiltrate the volume of one (1) inch over the post-developed impervious surface, therefore the required V= (1")(1'/12")(377,668 sf) = 31,472 cf.

The infiltration BMP has been sized using the "Simple Dynamic" Method, refer to Appendix D for the HydroCAD report. The lowest orifice/outlet in the subsurface infiltration system has been set above the required volume per the Simple Dynamic Method.

The basin drawdown time is defined as:
$\text{Time}_{\text{drawdown}} = R_v / (K)(\text{bottom area})$
where R_v = Required Recharge Volume, ft3
K = Saturated Hydraulic Conductivity (Rawls Table)
Bottom area = Bottom area of recharge structure

Table 4.3 – Drawdown Calculation

System	R_v	K	Bottom Area	$Time_{drawdown}$
Sub-surface Sys 1	10,532 cf	2.41 in/hr	9,620 sf	5.5 hrs
Sub-surface Sys 2	6,794 cf	8.27 in/hr	12,059 sf	0.8 hrs

Note: Volume for drawdown is based on the volume from HydroCAD below the lowest outlet.

Standard 4

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

- *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;*
- *Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and*
- *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

The proposed stormwater management systems are designed so that the 80% TSS removal standard will be met for each drainage area. Standard #4 is met when structural stormwater best management practices are sized to capture and treat the required water quality volume and pretreatment is provided in accordance with the Massachusetts Stormwater Handbook. Standard #4 also requires that suitable source control measures are identified in the Long Term Pollution Prevention Plan. The 80% TSS removal standard will be met using some combination of the following: street sweeping, porous pavement, water quality structure and several subsurface infiltration systems consisting of Stormtech chambers.

The water quality volume for the site development will be captured and treated using an infiltration system equipped with isolator rows. All systems will be sized to meet the water quality flow rate for the 0.5" storm event.

TSS Removal Credits for Street Sweeping (Massachusetts Stormwater Handbook Volume 2 Chapter 1)

TSS Removal Rate	High Efficiency Vacuum Sweeper – Frequency of Sweeping	Regenerative Air Sweeper – Frequency of Sweeping	Mechanical Sweeper (Rotary Broom)
5%	Quarterly Average, with sweeping scheduled primarily in spring and fall.	Quarterly Average, with sweeping scheduled primarily in spring and fall.	Monthly Average, with sweeping scheduled primarily in spring and fall.

TSS Removal Calculation Worksheet – Existing Wet Basin/Fire Pond

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Deep Sump Hooded Catch Basin	25%	1.00	0.25	0.75
Proprietary Separator	50%*	0.75	0.375	0.375
Wet Basin	80%	0.375	0.30	0.075
Total TSS Removal				**92.5%**

*Proprietary TSS removal rates have been capped at 50% though manufacturer studies report more effectiveness.

TSS Removal Calculation Worksheet – Sub-Surface Infiltration Systems Prior to Infiltration

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Deep Sump Hooded Catch Basin	25%	1.00	0.25	0.75
Proprietary Separator	50%*	0.75	0.375	0.375
Total TSS Removal prior to infiltration				**62.5% (44% Required)**

*Proprietary TSS removal rates have been capped at 50% though manufacturer studies report more effectiveness.

TSS Removal Calculation Worksheet – Sub-Surface Infiltration Systems				
A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Deep Sump Hooded Catch Basin	25%	1.00	0.25	0.75
Proprietary Separator	50%*	0.75	0.375	0.375
Sub-Surface infiltration with Isolator Row	80%	0.375	0.30	0.075
			Total TSS Removal	**92.5%**

*Proprietary TSS removal rates have been capped at 50% though manufacturer studies report more effectiveness.

Standard 5

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The proposed development is considered a source of higher potential pollutant loads because the proposed parking area is considered a high-intensity parking area (over 1,000 vehicle trips per day). Pre-treatment and source reduction are provided to the maximum extent practicable. The drainage system will be designed to treat 1” water quality volume and provide 44% TSS removal prior to discharge to an infiltration device. The SMS will be designed with deep-sump hooded catch basins, hydrodynamic separators, and infiltration chambers equipped with isolator rows to provide 44% TSS removal prior to recharge.

Standard 6

Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural *stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.*

The project development is located adjacent to several Zone I's and located within the Interim Wellhead Protection Area. The drainage system will be designed to treat 1" water quality volume and provide 44% TSS removal prior to discharge to an infiltration device. The SMS will be designed with deep-sump hooded catch basins, hydrodynamic separators, and infiltration chambers equipped with isolator rows to provide 44% TSS removal prior to recharge.

The existing southerly fire pond will be located within a Zone 1 to the proposed drinking water supply well. As such, this pond is no longer considered as part of the stormwater management system. It will continue to perform its function as a fire pond and the receiving water body for the outlets from the proposed SMS.

Standard 7

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

The project is considered a mix of redevelopment and new development. Under existing conditions, there is approximately 274,710 sf of existing impervious surfaces (pavement/roof). Under proposed conditions, the project will have a total of 377,668 sf of impervious surface area, therefore a net increase of 102,958 sf. Per the Massachusetts Stormwater Handbook, the project is only required to recharge the increase in impervious surface above existing conditions. The main access road, the parking area associated with the office building, a portion of the clubhouse, the clubhouse amenity area and a small portion of the parking lot is being considered the redevelopment portion for the property. The impervious area has been decreased to the existing front wet basin/fire pond. A majority of the existing drainage along the front portion of the site will remain. Stormwater from the newly constructed areas associated with and adjacent to the new clubhouse, will be improved through the use of a Contech CDS 2015-4 water quality structure.

All runoff from the remaining impervious areas will be collected by the proposed closed drainage system and will be directed into one of two (2) sub-surface infiltration system. The proposed sub-surface infiltration systems have also been designed to recharge for the impervious area from the front portion of the site.

Standard 8
A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities will be developed. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

Standard 9
A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

A Long-Term Operation & Maintenance (O&M) Plan has been developed for the proposed stormwater management system and is included within this document. See Appendix F of this report.

Standard 10
All illicit discharges to the stormwater management system are prohibited.

There are no expected illicit discharges to the stormwater management system. The applicant will submit the Illicit Discharge Compliance Statement prior to the discharge of stormwater runoff to the post-construction stormwater best management practices and prior to the issuance of a Certificate of Compliance.

See the next page for the MassDEP Stormwater Checklist.

MassDEP Stormwater Checklist

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

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A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

PHILIP L.
CORDEIRO
CIVIL
NO. 47083

Philip L Cordeiro
c=US, o=Allen and Major Associates Inc.,
ou=A01410C00000175798BB4FD00002012, cn=Philip
L Cordeiro
2022.09.07 13:47:41 -04'00'

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of “country drainage” versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☒ Other (describe): ____________________

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

  ☒ is within the Zone II or Interim Wellhead Protection Area

  ☒ is near or to other critical areas

  ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

  ☒ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½” or 1” Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☒ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

  ☒ Name of the stormwater management system owners;

  ☒ Party responsible for operation and maintenance;

  ☒ Schedule for implementation of routine and non-routine maintenance tasks;

  ☒ Plan showing the location of all stormwater BMPs maintenance access areas;

  ☐ Description and delineation of public safety features;

  ☒ Estimated operation and maintenance budget; and

  ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

  ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;

  ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

SECTION 5.0

EXCEPTIONS & PREVIOUSLY APPROVED PROJECTS

5.1 LIST OF REQUESTED EXCEPTIONS TO LOCAL REQUIREMENTS

The Applicant's requested waivers are based on the Plans entitled "Preliminary Application for Comprehensive Permit ALTA Nashoba Valley 580 Main Street Bolton, MA dated September 10, 2021 prepared by Allen & Major Associates, Inc. ("Site Development Plans").

Board of Health Regulations, Protection to Groundwater

- Section 1.11 Protection of Ground Water
  It is the applicant's opinion that a Comprehensive Permit issued by the Zoning Board of Appeals will meet this criteria and therefore not require or seek an additional permit from the Board of Health for the Protection to Groundwater, otherwise a waiver is requested to waive this section in its entirety. The Applicant is required to obtain a Groundwater Discharge permit from MassDEP which would require hydrogeologic assessment and groundwater monitoring to be completed prior to the issuance of the permit.
- Section 1.11.2 Performance Standards, d)
  Applicant requests a waiver from this section in its entirety as the underground tanks located onsite shall be subject to MassDEP permitting review and inspection requirements for wastewater and drinking water supply.
- Section 1.11.2 Performance Standards, g)
  Applicant requests a waiver from this section in its entirety. An erosion and sediment control plan shall be implemented in conformance with the regulations of the EPA NPDES program and the Wetlands Protection Act requirements for erosion protection.

Wetlands By-Law

- Section 1.18 Wetlands ByLaw
  Applicant requests a waiver from this section in its entirety. The proposed development will be done in accordance with the Wetland Protection Act.

Wetlands By-Law Regulations

- Applicant requests a waiver from this section in its entirety. The proposed development will be done in accordance with the Wetland Protection Act.

Board of Health Regulations, Requirements for the subsurface Disposal of Sanitary Sewage

- Applicant requests a waiver from this section in its entirety. The Applicant is required to obtain a Groundwater Discharge Permit from MassDEP and is subject to the requirements published by MassDEP.
- Regulation 4: Distances

Applicant requests a waiver from this section in its entirety. Setback distances for onsite sewage treatment shall be dictated by the setbacks published by MassDEP imposed in conjunction with the issuance of a Groundwater Discharge Permit (WP 79 or other).

Board of Health Regulations, Well Regulations

- Applicant requests a waiver from this section in its entirety. Potable well siting, setback requirements and construction shall be dictated by the setbacks published by MassDEP imposed in conjunction with the issuance of a Public Drinking Water Supply (WS 13 permit or other).

Subdivision Rules and Regulations

- Applicant requests a waiver from the entirety of the Subdivision Rules and Regulations as the project does not constitute a subdivision of land and the design and permitting requirements contained within the regulations.
- Even though a waiver has been requested in its entirety, the proposed Stormwater Management System has been designed in accordance with the MassDEP stormwater standards to meet pre-development peak discharge rates. Local requirements for runoff volume at the design points and the rainfall data utilized is the latest edition of NOAA Atlas 14 as required by the Subdivision Rules & Regulations has been utilized.

Bolton Code, Chapter 147 Groundwater Protection

- It is the applicant's opinion that a Comprehensive Permit issued by the Zoning Board of Appeals will meet this criteria and therefore not require or seek an additional permit from the Board of Health for the Protection to Groundwater, otherwise a waiver is requested to waive this section in its entirety. The Applicant is required to obtain a Groundwater Discharge permit from MassDEP which would require hydrogeologic assessment and groundwater monitoring to be completed prior to the issuance of the permit.

Bolton Code, Chapter 211, Streets and Sidewalk

- Applicant requests a waiver from the entirety of this Chapter. The Applicant requests the Town to issue any necessary street and sidewalk permits through decision of the Zoning Board of Appeals as part of any Comprehensive Permit duly issued.

Bolton Code, Chapter 250, Zoning

- §250-12, Schedule of Permitted Uses
    - Applicant requests residential use to be allowed within the Limited Business District as shown on the Site Development Plans.
- §250-13, Dimensional Regulations, C. One building per lot.

  - Applicant requests the four residential structures, clubhouse, mail center, garages and other necessary buildings as shown on the Site Development Plans be located on a single lot.
- §250-13, Dimensional Regulations, F. Building Height.
  - Applicant requests a waiver from the entirety of this section to construct the four three-story residential structures with heights as shown on the architectural elevation drawings as prepared by Market Square Architects dated September 10, 2021.
- §250-17, Driveways and Parking, C. Parking. (7) Schedule of Minimum Parking
  - Applicant requests a waiver from the parking section in the absence of residential parking counts and the requirement for a Special Permit issued by the Zoning Board of Appeals.
- §250-17, Driveways and Parking, C. Parking. (11) Standard Parking Dimensional Regulations
  - Applicant requests a waiver in providing an additional 2 feet where parking abuts a sidewalk.
- §250-17, Driveways and Parking, C. Parking. (12) Off-Street Parking and Loading Area Design Requirements, (b) Setbacks.
  - Applicant requests a waiver to provide parking less than 10 feet to a proposed side lot line of an Approval Not Required division of land between adjoining parcels of the Development and 580 Main Street; Subject to necessary easements and agreements.
- §250-17, Driveways and Parking, C. Parking. (12) Off-Street Parking and Loading Area Design Requirements, (d) Perimeter Landscaping Requirements.
  - Applicant requests a waiver from the requirement of a 10 foot wide perimeter buffer strip for the common lot line with the lot at 580 Main Street.
- §250-17, Driveways and Parking, C. Parking. (12) Off-Street Parking and Loading Area Design Requirements, (e) Interior Landscaping Requirements.
  - Applicant requests a waiver form this section in its entirety to provide parking fields as shown on the Site Development Plans with landscaping as shown on the site amenity landscape drawings.
- §250-18, Sign Regulations,
  - Applicant requests acceptance of the site signage as shown on the Site Development Drawings as part of any Comprehensive Permit issued by the Zoning Board of Appeals in lieu of permit issued by the Board of Selectmen.
- §250-18, Sign Regulations, A
  - Applicant requests waiver to provide signage in excess of 36 square feet.
- §250-19.1, Firefighting Water Supply, B
  - Applicant requests a waiver on requirement of approval of a firefighting system via the Planning Board. The system approval shall be incorporated into the

Comprehensive Permit as issued by the Bolton Zoning Board of Appeals upon consultation with the Bolton Fire Department. Final system design shall be subject to issue of a Building Permit subsequent to full review of the Fire Protection systems by the Bolton Fire Department.

- §250-23, Business, Commercial, and Industrial Regulations
    - Applicant requests a waiver from this section in its entirety for any applicable design standards for lots within the Limited Business District with overlays.
- §250-23.2, Mixed Use Village Overlay District
    - Applicant requests a waiver from this section in its entirety for any applicable design standards for lots within the Mixed Use Village Overlay District.
- §250-25, Wireless Communications
    - Applicant requests a waiver from this section in its entirety for any applicable design standards for lots within the Wireless Communications Overlay District.

Zoning Board of Appeals Rules & Regulations

- Section 6.3.18
    - Applicant requests a waiver from including preliminary foundation plan, wall sections, electrical, plumbing and mechanical plans. These plans will be included as part of the construction set, which will be submitted for the Building Permit.

5.2 1986 SPECIAL PERMIT CONDITIONS

The existing business park received a limited Business Special Permit from the Board of Selectmen on October 25, 1986. The permit was issued to the Flatley Company for a 100,000 sf building. The permit had several conditions/agreements identified which include the following:

1. The owner and all future tenants shall grant access to and parking for the Bolton Fair. All access roads to the property and all parking lots on the property shall be available one weekend per year Friday evening through Sunday evening for the conduct of the Bolton Fair on surrounding town property. The Owner and tenants will be notified of the exact dates of the Bolton Fair after those dates have been set;
2. The owner shall provide the Town of Bolton access to surrounding town land. To the east an emergency access from the parking lots or roadways will be provided with access to the crossing at the existing culvert. To the west, a permanent access from the driveway to the wooden town building and its surrounding land will be provided. All such access ways shall be as shown on the plan submitted in the special permit process and may be relocated at the discretion of the property owner;

3. The owner shall complete a study design for an appropriate traffic study for the Town of Bolton. The owner shall also make a financial contribution to the Route 117 corridor traffic study of not less than half of the study's cost not covered by State or Federal funds, but in no event to exceed $20,000.00. The Selectmen shall determine the type and scope of study and the start date of the study. The Selectmen shall issue a statement of compliance suitable for recording upon completion of the obligation imposed in this paragraph;
4. The owner of the facility will require the establishment of tenant programs in transportation systems management as approved by the Metropolitan Area Planning Council. The program's purpose shall be to minimize the auto traffic in and out of the facility during peak hours. The program should include as a minimum consideration of flexible working hours and carpool incentives;
5. The owner shall maintain a 60-ft wide corridor from buildings along the entire east and west boundaries of the property in anticipation of a Bolton By-pass as may be determined by the Selectmen in the future. Owner agrees to relocate site driveways as required to be harmonious with the proposed By-pass. This provision shall be deemed terminated when the Town of Bolton completes any taking required at the time the By-pass is constructed and in any event this provision shall be deemed excised from this special permit if and when the anticipated By-pass is located on the property other than the subject premises. The Selectmen shall issue a Certificate suitable for recording attesting to the excise of this paragraph from the special permit when the terms of this paragraph warrant same;
6. The construction of the building and access roadways shall not restrict access to the existing pond. The owner shall designate a public access way not less than 10-ft in width from Route 117 to the presently existing pond for public access to the pond for fishing and other recreational uses. An area forty (40) feet in width from the edge of the presently existing pond shall be reserved for public fishing and recreation use and may be maintained and/or improved by the Town of Bolton. The owner shall have the right to relocate said public access way provided that the public access to the pond is not unreasonably impaired thereby;
7. No trash from the proposed facility shall be taken to the Bolton landfill;
8. It is the understanding of the Selectmen and the owner that any expansion is limited to an additional 100,000 square feet per agreement of the Town and the owner during the 1986 special permit process. A new special permit would be required for any such expansion.

The applicant hereby requests that these conditions which did not have a sunset provision when enacted under the original permit and were subject to the originating parcel either be extinguished in their entirety as part of the Comprehensive Permit issued in due course or otherwise be pertinent to the remaining portion of the land only (identified as Lot 1 on the Property Modification Plan) if applicable.

APPENDIX A

SUPPORT DOCUMENTS TO COMPREHENSIVE PERMIT APPLICATION

APPLICATION FOR HEARING

PROJECT ELIGIBILITY LETTER

EVIDENCE OF SITE CONTROL

APPLICANT DETAILS & FINANCIAL INFORMATION

CERTIFIED ABUTTER'S LIST

Pd ck# 890
9/9/2021

TOWN OF BOLTON

ASSESSORS OFFICE
TOWN HALL
663 MAIN STREET
BOLTON, MASSACHUSETTS 01740
PHONE (978) 779-5556 FAX (978) 779-5461

Date of Application September 7, 2021

REQUEST FOR LIST OF ABUTTERS

Effective August 24, 2004, anyone requesting a list of abutters must give at least three (3) working days notice. This notice will allow the Assessors Office sufficient time necessary to prepare the list of Abutters.

Effective July 1, 2004, the fee schedule is $15 per certified abutters list.

**Please note that these fees apply to preparation of new list or verification or reverification of an existing list.*

Please indicate with a check

_______ **Immediate Abutters (Board of Selectmen)**
x **Board of Appeals, Planning Board, Site Plan review - within 300 feet**
_______ **Conservation Commission within 100 feet or distance = _______ feet**
_______ **Planning Board for sub division – 500 feet**
_______ **Abutter to Abutter within distance of_________ feet**

Map ______________________ **Parcel(s)** 004.C-0000-0024.0

Allen & Major Associates, Inc. (on behalf of Bolton Office Park LLC).
Applicant (please print)

580 Main Street
Location of Property

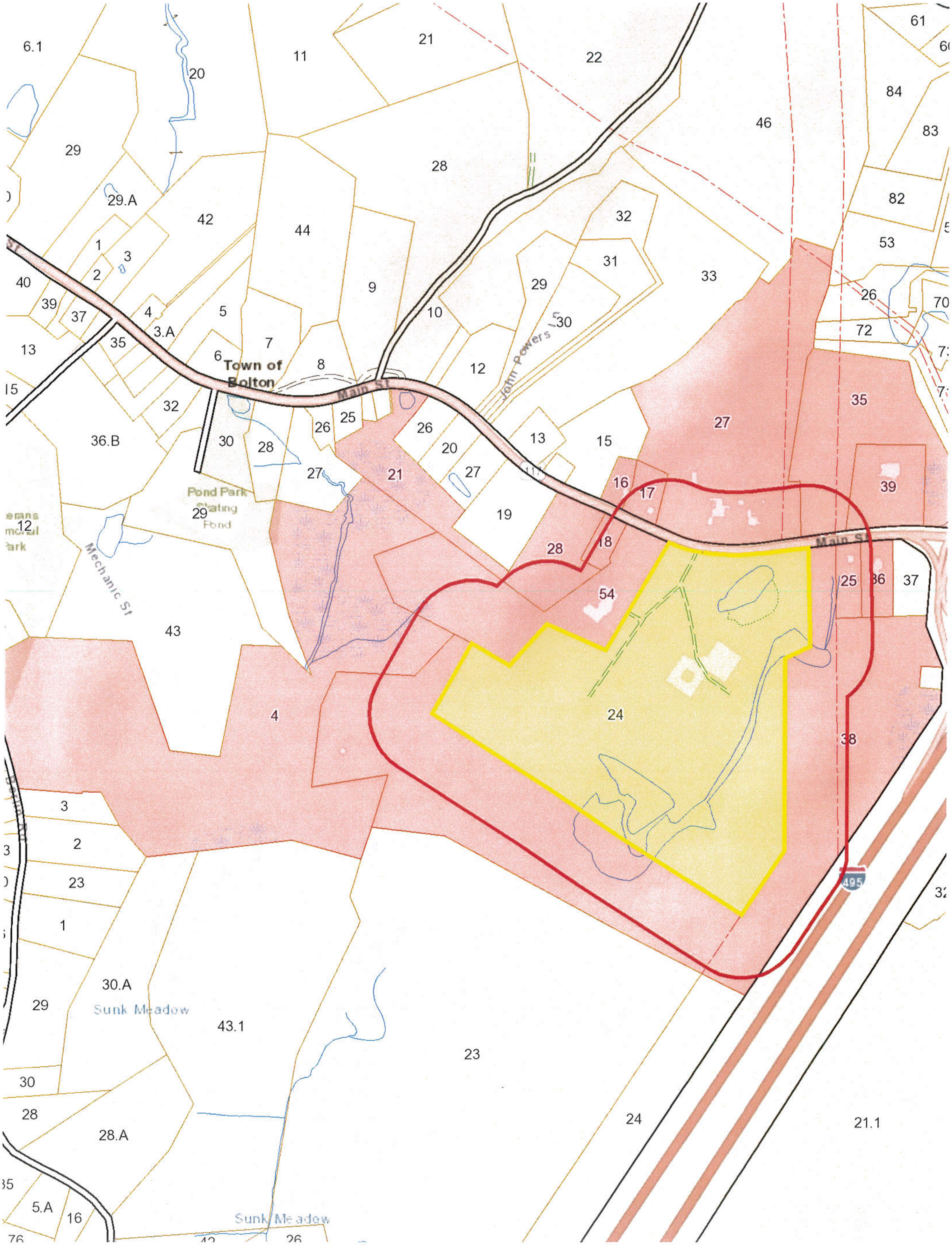
(for LANDOWNER)
Signature of Applicant

(A&M) 10 Main Street, Lakeville, MA
Mailing Address of Applicant

(508) 923-1010
Telephone Number

(___)_________
FAX Number

PLEASE NOTE: THIS ABUTTERS LIST IS VALID FOR SIX MONTHS



Town of Bolton
Main St
Main St
John Powers Ln
Mechanic St
Pond Park Skating Pond
Veterans Memorial Park
Sunk Meadow
Sunk Meadow
495
6.1
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11
21
22
46
61
84
83
29
28
29.A
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44
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21.1
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28.A
5.A
16
26

300 foot Abutters List Report

Bolton, MA
September 07, 2021

Subject Property:

Parcel Number: 004.C-0000-0024.0
CAMA Number: 004.C-0000-0024.0
Property Address: 580 MAIN ST

Mailing Address: BOLTON OFFICE PARK LLC
100 GRANDVIEW RD, STE 312
BRAINTREE, MA 02184

Abutters:

Parcel Number: 002.0-0000-0016.0
CAMA Number: 002.0-0000-0016.0
Property Address: 607 MAIN ST

Mailing Address: HASTIE MARISA
607 MAIN ST
BOLTON, MA 01740

Parcel Number: 002.0-0000-0017.0
CAMA Number: 002.0-0000-0017.0
Property Address: 601 MAIN ST

Mailing Address: NICHOLS ROBERT A TR 601-603 MAIN ST REALTY TRUST
50 HOPKINTON RD
WESTBORO, MA 01581-104

Parcel Number: 002.0-0000-0018.0
CAMA Number: 002.0-0000-0018.0
Property Address: 608 MAIN ST

Mailing Address: BICKFORD KAREN & JOHN
10 WILDER RD
BOLTON, MA 01740

Parcel Number: 002.0-0000-0021.0
CAMA Number: 002.0-0000-0021.0
Property Address: 0 MAIN ST

Mailing Address: ROUFAIL NABIL, TR, HARES REALTY TR

7 DEER RUN
CHARLTON, MA 01507

Parcel Number: 002.0-0000-0028.0
CAMA Number: 002.0-0000-0028.0
Property Address: 0 MAIN ST

Mailing Address: ROUFAIL NABIL, TR, HARES REALTY TR

7 DEER RUN
CHARLTON, MA 01507

Parcel Number: 004.C-0000-0004.0
CAMA Number: 004.C-0000-0004.0
Property Address: 0 BERLIN RD

Mailing Address: TOWN OF BOLTON DERBY PURCHASE & SAWYER 1967
663 MAIN ST
BOLTON, MA 01740

Parcel Number: 004.C-0000-0025.0
CAMA Number: 004.C-0000-0025.0
Property Address: 562 MAIN ST

Mailing Address: WACHUSETT REALTY LLC
200 CHURCH ST
CLINTON, MA 01510

Parcel Number: 004.C-0000-0027.0
CAMA Number: 004.C-0000-0027.0
Property Address: 579 MAIN ST

Mailing Address: BOLTON PROPERTY MANAGEMENT LLC

579 MAIN ST
BOLTON, MA 01740

Parcel Number: 004.C-0000-0035.0
CAMA Number: 004.C-0000-0035.0
Property Address: 0 MAIN ST

Mailing Address: FREIDUS FREDERIC J TR 563 MAIN STREET RTY TR
138 WATTAQUADOCK HILL RD
BOLTON, MA 01740

Parcel Number: 004.C-0000-0036.0
CAMA Number: 004.C-0000-0036.0
Property Address: 556 MAIN ST

Mailing Address: CAVINESS ALAN R TR FIVE FIFTY SIX GREAT RD RTY TR
556 MAIN ST
BOLTON, MA 01740

CAI Technologies
www.cai-tech.com

300 foot Abutters List Report

Bolton, MA
September 07, 2021

Parcel Number: 004.C-0000-0038.0
CAMA Number: 004.C-0000-0038.0
Property Address: 0 MAIN ST
Mailing Address: TOWN OF BOLTON FLATLEY FIELD &
CELLONE
P O BOX 278
BOLTON, MA 01740

Parcel Number: 004.C-0000-0039.0
CAMA Number: 004.C-0000-0039.0
Property Address: 563 MAIN ST
Mailing Address: SWAND LLC
563 MAIN ST
BOLTON, MA 01740

Parcel Number: 004.C-0000-0054.0
CAMA Number: 004.C-0000-0054.0
Property Address: 600 MAIN ST
Mailing Address: BOLTON SENIOR HOUSING CORP
663 MAIN ST
BOLTON, MA 01740

As set forth in the Assessor's records as of January 1, 2021.

Kelly Garlock

Kelly Garlock
Assistant Assessor

BICKFORD KAREN & JOHN
10 WILDER RD
BOLTON, MA 01740

BOLTON PROPERTY MANAGEMEN
579 MAIN ST
BOLTON, MA 01740

BOLTON SENIOR HOUSING COR
663 MAIN ST
BOLTON, MA 01740

CAVINESS ALAN R TR
FIVE FIFTY SIX GREAT RD R
556 MAIN ST
BOLTON, MA 01740

FREIDUS FREDERIC J TR
563 MAIN STREET RTY TR
138 WATTAQUADOCK HILL RD
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HASTIE MARISA
607 MAIN ST
BOLTON, MA 01740

NICHOLS ROBERT A TR
601-603 MAIN ST REALTY TR
50 HOPKINTON RD
WESTBORO, MA 01581-104

ROUFAIL NABIL, TR, HARES
7 DEER RUN
CHARLTON, MA 01507

ROUFAIL NABIL, TR, HARES
7 DEER RUN
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SWAND LLC
563 MAIN ST
BOLTON, MA 01740

TOWN OF BOLTON
FLATLEY FIELD & CELLONE
P O BOX 278
BOLTON, MA 01740

TOWN OF BOLTON
DERBY PURCHASE & SAWYER 1
663 MAIN ST
BOLTON, MA 01740

WACHUSETT REALTY LLC
200 CHURCH ST
CLINTON, MA 01510

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BOLTON, MA 01740

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BOLTON, MA 01740

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BOLTON, MA 01740

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BOLTON, MA 01740

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50 HOPKINTON RD
WESTBORO, MA 01581-104

ROUFAIL NABIL, TR, HARES
7 DEER RUN
CHARLTON, MA 01507

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TOWN OF BOLTON
FLATLEY FIELD & CELLONE
P O BOX 278
BOLTON, MA 01740

TOWN OF BOLTON
DERBY PURCHASE & SAWYER 1
663 MAIN ST
BOLTON, MA 01740

WACHUSETT REALTY LLC
200 CHURCH ST
CLINTON, MA 01510

APPENDIX C

GEOTECHNICAL REPORT

REPORT ON

PRELIMINARY GEOTECHNICAL REPORT
PROPOSED DEVELOPMENT
580 MAIN STREET
BOLTON, MASSACHUSETTS

by
Haley & Aldrich, Inc.
Boston, Massachusetts

for
WP East Acquisitions, LLC
Lexington, Massachusetts

File No. 135679-002
April 2021

HALEY & ALDRICH, INC.
465 Medford St.
Suite 2200
Boston, MA 02129
617.886.7400

SIGNATURE PAGE FOR

REPORT ON

PRELIMINARY GEOTECHNICAL REPORT
PROPOSED DEVELOPMENT
580 MAIN STREET
BOLTON, MASSACHUSETTS

PREPARED FOR
WP EAST ACQUISITIONS, LLC
LEXINGTON, MASSACHUSETTS

PREPARED BY:

Michael J. Weaver, P.E. (MA)
Senior Associate
Haley & Aldrich, Inc.

REVIEWED AND APPROVED BY:

John T. Difini, P.E. (MA)
Principal
Haley & Aldrich, Inc

HALEY & ALDRICH, INC.
465 Medford St.
Suite 2200
Boston, MA 02129
617.886.7400

1 April 2021
File No. 135679-002

WP East Acquisitions, LLC
c/o Wood Partners
91 Hartwell Avenue
Lexington, Massachusetts 02421

Attention: David Moore

Subject: Preliminary Geotechnical Report
Proposed Residential Development
580 Main Street
Bolton, Massachusetts

Ladies and Gentlemen:

This letter report summarizes the results of a preliminary geotechnical investigation performed by Haley & Aldrich, Inc. (Haley & Aldrich) for a proposed multi-family residential development project located at 580 Main Street, Bolton, Massachusetts. The work summarized in this report was performed in accordance with our proposal dated 2 September 2020 and your subsequent authorization.

The information presented in this report is intended for initial project planning and preliminary cost estimating purposes only. Final design recommendations and associated construction requirements will be developed during the final design phase of the project upon completion of final design explorations.

Introduction

SITE CONDITIONS

The project site is located at 580 Main Street in Bolton, Massachusetts as shown on the attached Figure 1. It is bordered to the north by an existing residential building, the east by Main Street, and the south and west by forested land.

The site is currently developed with one, 2-story brick office/industrial building. The remainder of the site consists of paved parking areas, grassed/landscaped areas, and detention ponds. The ground floor of the building is set at approximately El. 353 such that it walks out to existing site grades on its north and west sides. The existing building has a basement at approximately El. 340 that is accessed by a loading dock area on the south side of the building.

Existing site grades along Main Street generally range from El. 350 (north end) to El. 345 (south end). Within the site, grades range from approximately El. 350 to El. 353 around the existing building and slope down to approximately El. 346 in the parking area along the western edge of the site adjacent to the detention pond area. There is also a groundwater well and pump house located along the north side of the property that services the building.

PROPOSED DEVELOPMENT

Based on the Wood Partner Concept Plan dated 9 March 2021 (provided in Appendix A), we understand that the proposed development will consist of the construction of four, 3-story residential buildings, four - three story townhouse buildings, and an amenity building. The residential buildings will each have 36 to 75 units and will occupy footprints ranging from approximately 17,500 to 30,000 square feet (sq ft). Each townhouse building will occupy a footprint of approximately 850 sq ft, and the amenity building will be 1-story in height and have a footprint of approximately 5,000 sq ft. No below grade space is planned for the buildings. At grade parking will surround each of the buildings. The west approximate half of the existing office building will be demolished, while its approximate east half will remain and continue to be used as office space. The locations of the proposed buildings relative to existing site conditions is shown on the attached Figure 2.

Proposed site grading was not available at the time this report was prepared, but based on the existing site grades, we anticipate that the new development will have grades similar to the existing site grades and as such no significant cuts or fills will be required across the site. Site development also includes the installation of new wastewater leaching fields to be design by others. The proposed leaching fields are to be located in the northeast portion of the site adjacent to the access road and Main Street.

Subsurface Explorations and Laboratory Testing

SUBSURFACE EXPLORATIONS

Haley & Aldrich conducted a subsurface exploration program consisting of nine (9) soil test borings (designated HA-1 through HA-9) and five test pits (designated TP20-1 to TP20-5) at the proposed project site.

The test borings were performed by Northern Drill Service during the period 5 through 7 October 2020 and were monitored in the field by a Haley & Aldrich geologist. The test borings were drilled using casing to depths ranging from 7 to 16 ft below the existing ground surface (bgs). Standard Penetration Tests (SPTs) using an automatic hammer were conducted continuously in the upper 6 ft of each test boring and then generally at 5-ft intervals thereafter. Two groundwater observation wells were installed in two completed boreholes (HA-1(OW) and HA-7(OW)).

The test pits were performed by Earthworks Industries, Inc. on 11 December 2020 and were monitored in the field by a Haley & Aldrich geologist and a representative from Onsite Engineering. The test pits were advanced in the vicinity of the existing leaching field to depths ranging from 4 to 8.5 feet bgs.

The approximate locations of the explorations relative to existing site conditions and proposed building locations are shown on Figure 2. Locations of explorations were estimated in the field by taping from existing site features by Haley & Aldrich field staff. Ground surface elevations at exploration locations were estimated using a site plan provided to us. As such, locations of and ground surface elevations at exploration locations should be considered approximate. Logs describing conditions encountered in each exploration (including form 11 documentation of the test pits) are provided in Appendix B.

LABORATORY TESTING

A geotechnical laboratory testing program consisting of grain size analysis and in-situ moisture content testing was conducted on four soil samples (two existing site fill, two glacial till) obtained from the test borings to aid with soil classification and on-site reuse evaluation. Laboratory testing results are presented in Appendix C.

Subsurface Conditions

SOIL AND BEDROCK

Subsurface conditions encountered at the exploration locations consisted of the following stratigraphic units starting at existing ground surface:

Subsurface Unit	Top of Stratum (approx.)	Range in Thickness (ft) (approx.)
Fill	El. 346 to El. 351	0.4 to 7
Glacial Till	El. 343 to El. 349	2 to >15
Bedrock	El. 333 to El. 345 (where encountered)	N/A

The generalized descriptions of the units are as follows:

- Fill was encountered to depths ranging from 0.4 to 7 ft bgs. In landscaped areas, the Fill consisted of loose to medium dense sandy ORGANIC SOIL. In areas below existing pavements, the Fill generally consisted of loose to medium dense silty SAND or poorly graded SAND with silt. The deepest Fill was encountered in boring HA-4 where a surficial layer of ORGANIC SOIL was underlain silty SAND fill.
- Glacial Till was encountered below the Fill at each boring location. The Glacial Till consisted of medium to very dense silty SAND with gravel. The Glacial Deposits ranged in thickness between about 2 ft to greater than 15 ft. Cobbles were noted to be present in the Glacial Till during drilling.
- Bedrock (probable) was encountered below the Glacial Till (where the Glacial Till was fully penetrated) at HA-1, HA-2, HA-7, HA-8, and HA-9 at depths ranging from about 4 ft to 14 ft bgs (corresponding to approximately El. 333 to El. 345). These estimates of probable bedrock were based on drill action, limited sample recoveries in split spoons, and refusal to the drilling

equipment (i.e., no coring of bedrock was conducted for this preliminary evaluation). Bedrock outcrops were observed near HA-4 and suspected bedrock outcrops were observed near HA-9.

GROUNDWATER

Two groundwater observation wells were installed as part of this preliminary evaluation (HA-1(OW) and HA-7(OW)). Water level readings obtained on 7 October 2020 (i.e., 1 to 2 days following well installation) indicate water levels of approximately 8.9 ft bgs (approximately El. 340) in HA-1(OW) and 5.5 ft bgs (approximately El. 340.5) in HA-7 (OW).

Based on our understanding of the subsurface conditions at the site, we anticipate groundwater may locally perch on the low permeability Glacial Till and Bedrock, particularly following precipitation events or during snowmelt. As such, it should be anticipated that groundwater levels at the site will fluctuate from those indicated herein. We recommend additional well readings be taken in support of final design and construction.

Preliminary Geotechnical Considerations

The preliminary geotechnical recommendations presented in this section are based on the conceptual design of the project and the subsurface conditions identified in the explorations referenced herein. Our preliminary geotechnical evaluations and subsequent preliminary geotechnical recommendations are provided in accordance with the 9th Edition of the Massachusetts State Building Code, and are intended to aid in your initial planning and preliminary cost estimating (i.e., not intended for project final design).

BUILDING FOUNDATIONS

Based on the subsurface conditions encountered in the test borings, the wall and column loads for the proposed buildings can be supported on shallow spread footing foundations bearing at conventional foundation depths on the Glacial Till, compacted structural fill placed above the Glacial Till following removal of existing Fill (if/where present) within the zone of influence of the footings, or on a 6 in. thickness of crushed stone (wrapped with filter fabric) placed over Bedrock.

For initial planning, we recommend that footings bearing on the Glacial Till or on compacted structural fill be sized for a maximum allowable bearing pressure of 6 kips per square foot (ksf). Foundations bearing on Bedrock may be designed using a maximum allowable bearing pressure of 10 ksf. For ease of design and construction, a single value of 6 ksf could be used for all footing regardless of bearing condition. These maximum bearing pressures apply to footings having a minimum width of 3 ft. Bearing pressures for footings less than 3 ft should be reduced proportionally to the footing width. We recommend a minimum footing width of 18 in.

For initial planning purposes, settlements of footings sized for these bearing pressures would be on the order of up to 1-in. total and ½ in. differential (over a distance of approximately 30 ft).

LOWEST LEVEL SLAB

The lowest level building slabs can be designed as conventional soil support slab-on-grades. We recommend that slabs bear on a minimum of 8 in. of imported Structural Fill or ¾ in. crushed stone separated from underlying/adjacent soils using a geotextile filter fabric (6 oz minimum, needle-punched, non-woven). Existing fill soils (with the exception of the surficial organic fill) may be left in-place below the slabs provided these soils are observed to be stable during re-compaction and some risk of minor slab cracking is tolerable. If not tolerable or where unsuitable soils are present during re-compaction, we recommend the existing fill be over-excavated a minimum of 12 in. below the slab base course level and replaced with compacted structural fill.

SEISMIC DESIGN CONSIDERATIONS

Based on the preliminary test borings, the Seismic Site Class is considered to be a C. The soils at the site are not considered to be susceptible to liquefaction under the Building Code design earthquake.

GROUNDWATER AND PERMANENT FOUNDATION DRAINAGE

Based on observations of water level in test borings, a design maximum groundwater level at about El. 343 or 100-yr flood elevation, whichever is higher should be used for preliminary design. At this time, slab waterproofing or permanent underslab drainage are not required for the indicated design maximum groundwater elevation (this recommendation may be subject to modification if the flood elevation is higher than the design maximum groundwater elevation). Perimeter drainage systems are not needed assuming that the lowest level slabs of the buildings are not finished more than 1 ft below the adjacent finished grades.

A moisture vapor retarded membrane is recommended directly beneath the ground floor slabs in occupied and finished spaces, or those with moisture sensitive spaces or floor coverings. Drainage should be provided behind site retaining walls (with discharge direct to the site storm drain or via a series of weep holes along the base of the wall).

RADON MITIGATION SYSTEM

Given the shallow depth to bedrock in the area, the project may want to consider the installation of a radon mitigation system below occupiable building space. A radon mitigation system typically consists of an 8-in. thick layer of ¾ in. crushed stone below a 15 mil Class A vapor barrier under the lowest building slab. Within the ¾ in. crushed stone layer is a network of perforate PVC pipes that are vented to the exterior of the building, typically within walls or column box-outs to the roof. The design should include routing power to the roof area in the event the system needs to be activated with mechanical fans.

UTILITIES AND OTHER SITE IMPROVEMENTS

We recommend that the following considerations be incorporated into the preliminary design:

- Utilities below soil-supported slabs-on-grade within the building footprint may be earth-supported and installed using conventional methods.
- Site utilities can be supported in the natural Glacial Till or Fill soils provided they are stable under re-compaction. Oversized materials, if present at the subgrade level, should be removed to preclude a “hard spot” along the utility bottom that could damage or break the utility. Similarly, if Bedrock is encountered within utility trenches it should be excavated to at least 6 in. below the bottom of the pipe to allow for uniform pipe bedding conditions.
- Foundations for light pole bases, guard rails, small signs, and similar lightweight ancillary structures can be designed and installed using conventional methods.
- Low-height retaining walls (in the range of 2 to 6 ft in height) may be required along the southern and western site limits to achieve the final site grades. The retaining walls may consist of gravity block walls or mechanically stabilized (grid reinforced) earth walls pending the retained height and required surcharge loads. Positioning of grid reinforced walls relative to property lines and other site constraints should consider lengths of grid reinforcement and excavation requirements for installation of grid reinforcement. For initially planning, it should be assumed that grid reinforcement lengths may be on the order of one times the wall height (for walls with level backslope grades), and that excavation limits would extend to 1.5 times the wall height from the back of the grid reinforcement (where existing grades are flat behind the wall).
- The existing Fill and Glacial Till were noted to be silty in nature (fines contents measured in the 16% to 50% range), which will pose some challenges to infiltration of stormwater on the site, possibly resulting in large systems for modest flows.
- As noted above, the existing site soils are poorly draining and as a result, a thicker than normal pavement section (thicker base course and thicker binder course) may be desirable to limit long term maintenance. For preliminary planning purposes, we recommend the following pavement section: 3.5 in. of pavement (1.5 in. wear course, 2 in. binder) over 12 in. of dense-graded crushed stone.

EARTHWORK AND DEWATERING

Based on anticipated grading for the proposed construction and subsurface conditions encountered in the test borings, conventional earthwork procedures and equipment can be used. Building excavations are anticipated to be above normal groundwater levels such that temporary dewatering to allow for construction in-the-dry is anticipated to largely consist of removal of precipitation that falls on and surface water that runs into excavations, and that this dewatering would be competed using local sumps, trenches, and pumps. Additional dewatering effort may be required for locally deeper excavations or on an intermittent basis during periods of moderate to heavy precipitation or snow melt.

Based on our visual classifications in the field and the results of the geotechnical laboratory testing undertaken on select soil samples (provided in Appendix C), the on-site Fill (not ORGANIC SOIL) and natural Glacial Till contain fines contents in the 16% to 50% range, which makes them very sensitive to moisture and freeze-thaw. As such, re-use of these soils as compacted fill to raise grades inside and outside of the building footprints will only be possible during periods of favorable weather and subject to their moisture content at the time of placement. Specifically, the on-site soils may be difficult or impossible to place and compact as compacted fill in wet weather seasons (i.e., spring, winter, and fall). Stockpiles of excavated soils that are intended to be reused as compacted fill should be protected from precipitation by covering with poly sheeting.

The existing Fill consisting of Organic Soil should be removed within the building footprints and in areas that will be paved in the future. The existing Fill below currently paved areas could remain below building slabs following proper proof compaction of the materials. Due to it's loose in-place density, the locally deeper Fill in the vicinity of HA-4 should be investigated further during final design to determine if it needs to be excavated and replaced or if it can stay in place with proof compaction as indicated above.

A local bedrock outcrop was observed near HA-4 and shallow bedrock was encountered in HA-2, HA-8, and HA-9. As a result, Bedrock will be encountered within the excavation for Building 7 and likely within excavations for Buildings 1, 2, 5, and 6. Additionally, the presence of local bedrock may impact future site utilities or below grade structures in this area. Blasting or hoe-ramming may be required to remove such outcrops.

Due to the fine-grained nature of the Glacial Till, foundation subgrades will be susceptible to disturbance from storm water and traffic. As such, placement of 3 to 6 in. of crushed stone on prepared foundations subgrades (with geotextile filter fabric separation) is recommended to protect the subgrades from disturbance during placement of re-bar and forms.

Based on the results of the explorations, the Glacial Till may contain cobbles and boulders that will require segregation prior to reuse as compacted fill and handling during construction.

ADDITIONAL EXPLORATIONS AND TESTING

Based on the observations during this due diligence phase, we recommend that additional explorations consisting of test pits, borings, and/or rock probes be conducted at the site to further investigate the locally thicker fill in the vicinity of HA-4, within the limits of the leaching fields, and to confirm subsurface conditions elsewhere on-site. The types, numbers, and locations will depend on the final development layout and proposed grading.

Closure

We appreciate the opportunity to provide these preliminary geotechnical engineering services on this project. Please do not hesitate to call if you would like to discuss any aspect of this report or the project.

Sincerely yours,
HALEY & ALDRICH, INC.

Michael J. Weaver, P.E. (MA)
Senior Associate

John T. Difini, P.E. (MA)
Principal

Enclosures:
- Figure 1 – Project Locus
- Figure 2 – Site and Subsurface Exploration Location Plan
- Appendix A – Concept Plans dated 9 March 2021
- Appendix B – Subsurface Exploration Logs
- Appendix C – Laboratory Testing Results

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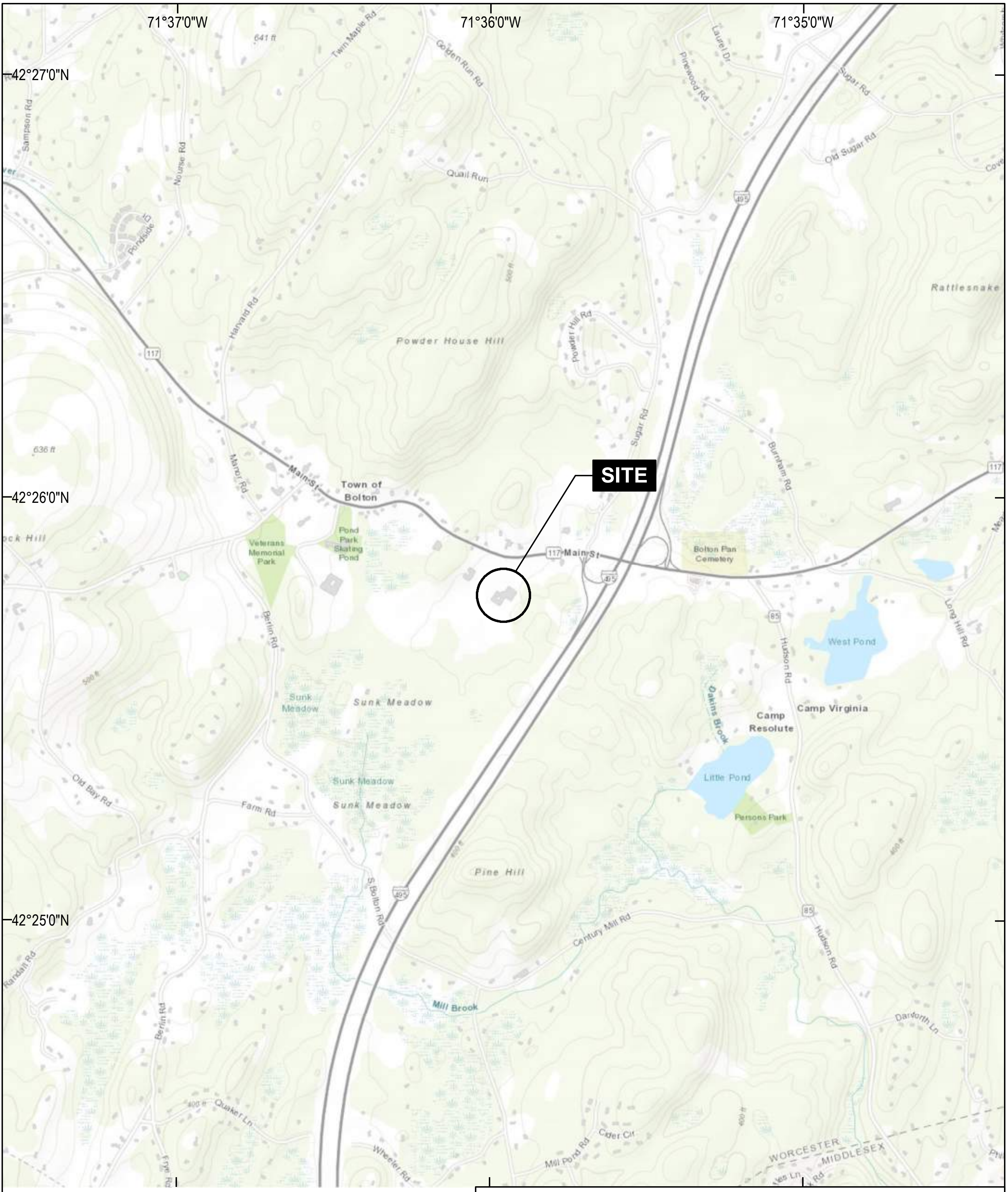
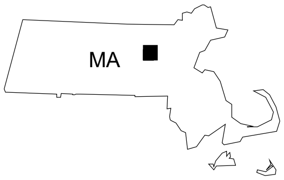
FIGURES





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MAP SOURCE: ESRI
SITE COORDINATES: 42°25'46"N, 71°35'57"W

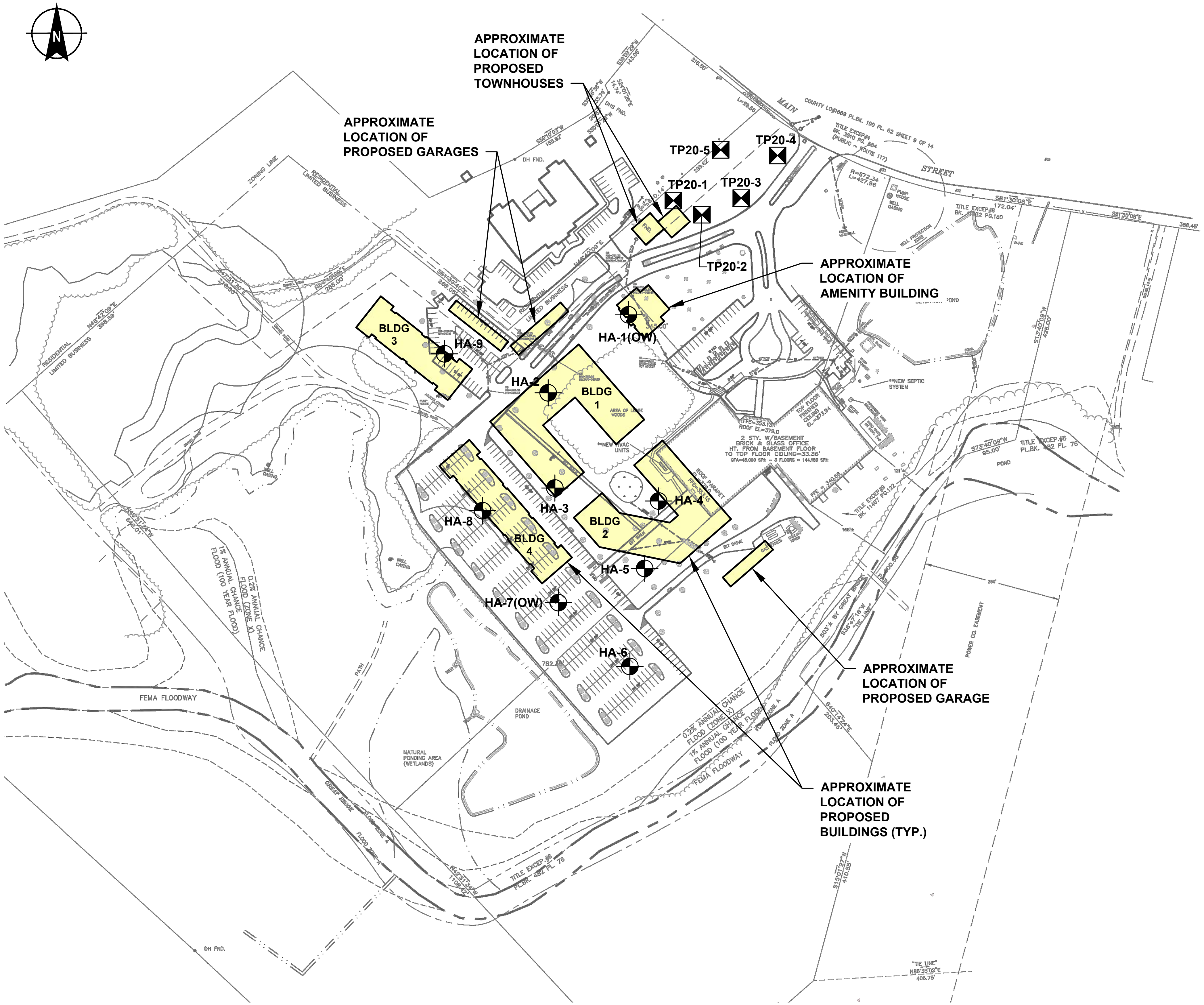
HALEY ALDRICH

580 MAIN STREET REDEVELOPMENT
580 MAIN STREET
BOLTON, MASSACHUSETTS

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
APRIL 2021

FIGURE 1



LEGEND

TP20-1 ☒	DESIGNATION AND APPROXIMATE LOCATION OF TEST PIT ADVANCED BY EARTHWORKS INDUSTRIES ON 11 DECEMBER 2020 UNDER OBSERVATION BY HALEY & ALDRICH REPRESENTATIVES
HA-2 ⊕	DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS ADVANCED BY NORTHERN DRILL SERVICE BETWEEN 5 AND 7 OCTOBER 2020 UNDER OBSERVATION BY HALEY & ALDRICH REPRESENTATIVES
(OW)	INDICATES OBSERVATION WELL INSTALLED IN COMPLETED BOREHOLE

NOTES

1. EXPLORATION LOCATIONS ARE CONSIDERED APPROXIMATE AND WERE DETERMINED BY TAPING TO EXISTING SITE FEATURES.
2. BASE PLAN TAKEN FROM PLAN ENTITLED "OVERALL PLAN - EXISTING CONDITION", DATED 7 MARCH 2014, PREPARED BY CONDYNE ENGINEERING.
3. LOCATION OF PROPOSED BUILDINGS OBTAINED FROM PLAN ENTITLED "CONCEPT PLAN", DATED 9 MARCH 2021, PREPARED BY WOOD PARTNERS.

0 200 400
SCALE IN FEET

HALEY ALDRICH

580 MAIN STREET REDEVELOPMENT
580 MAIN STREET
BOLTON, MASSACHUSETTS

SITE AND SUBSURFACE
EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
APRIL 2021

FIGURE 2

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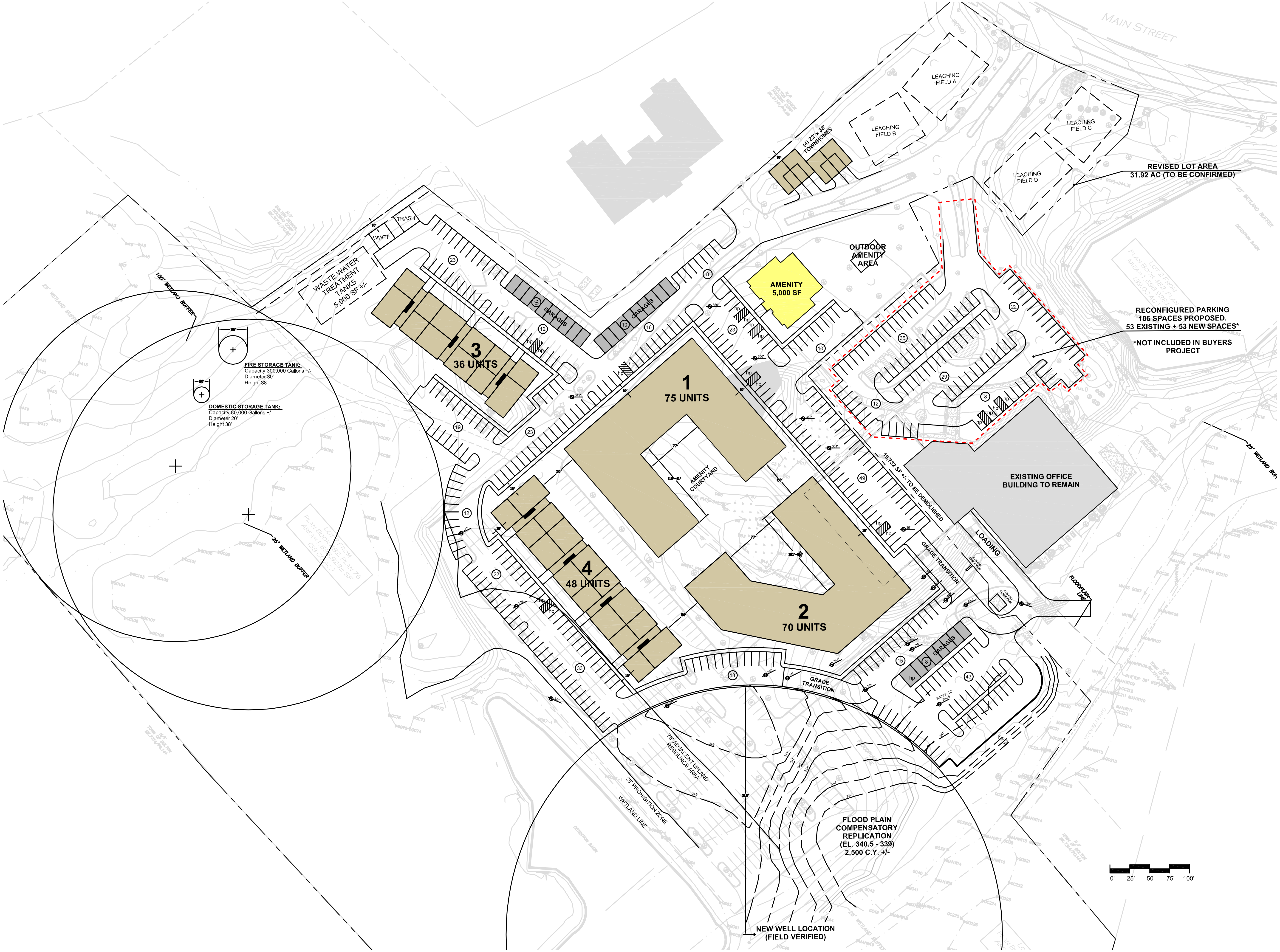
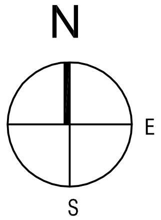
APPENDIX A

Concept Plans dated 9 March 2021

BOLTON
580 MAIN ST.





CONCEPT PLAN

3.9.21

WOOD
PARTNERS

BOLTON
580 MAIN ST.

48 UNIT: BUILDING #4 3 story walk up # of buildings 1

UNIT TYPE	NRSF	FLOOR 1	FLOOR 2	FLOOR 3	TOTAL UNITS	NRSF	%		FLOOR	GSF
1 Bed/1 BA	750	6			6	4,500	13%		3	17,540
1 Bed/1 BA	810	2	2	2	6	4,860	13%		2	17,540
1 Bed/1 BA + den	850		6	6	12	10,200	25%	50%	1	17,540
2 Bed/2 BA	1,080	6	4	4	14	15,120	29%			
2 Bed/2 BA + den	1,180		2	2	4	4,720	8%	38%		52,620
3 Bed/2 BA	1,350	2	2	2	6	8,100	13%	13%	Efficiency	90.3%
		16	16	16	48	47,500	100%	100%		

36 UNIT: BUILDING #3 3 story walk up # of buildings 1

UNIT TYPE	NRSF	FLOOR 1	FLOOR 2	FLOOR 3	TOTAL UNITS	NRSF	%		FLOOR	GSF
1 Bed/1 BA	750	4			4	3,000	11%		3	13,320
1 Bed/1 BA	810	2	2	2	6	4,860	17%		2	13,320
1 Bed/1 BA + den	850		4	4	8	6,800	22%	50%	1	13,320
2 Bed/2 BA	1,080	4	2	2	8	8,640	22%			
2 Bed/2 BA + den	1,180		2	2	4	4,720	11%	33%		39,960
3 Bed/2 BA	1,350	2	2	2	6	8,100	17%	17%	Efficiency	90.4%
		12	12	12	36	36,120	100%	100%		

75 UNIT: BUILDING #1 3 story walk up # of buildings 1

UNIT TYPE	NRSF	FLOOR 1	FLOOR 2	FLOOR 3	TOTAL UNITS	NRSF	%		FLOOR	GSF
1 Bed/1 BA	750	3	6	6	15	11,250	20%		3	29,842
1 Bed/1 BA	810	1	1	1	3	2,430	4%		2	29,842
1 Bed/1 BA + den	850	4	4	4	12	10,200	16%	40%	1	29,842
2 Bed/2 BA	1,080	13	13	13	39	42,120	52%			
2 Bed/2 BA + den	1,180					-	0%	52%		89,526
3 Bed/2 BA	1,350	2	2	2	6	8,100	8%	8%	Efficiency	82.8%
		23	26	26	75	74,100	100%	100%		

75 UNITS: BUILDING #2 3 story walk up # of buildings 1

UNIT TYPE	NRSF	FLOOR 1	FLOOR 2	FLOOR 3	TOTAL UNITS	NRSF	%		FLOOR	GSF
1 Bed/1 BA	750	4	6	6	16	12,000	23%		3	27,625
1 Bed/1 BA	810					-	0%		2	27,625
1 Bed/1 BA + den	850	4	4	4	12	10,200	17%	40%	1	27,625
2 Bed/2 BA	1,080	12	12	12	36	38,880	51%			
2 Bed/2 BA + den	1,180					-	0%	51%		82,875
3 Bed/2 BA	1,350	2	2	2	6	8,100	9%	9%	Efficiency	83.5%
		22	24	24	70	69,180	100%	100%		

TOWNHOMES 3 story walk up # of buildings 4

UNIT TYPE	NRSF					NRSF	%		FLOOR	GSF
3 Bed /2.5 BA	2,505	4				10,020	100%		3	835
									2	835
									1	835
									NRSF per townhome	2,505
		4				10,020	100%		GSF total	10,020

PROJECT TOTALS

								# of beds		
1 Bed/1 BA	750				41	30,750	18%	41	Amenity Space	5,000
1 Bed/1 BA	810				15	12,150	6%	15		
1 Bed/1 BA + den	850				44	37,400	19%	44	**PARKING TOTALS**	
2 Bed/2 BA	1,080				97	104,760	42%	194	At Grade Spaces	325
2 Bed/2 BA + den	1,180				8	9,440	3%	16	Garage Spaces	32
3 Bed/2 BA	1,350				24	32,400	10%	72	Total	357
3 bed townhomes	2,505				4	10,020	2%	12	Ratio per unit	1.53
					233	236,920	100%	394	Ratio per bedroom	0.91
					Total GSF	275,001				
					Efficiency	86.2%				

CONCEPT PLAN

3.9.21

WOOD PARTNERS

APPENDIX B

Subsurface Exploration Logs

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-1(OW)

Project 580 MAIN STREET, BOLTON, MA
Client WP EAST ACQUISITIONS, LCC
Contractor NORTHERN DRILL SERVICE, INC.

File No. 135678-002
Sheet No. 1 of 1
Start October 6, 2020
Finish October 6, 2020
Driller Z. Miller
H&A Rep. A. Fleming
Elevation 349.0
Datum
Location See Plan

	Casing	Sampler	Barrel
Type	HW	S	--
Inside Diameter (in.)	4.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: Mobile Drill B57, Truck
Bit Type: Roller Bit
Drill Mud: None
Casing: HW Drive to 13.0 ft
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 5 15 16	S1 14	0.0 2.0	OL/ OH			Loose dark brown sandy ORGANIC SOIL (OL/OH), mps 0.3 in., no structure, no odor, moist, trace roots -FILL-					30	70				
				SM		348.0 1.0	Medium dense light brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, moist	5	10	10	20	30	25				
	14 24 25 24	S2 11	2.0 4.0	SM			Dense light brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, moist Note: Laboratory grainsize test completed.	9	18	8	14	28	23				
5	15 16 15 13	S3 12	4.0 6.0	SM			Dense light brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet -GLACIAL TILL-	10	10	10	15	35	20				
10	18 97 45 19	S4 7	9.0 11.0	SM			Very dense gray brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet Note: Potential bedrock encountered at 13.0 ft. Drill action from 13.0 ft to 15.5 ft indicates bedrock.	10	10	10	20	30	20				
15						336.0 13.0	TOP OF PROBABLE BEDROCK 13.0 FT- -PROBABLE BEDROCK-										
						333.5 15.5	BOTTOM OF EXPLORATION 15.5 FT Note: Observation well installed upon completion. See well installation report for details.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
10/7/20	0932	2.0			8.85

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	15.5
Rock Cored (ft)	-
Samples	S4

Boring No. HA-1(OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. HA-1(OW)

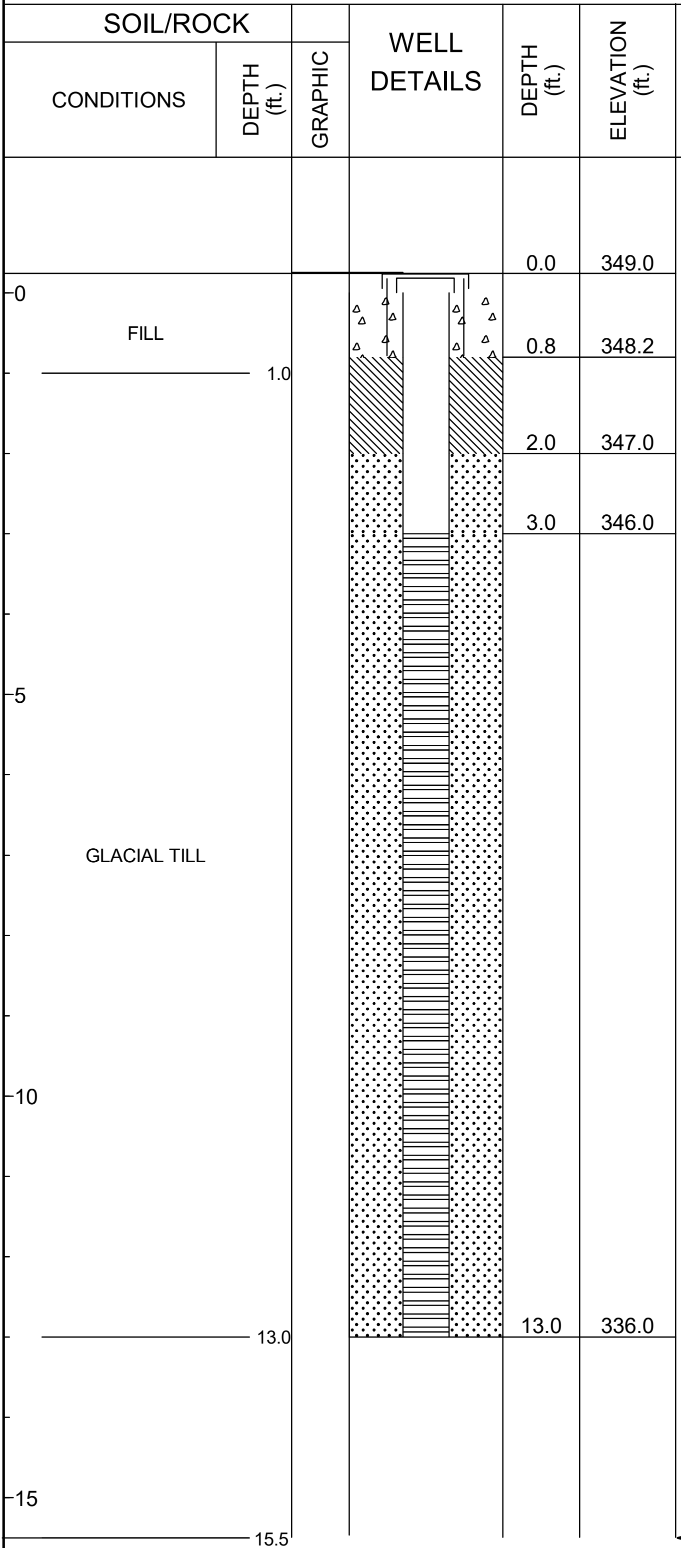
Project 580 MAIN STREET
Location BOLTON, MA
Client WP EAST ACQUISITIONS, LCC
Contractor NORTHERN DRILL SERVICE, INC.
Driller Z. Miller

Initial Water Level (depth bgs) ~8.0 ft

Well Diagram
- ☐ Riser Pipe
- ▤ Screen
- ▒ Filter Sand
- ▩ Cuttings
- ■ Grout
- ▵ Concrete
- ▨ Bentonite Seal

File No. 135678-002
Date Installed 6 Oct 2020
H&A Rep. A. Fleming
Location See Plan

Ground El. 349.0
Datum



WELL CONSTRUCTION DETAILS

Type of protective cover Roadway Box

Depth of Roadway Box below ground surface 0.0 ft

Depth of top of riser below ground surface 0.3 ft

Type of protective casing Roadway Box

Length 10.0 ft

Inside diameter 4.0 in.

Depth of bottom of Roadway Box 10.0 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2.0 in.

Depth of bottom of riser pipe 3.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	0.8
Bentonite	0.8	1.2
Filter Sand	2.0	11.0
	-	-

Diameter of borehole 4.0 in.

Depth to top of well screen 3.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2.0 in.

Type of Backfill around Screen Filter Sand

Depth to bottom of well screen 13.0 ft

Bottom of silt trap 13.0 ft

Depth of bottom of well 13.0 ft

Depth of bottom of borehole 15.5 ft

COMMENTS:

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-2

Project	580 MAIN STREET, BOLTON, MA
Client	WP EAST ACQUISITIONS, LCC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	135678-002
Sheet No.	1 of 1
Start	October 6, 2020
Finish	October 6, 2020
Driller	Z. Miller
H&A Rep.	A. Fleming
Elevation	349.0
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HW	S	--
Inside Diameter (in.)	4.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: Mobile Drill B57, Truck
Bit Type: Roller Bit
Drill Mud: None
Casing: HW Drive to 7.4 ft
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model: NA

							Gravel		Sand				Field Test			
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0	3 8 25 39	S1 16	0.0 2.0	OL/ OH	348.4 0.6	Medium dense dark brown sandy ORGANIC SOIL (OL/OH), mps 0.2 in., no structure, no odor, moist, trace roots -FILL-					30	70				
				SM		Dense light brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, moist	10	10	5	15	40	20				
	53 61 43 42	S2 9	2.0 4.0	SM		Similar to above	10	10	5	15	40	20				
5	12 14 14 11	S3 7	4.0 6.0	SM		Medium dense light brown to brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, wet -GLACIAL TILL-	10	10	10	15	35	20				
					341.6 7.4	TOP OF PROBABLE BEDROCK 7.4 FT- Note: Probable bedrock encountered at 7.4 ft. Drill action from 7.4 to 10.0 ft indicates bedrock. -PROBABLE BEDROCK-										
10					339.0 10.0	BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫ Riser Pipe
▤ Screen
░ Filter Sand
▨ Cuttings
■ Grout
△ Concrete
▧ Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	S3

Boring No. HA-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-3

Project	580 MAIN STREET, BOLTON, MA	File No.	135678-002
Client	WP EAST ACQUISITIONS, LCC	Sheet No.	1 of 1
Contractor	NORTHERN DRILL SERVICE, INC.	Start	October 7, 2020
		Finish	October 7, 2020
		Driller	Z. Miller
		H&A Rep.	A. Fleming
		Elevation	347.0
		Datum	
		Location	See Plan

	Casing	Sampler	Barrel
Type	HW	S	--
Inside Diameter (in.)	4.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: Mobile Drill B57, Truck
Bit Type: Roller Bit
Drill Mud: None
Casing: HW Drive to 14.0 ft
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 6 11 31	S1 14	0.0 2.0	OL/OH	346.6 0.4	Loose dark brown sandy ORGANIC SOIL (OL/OH), mp 0.2 in., no structure, no odor, moist -FILL-					30	70				
				SM		Medium dense light brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, moist	5	10	5	20	40	20				
	32 100/5"	S2 4	2.0 2.9	SM		Very dense light brown silty SAND with gravel (SM), mps 1.0 in., no structure, no odor, moist Note: Drill action from 2.9 ft to 3.7 ft indicates boulder.	10	10	10	15	35	20				
5	19 24 24 20	S3 8	4.0 6.0	SM		Dense light brown to brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet	10	10	10	15	35	20				
10	10 10 11 14	S4 6	9.0 11.0	SM		Medium dense gray silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet	10	15	15	25	20	15				
						-GLACIAL TILL-										
15	19 21 14 18	S5 5	14.0 16.0	SM		Dense gray silty SAND with gravel (SM), mps 0.9 in.,n no structure, no odor, wet	10	15	15	25	20	15				
					331.0 16.0	BOTTOM OF EXPLORATION 16.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
10/7/2020	0925	0.25	9.0	16.0	3.11

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	16.0
Rock Cored (ft)	-
Samples	S5

Boring No. HA-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-4

Project 580 MAIN STREET, BOLTON, MA
Client WP EAST ACQUISITIONS, LCC
Contractor NORTHERN DRILL SERVICE, INC.

File No. 135678-002
Sheet No. 1 of 1
Start October 7, 2020
Finish October 7, 2020
Driller Z. Miller
H&A Rep. A. Fleming
Elevation 350.0
Datum
Location See Plan

	Casing	Sampler	Barrel
Type	HW	S	--
Inside Diameter (in.)	4.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: Mobile Drill B57, Truck
Bit Type: Roller Bit
Drill Mud: None
Casing: HW Drive to 14.0 ft
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 2 5 6	S1 8	0.0 2.0	OL/ OH	349.7 0.3	Very loose dark brown sandy ORGANIC SOIL (OL/OH), mps 0.1 in., no structure, no odor, moist					30	70				
				SM		Loose tan to light brown silty SAND (SM), mps 0.2 in., no structure, no odor, moist				5	65	30				
	3 4 3 5	S2 11	2.0 4.0	SM		Loose tan to light brown silty SAND (SM), mps 0.3 in., no structure, no odor, moist Note: Laboratory grainsize test completed.		11	4	12	47	26				
5	4 4 7 5	S3 5	4.0 6.0	SM		Medium dense brown to light brown silty SAND (SM), mps 0.7 in., no structure, no odor, moist	5	5	5	15	55	15				
						-FILL-										
					343.0 7.0	Note: Casing advancement and drill action indicate significant increase in density at 7.0 ft.										
10	20 18 16 15	S5 9	9.0 11.0	SM		Dense brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet	5	10	5	20	40	20				
						-GLACIAL TILL-										
15	17 29 29 39	S5 3	14.0 16.0	SM		Very dense brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, wet	10	10	10	15	35	20				
					334.0 16.0	BOTTOM OF EXPLORATION 16.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
10/7/20	1455	0.2	9.0	16.0	7.41

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 16.0
Rock Cored (ft) -
Samples S5

Boring No. HA-4

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-5

Project	580 MAIN STREET, BOLTON, MA	File No.	135678-002
Client	WP EAST ACQUISITIONS, LCC	Sheet No.	1 of 1
Contractor	NORTHERN DRILL SERVICE, INC.	Start	October 7, 2020
		Finish	October 7, 2020
		Driller	Z. Miller
		H&A Rep.	A. Fleming
		Elevation	346.0
		Datum	
		Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Mobile Drill B57, Truck
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	300	140	-	Casing: HW Drive to 14.0 ft
Hammer Fall (in.)	24	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	4 5 10 18	S1 16	0.0 2.0	OL/OH		Loose dark brown sandy ORGANIC SOIL (OL/OH), mps 0.3 in., no structure, no odor, moist		5			25	70				
				SM	345.1 0.9	Medium dense brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, moist	5	10	10	20	35	20				
	20 21 13 11	S2 9	2.0 4.0	SM		Similar to above	5	10	10	20	35	20				
5	17 14 30 27	S3 7	4.0 6.0	SM		Dense light brown to brown silty SAND (SM), mps 0.9 in., no structure, no odor, wet	5	10	10	15	40	20				
10	11 9 20 14	S4 8	9.0 11.0	SM		Medium dense brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet	5	10	10	40	20	15				
						-GLACIAL TILL-										
15	25 32 42 19	S5 8	14.0 16.0	SM		Very dense brown to gray brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, wet	10	10	10	30	25	15				
					330.0 16.0	BOTTOM OF EXPLORATION 16.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
10/7/20	1230	0.25	9.0	16.0	5.22

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	16.0
Rock Cored (ft)	-
Samples	S5

Boring No. HA-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-6

Project	580 MAIN STREET, BOLTON, MA	File No.	135678-002
Client	WP EAST ACQUISITIONS, LCC	Sheet No.	1 of 1
Contractor	NORTHERN DRILL SERVICE, INC.	Start	October 5, 2020
		Finish	October 6, 2020
		Driller	Z. Miller
		H&A Rep.	A. Fleming
		Elevation	346.0
		Datum	
		Location	See Plan

	Casing	Sampler	Barrel
Type	HW	S	--
Inside Diameter (in.)	4.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: Mobile Drill B57, Truck
Bit Type: Roller Bit
Drill Mud: None
Casing: HW Drive to 9.0 ft
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					345.8 0.2	-BITUMINOUS CONCRETE-										
	5 5 6	S1 13	0.5 2.0	SM		Medium dense brown silty SAND (SM), mps 0.4 in., no structure, no odor, moist -FILL-		5		25	55	15				
	7 11 13 46	S2 7	2.0 4.0	SM		Similar to above		5		25	55	15				
				SM	343.5 2.5	Medium dense brown to light brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, moist										
						Note: From 4.0-4.4 ft drill action indicates cobble.										
5	11 6 10 25	S3 8	4.5 6.5	SM		Medium dense brown to light brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet Note: Laboratory grainsize test completed.		29	11	25	19	16				
						-GLACIAL TILL-										
10	23 37 47 44	S4 5	9.0 11.0	SM		Very dense brown light brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, wet	10	10	5	15	40	20				
					335.0 11.0	BOTTOM OF EXPLORATION 11.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
10/6/20	0710	16.0	9.0	11.0	7.19

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	11.0
Rock Cored (ft)	-
Samples	S4

Boring No. HA-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

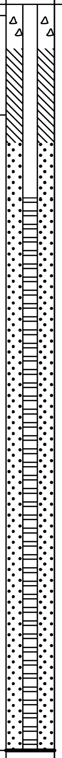
HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-7(OW)

Project	580 MAIN STREET, BOLTON, MA	File No.	135678-002
Client	WP EAST ACQUISITIONS, LCC	Sheet No.	1 of 1
Contractor	NORTHERN DRILL SERVICE, INC.	Start	October 5, 2020
		Finish	October 5, 2020
		Driller	Z. Miller
		H&A Rep.	A. Fleming
		Elevation	346.0
		Datum	
		Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Mobile Drill B57, Truck
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	300	140	-	Casing: HW Drive to 13.5 ft Hoist/Hammer: Winch / Automatic Hammer
Hammer Fall (in.)	24	30	-	PID Make & Model: NA



Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						345.8 0.2	-BITUMINOUS CONCRETE-										
	6 6 10	S1 9	0.5 2.0	SP-SM			Medium dense brown to light brown poorly graded SAND with silt (SP-SM), mps 0.3 in.,no structure, no odor, moist Note: Laboratory grainsize test completed.		3	2	7	39	49				
						344.0 2.0	-FILL-										
	14 16 11 16	S2 11	2.0 4.0	SM			Medium dense brown to gray brown silty SAND with gravel (SM), mps 0.7 in., no structure, no odor, moist	5	10	10	35	25	15				
5	9 7 7 5	S3 12	4.0 6.0	SM			Medium dense brown to gray brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, moist	5	10	10	30	25	20				
10	15 23 13 16	S4 6	9.0 11.0	SM			Dense brown to light brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet	5	10	10	20	35	20				
							-GLACIAL TILL-										
						332.5 13.5	Note: Advanced roller bit from 13.5-16.0ft. Drill action indicates probable bedrock. TOP OF PROBABLE BEDROCK 13.5 FT-										
15							-PROBABLE BEDROCK-										
						330.0 16.0	BOTTOM OF EXPLORATION 16.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
10/6/20	0715		OW Reading		5.56
10/7/20	0939		OW READING		5.55

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
☰	Screen
⁘	Filter Sand
▨	Cuttings
■	Grout
△	Concrete
▧	Bentonite Seal

Summary

Overburden (ft)	16.0
Rock Cored (ft)	-
Samples	S4

Boring No. HA-7(OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

Well No. HA-7(OW)

Project 580 MAIN STREET
Location BOLTON, MA
Client WP EAST ACQUISITIONS, LCC
Contractor NORTHERN DRILL SERVICE, INC.
Driller Z. Miller

Initial Water Level (depth bgs) 4.5 ft

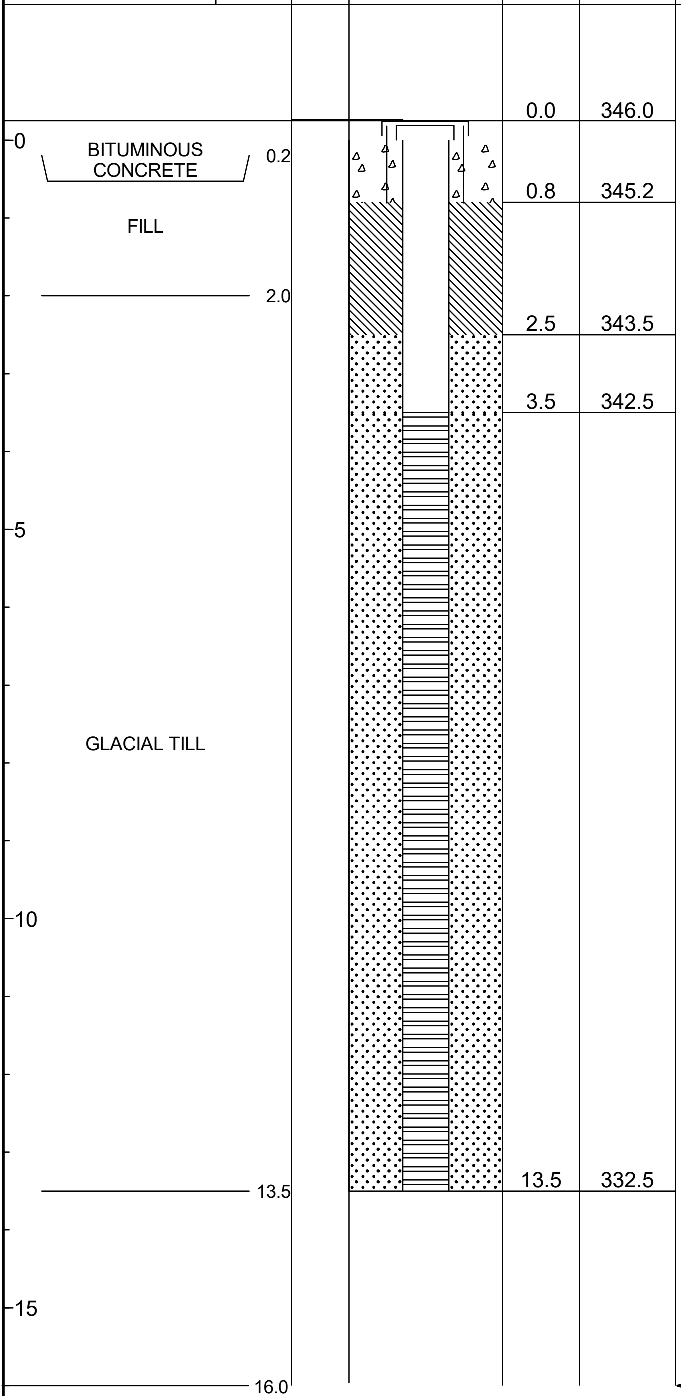
Well Diagram

- ▥ Riser Pipe
- ▤ Screen
- ░ Filter Sand
- ▒ Cuttings
- ■ Grout
- ∴ Concrete
- ▧ Bentonite Seal

File No. 135678-002
Date Installed 5 Oct 2020
H&A Rep. A. Fleming
Location See Plan

Ground El. 346.0
Datum

SOIL/ROCK		GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
CONDITIONS	DEPTH (ft.)				



WELL CONSTRUCTION DETAILS

Type of protective cover Roadway Box

Depth of Roadway Box below ground surface 0.0 ft

Depth of top of riser below ground surface 0.3 ft

Type of protective casing Roadway Box

Length 10.0 ft

Inside diameter 4.0 in.

Depth of bottom of Roadway Box 10.0 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2.0 in.

Depth of bottom of riser pipe 3.5 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	0.8
Bentonite	0.8	1.7
Filter Sand	2.5	11.0
	-	-

Diameter of borehole 4.0 in.

Depth to top of well screen 3.5 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2.0 in.

Type of Backfill around Screen Filter Sand

Depth to bottom of well screen 13.5 ft

Bottom of silt trap 13.5 ft

Depth of bottom of well 13.5 ft

Depth of bottom of borehole 16.0 ft

COMMENTS:

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-8

Project	580 MAIN STREET, BOLTON, MA	File No.	135678-002
Client	WP EAST ACQUISITIONS, LCC	Sheet No.	1 of 1
Contractor	NORTHERN DRILL SERVICE, INC.	Start	October 5, 2020
		Finish	October 5, 2020
		Driller	Z. Miller
		H&A Rep.	A. Fleming
		Elevation	347.0
		Datum	
		Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Mobile Drill B57, Truck
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	300	140	-	Casing: HW Drive to 4.1 ft
Hammer Fall (in.)	24	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					346.8 0.2	-BITUMINOUS CONCRETE-										
	12 14 33	S1 9	0.5 2.0	SM		Medium dense brown silty SAND (SM), mps 0.6 in., no structure, no odor, moist, trace pocket of gray brown poorly graded sand -FILL-		5	10	30	35	20				
	18 16 12 25	S2 10	2.0 4.0	SM	345.0 2.0	Medium dense brown to light brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, moist -GLACIAL TILL-	5	10	10	20	35	20				
5					343.0 4.0	TOP OF PROBABLE BEDROCK 4.0 FT- Note: Drill action indicates bedrock. Advanced drill bit from 4.0-7.0 ft. -PROBABLE BEDROCK-										
					340.0 7.0	BOTTOM OF EXPLORATION 7.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
					NE

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	7.0
Rock Cored (ft)	-
Samples	S2

Boring No. HA-8

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-9

Project	580 MAIN STREET, BOLTON, MA	File No.	135678-002
Client	WP EAST ACQUISITIONS, LCC	Sheet No.	1 of 1
Contractor	NORTHERN DRILL SERVICE, INC.	Start	October 6, 2020
		Finish	October 6, 2020
		Driller	Z. Miller
		H&A Rep.	A. Fleming
		Elevation	351.0
		Datum	
		Location	See Plan

	Casing	Sampler	Barrel
Type	HW	S	--
Inside Diameter (in.)	4.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: Mobile Drill B57, Truck
Bit Type: Roller Bit
Drill Mud: None
Casing: HW Drive to 6.4 ft
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					350.8 0.2	-BITUMINOUS CONCRETE-										
	7 8 16	S1 7	0.5 2.0	SP		Medium dense brown to light brown poorly graded SAND (SP), mps 0.4 in., no structure, no odor, moist -FILL-		5	5	55	30	5				
	12 12 10 11	S2 10	2.0 4.0	SM	349.0 2.0	Medium dense brown to light brown silty SAND with gravel (SM), mps 0.9 in., no structure, no odor, moist	10	10	10	15	35	20				
5	4 10 16 9	S3 6	4.0 6.0	SM		Medium dense brown to light brown silty SAND with gravel (SM), mps 0.7 in., no structure, no odor, wet -GLACIAL TILL-		15	15	25	20	25				
					344.6 6.4	TOP OF PROBABLE BEDROCK 6.4 FT Note: Probable bedrock encountered at 6.4 ft. Drill action 6.4 to 9.0 ft indicates bedrock. -PROBABLE BEDROCK-										
	50/2"	S4 1	9.0 9.1		341.9 9.1	Note: Attempted spoon at 9.0 ft. Recovery less than 1 in. of bedrock chips. BOTTOM OF EXPLORATION 9.1 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
					5.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

▥	Riser Pipe
▤	Screen
░	Filter Sand
▒	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	9.1
Rock Cored (ft)	-
Samples	S4

Boring No. HA-9

Field Tests:

Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST PIT LOG

Test Pit No. TP20-1

Project	580 MAIN STREET	**File No.**	135679-002
Location	BOLTON, MA	**H&A Rep**	S. Shay
Client	WP EAST ACQUISTIONS, LLC	**Date**	11 Dec 2020
Contractor	EARTHWORK INDUSTRIES, INC.		
Equipment Used	Doosan DX50	**Weather**	Mostly Sunny, 30s-40s

Ground El.: 351.0 (est.)

El. Datum:

Location: See Plan

Groundwater depths/entry rates (in./min.): 6.8

Depth (ft)	Sample ID	Stratum Change Elev./ Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Tests Dilatancy	Field Tests Toughness	Field Tests Plasticity	Field Tests Strength
0			OL/ OH	Dark brown sandy ORGANIC SOIL (OL/OH), no oversized, mps 0.5 in., no structure, no odor, moist				20	20	60				
1		350.0 1.0	SP-SM	Dark brown poorly graded SAND with silt and gravel (SP-SM), 5% oversized, mps 4.0 in., no structure, no odor, moist -FILL-	5	10	20	20	35	10				
2 3		348.8 2.2	SP	Brown poorly graded SAND with gravel (SP), 5% oversized, mps 1.0 in., no structure, although moderately bonded, odor, moist	5	10	20	35	30					
4 5 6		347.0 4.0	SP-SM	Gray brown poorly graded SAND with silt and gravel (SP-SM), 10-12% oversized, mps 3.3 in., no structure, no odor, moist, difficult to excavate -GLACIAL TILL-	10	15	15	20	30	10				
7		344.0 7.0		BOTTOM OF EXPLORATION 7.0 FT										

Obstructions: None

Remarks: Dave Formato, on site engineer reviewed open pit. See also Form 11 table. Standard TP backfill.

Field Tests

Dilatancy	R - Rapid S - Slow N - None
Toughness	L - Low M - Medium H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High
Dry Strength	N - None L - Low M - Medium H - High V - Very High

Standing Water in Completed Pit

at depth	6.8	ft
measured after	3.0	hours elapsed

Boulders

Diameter (in.)	Number		Approx. Vol. (cu.ft)
12 to 24	3.0	=	4.5
over 24	1	=	12.0

Test Pit Dimensions (ft)

Pit Length x Width (ft) 10.0x3.0

Pit Depth (ft) 7.0

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST PIT LOG

Test Pit No. **TP20-2**

Project **580 MAIN STREET**
Location BOLTON, MA
Client WP EAST ACQUISTIONS, LLC
Contractor EARTHWORK INDUSTRIES, INC.
Equipment Used Doosan DX50

File No. 135679-002
H&A Rep S. Shay
Date 11 Dec 2020
Weather Mostly Sunny, 30s-40s

Ground El.: 351.0 (est.)
El. Datum:
Location: See Plan
Groundwater depths/entry rates (in./min.): 7.2

Depth (ft)	Sample ID	Stratum Change Elev./ Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Tests Dilatancy	Field Tests Toughness	Field Tests Plasticity	Field Tests Strength
0		350.0 1.0	OL/ OH	Dark brown sandy ORGANIC SOIL (OL/OH), no oversized, mps 0.5 in., no structure, no odor, moist				15	20	65				
2		348.0 3.0	SM	Olive brown to brown silty SAND with gravel (SM), 10-12% oversie, mps 1.0 in., no structure, no odor, moist appears to be disturbed -FILL-	10	10	10	15	30	25				
4 6		343.5 7.5	SP-SM	Brown poorly graded SAND with silt and gravel (SP-SM), 30% oversized, mps 3.5 in. (2 large boulders), no structure, moderately difficult to excavate, no odor, moist -GLACIAL TILL DEPOSITS-	10	20	15	30	15	10				
				BOTTOM OF EXPLORATION 7.5 FT										

Obstructions: None

Remarks: Dave Formato, on site engineer reviewed open pit. See also Form 11 table. Standard TP backfill.

Field Tests

Dilatancy	R - Rapid S - Slow N - None
Toughness	L - Low M - Medium H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High
Dry Strength	N - None L - Low M - Medium H - High V - Very High

Standing Water in Completed Pit

at depth	7.2	ft
measured after	3.0	hours elapsed

Boulders

Diameter (in.)	Number		Approx. Vol. (cu.ft)
12 to 24	2.0	=	2.0
over 24	2	=	21

Test Pit Dimensions (ft)

Pit Length x Width (ft) 7.0x5.0
Pit Depth (ft) 7.5

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

HA TESTPIT-09 PLOG-HA-LIB09-BOS STANDARD ONLY-R.GLB HA-TP07-1.GDT \\HALEYALDRICH.COM\SHARE\CF\PROJECTS\135679\GINT\135679-002-TP.GPJ 31 Mar 21

HALEY ALDRICH

TEST PIT LOG

Test Pit No. **TP20-3**

Project **580 MAIN STREET**
Location BOLTON, MA
Client WP EAST ACQUISTIONS, LLC
Contractor EARTHWORK INDUSTRIES, INC.
Equipment Used Doosan DX50

File No. 135679-002
H&A Rep S. Shay
Date 11 Dec 2020
Weather Mostly Sunny, 30s-40s

Ground El.: 351.0 (est.)
El. Datum:
Location: See Plan
Groundwater depths/entry rates (in./min.): Dry

Depth (ft)	Sample ID	Stratum Change Elev./ Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Tests Dilatancy	Field Tests Toughness	Field Tests Plasticity	Field Tests Strength
0			OL/ OH	Dark brown sandy ORGANIC SOIL(OL/OH), no oversized, mps 1.0 in., no structure, no odor, moist				20	20	60				
		350.0 1.0	SM	Gray brown silty SAND with gravel (SM), 5-10% oversized, mps 6.0 in., no structure within layers, no odor, moist										
2				Several distinct layers noted within FILL layer. Color of layers of varied from gray brown, dark brown, to olive. Material composition was consistent.	10	10	15	20	20	25				
			SM											
4				-FILL-										
		346.0 5.0		Note: Discontinuous tan medium stand at 5.0 ft thin layer.										
			SP-SM	5.0-5.4 ft brown/orange brown mottled										
6				Brown poorly graded SAND with silt and gravel (SP-SM), 30% oversized, mostly as well rounded cobbles, 3-4 in. dense, mps 5.0 in., weakly stratified, no odor, moist	10	15	15	35	15	10				
				-GLACIAL TILL DEPOSITS-										
8														
		342.0 9.0		BOTTOM OF EXPLORATION 9.0 FT										

Obstructions: None

Remarks: Dave Formato, on site engineer reviewed open pit. See also Form 11 table. Standard TP backfill.

Field Tests

Dilatancy	R - Rapid S - Slow N - None
Toughness	L - Low M - Medium H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High
Dry Strength	N - None L - Low M - Medium H - High V - Very High

Standing Water in Completed Pit

at depth	Dry	ft
measured after	1.0	hours elapsed

Boulders

Diameter (in.)	Number	Approx. Vol. (cu.ft)
12 to 24	-	= -
over 24	-	= -

Test Pit Dimensions (ft)

Pit Length x Width (ft) 10.0x3.0
Pit Depth (ft) 9.0

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST PIT LOG

Test Pit No. TP20-4

Project 580 MAIN STREET
Location BOLTON, MA
Client WP EAST ACQUISTIONS, LLC
Contractor EARTHWORK INDUSTRIES, INC.
Equipment Used Doosan DX50

File No. 135679-002
H&A Rep S. Shay
Date 11 Dec 2020
Weather Mostly Sunny, 30s-40s

Ground El.: 352.0 (est.)
El. Datum:
Location: See Plan
Groundwater depths/entry rates (in./min.): Dry

Depth (ft)	Sample ID	Stratum Change Elev./ Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Tests			
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0			SM	Dark brown silty SAND (SM), no oversized, mps 0.5 in., no oversized, mps 0.5 in., no structure, no odor, moist, 15% roots with organic debris		10	10	15	25	40				
2				-FILL-										
		349.4 2.6	GP	Brown poorly graded GRAVEL with sand (SP), 30% oversized as rounded cobbles, mps 8.0 in., no structure, no odor, moist	15	40	20	10	10	5				
4														
		346.5 5.5	SP	Brown poorly graded SAND (SP), no oversized, mps 0.1 in., stratified, no odor, moist, faint brown mottling -GLACIOFLUVIAL DEPOSITS-				20	75	5				
6		346.0 6.0	SP-SM	Brown poorly graded SAND with silt and gravel (SP-SM), 20% oversized	10	15	15	15	35	10				
8				-GLACIAL TILL DEPOSITS-										
		343.5 8.5		BOTTOM OF EXPLORATION 8.5 FT										

Obstructions: None

Remarks: Dave Formato, on site engineer reviewed open pit. See also Form 11 table. Standard TP backfill.

Field Tests

Dilatancy	R - Rapid S - Slow N - None
Toughness	L - Low M - Medium H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High
Dry Strength	N - None L - Low M - Medium H - High V - Very High

Standing Water in Completed Pit

at depth	Dry	ft
measured after	0.75	hours elapsed

Boulders

Diameter (in.)	Number	Approx. Vol. (cu.ft)
12 to 24	-	= -
over 24	-	= -

Test Pit Dimensions (ft)

Pit Length x Width (ft) 10.0x3.0
Pit Depth (ft) 8.5

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST PIT LOG

Test Pit No. TP20-5

Project	580 MAIN STREET	**File No.**	135679-002
Location	BOLTON, MA	**H&A Rep**	S. Shay
Client	WP EAST ACQUISTIONS, LLC	**Date**	11 Dec 2020
Contractor	EARTHWORK INDUSTRIES, INC.	**Weather**	Mostly Sunny, 30s-40s
Equipment Used	Doosan DX50		

Ground El.: 352.0 (est.)

El. Datum:

Location: See Plan

Groundwater depths/entry rates (in./min.): Dry

Depth (ft)	Sample ID	Stratum Change Elev./ Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Tests			
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0				Dark brown sandy ORGANIC SOIL (OL/OH)				5	30	65				
			OL/ OH											
1		351.0 1.0		-FILL-										
2			SM	Dark brown silty SAND with gravel (SM), 3% oversized, mps 3.5 in., no structure, no odor, moist	10	10	15	20	20	25				
3				Note: Red electric warning tape electric warning tape for existing buried electric utility. Concrete exposed in hand digginat 4.0 ft.										
4		348.0 4.0		BOTTOM OF EXPLORATION 4.0 FT										
				Note: Concrete exposed in hang digging.										

Obstructions: Buried electric concrete encased conduit.

Remarks: Dave Formato, on site engineer reviewed open pit. Form 11 table not required. Standard TP backfill.

Field Tests

Dilatancy	R - Rapid	S - Slow	N - None		
Toughness	L - Low	M - Medium	H - High		
Plasticity	N - Nonplastic	L - Low	M - Medium	H - High	
Dry Strength	N - None	L - Low	M - Medium	H - High	V - Very High

Standing Water in Completed Pit

at depth	Dry	ft
measured after	-	hours elapsed

Boulders

Diameter (in.)	Number	Approx. Vol. (cu.ft)
12 to 24	-	= -
over 24	-	= -

Test Pit Dimensions (ft)

Pit Length x Width (ft) 8.0x3.0

Pit Depth (ft) 4.0

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

580 Main St. Bolton, MA
135679-002
12/11/20

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0 1.0	Fill	2.5Y 3/2		Not present		SILT LOAM	0	0	Structureless	Loose	
1.0 2.2	Fill	10YR 3/3				SANDY LOAM	20	5	"	Friable	
2.2 4.0	Fill	10YR 4/6				LOAMY SAND	40	10	Massive	Friable	Variegated colors
4.0 7.0	C	10YR 4/3	5.6	5YR 4/4	10-15	SANDY LOAM	35	10	Massive	very friable	weak mottling discontinuous

Additional Notes:

ESHW at 5.6'

Standing water in pit at 6.8' after 3 hr.

A. Shay

580 Main St, Bolton, MA
135679-002
12/11/20

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0 1.0	Fill	2.5Y 2.5/1		not present		SILT LOAM	2	0	structureless	Loose	
1.0 3.0	Fill	10YR 5/2				SILT LOAM	20	20	structureless	Friable	
3.0 7.5	C	7.5YR 3/2	5.5	2.5YR 3/2	8-10	SANDY LOAM	25	30	Massive	Friable	Discontinuous mottles, few

Additional Notes:

3 large boulders 3-7.0'

ESHW at 5.5', standing water in pit at 7.2 after 30 hrs.

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-3

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0 1.0	fill	10YR 2/1			Not present	SILT LOAM	0	0	structure-less	Friable	
1.0 1.8		10YR 5/2					5	5			
1.8 2.8		10YR 3/2					2-4	5			
2.8 4.0		2.5Y 4/3					5-8	2			
4.0 5.0		10YR 3/2					5	2			
5.0 9.0	C	10YR 3/3	5.0 5.4	5YR 4/3	30	Loamy SAND	35	25	Massive	Friable	

Additional Notes:

ESHW @ 5.0'.

580 Main St., Bolton, MA
135679-002
12/11/20

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-4

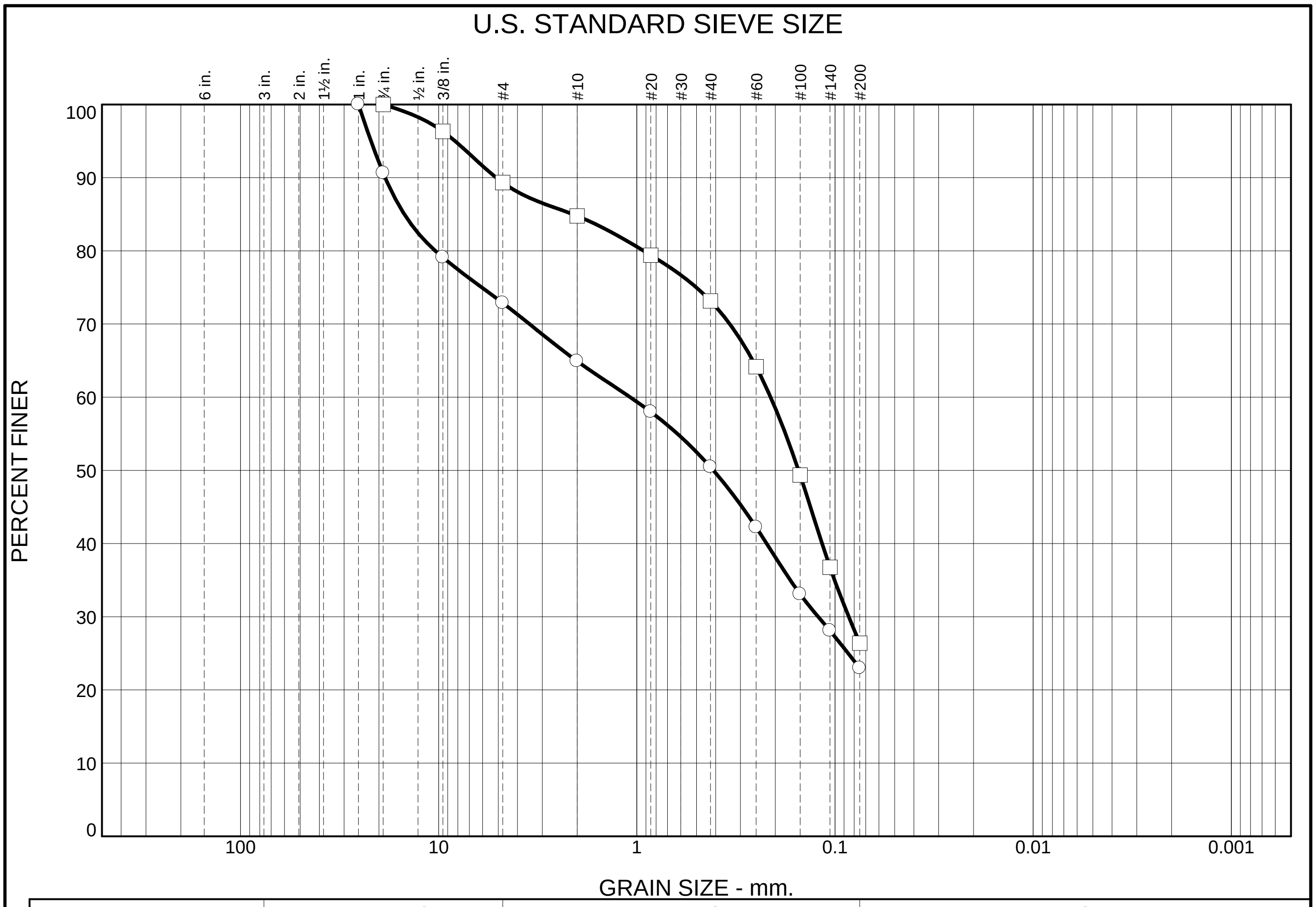
Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0 2.6	Fill	10 YR 2/2		not present		SILT LOAM	10	10	Structureless	Friable	
2.6 5.5	Fill	10 YR 4/2				SILT LOAM	60	25	"	Friable	
5.5 6.0	C1	2.5Y 5/1	5.7	5 YR 5/2	8-10	SAND	0	0	Single-grain	very friable	Thin mottling
6.0 8.5	C2	10 YR 4/3		not apparent		Loamy SAND	20	10	Massive	Friable	

Additional Notes:

ESHW AT 5.7'

APPENDIX C

Laboratory Testing Results



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	9.4	17.7	8.0	14.4	27.5	23.0	
☐	0.0	0.0	10.7	4.5	11.7	46.7	26.4	

	Expl. No.	Sample No.	Depth (ft)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	HA-1	S02	2.0-4.0				5.9			SM
☐	HA-4	S02	2.0-4.0				4.1			SM

	Sample Description
○	Yellow brown silty sand with gravel
☐	Olive brown silty sand

Remarks:

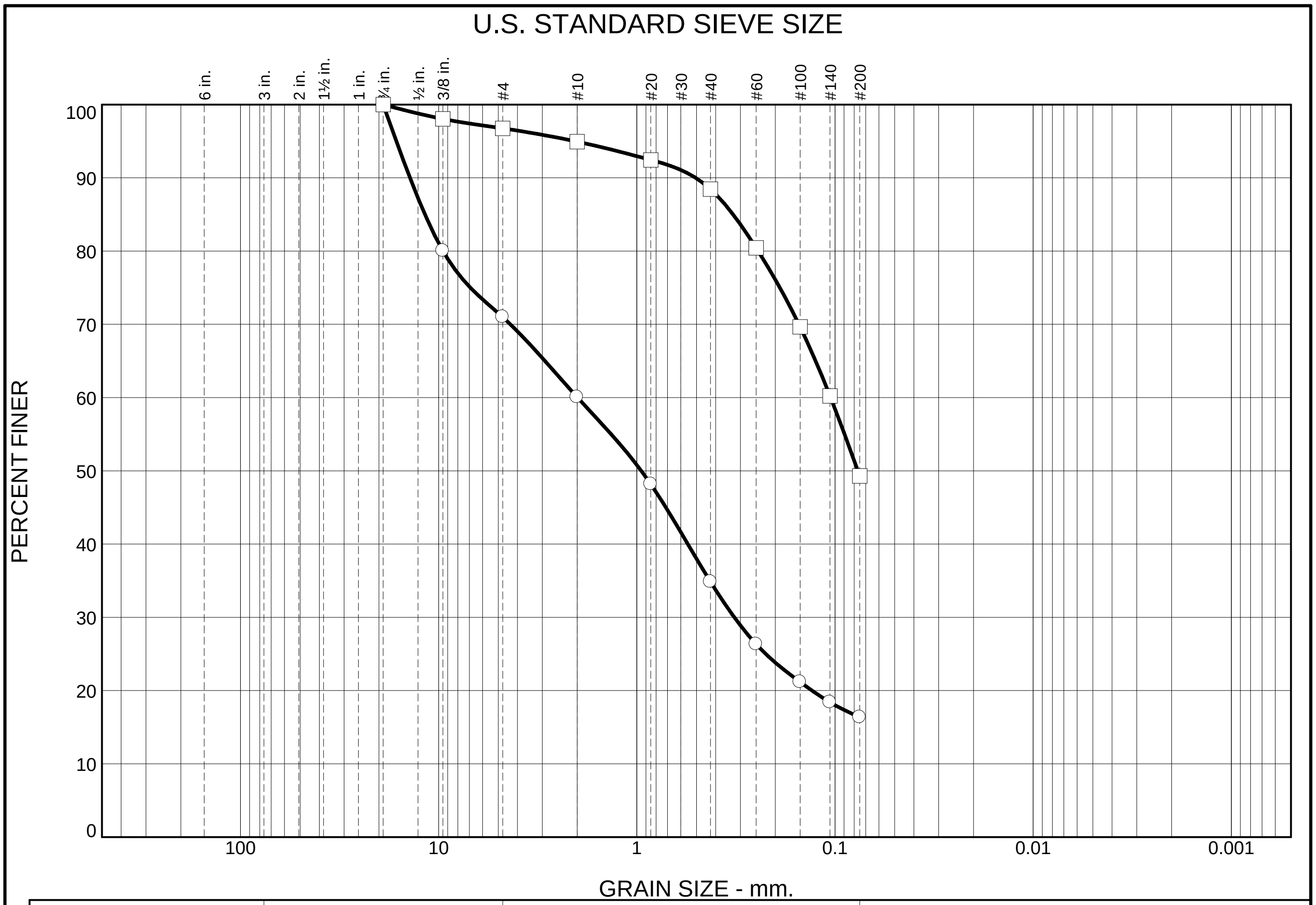
HALEY ALDRICH

580 Main Street - Geotechnical Due Diligence
Medford, Massachusetts

GRAIN SIZE DISTRIBUTION

DATE: 10/15/2020

FILE NO: 135679-002



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	29.0	10.9	25.2	18.5	16.4	
☐	0.0	0.0	3.2	1.9	6.4	39.2	49.3	

	Expl. No.	Sample No.	Depth (ft)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	HA-6	S03	4.5-6.5				10.1			SM
☐	HA-7	S01	0.5-2.0				16.7			SM

Sample Description

○ Olive brown silty sand with gravel

☐ Yellow brown silty sand

Remarks:

HALEY ALDRICH

580 Main Street - Geotechnical Due Diligence
Medford, Massachusetts

GRAIN SIZE DISTRIBUTION

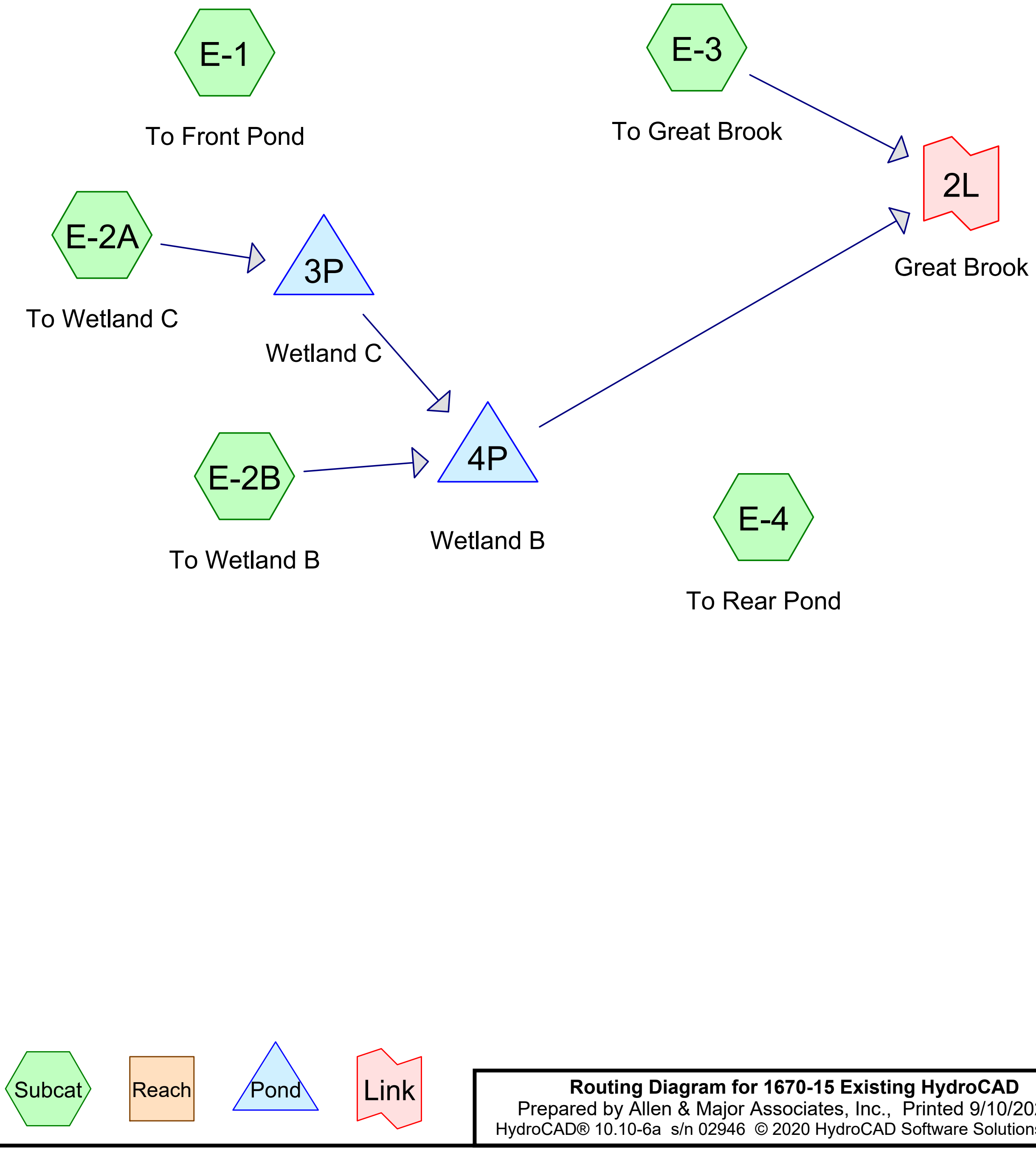
DATE: 10/15/2020

FILE NO: 135679-002

APPENDIX D

HYDROCAD

PRE-DEVELOPMENT



Routing Diagram for 1670-15 Existing HydroCAD
Prepared by Allen & Major Associates, Inc., Printed 9/10/2021
HydroCAD® 10.10-6a s/n 02946 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.27	2
2	10-Year	Type III 24-hr		Default	24.00	1	5.02	2
3	25-Year	Type III 24-hr		Default	24.00	1	6.11	2
4	100-Year	Type III 24-hr		Default	24.00	1	7.79	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
570,054	61	>75% Grass cover, Good, HSG B (E-1, E-2A, E-2B, E-3, E-4)
3,171	80	>75% Grass cover, Good, HSG D Wetlands (E-2B)
9,139	96	Gravel surface, HSG B (E-3)
83,392	98	Paved parking, HSG B (E-1)
48,239	98	Roofs, HSG B (E-1, E-3)
143,079	98	Unconnected pavement, HSG B (E-2A, E-2B, E-3, E-4)
103,504	98	Water Surface, HSG B (E-1, E-4)
156,682	55	Woods, Good, HSG B (E-1, E-2A, E-2B, E-3, E-4)
4,081	77	Woods, Good, HSG D Wetlands (E-2A)
1,121,341	**73**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
1,114,089	HSG B	E-1, E-2A, E-2B, E-3, E-4
0	HSG C	
7,252	HSG D	E-2A, E-2B
0	Other	
1,121,341		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	570,054	0	3,171	0	573,225	>75% Grass cover, Good	
0	9,139	0	0	0	9,139	Gravel surface	
0	83,392	0	0	0	83,392	Paved parking	
0	48,239	0	0	0	48,239	Roofs	
0	143,079	0	0	0	143,079	Unconnected pavement	
0	103,504	0	0	0	103,504	Water Surface	
0	156,682	0	4,081	0	160,763	Woods, Good	
0	**1,114,089**	**0**	**7,252**	**0**	**1,121,341**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	E-1	0.00	0.00	184.0	0.0155	0.013	0.0	12.0	0.0
2	4P	344.59	342.78	107.0	0.0169	0.013	0.0	18.0	0.0

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=345,377 sf 53.30% Impervious Runoff Depth>1.45"
Flow Length=405' Tc=10.4 min CN=80 Runoff=11.54 cfs 41,807 cf

Subcatchment E-2A: To Wetland C Runoff Area=63,246 sf 6.89% Impervious Runoff Depth>0.51"
Flow Length=314' Tc=7.8 min UI Adjusted CN=62 Runoff=0.56 cfs 2,687 cf

Subcatchment E-2B: To Wetland B Runoff Area=62,941 sf 6.46% Impervious Runoff Depth>0.51"
Flow Length=203' Tc=5.7 min UI Adjusted CN=62 Runoff=0.61 cfs 2,676 cf

Subcatchment E-3: To Great Brook Runoff Area=423,611 sf 1.82% Impervious Runoff Depth>0.47"
Flow Length=353' Tc=8.6 min CN=61 Runoff=3.16 cfs 16,641 cf

Subcatchment E-4: To Rear Pond Runoff Area=226,166 sf 78.70% Impervious Runoff Depth>2.14"
Flow Length=219' Tc=7.2 min CN=89 Runoff=12.44 cfs 40,386 cf

Pond 3P: Wetland C Peak Elev=344.67' Storage=2,687 cf Inflow=0.56 cfs 2,687 cf
Outflow=0.00 cfs 0 cf

Pond 4P: Wetland B Peak Elev=344.75' Storage=823 cf Inflow=0.61 cfs 2,676 cf
18.0" Round Culvert n=0.013 L=107.0' S=0.0169 '/' Outflow=0.11 cfs 2,086 cf

Link 2L: Great Brook Inflow=3.16 cfs 18,728 cf
Primary=3.16 cfs 18,728 cf

Total Runoff Area = 1,121,341 sf Runoff Volume = 104,198 cf Average Runoff Depth = 1.12"
66.27% Pervious = 743,127 sf 33.73% Impervious = 378,214 sf

Summary for Subcatchment E-1: To Front Pond

[47] Hint: Peak is 260% of capacity of segment #4

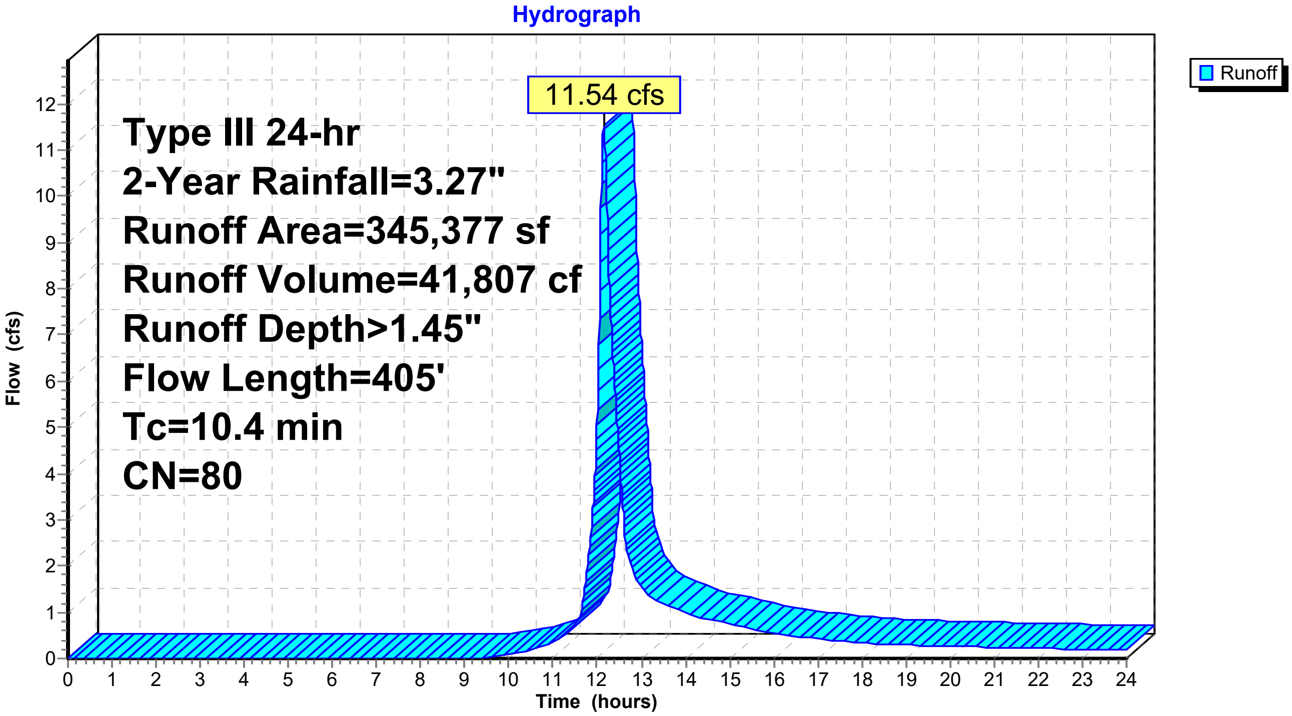
Runoff = 11.54 cfs @ 12.15 hrs, Volume= 41,807 cf, Depth> 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

Area (sf)	CN	Description
22,632	55	Woods, Good, HSG B
138,642	61	>75% Grass cover, Good, HSG B
83,392	98	Paved parking, HSG B
48,095	98	Roofs, HSG B
52,616	98	Water Surface, HSG B
345,377	80	Weighted Average
161,274		46.70% Pervious Area
184,103		53.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0060	0.09		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.4	58	0.0190	2.22		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	20	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.5	184	0.0155	5.65	4.44	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	93	0.0699	3.97		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
10.4	405	Total			

Subcatchment E-1: To Front Pond



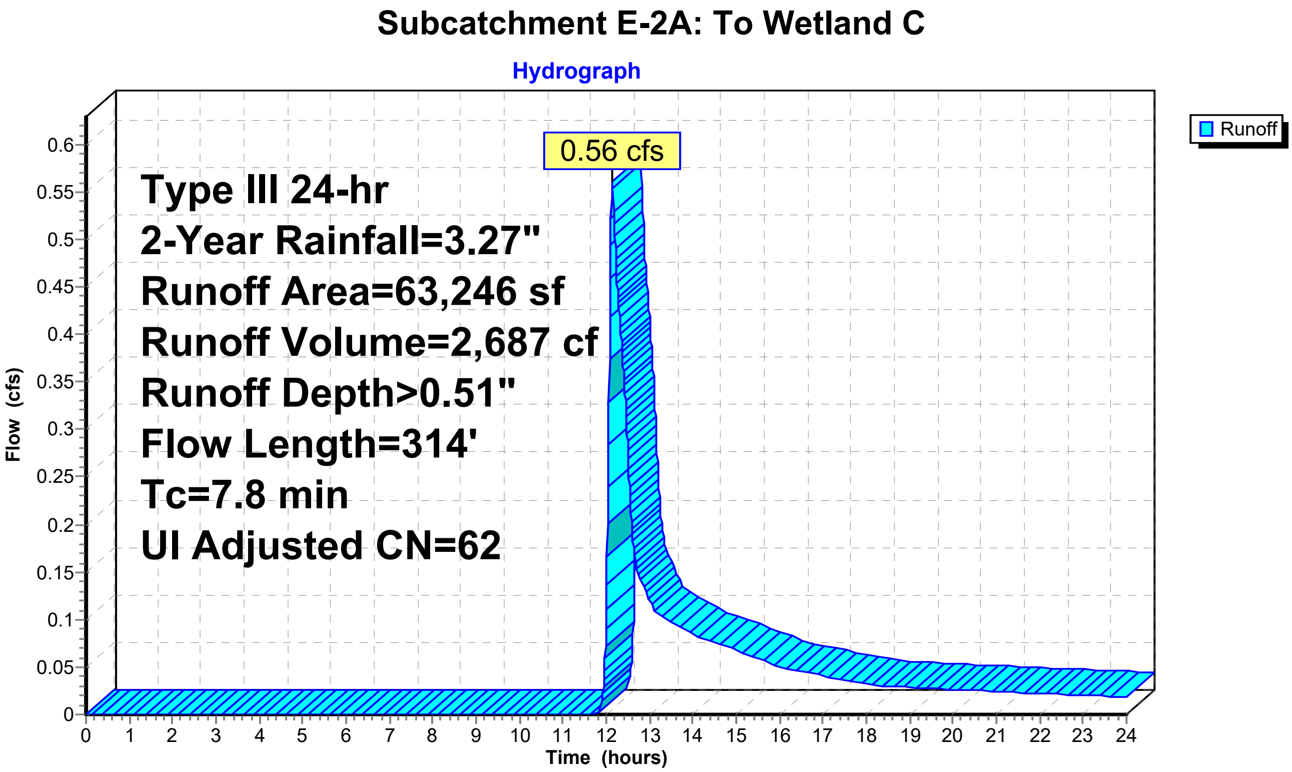
Summary for Subcatchment E-2A: To Wetland C

Runoff = 0.56 cfs @ 12.14 hrs, Volume= 2,687 cf, Depth> 0.51"
Routed to Pond 3P : Wetland C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

	Area (sf)	CN	Adj	Description
	13,064	55		Woods, Good, HSG B
	41,744	61		>75% Grass cover, Good, HSG B
	3,778	98		Unconnected pavement, HSG B
	579	98		Unconnected pavement, HSG B
*	4,081	77		Woods, Good, HSG D Wetlands
	63,246	63	62	Weighted Average, UI Adjusted
	58,889			93.11% Pervious Area
	4,357			6.89% Impervious Area
	4,357			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0160	0.14		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
1.7	264	0.0257	2.58		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
7.8	314	Total			



Summary for Subcatchment E-2B: To Wetland B

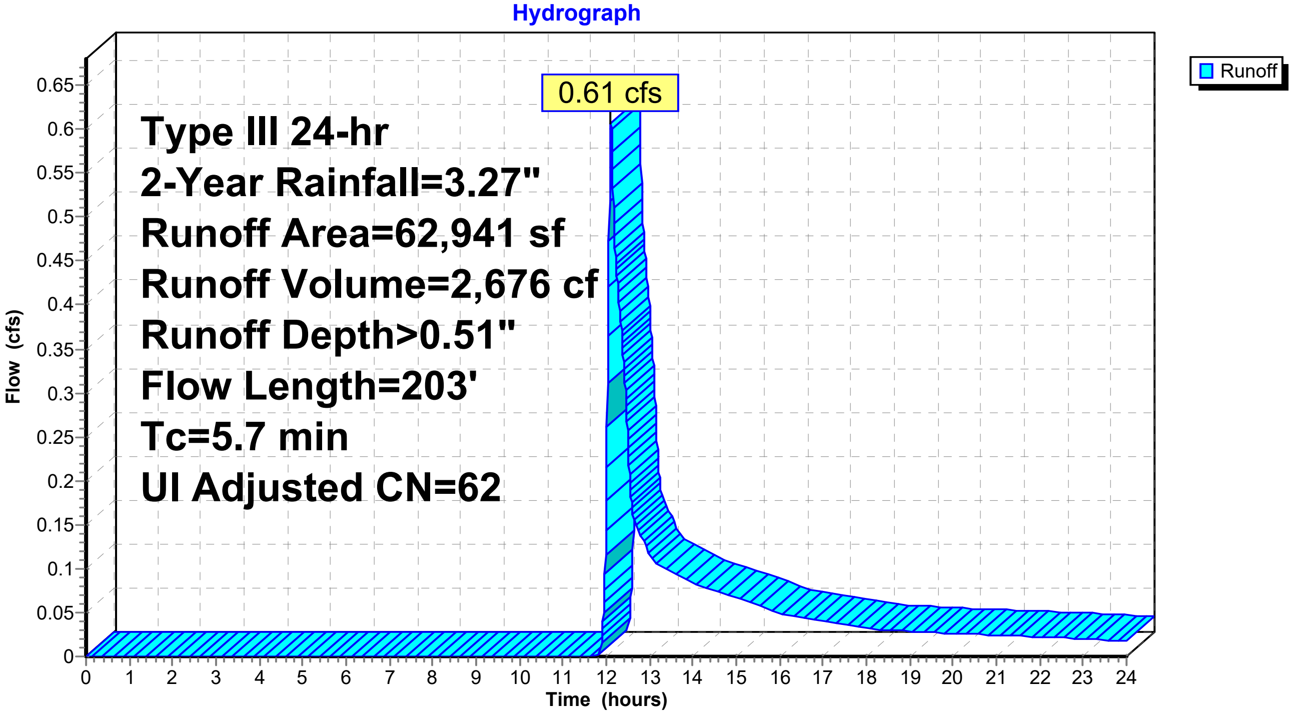
Runoff = 0.61 cfs @ 12.11 hrs, Volume= 2,676 cf, Depth> 0.51"
Routed to Pond 4P : Wetland B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

	Area (sf)	CN	Adj	Description
	13,824	55		Woods, Good, HSG B
	41,883	61		>75% Grass cover, Good, HSG B
	1,522	98		Unconnected pavement, HSG B
	2,541	98		Unconnected pavement, HSG B
*	3,171	80		>75% Grass cover, Good, HSG D Wetlands
	62,941	63	62	Weighted Average, UI Adjusted
	58,878			93.54% Pervious Area
	4,063			6.46% Impervious Area
	4,063			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0320	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
1.1	153	0.0196	2.25		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
5.7	203	Total			

Subcatchment E-2B: To Wetland B



Summary for Subcatchment E-3: To Great Brook

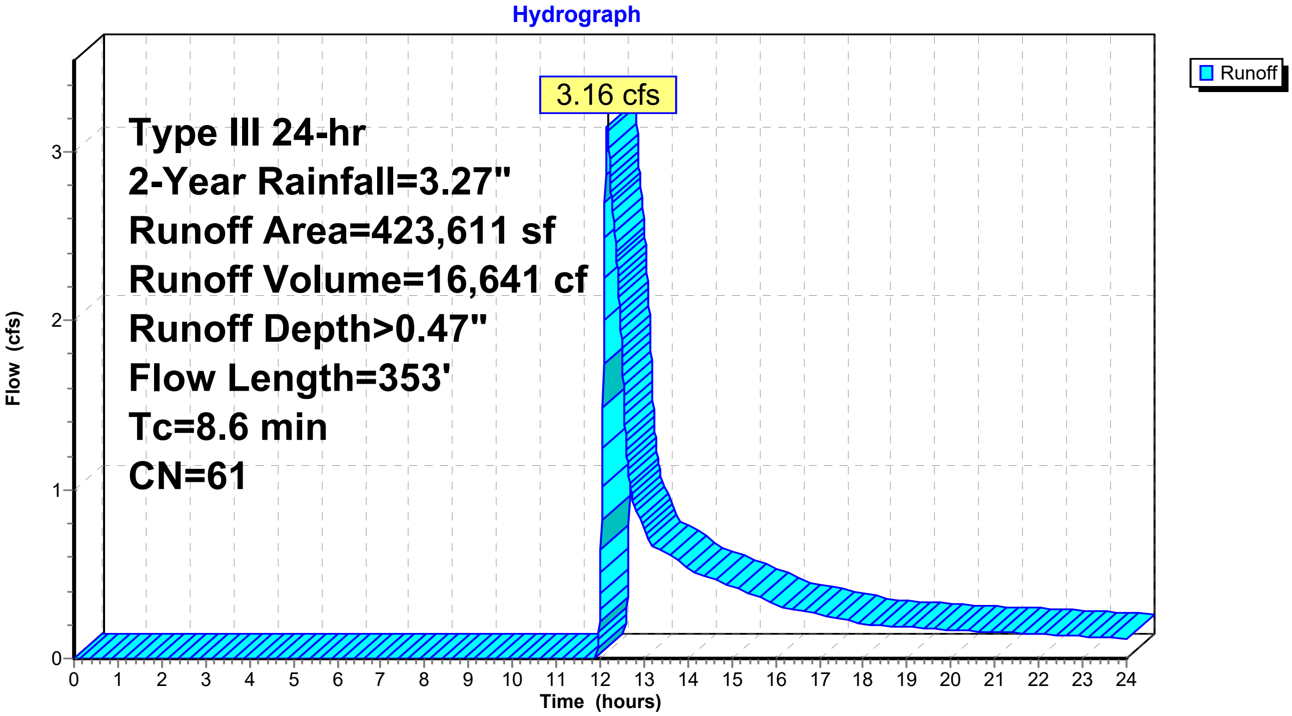
Runoff = 3.16 cfs @ 12.16 hrs, Volume= 16,641 cf, Depth> 0.47"
Routed to Link 2L : Great Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

Area (sf)	CN	Description
80,008	55	Woods, Good, HSG B
326,758	61	>75% Grass cover, Good, HSG B
9,139	96	Gravel surface, HSG B
7,562	98	Unconnected pavement, HSG B
144	98	Roofs, HSG B
423,611	61	Weighted Average
415,905		98.18% Pervious Area
7,706		1.82% Impervious Area
7,562		98.13% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.2	57	0.0789	4.52		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
2.8	246	0.0081	1.45		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.6	353	Total			

Subcatchment E-3: To Great Brook



Summary for Subcatchment E-4: To Rear Pond

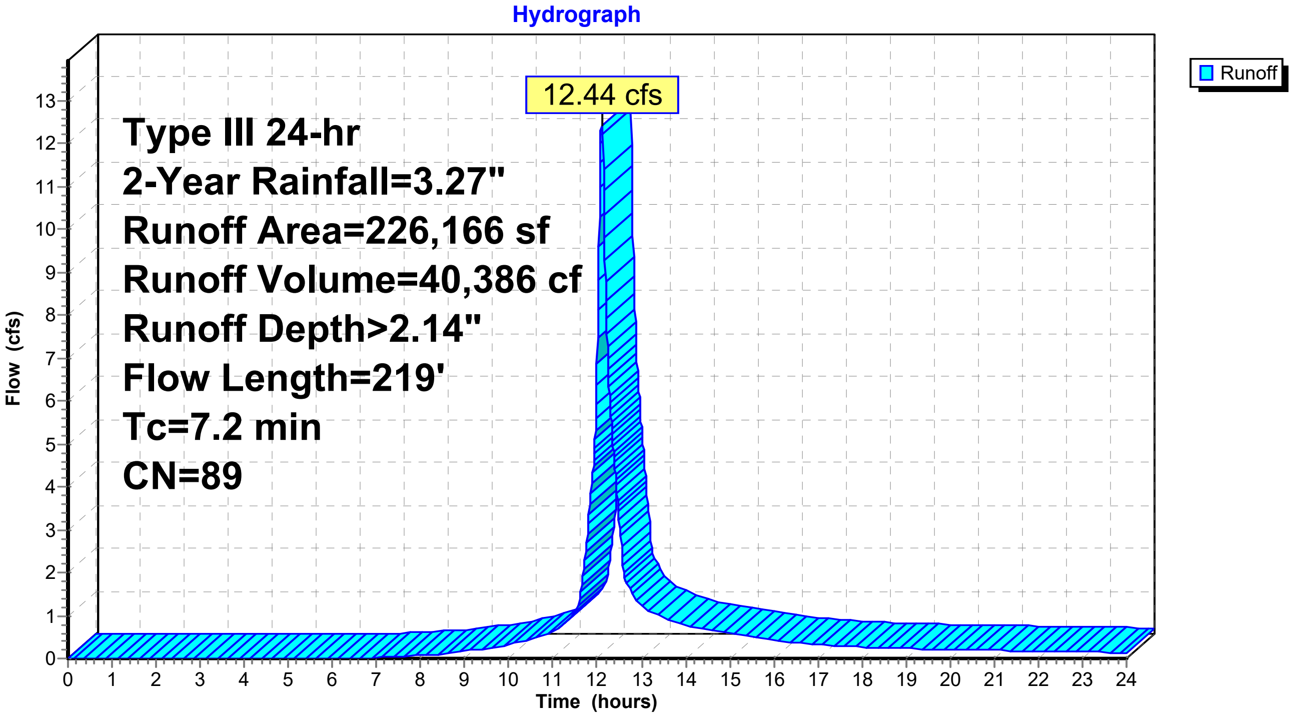
Runoff = 12.44 cfs @ 12.10 hrs, Volume= 40,386 cf, Depth> 2.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

Area (sf)	CN	Description
27,154	55	Woods, Good, HSG B
21,027	61	>75% Grass cover, Good, HSG B
127,097	98	Unconnected pavement, HSG B
50,888	98	Water Surface, HSG B
226,166	89	Weighted Average
48,181		21.30% Pervious Area
177,985		78.70% Impervious Area
127,097		71.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.0	20	0.2500	8.05		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
1.3	105	0.0067	1.32		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	44	0.0364	2.86		**Shallow Concentrated Flow, D-E** Grassed Waterway Kv= 15.0 fps
7.2	219	Total			

Subcatchment E-4: To Rear Pond



Summary for Pond 3P: Wetland C

```
Inflow Area =          63,246 sf,   6.89% Impervious,  Inflow Depth >   0.51"    for  2-Year event
Inflow      =        0.56 cfs @  12.14 hrs,  Volume=            2,687 cf
Outflow     =        0.00 cfs @   0.00 hrs,  Volume=                0 cf,  Atten= 100%,  Lag= 0.0 min
Primary     =        0.00 cfs @   0.00 hrs,  Volume=                0 cf
    Routed to Pond 4P : Wetland B
```

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 344.67' @ 24.00 hrs Surf.Area= 3,223 sf Storage= 2,687 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

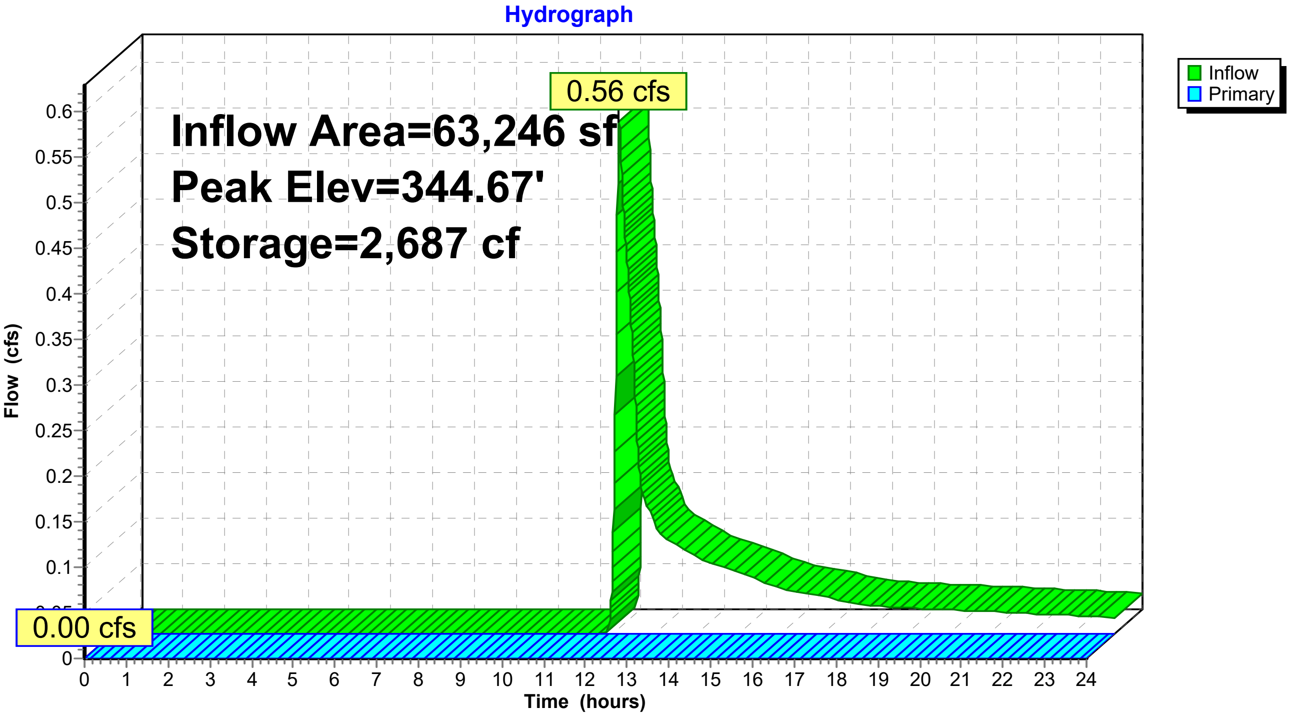
Volume	Invert	Avail.Storage	Storage Description
#1	343.00'	8,932 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
343.00	238	0	0
344.00	1,785	1,012	1,012
345.00	3,934	2,860	3,871
346.00	6,187	5,061	8,932

Device	Routing	Invert	Outlet Devices
#1	Primary	345.30'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=343.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

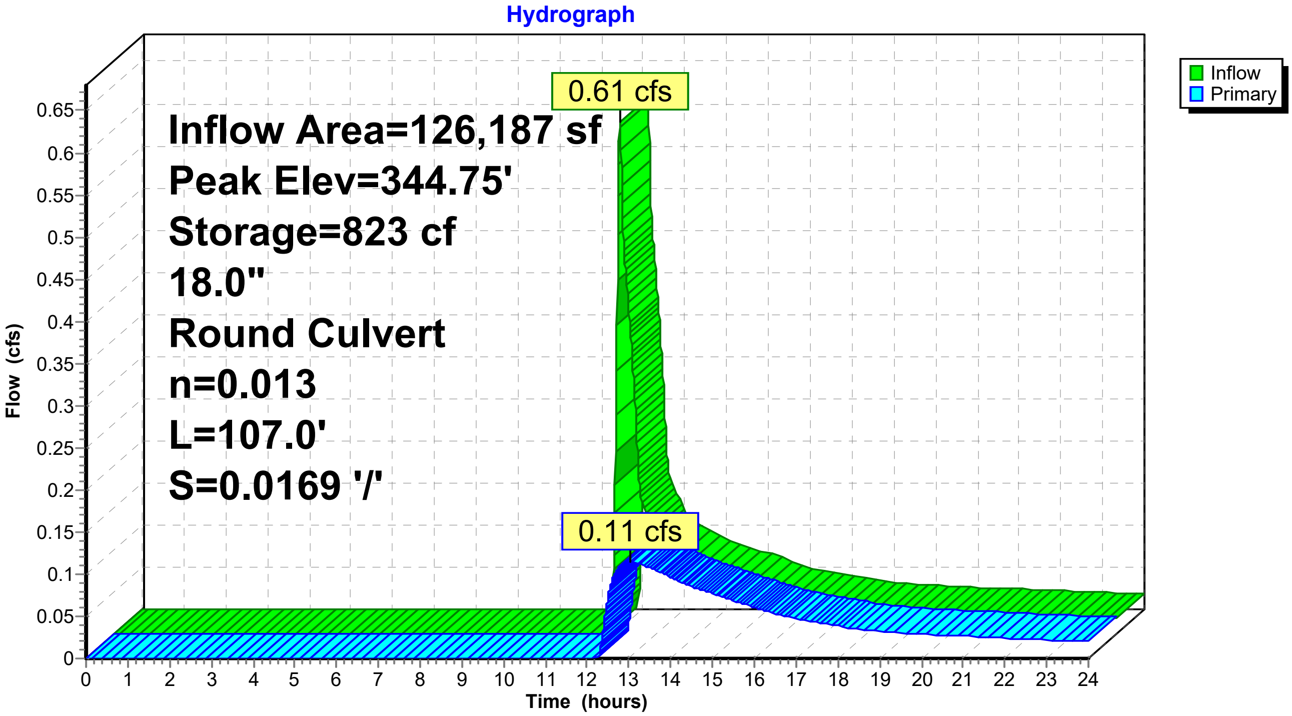
Pond 3P: Wetland C



Summary for Pond 4P: Wetland B

```
Inflow Area =       126,187 sf,  6.67% Impervious,  Inflow Depth >  0.25"   for  2-Year event
Inflow     =      0.61 cfs @  12.11 hrs,  Volume=         2,676 cf
Outflow    =      0.11 cfs @  13.02 hrs,  Volume=         2,086 cf,  Atten= 81%,  Lag= 54.2 min
Primary    =      0.11 cfs @  13.02 hrs,  Volume=         2,086 cf
    Routed to Link 2L : Great Brook

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 344.75' @ 13.02 hrs   Surf.Area= 2,761 sf   Storage= 823 cf

Plug-Flow detention time= 167.5 min calculated for 2,085 cf (78% of inflow)
Center-of-Mass det. time= 77.5 min ( 983.1 - 905.6 )

Volume      Invert    Avail.Storage   Storage Description
   #1       344.25'       10,492 cf   Custom Stage Data (Prismatic)Listed below (Recalc)

 Elevation        Surf.Area        Inc.Store       Cum.Store
    (feet)          (sq-ft)     (cubic-feet)    (cubic-feet)
    344.25              563                0               0
    345.00            3,891            1,670           1,670
    346.00           13,752            8,822          10,492

Device  Routing          Invert   Outlet Devices
   #1   Primary          344.59'  18.0"  Round Culvert
                                  L= 107.0'   RCP, mitered to conform to fill,  Ke= 0.700
                                  Inlet / Outlet Invert= 344.59' / 342.78'   S= 0.0169 '/'   Cc= 0.900
                                  n= 0.013,  Flow Area= 1.77 sf

Primary OutFlow  Max=0.11 cfs @ 13.02 hrs  HW=344.75'   (Free Discharge)
└─1=Culvert  (Inlet Controls 0.11 cfs @ 1.18 fps)
```

Pond 4P: Wetland B

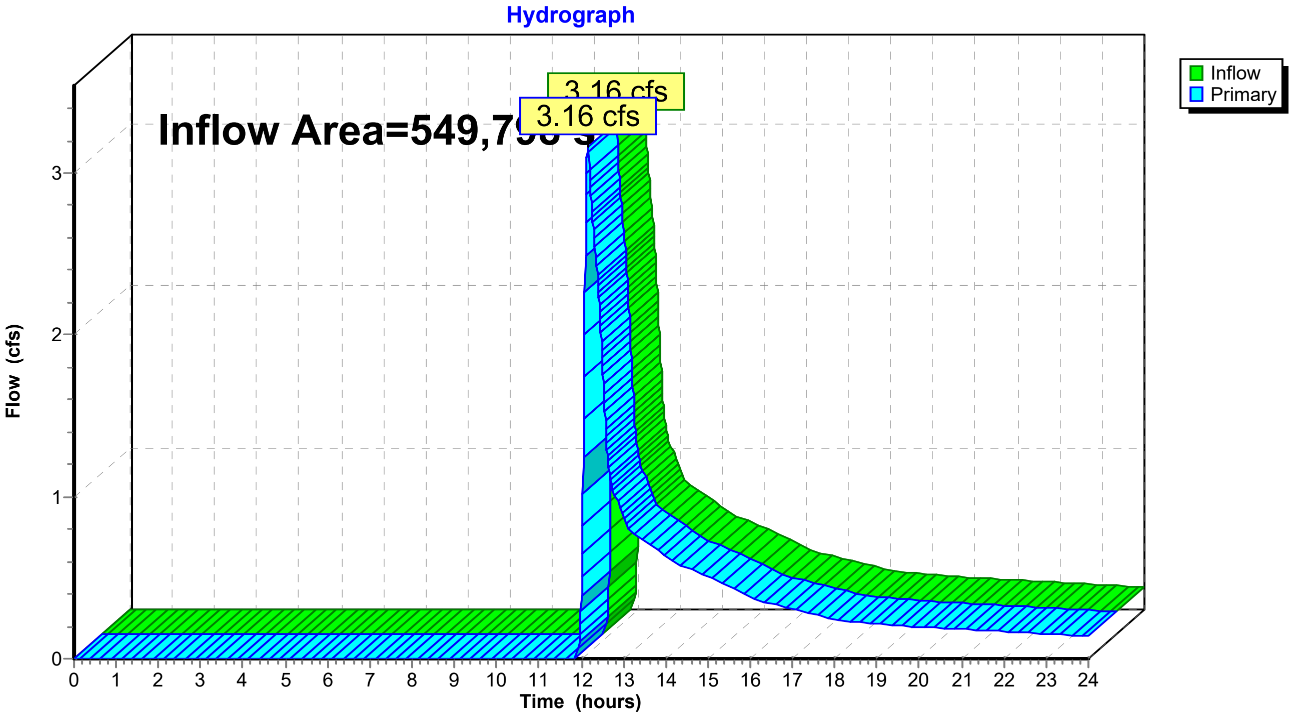


Summary for Link 2L: Great Brook

Inflow Area = 549,798 sf, 2.93% Impervious, Inflow Depth > 0.41" for 2-Year event
Inflow = 3.16 cfs @ 12.16 hrs, Volume= 18,728 cf
Primary = 3.16 cfs @ 12.16 hrs, Volume= 18,728 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Great Brook



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=345,377 sf 53.30% Impervious Runoff Depth>2.90"
Flow Length=405' Tc=10.4 min CN=80 Runoff=23.34 cfs 83,594 cf

Subcatchment E-2A: To Wetland C Runoff Area=63,246 sf 6.89% Impervious Runoff Depth>1.45"
Flow Length=314' Tc=7.8 min UI Adjusted CN=62 Runoff=2.14 cfs 7,630 cf

Subcatchment E-2B: To Wetland B Runoff Area=62,941 sf 6.46% Impervious Runoff Depth>1.45"
Flow Length=203' Tc=5.7 min UI Adjusted CN=62 Runoff=2.29 cfs 7,598 cf

Subcatchment E-3: To Great Brook Runoff Area=423,611 sf 1.82% Impervious Runoff Depth>1.38"
Flow Length=353' Tc=8.6 min CN=61 Runoff=13.06 cfs 48,638 cf

Subcatchment E-4: To Rear Pond Runoff Area=226,166 sf 78.70% Impervious Runoff Depth>3.79"
Flow Length=219' Tc=7.2 min CN=89 Runoff=21.50 cfs 71,369 cf

Pond 3P: Wetland C Peak Elev=345.32' Storage=5,239 cf Inflow=2.14 cfs 7,630 cf
Outflow=0.15 cfs 2,440 cf

Pond 4P: Wetland B Peak Elev=345.05' Storage=1,891 cf Inflow=2.29 cfs 10,037 cf
18.0" Round Culvert n=0.013 L=107.0' S=0.0169 '/' Outflow=0.95 cfs 9,274 cf

Link 2L: Great Brook Inflow=13.62 cfs 57,912 cf
Primary=13.62 cfs 57,912 cf

Total Runoff Area = 1,121,341 sf Runoff Volume = 218,828 cf Average Runoff Depth = 2.34"
66.27% Pervious = 743,127 sf 33.73% Impervious = 378,214 sf

Summary for Subcatchment E-1: To Front Pond

[47] Hint: Peak is 526% of capacity of segment #4

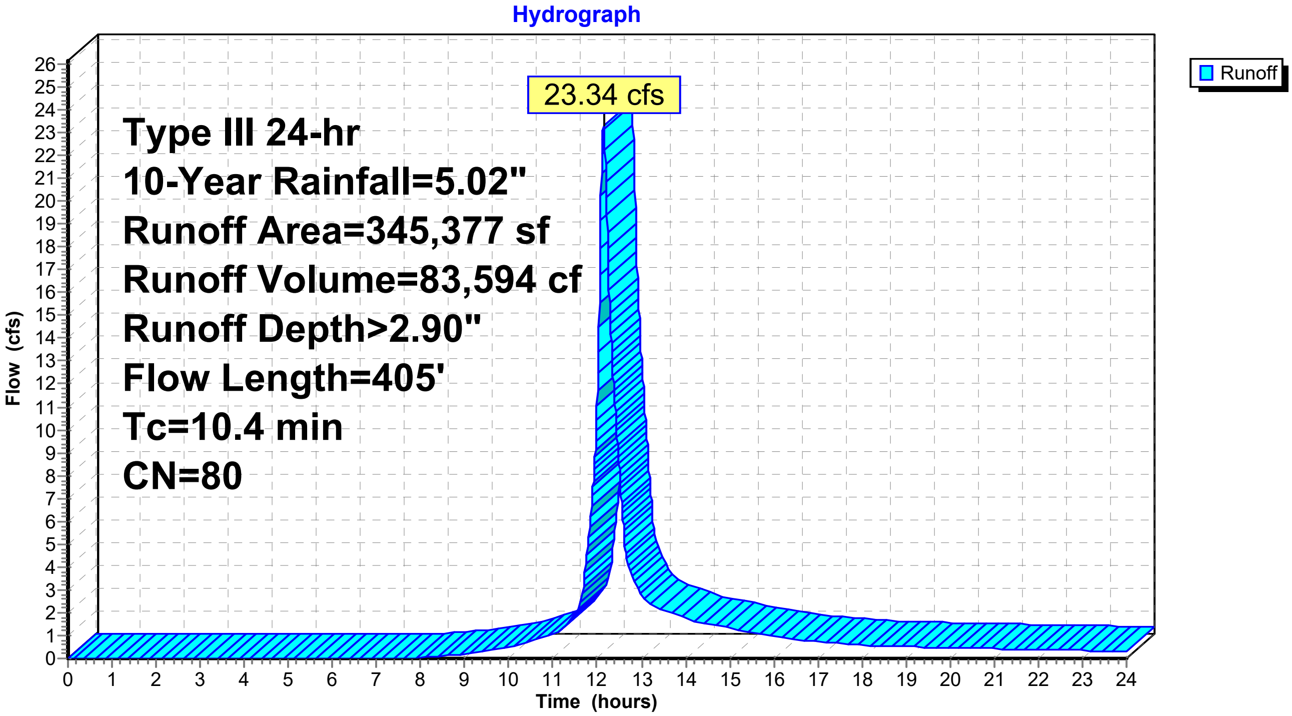
Runoff = 23.34 cfs @ 12.14 hrs, Volume= 83,594 cf, Depth> 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

Area (sf)	CN	Description
22,632	55	Woods, Good, HSG B
138,642	61	>75% Grass cover, Good, HSG B
83,392	98	Paved parking, HSG B
48,095	98	Roofs, HSG B
52,616	98	Water Surface, HSG B
345,377	80	Weighted Average
161,274		46.70% Pervious Area
184,103		53.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0060	0.09		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.4	58	0.0190	2.22		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	20	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.5	184	0.0155	5.65	4.44	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	93	0.0699	3.97		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
10.4	405	Total			

Subcatchment E-1: To Front Pond



Summary for Subcatchment E-2A: To Wetland C

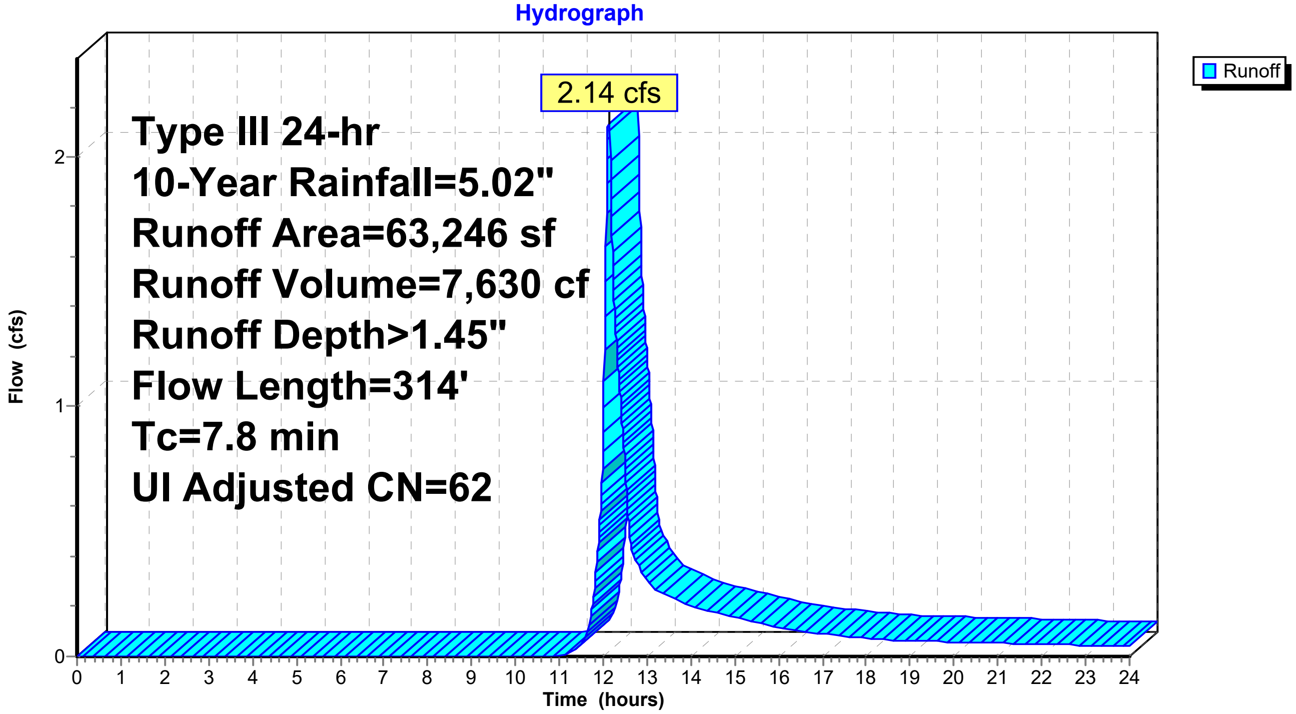
Runoff = 2.14 cfs @ 12.12 hrs, Volume= 7,630 cf, Depth> 1.45"
Routed to Pond 3P : Wetland C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

	Area (sf)	CN	Adj	Description
	13,064	55		Woods, Good, HSG B
	41,744	61		>75% Grass cover, Good, HSG B
	3,778	98		Unconnected pavement, HSG B
	579	98		Unconnected pavement, HSG B
*	4,081	77		Woods, Good, HSG D Wetlands
	63,246	63	62	Weighted Average, UI Adjusted
	58,889			93.11% Pervious Area
	4,357			6.89% Impervious Area
	4,357			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0160	0.14		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
1.7	264	0.0257	2.58		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
7.8	314	Total			

Subcatchment E-2A: To Wetland C



Summary for Subcatchment E-2B: To Wetland B

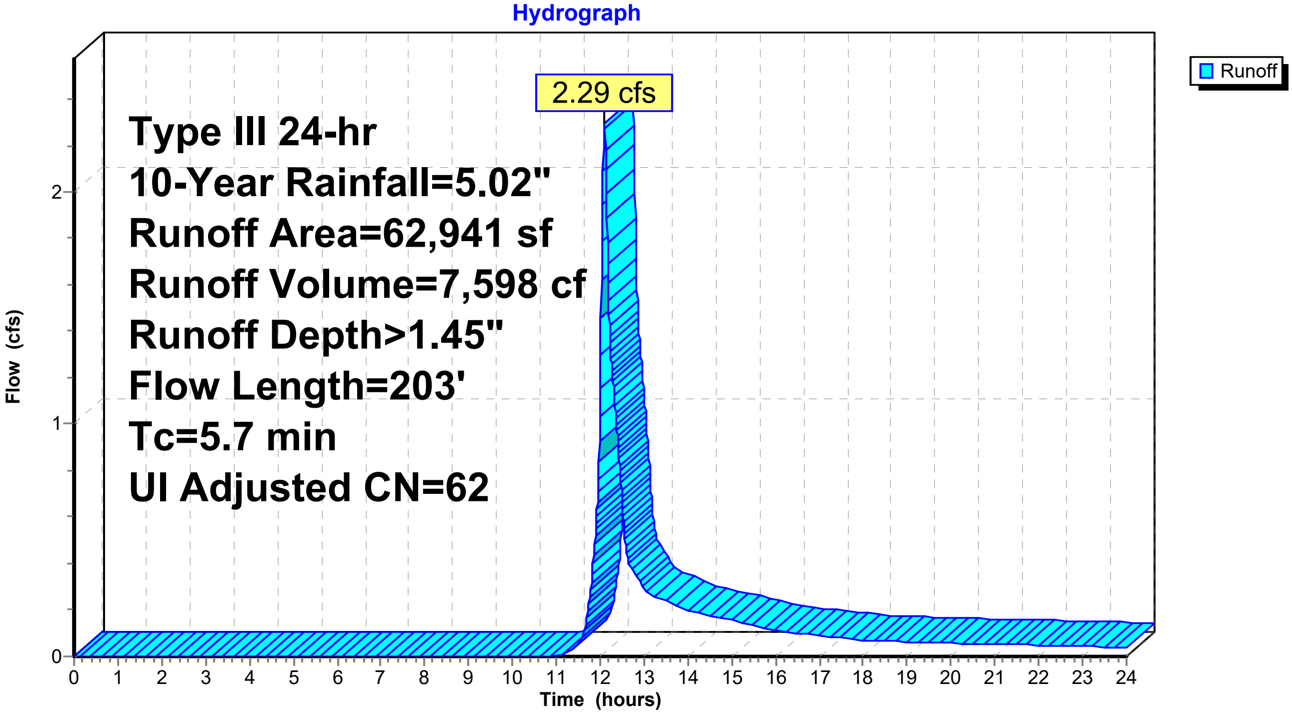
Runoff = 2.29 cfs @ 12.09 hrs, Volume= 7,598 cf, Depth> 1.45"
Routed to Pond 4P : Wetland B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

	Area (sf)	CN	Adj	Description
	13,824	55		Woods, Good, HSG B
	41,883	61		>75% Grass cover, Good, HSG B
	1,522	98		Unconnected pavement, HSG B
	2,541	98		Unconnected pavement, HSG B
*	3,171	80		>75% Grass cover, Good, HSG D Wetlands
	62,941	63	62	Weighted Average, UI Adjusted
	58,878			93.54% Pervious Area
	4,063			6.46% Impervious Area
	4,063			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0320	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
1.1	153	0.0196	2.25		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
5.7	203	Total			

Subcatchment E-2B: To Wetland B



Summary for Subcatchment E-3: To Great Brook

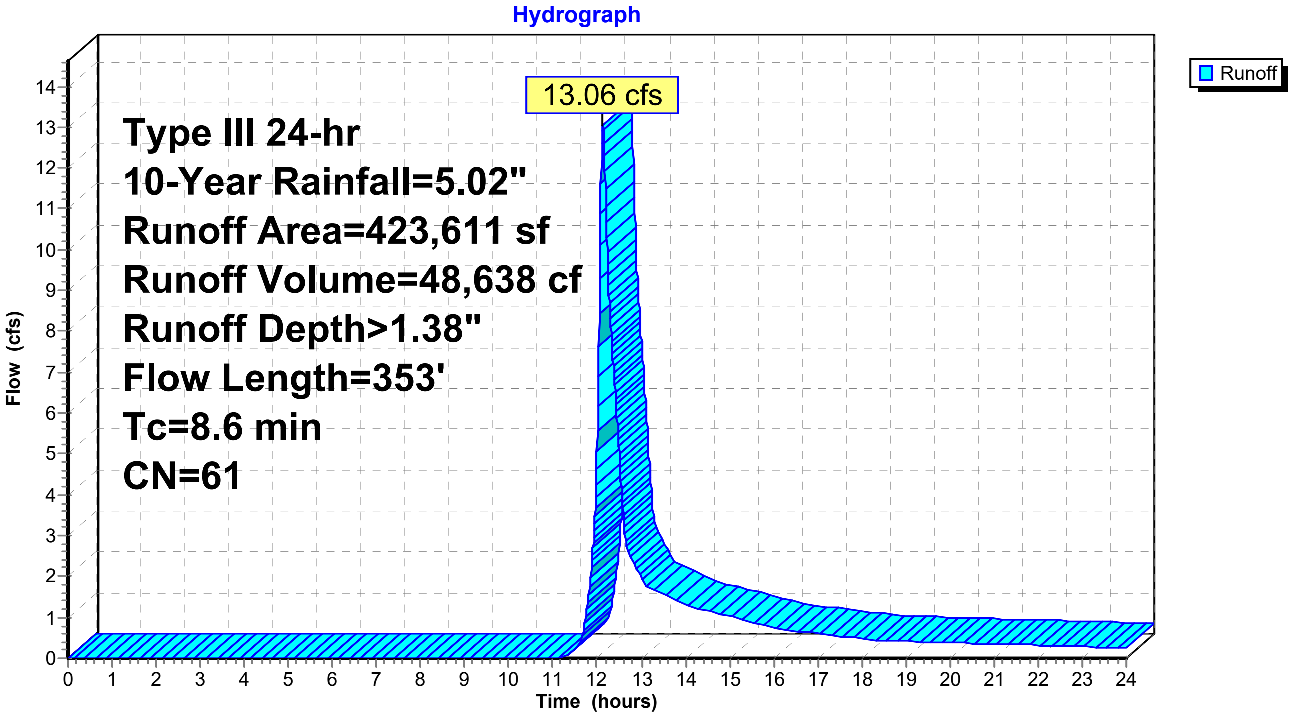
Runoff = 13.06 cfs @ 12.13 hrs, Volume= 48,638 cf, Depth> 1.38"
Routed to Link 2L : Great Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

Area (sf)	CN	Description
80,008	55	Woods, Good, HSG B
326,758	61	>75% Grass cover, Good, HSG B
9,139	96	Gravel surface, HSG B
7,562	98	Unconnected pavement, HSG B
144	98	Roofs, HSG B
423,611	61	Weighted Average
415,905		98.18% Pervious Area
7,706		1.82% Impervious Area
7,562		98.13% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.2	57	0.0789	4.52		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
2.8	246	0.0081	1.45		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.6	353	Total			

Subcatchment E-3: To Great Brook



Summary for Subcatchment E-4: To Rear Pond

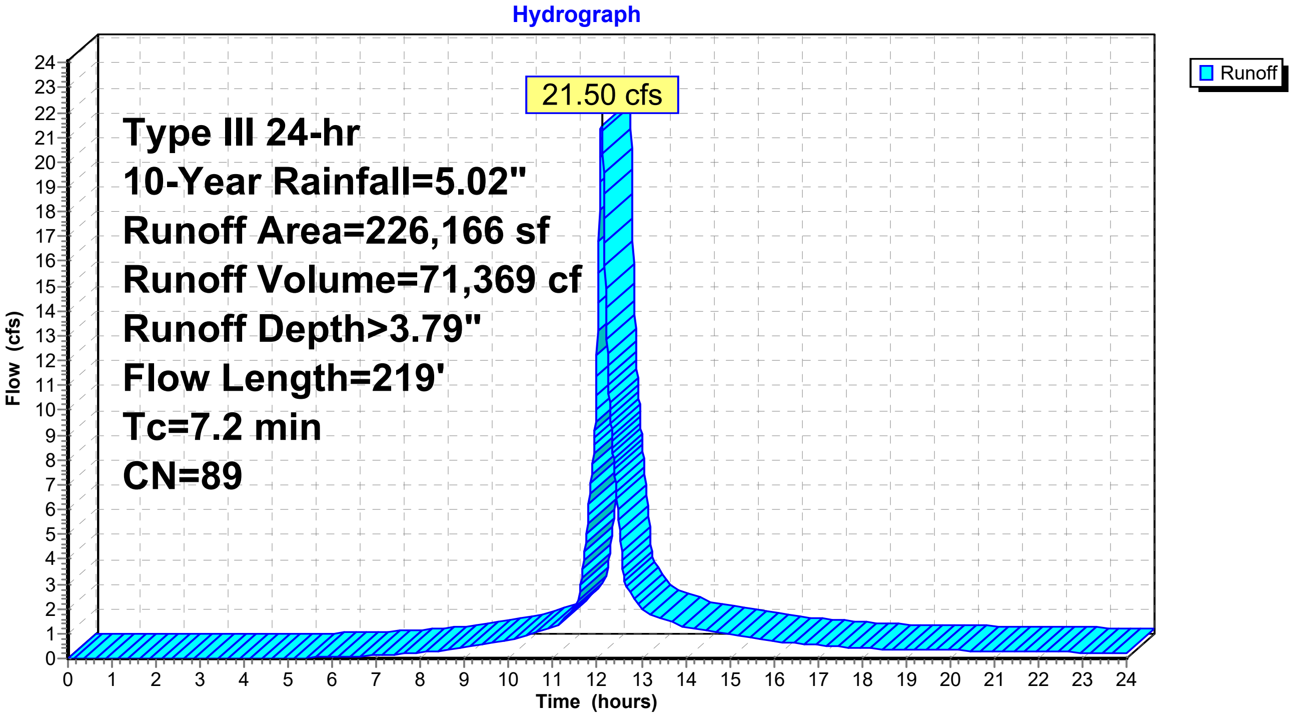
Runoff = 21.50 cfs @ 12.10 hrs, Volume= 71,369 cf, Depth> 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

Area (sf)	CN	Description
27,154	55	Woods, Good, HSG B
21,027	61	>75% Grass cover, Good, HSG B
127,097	98	Unconnected pavement, HSG B
50,888	98	Water Surface, HSG B
226,166	89	Weighted Average
48,181		21.30% Pervious Area
177,985		78.70% Impervious Area
127,097		71.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.0	20	0.2500	8.05		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
1.3	105	0.0067	1.32		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	44	0.0364	2.86		**Shallow Concentrated Flow, D-E** Grassed Waterway Kv= 15.0 fps
7.2	219	Total			

Subcatchment E-4: To Rear Pond



Summary for Pond 3P: Wetland C

Inflow Area = 63,246 sf, 6.89% Impervious, Inflow Depth > 1.45" for 10-Year event
Inflow = 2.14 cfs @ 12.12 hrs, Volume= 7,630 cf
Outflow = 0.15 cfs @ 15.19 hrs, Volume= 2,440 cf, Atten= 93%, Lag= 183.8 min
Primary = 0.15 cfs @ 15.19 hrs, Volume= 2,440 cf
Routed to Pond 4P : Wetland B

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 345.32' @ 15.19 hrs Surf.Area= 4,652 sf Storage= 5,239 cf

Plug-Flow detention time= 379.5 min calculated for 2,440 cf (32% of inflow)
Center-of-Mass det. time= 235.2 min (1,104.8 - 869.5)

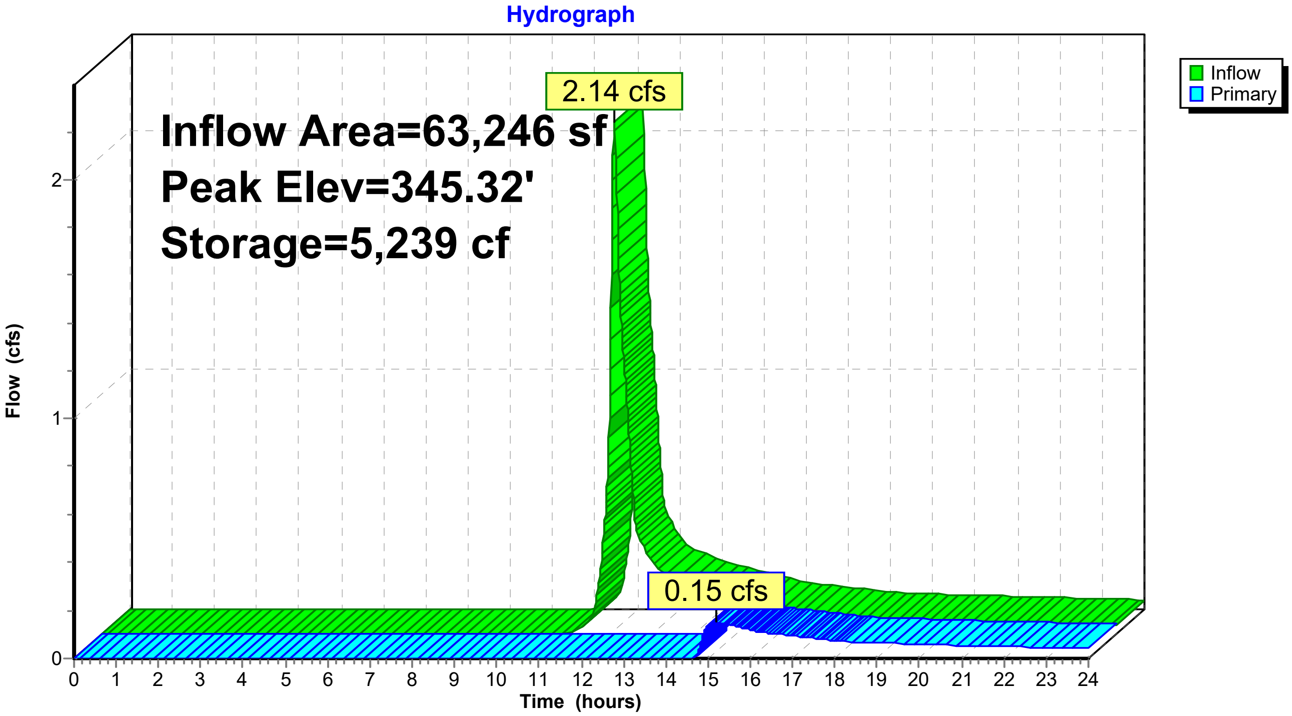
Volume	Invert	Avail.Storage	Storage Description
#1	343.00'	8,932 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
343.00	238	0	0
344.00	1,785	1,012	1,012
345.00	3,934	2,860	3,871
346.00	6,187	5,061	8,932

Device	Routing	Invert	Outlet Devices
#1	Primary	345.30'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.13 cfs @ 15.19 hrs HW=345.32' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.13 cfs @ 0.34 fps)

Pond 3P: Wetland C



Summary for Pond 4P: Wetland B

Inflow Area = 126,187 sf, 6.67% Impervious, Inflow Depth > 0.95" for 10-Year event
Inflow = 2.29 cfs @ 12.09 hrs, Volume= 10,037 cf
Outflow = 0.95 cfs @ 12.39 hrs, Volume= 9,274 cf, Atten= 59%, Lag= 17.8 min
Primary = 0.95 cfs @ 12.39 hrs, Volume= 9,274 cf
Routed to Link 2L : Great Brook

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 345.05' @ 12.39 hrs Surf.Area= 4,415 sf Storage= 1,891 cf

Plug-Flow detention time= 70.1 min calculated for 9,274 cf (92% of inflow)
Center-of-Mass det. time= 33.8 min (959.3 - 925.5)

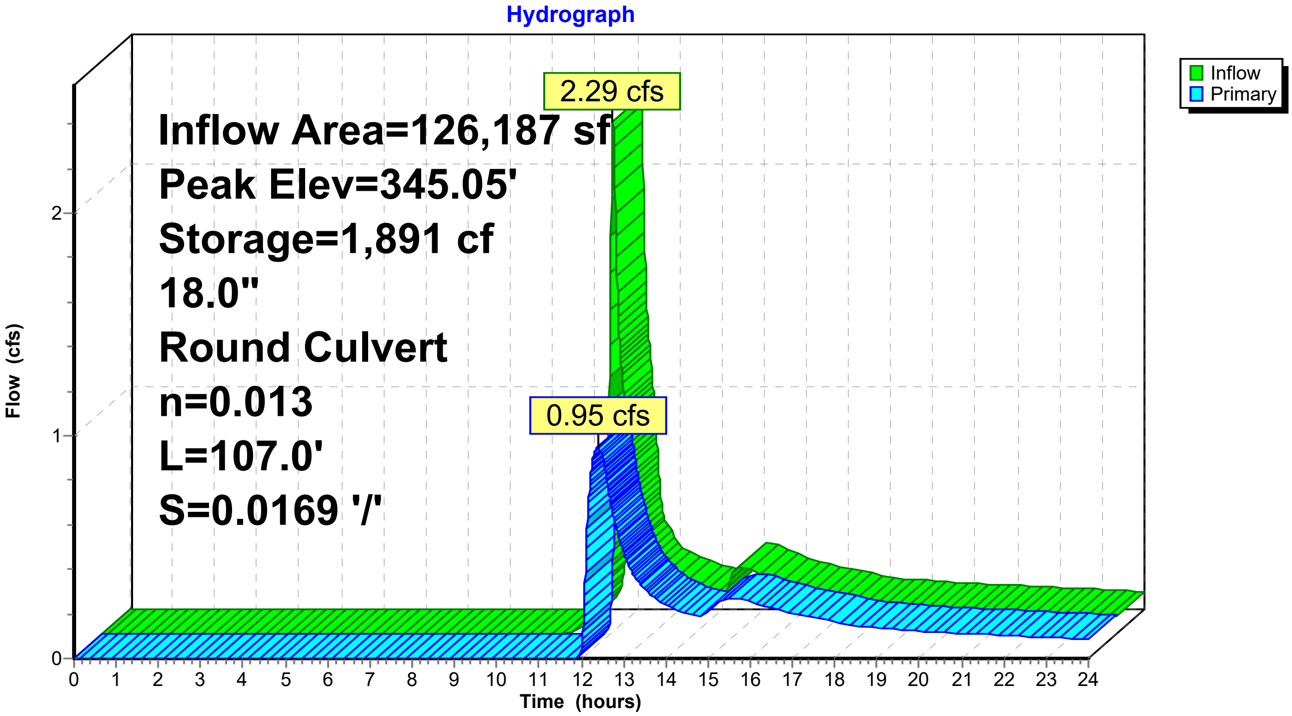
Volume	Invert	Avail.Storage	Storage Description
#1	344.25'	10,492 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
344.25	563	0	0
345.00	3,891	1,670	1,670
346.00	13,752	8,822	10,492

Device	Routing	Invert	Outlet Devices
#1	Primary	344.59'	**18.0" Round Culvert** L= 107.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 344.59' / 342.78' S= 0.0169 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=0.95 cfs @ 12.39 hrs HW=345.05' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.95 cfs @ 2.04 fps)

Pond 4P: Wetland B

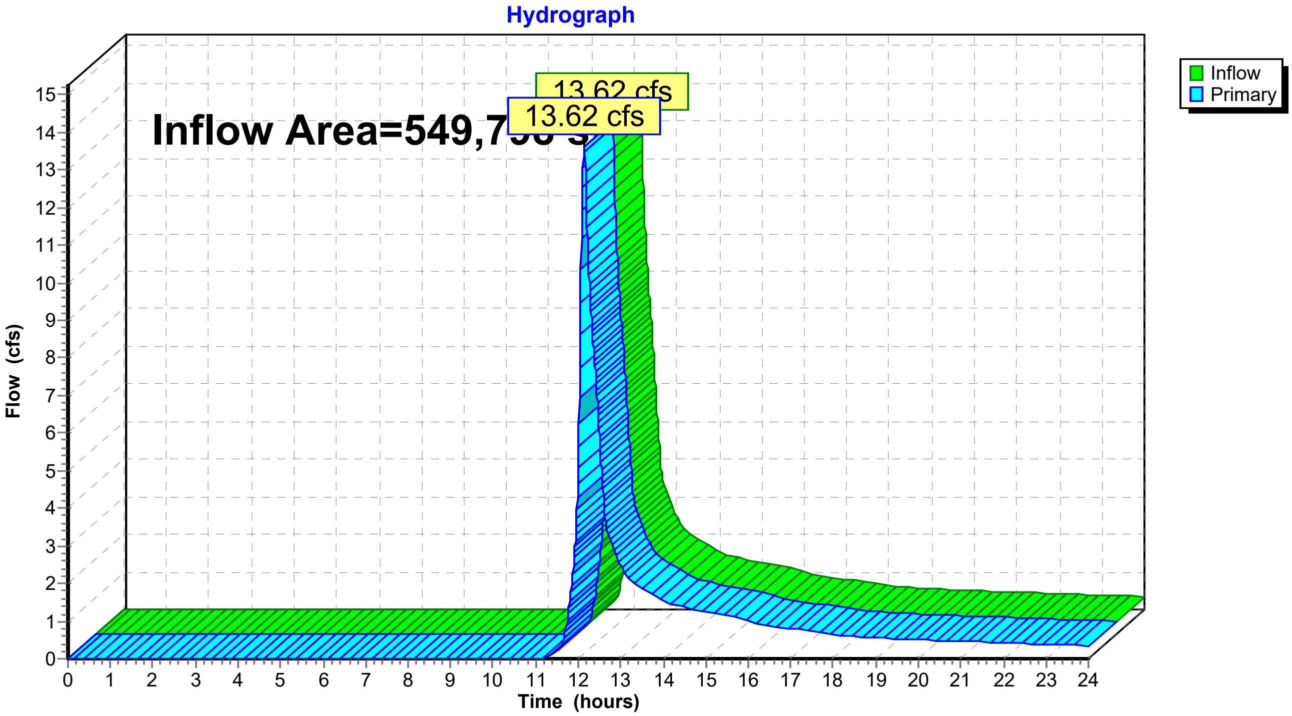


Summary for Link 2L: Great Brook

```
Inflow Area =         549,798 sf,    2.93% Impervious,  Inflow Depth >   1.26"    for  10-Year event
Inflow      =       13.62 cfs @   12.14 hrs,  Volume=           57,912 cf
Primary     =       13.62 cfs @   12.14 hrs,  Volume=           57,912 cf,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Great Brook



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=345,377 sf 53.30% Impervious Runoff Depth>3.87"
Flow Length=405' Tc=10.4 min CN=80 Runoff=31.02 cfs 111,477 cf

Subcatchment E-2A: To Wetland C Runoff Area=63,246 sf 6.89% Impervious Runoff Depth>2.16"
Flow Length=314' Tc=7.8 min UI Adjusted CN=62 Runoff=3.33 cfs 11,394 cf

Subcatchment E-2B: To Wetland B Runoff Area=62,941 sf 6.46% Impervious Runoff Depth>2.16"
Flow Length=203' Tc=5.7 min UI Adjusted CN=62 Runoff=3.57 cfs 11,345 cf

Subcatchment E-3: To Great Brook Runoff Area=423,611 sf 1.82% Impervious Runoff Depth>2.07"
Flow Length=353' Tc=8.6 min CN=61 Runoff=20.67 cfs 73,247 cf

Subcatchment E-4: To Rear Pond Runoff Area=226,166 sf 78.70% Impervious Runoff Depth>4.84"
Flow Length=219' Tc=7.2 min CN=89 Runoff=27.13 cfs 91,157 cf

Pond 3P: Wetland C Peak Elev=345.35' Storage=5,375 cf Inflow=3.33 cfs 11,394 cf
Outflow=0.53 cfs 6,194 cf

Pond 4P: Wetland B Peak Elev=345.21' Storage=2,709 cf Inflow=3.57 cfs 17,539 cf
18.0" Round Culvert n=0.013 L=107.0' S=0.0169 '/' Outflow=1.63 cfs 16,718 cf

Link 2L: Great Brook Inflow=21.97 cfs 89,965 cf
Primary=21.97 cfs 89,965 cf

Total Runoff Area = 1,121,341 sf Runoff Volume = 298,621 cf Average Runoff Depth = 3.20"
66.27% Pervious = 743,127 sf 33.73% Impervious = 378,214 sf

Summary for Subcatchment E-1: To Front Pond

[47] Hint: Peak is 699% of capacity of segment #4

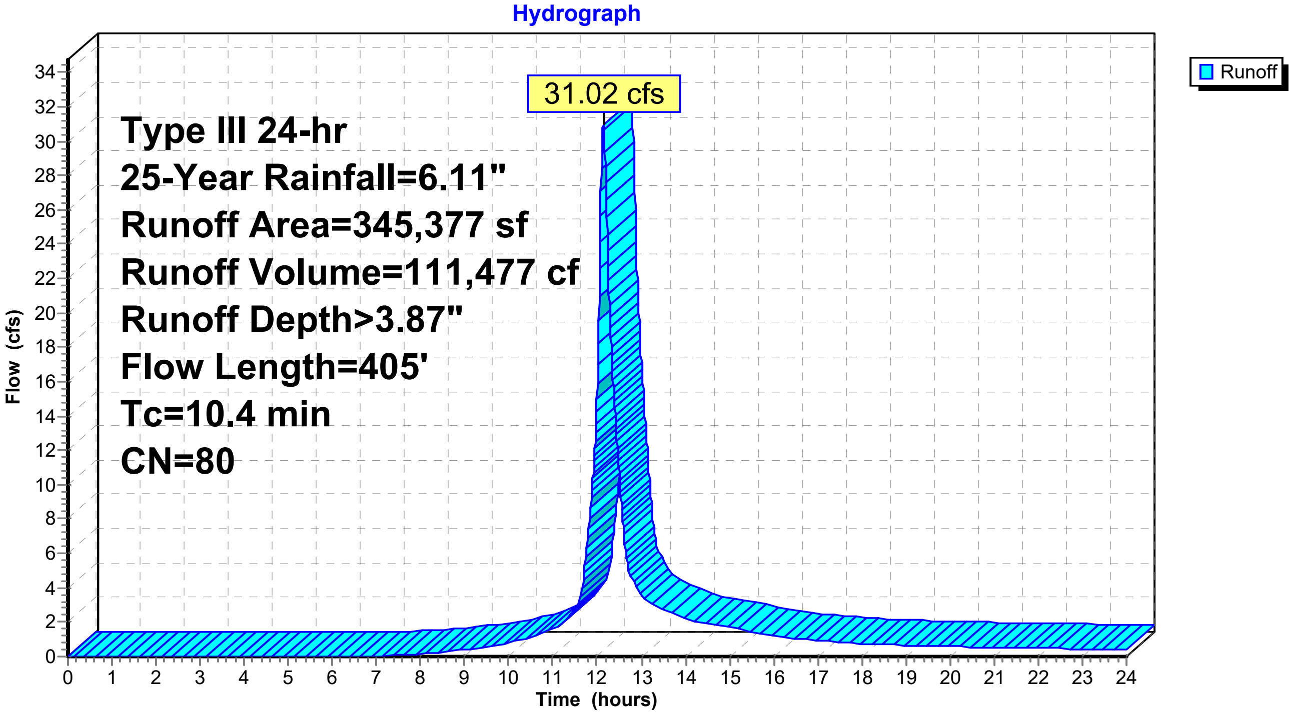
Runoff = 31.02 cfs @ 12.14 hrs, Volume= 111,477 cf, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

Area (sf)	CN	Description
22,632	55	Woods, Good, HSG B
138,642	61	>75% Grass cover, Good, HSG B
83,392	98	Paved parking, HSG B
48,095	98	Roofs, HSG B
52,616	98	Water Surface, HSG B
345,377	80	Weighted Average
161,274		46.70% Pervious Area
184,103		53.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0060	0.09		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.4	58	0.0190	2.22		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	20	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.5	184	0.0155	5.65	4.44	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	93	0.0699	3.97		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
10.4	405	Total			

Subcatchment E-1: To Front Pond



Summary for Subcatchment E-2A: To Wetland C

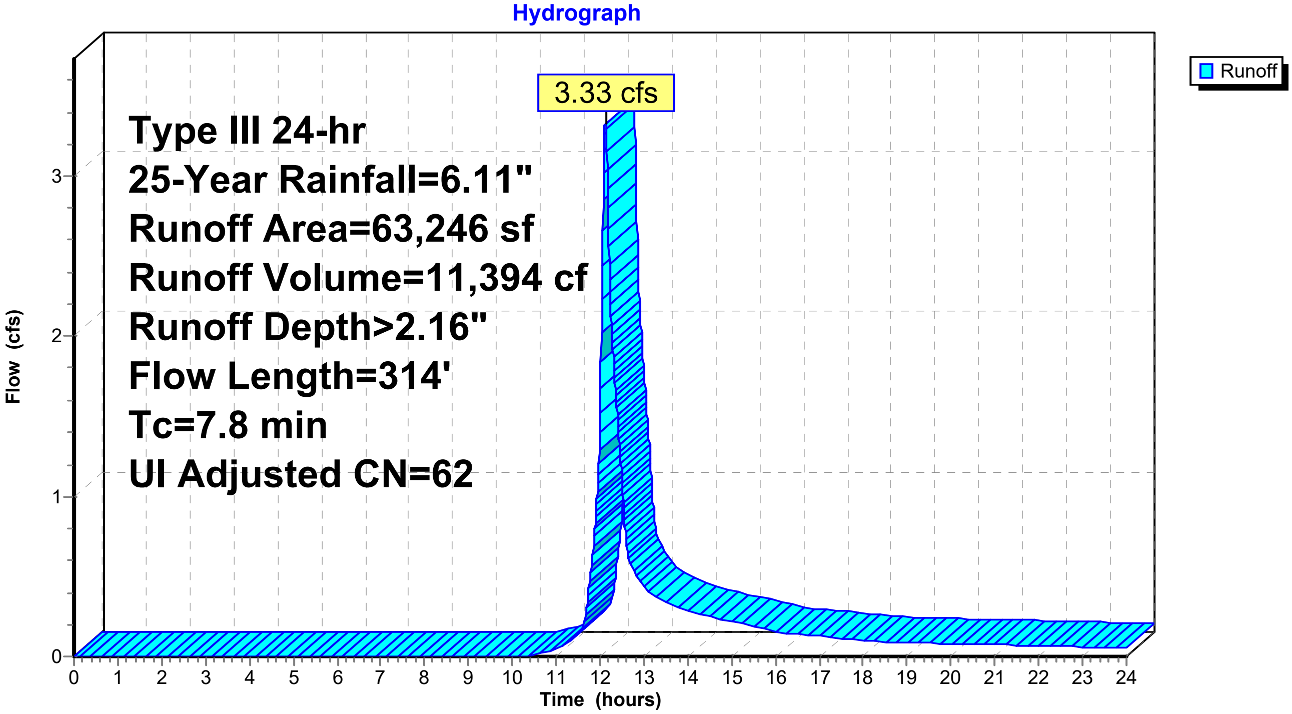
Runoff = 3.33 cfs @ 12.12 hrs, Volume= 11,394 cf, Depth> 2.16"
Routed to Pond 3P : Wetland C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

	Area (sf)	CN	Adj	Description
	13,064	55		Woods, Good, HSG B
	41,744	61		>75% Grass cover, Good, HSG B
	3,778	98		Unconnected pavement, HSG B
	579	98		Unconnected pavement, HSG B
*	4,081	77		Woods, Good, HSG D Wetlands
	63,246	63	62	Weighted Average, UI Adjusted
	58,889			93.11% Pervious Area
	4,357			6.89% Impervious Area
	4,357			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0160	0.14		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
1.7	264	0.0257	2.58		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
7.8	314	Total			

Subcatchment E-2A: To Wetland C



Summary for Subcatchment E-2B: To Wetland B

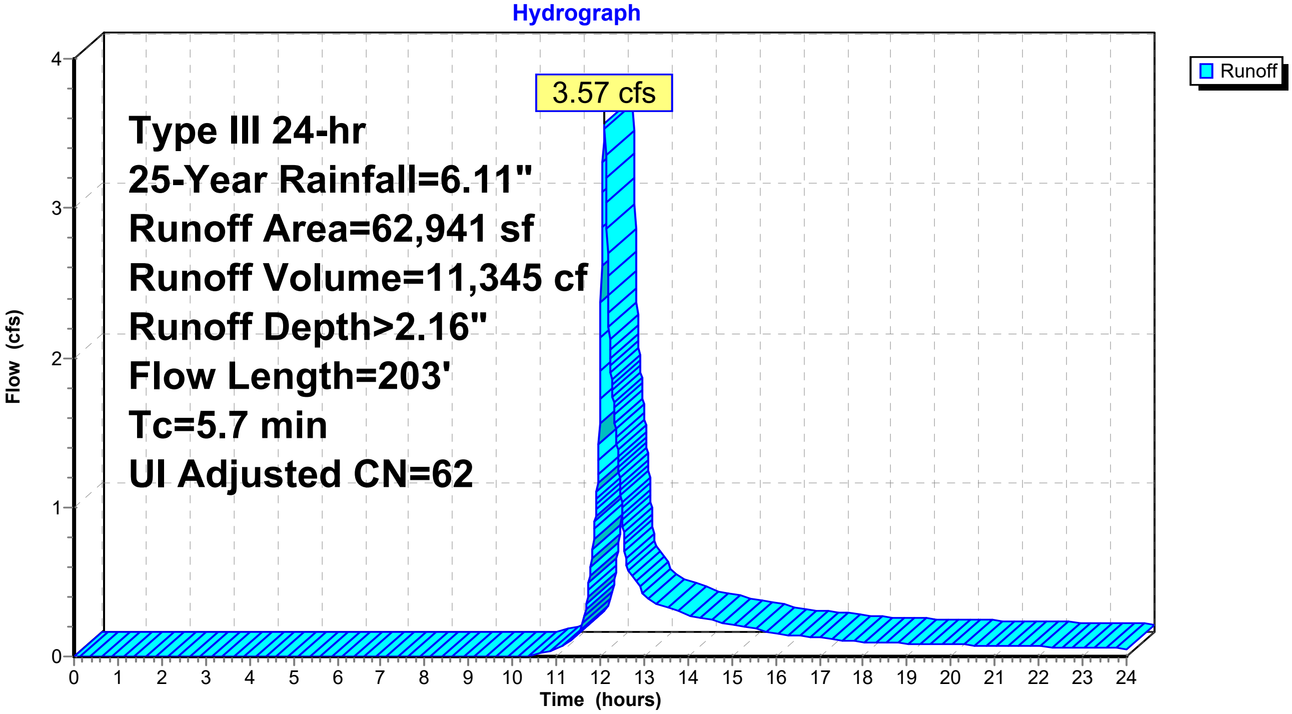
Runoff = 3.57 cfs @ 12.09 hrs, Volume= 11,345 cf, Depth> 2.16"
Routed to Pond 4P : Wetland B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

	Area (sf)	CN	Adj	Description
	13,824	55		Woods, Good, HSG B
	41,883	61		>75% Grass cover, Good, HSG B
	1,522	98		Unconnected pavement, HSG B
	2,541	98		Unconnected pavement, HSG B
*	3,171	80		>75% Grass cover, Good, HSG D Wetlands
	62,941	63	62	Weighted Average, UI Adjusted
	58,878			93.54% Pervious Area
	4,063			6.46% Impervious Area
	4,063			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0320	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
1.1	153	0.0196	2.25		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
5.7	203	Total			

Subcatchment E-2B: To Wetland B



Summary for Subcatchment E-3: To Great Brook

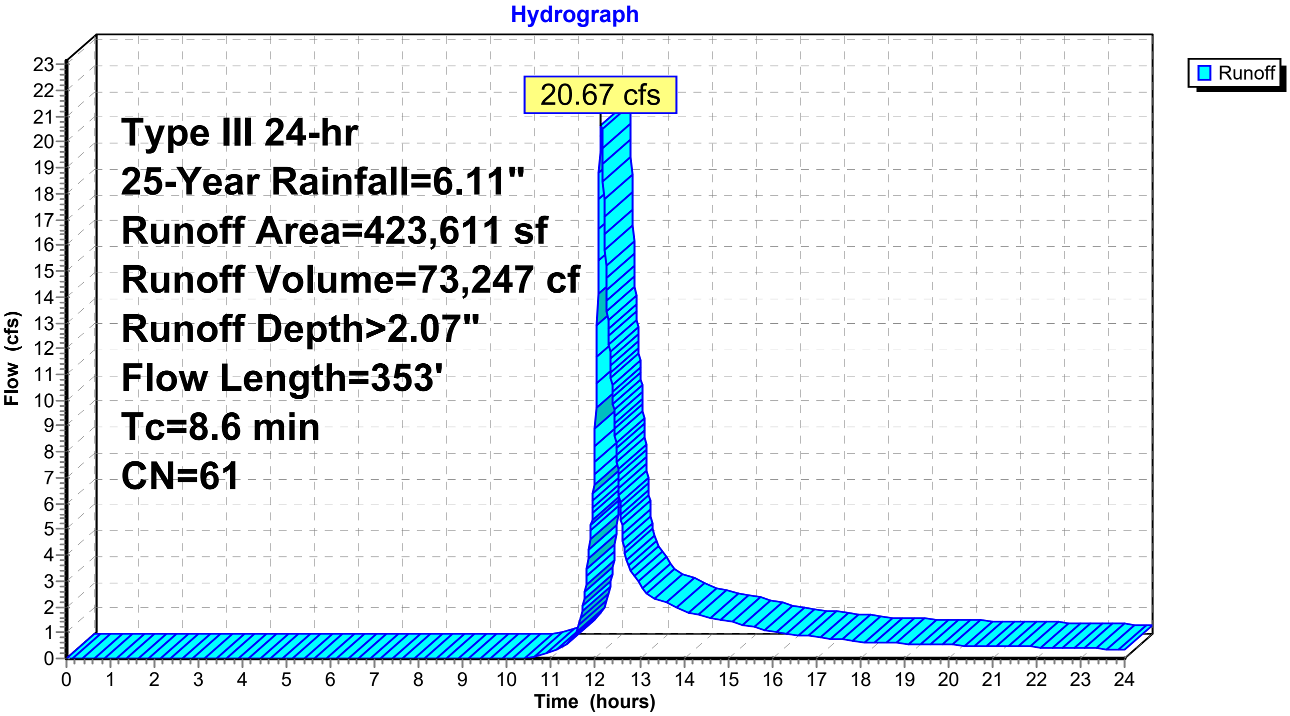
Runoff = 20.67 cfs @ 12.13 hrs, Volume= 73,247 cf, Depth> 2.07"
Routed to Link 2L : Great Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

Area (sf)	CN	Description
80,008	55	Woods, Good, HSG B
326,758	61	>75% Grass cover, Good, HSG B
9,139	96	Gravel surface, HSG B
7,562	98	Unconnected pavement, HSG B
144	98	Roofs, HSG B
423,611	61	Weighted Average
415,905		98.18% Pervious Area
7,706		1.82% Impervious Area
7,562		98.13% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.2	57	0.0789	4.52		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
2.8	246	0.0081	1.45		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.6	353	Total			

Subcatchment E-3: To Great Brook



Summary for Subcatchment E-4: To Rear Pond

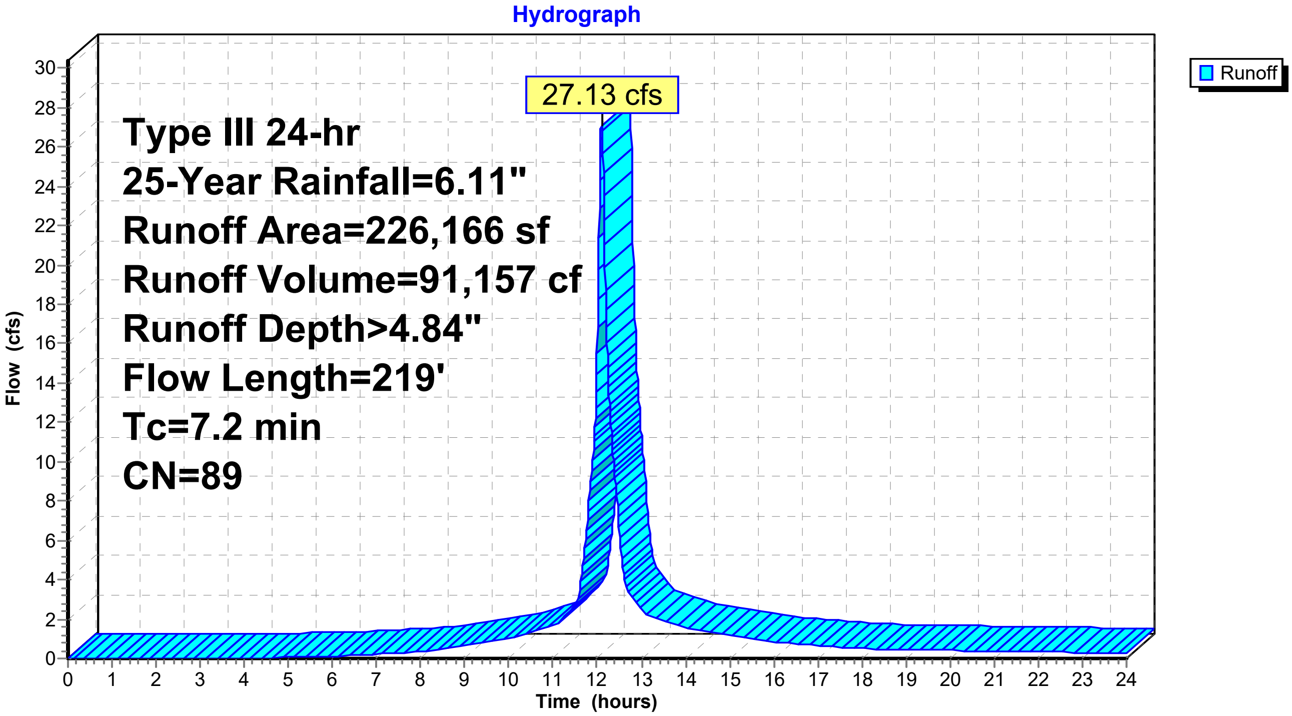
Runoff = 27.13 cfs @ 12.10 hrs, Volume= 91,157 cf, Depth> 4.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

Area (sf)	CN	Description
27,154	55	Woods, Good, HSG B
21,027	61	>75% Grass cover, Good, HSG B
127,097	98	Unconnected pavement, HSG B
50,888	98	Water Surface, HSG B
226,166	89	Weighted Average
48,181		21.30% Pervious Area
177,985		78.70% Impervious Area
127,097		71.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.0	20	0.2500	8.05		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
1.3	105	0.0067	1.32		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	44	0.0364	2.86		**Shallow Concentrated Flow, D-E** Grassed Waterway Kv= 15.0 fps
7.2	219	Total			

Subcatchment E-4: To Rear Pond



Summary for Pond 3P: Wetland C

Inflow Area = 63,246 sf, 6.89% Impervious, Inflow Depth > 2.16" for 25-Year event
Inflow = 3.33 cfs @ 12.12 hrs, Volume= 11,394 cf
Outflow = 0.53 cfs @ 12.78 hrs, Volume= 6,194 cf, Atten= 84%, Lag= 39.4 min
Primary = 0.53 cfs @ 12.78 hrs, Volume= 6,194 cf
Routed to Pond 4P : Wetland B

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 345.35' @ 12.78 hrs Surf.Area= 4,717 sf Storage= 5,375 cf

Plug-Flow detention time= 236.9 min calculated for 6,191 cf (54% of inflow)
Center-of-Mass det. time= 113.5 min (970.5 - 857.1)

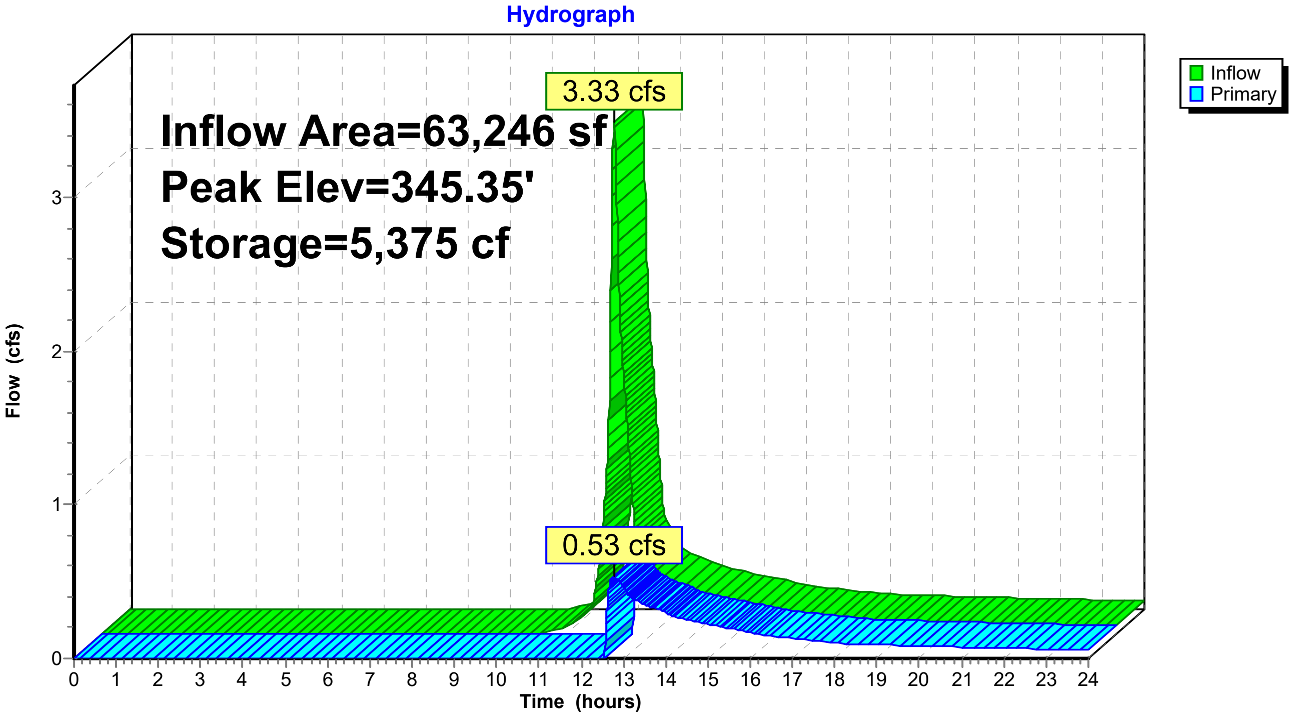
Volume	Invert	Avail.Storage	Storage Description
#1	343.00'	8,932 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
343.00	238	0	0
344.00	1,785	1,012	1,012
345.00	3,934	2,860	3,871
346.00	6,187	5,061	8,932

Device	Routing	Invert	Outlet Devices
#1	Primary	345.30'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.52 cfs @ 12.78 hrs HW=345.35' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.52 cfs @ 0.54 fps)

Pond 3P: Wetland C



Summary for Pond 4P: Wetland B

Inflow Area = 126,187 sf, 6.67% Impervious, Inflow Depth > 1.67" for 25-Year event
Inflow = 3.57 cfs @ 12.09 hrs, Volume= 17,539 cf
Outflow = 1.63 cfs @ 12.32 hrs, Volume= 16,718 cf, Atten= 54%, Lag= 13.7 min
Primary = 1.63 cfs @ 12.32 hrs, Volume= 16,718 cf
Routed to Link 2L : Great Brook

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 345.21' @ 12.32 hrs Surf.Area= 5,969 sf Storage= 2,709 cf

Plug-Flow detention time= 49.8 min calculated for 16,711 cf (95% of inflow)
Center-of-Mass det. time= 26.1 min (922.1 - 896.1)

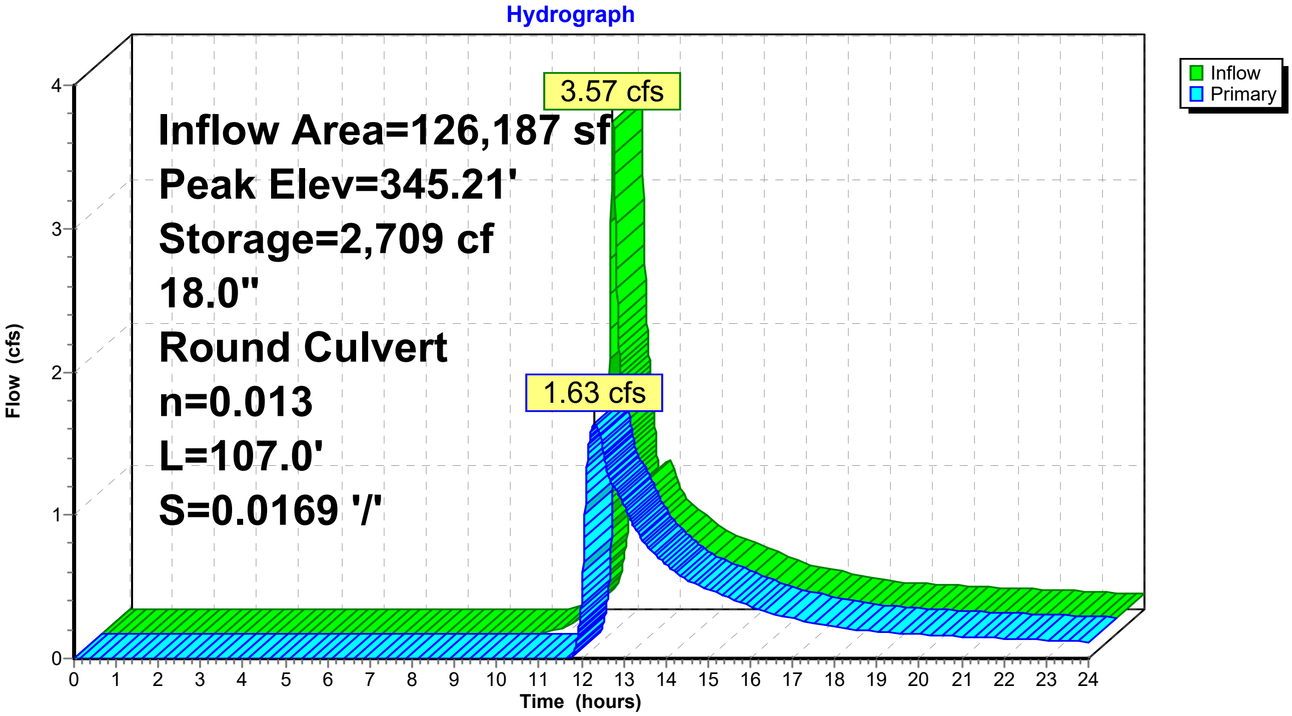
Volume	Invert	Avail.Storage	Storage Description
#1	344.25'	10,492 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
344.25	563	0	0
345.00	3,891	1,670	1,670
346.00	13,752	8,822	10,492

Device	Routing	Invert	Outlet Devices
#1	Primary	344.59'	**18.0" Round Culvert** L= 107.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 344.59' / 342.78' S= 0.0169 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=1.63 cfs @ 12.32 hrs HW=345.21' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.63 cfs @ 2.37 fps)

Pond 4P: Wetland B

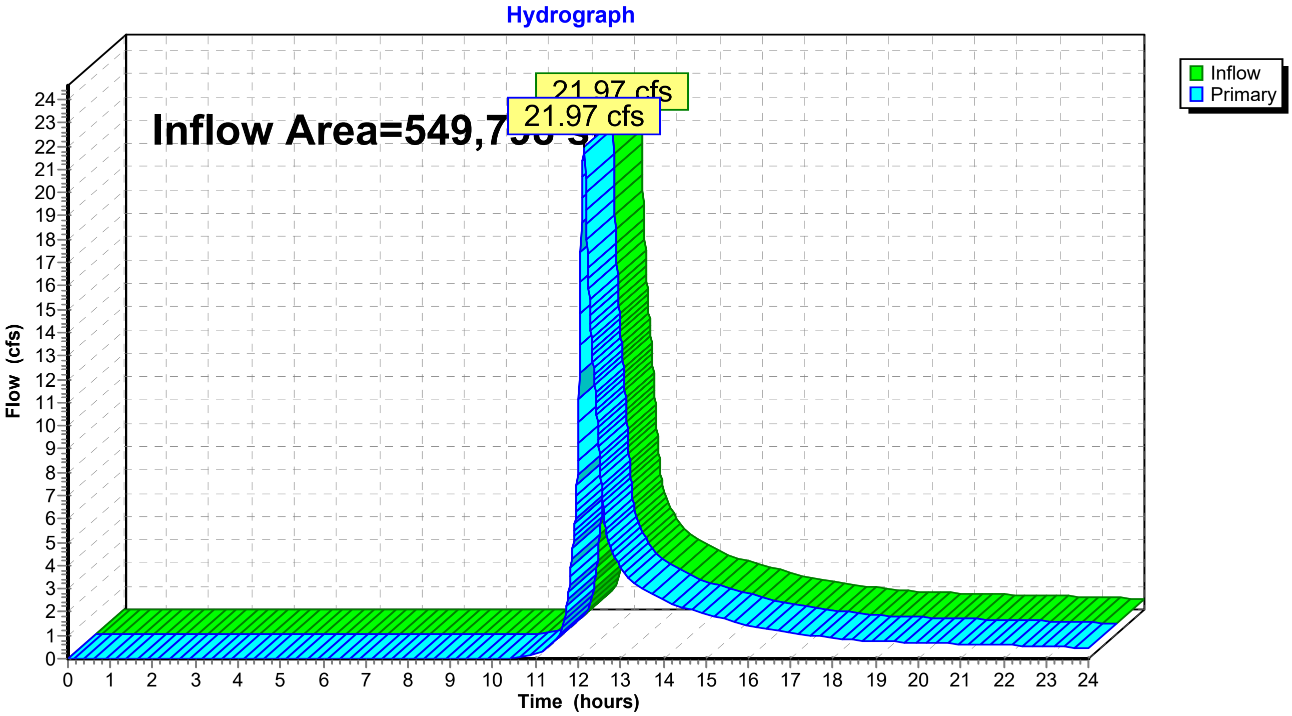


Summary for Link 2L: Great Brook

Inflow Area = 549,798 sf, 2.93% Impervious, Inflow Depth > 1.96" for 25-Year event
Inflow = 21.97 cfs @ 12.13 hrs, Volume= 89,965 cf
Primary = 21.97 cfs @ 12.13 hrs, Volume= 89,965 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Great Brook



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=345,377 sf 53.30% Impervious Runoff Depth>5.42"
Flow Length=405' Tc=10.4 min CN=80 Runoff=42.99 cfs 155,956 cf

Subcatchment E-2A: To Wetland C Runoff Area=63,246 sf 6.89% Impervious Runoff Depth>3.39"
Flow Length=314' Tc=7.8 min UI Adjusted CN=62 Runoff=5.36 cfs 17,860 cf

Subcatchment E-2B: To Wetland B Runoff Area=62,941 sf 6.46% Impervious Runoff Depth>3.39"
Flow Length=203' Tc=5.7 min UI Adjusted CN=62 Runoff=5.75 cfs 17,783 cf

Subcatchment E-3: To Great Brook Runoff Area=423,611 sf 1.82% Impervious Runoff Depth>3.28"
Flow Length=353' Tc=8.6 min CN=61 Runoff=33.72 cfs 115,749 cf

Subcatchment E-4: To Rear Pond Runoff Area=226,166 sf 78.70% Impervious Runoff Depth>6.47"
Flow Length=219' Tc=7.2 min CN=89 Runoff=35.73 cfs 122,015 cf

Pond 3P: Wetland C Peak Elev=345.45' Storage=5,885 cf Inflow=5.36 cfs 17,860 cf
Outflow=2.99 cfs 12,651 cf

Pond 4P: Wetland B Peak Elev=345.59' Storage=5,705 cf Inflow=5.78 cfs 30,433 cf
18.0" Round Culvert n=0.013 L=107.0' S=0.0169 '/' Outflow=3.77 cfs 29,529 cf

Link 2L: Great Brook Inflow=36.04 cfs 145,278 cf
Primary=36.04 cfs 145,278 cf

Total Runoff Area = 1,121,341 sf Runoff Volume = 429,363 cf Average Runoff Depth = 4.59"
66.27% Pervious = 743,127 sf 33.73% Impervious = 378,214 sf

Summary for Subcatchment E-1: To Front Pond

[47] Hint: Peak is 969% of capacity of segment #4

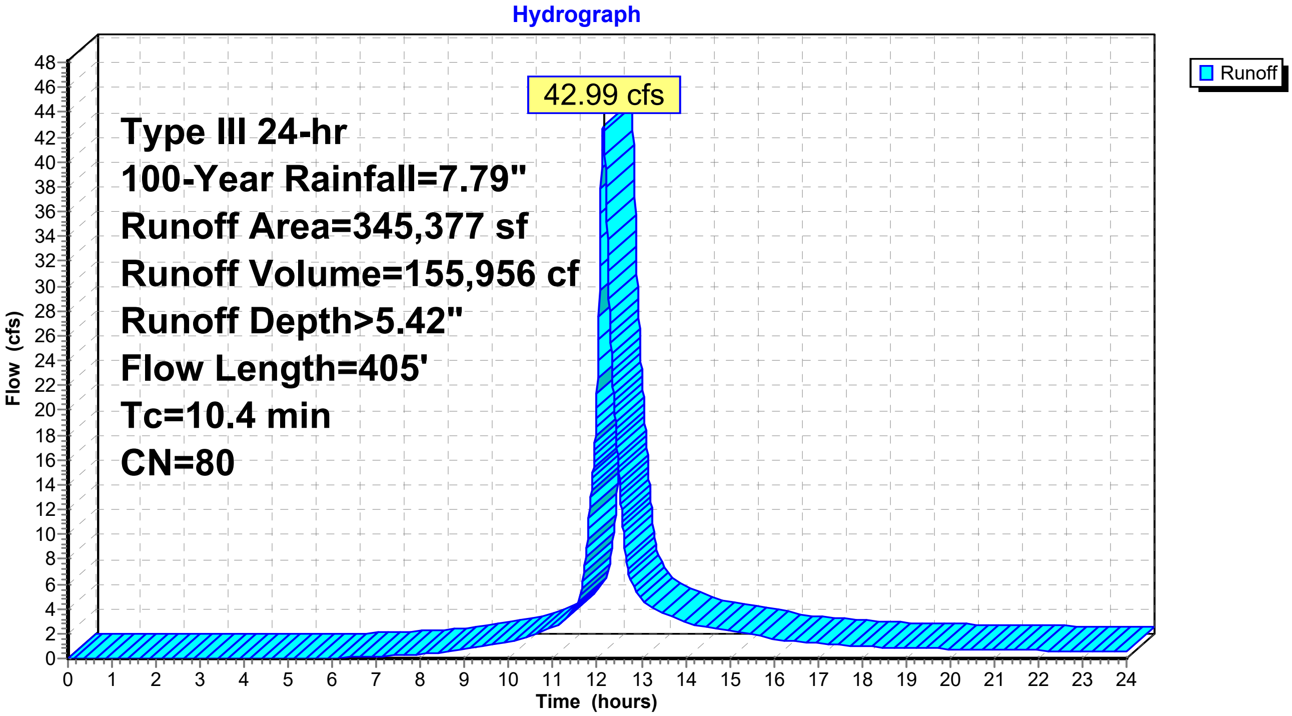
Runoff = 42.99 cfs @ 12.14 hrs, Volume= 155,956 cf, Depth> 5.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

Area (sf)	CN	Description
22,632	55	Woods, Good, HSG B
138,642	61	>75% Grass cover, Good, HSG B
83,392	98	Paved parking, HSG B
48,095	98	Roofs, HSG B
52,616	98	Water Surface, HSG B
345,377	80	Weighted Average
161,274		46.70% Pervious Area
184,103		53.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0060	0.09		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.4	58	0.0190	2.22		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	20	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.5	184	0.0155	5.65	4.44	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	93	0.0699	3.97		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
10.4	405	Total			

Subcatchment E-1: To Front Pond



Summary for Subcatchment E-2A: To Wetland C

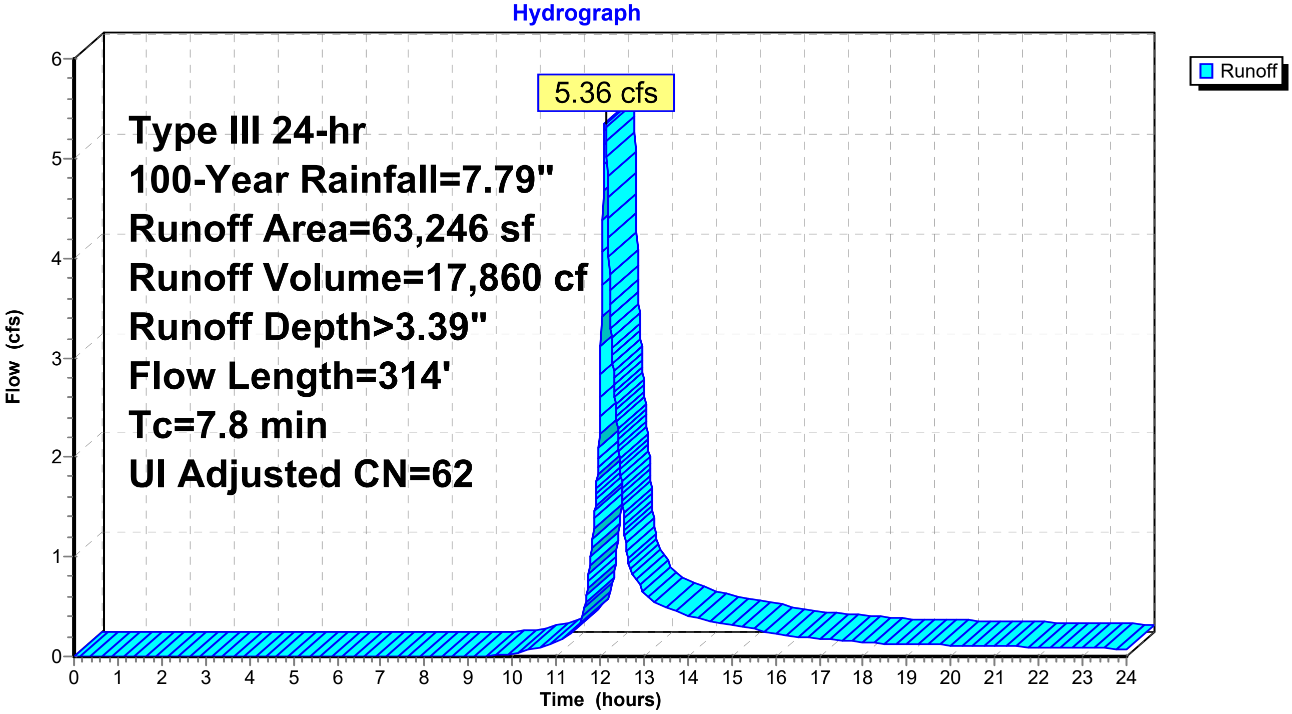
Runoff = 5.36 cfs @ 12.12 hrs, Volume= 17,860 cf, Depth> 3.39"
Routed to Pond 3P : Wetland C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

	Area (sf)	CN	Adj	Description
	13,064	55		Woods, Good, HSG B
	41,744	61		>75% Grass cover, Good, HSG B
	3,778	98		Unconnected pavement, HSG B
	579	98		Unconnected pavement, HSG B
*	4,081	77		Woods, Good, HSG D Wetlands
	63,246	63	62	Weighted Average, UI Adjusted
	58,889			93.11% Pervious Area
	4,357			6.89% Impervious Area
	4,357			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0160	0.14		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
1.7	264	0.0257	2.58		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
7.8	314	Total			

Subcatchment E-2A: To Wetland C



Summary for Subcatchment E-2B: To Wetland B

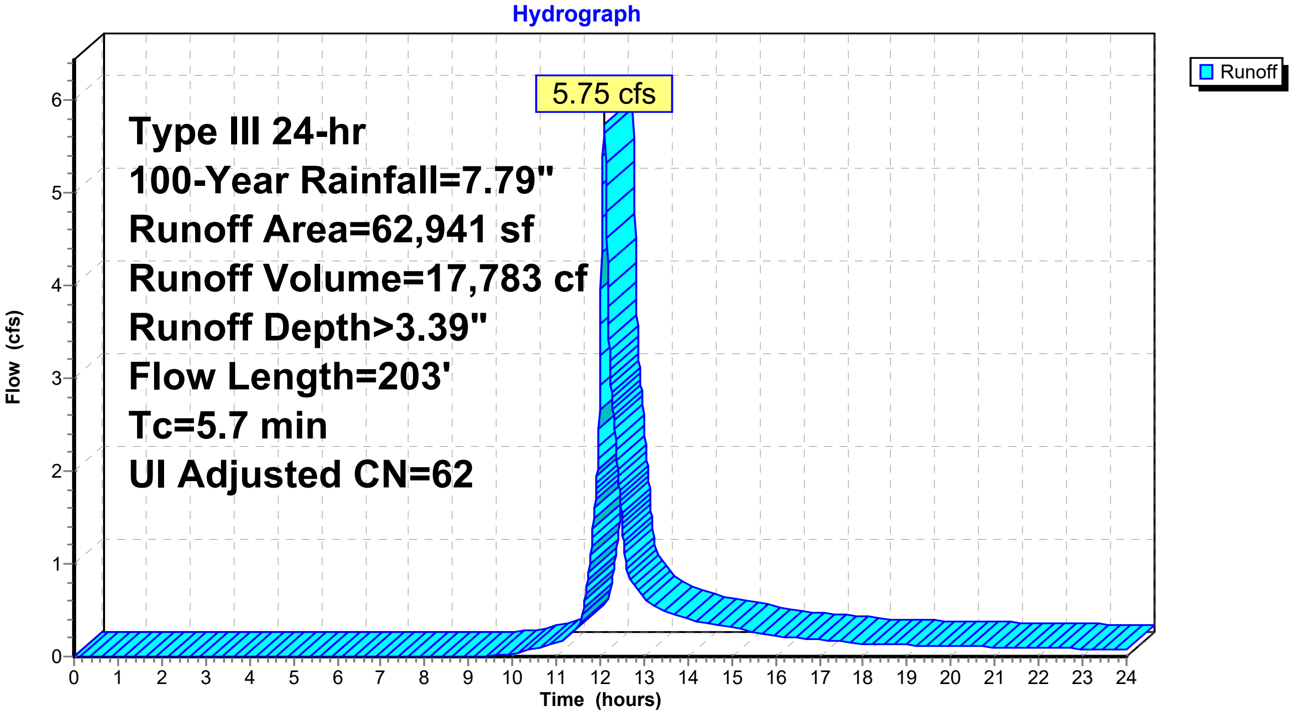
Runoff = 5.75 cfs @ 12.09 hrs, Volume= 17,783 cf, Depth> 3.39"
Routed to Pond 4P : Wetland B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

	Area (sf)	CN	Adj	Description
	13,824	55		Woods, Good, HSG B
	41,883	61		>75% Grass cover, Good, HSG B
	1,522	98		Unconnected pavement, HSG B
	2,541	98		Unconnected pavement, HSG B
*	3,171	80		>75% Grass cover, Good, HSG D Wetlands
	62,941	63	62	Weighted Average, UI Adjusted
	58,878			93.54% Pervious Area
	4,063			6.46% Impervious Area
	4,063			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0320	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
1.1	153	0.0196	2.25		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
5.7	203	Total			

Subcatchment E-2B: To Wetland B



Summary for Subcatchment E-3: To Great Brook

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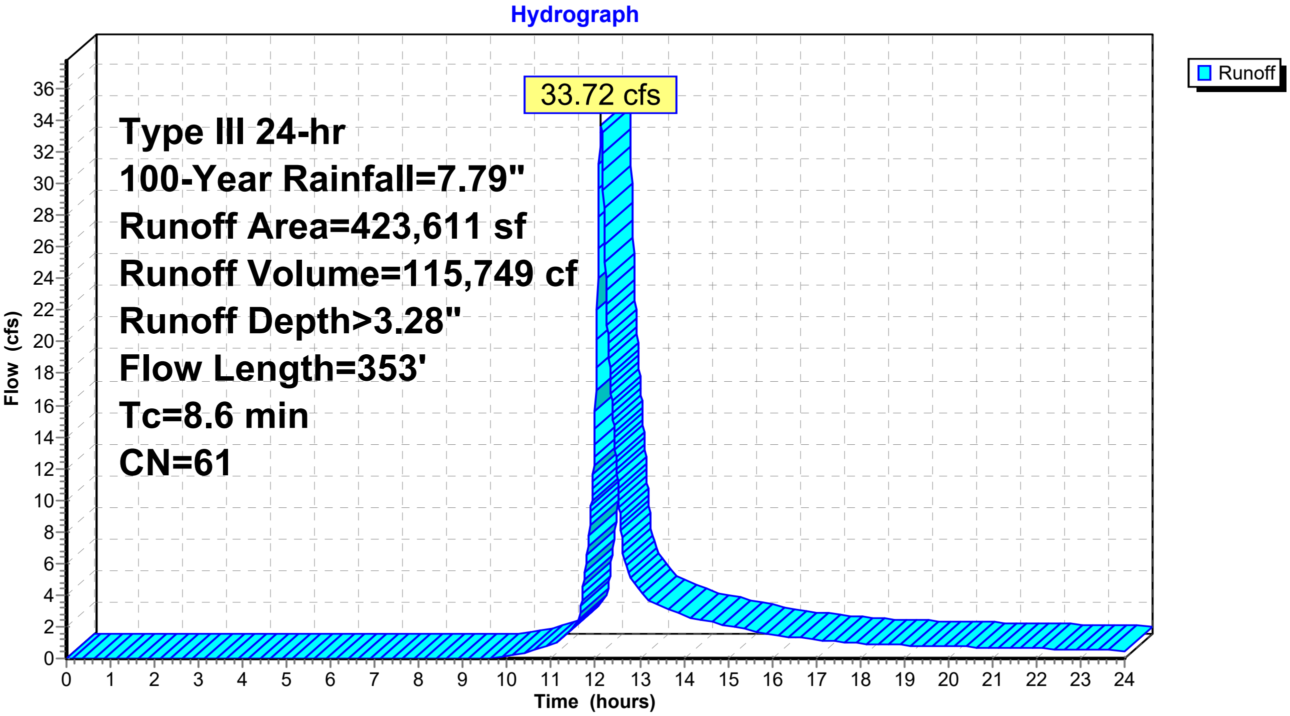
Runoff      =        33.72 cfs @   12.13 hrs,  Volume=           115,749 cf,  Depth>  3.28"
    Routed to Link 2L : Great Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr  100-Year Rainfall=7.79"

      Area (sf)   CN   Description
-----------------------------------------------------------------------
         80,008   55   Woods, Good, HSG B
        326,758   61   >75% Grass cover, Good, HSG B
          9,139   96   Gravel surface, HSG B
          7,562   98   Unconnected pavement, HSG B
            144   98   Roofs, HSG B
-----------------------------------------------------------------------
        423,611   61   Weighted Average
        415,905        98.18% Pervious Area
          7,706        1.82% Impervious Area
          7,562        98.13% Unconnected

     Tc  Length   Slope  Velocity  Capacity  Description
  (min)  (feet)  (ft/ft)  (ft/sec)     (cfs)
-----------------------------------------------------------------------
    5.6      50  0.0200      0.15            Sheet Flow, A-B
                                             Grass: Short   n= 0.150   P2= 3.27"
    0.2      57  0.0789      4.52            Shallow Concentrated Flow, B-C
                                             Unpaved   Kv= 16.1 fps
    2.8     246  0.0081      1.45            Shallow Concentrated Flow, C-D
                                             Unpaved   Kv= 16.1 fps
-----------------------------------------------------------------------
    8.6     353  Total
```

Subcatchment E-3: To Great Brook



Summary for Subcatchment E-4: To Rear Pond

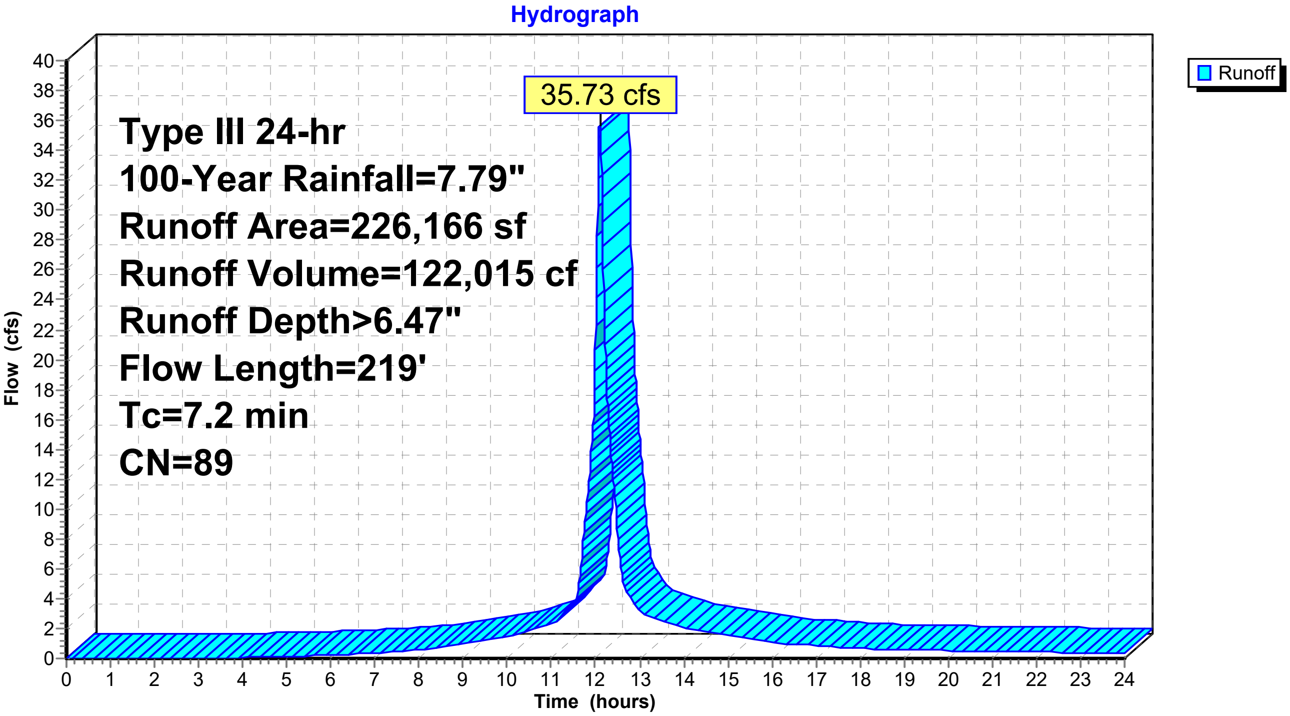
Runoff = 35.73 cfs @ 12.10 hrs, Volume= 122,015 cf, Depth> 6.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

Area (sf)	CN	Description
27,154	55	Woods, Good, HSG B
21,027	61	>75% Grass cover, Good, HSG B
127,097	98	Unconnected pavement, HSG B
50,888	98	Water Surface, HSG B
226,166	89	Weighted Average
48,181		21.30% Pervious Area
177,985		78.70% Impervious Area
127,097		71.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.0	20	0.2500	8.05		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
1.3	105	0.0067	1.32		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	44	0.0364	2.86		**Shallow Concentrated Flow, D-E** Grassed Waterway Kv= 15.0 fps
7.2	219	Total			

Subcatchment E-4: To Rear Pond



Summary for Pond 3P: Wetland C

Inflow Area = 63,246 sf, 6.89% Impervious, Inflow Depth > 3.39" for 100-Year event
Inflow = 5.36 cfs @ 12.12 hrs, Volume= 17,860 cf
Outflow = 2.99 cfs @ 12.28 hrs, Volume= 12,651 cf, Atten= 44%, Lag= 10.2 min
Primary = 2.99 cfs @ 12.28 hrs, Volume= 12,651 cf
Routed to Pond 4P : Wetland B

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 345.45' @ 12.28 hrs Surf.Area= 4,955 sf Storage= 5,885 cf

Plug-Flow detention time= 156.7 min calculated for 12,651 cf (71% of inflow)
Center-of-Mass det. time= 59.0 min (902.7 - 843.7)

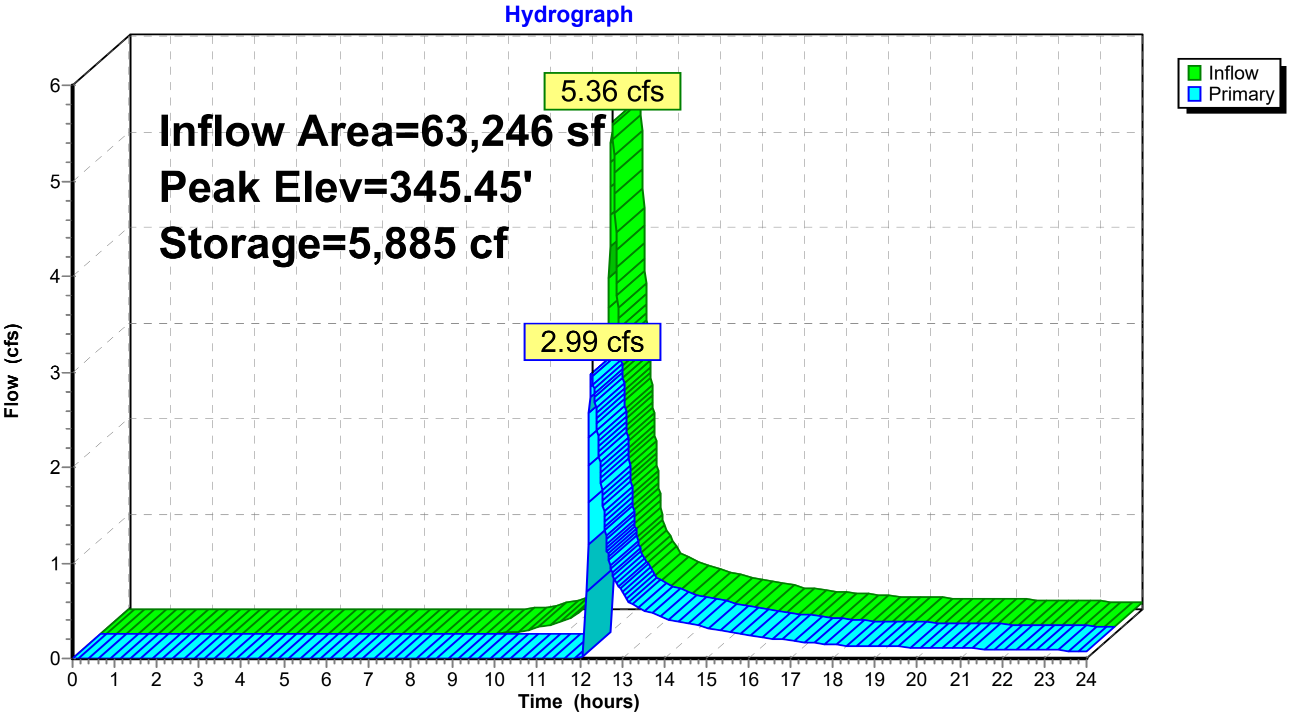
Volume	Invert	Avail.Storage	Storage Description
#1	343.00'	8,932 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
343.00	238	0	0
344.00	1,785	1,012	1,012
345.00	3,934	2,860	3,871
346.00	6,187	5,061	8,932

Device	Routing	Invert	Outlet Devices
#1	Primary	345.30'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.98 cfs @ 12.28 hrs HW=345.45' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 2.98 cfs @ 0.97 fps)

Pond 3P: Wetland C



Summary for Pond 4P: Wetland B

```
[81] Warning: Exceeded Pond 3P by 0.24' @ 12.11 hrs

Inflow Area =        126,187 sf,   6.67% Impervious,  Inflow Depth >   2.89"   for  100-Year event
Inflow      =         5.78 cfs @  12.26 hrs,  Volume=          30,433 cf
Outflow     =         3.77 cfs @  12.47 hrs,  Volume=          29,529 cf,  Atten= 35%,  Lag= 12.6 min
Primary     =         3.77 cfs @  12.47 hrs,  Volume=          29,529 cf
    Routed to Link 2L : Great Brook

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 345.59' @ 12.47 hrs   Surf.Area= 9,732 sf   Storage= 5,705 cf

Plug-Flow detention time= 38.8 min calculated for 29,517 cf (97% of inflow)
Center-of-Mass det. time= 22.8 min ( 890.0 - 867.3 )

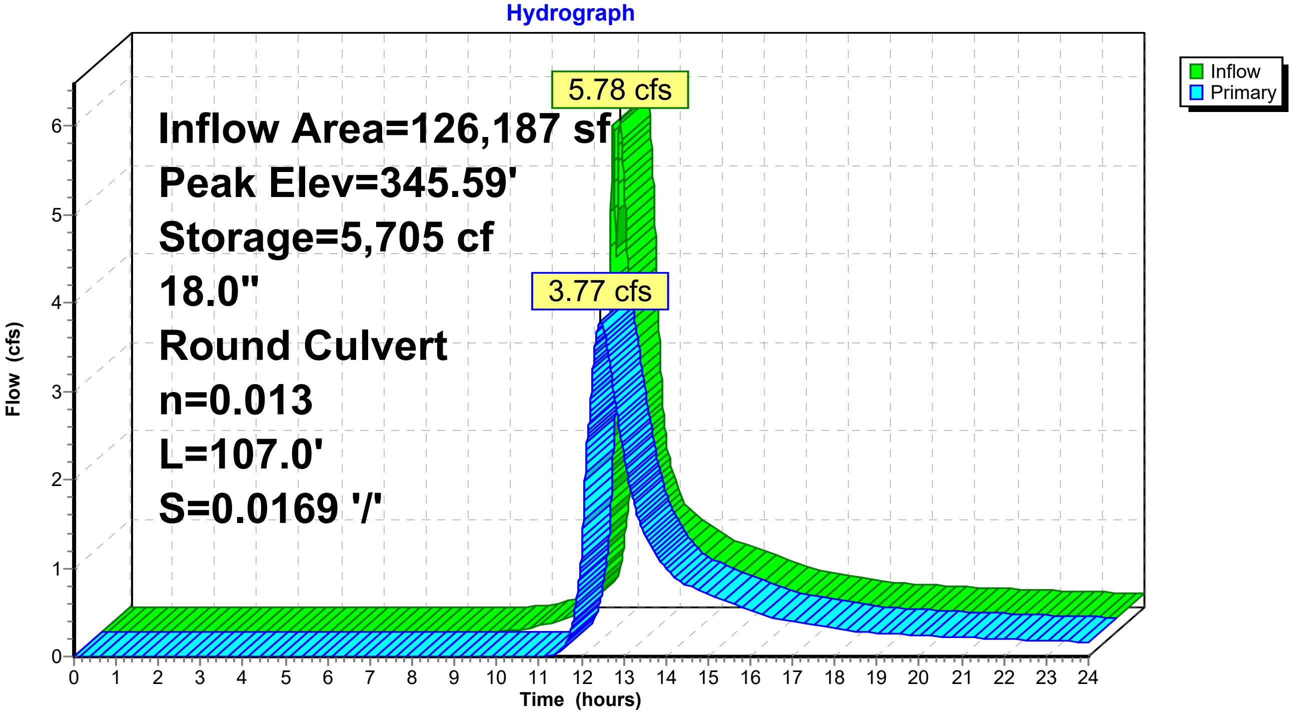
Volume        Invert     Avail.Storage   Storage Description
   #1        344.25'         10,492 cf   Custom Stage Data (Prismatic)Listed below (Recalc)

 Elevation          Surf.Area          Inc.Store          Cum.Store
    (feet)            (sq-ft)       (cubic-feet)       (cubic-feet)
    344.25                563                  0                  0
    345.00              3,891              1,670              1,670
    346.00             13,752              8,822             10,492

Device   Routing          Invert   Outlet Devices
   #1    Primary         344.59'   18.0"  Round Culvert
                                   L= 107.0'   RCP, mitered to conform to fill,  Ke= 0.700
                                   Inlet / Outlet Invert= 344.59' / 342.78'   S= 0.0169 '/'   Cc= 0.900
                                   n= 0.013,  Flow Area= 1.77 sf

Primary OutFlow  Max=3.77 cfs @ 12.47 hrs  HW=345.59'   (Free Discharge)
└─1=Culvert  (Inlet Controls 3.77 cfs @ 3.01 fps)
```

Pond 4P: Wetland B

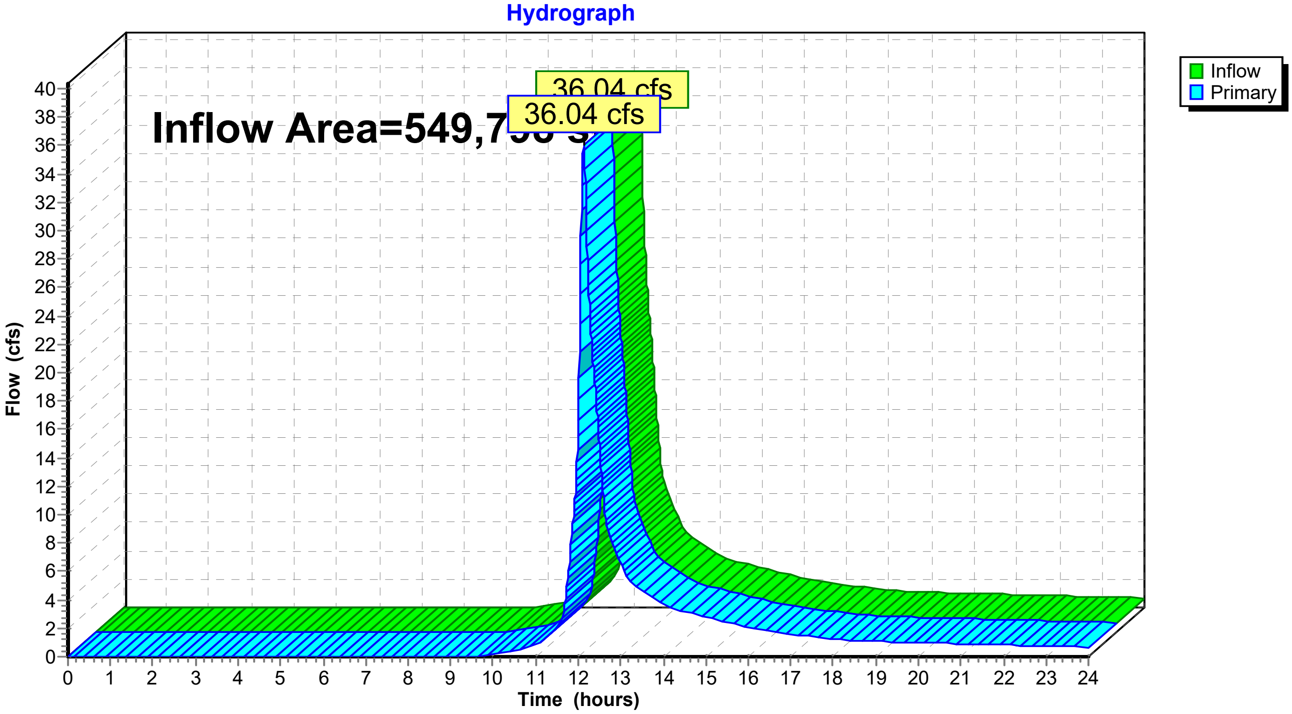


Summary for Link 2L: Great Brook

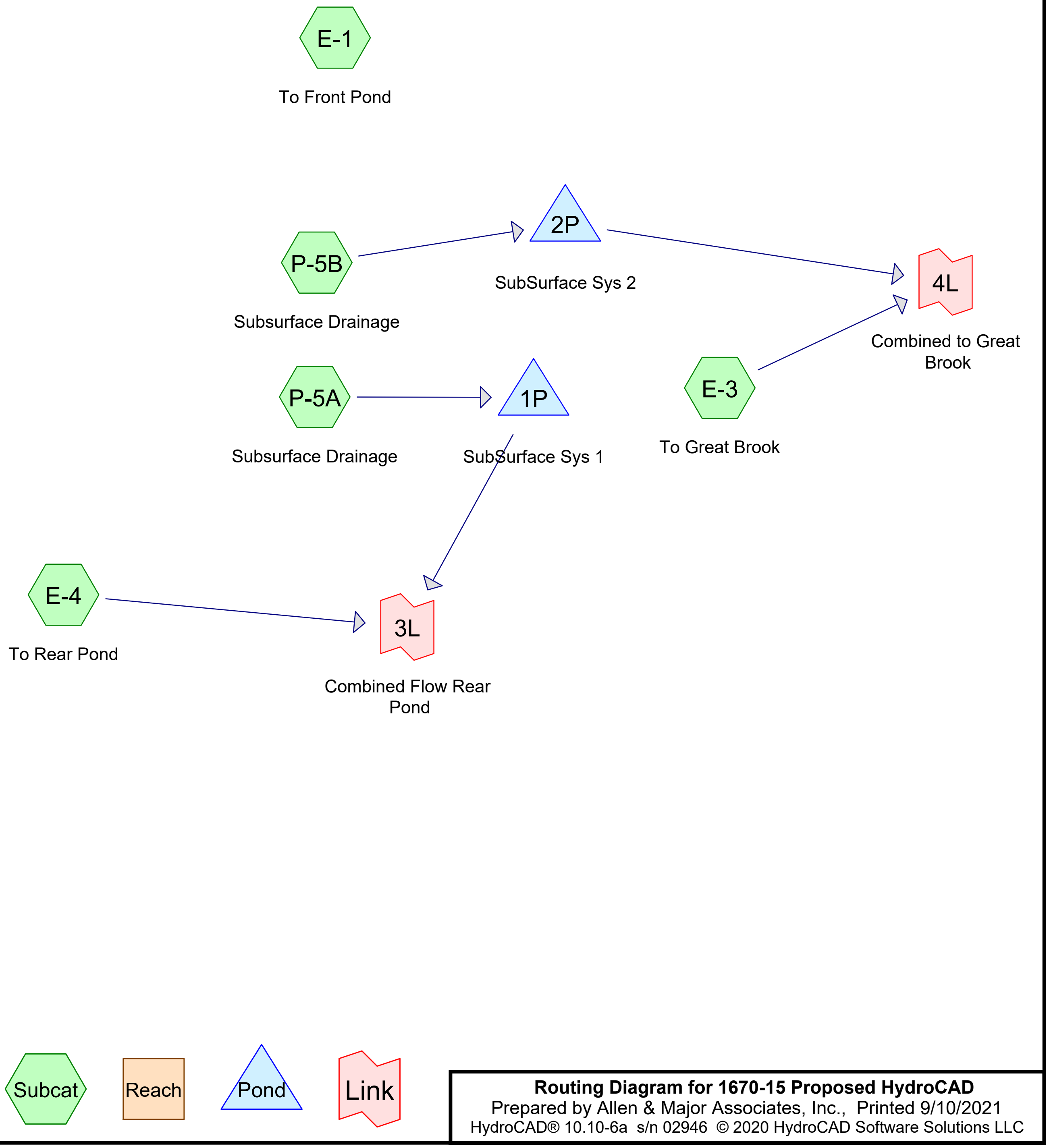
Inflow Area = 549,798 sf, 2.93% Impervious, Inflow Depth > 3.17" for 100-Year event
Inflow = 36.04 cfs @ 12.13 hrs, Volume= 145,278 cf
Primary = 36.04 cfs @ 12.13 hrs, Volume= 145,278 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Great Brook



POST-DEVELOPMENT



Routing Diagram for 1670-15 Proposed HydroCAD
Prepared by Allen & Major Associates, Inc., Printed 9/10/2021
HydroCAD® 10.10-6a s/n 02946 © 2020 HydroCAD Software Solutions LLC

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 4092 MA Essex Essex County
Rainfall events imported from "NRCS-Rain.txt" for 4165 MA Manchester Essex County

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.27	2
2	10-Year	Type III 24-hr		Default	24.00	1	5.02	2
3	25-Year	Type III 24-hr		Default	24.00	1	6.11	2
4	100-Year	Type III 24-hr		Default	24.00	1	7.79	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
527,853	61	>75% Grass cover, Good, HSG B (E-1, E-3, E-4, P-5A, P-5B)
7,327	96	Gravel surface, HSG B (E-3)
237,425	98	Paved parking, HSG B (E-1, P-5A, P-5B)
131,980	98	Roofs, HSG B (E-1, E-3, P-5A, P-5B)
8,687	98	Unconnected pavement, HSG B (E-3)
103,504	98	Water Surface, HSG B (E-1, E-4)
102,662	55	Woods, Good, HSG B (E-1, E-3, E-4)
1,119,438	**77**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
1,119,438	HSG B	E-1, E-3, E-4, P-5A, P-5B
0	HSG C	
0	HSG D	
0	Other	
1,119,438		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	527,853	0	0	0	527,853	>75% Grass cover, Good	
0	7,327	0	0	0	7,327	Gravel surface	
0	237,425	0	0	0	237,425	Paved parking	
0	131,980	0	0	0	131,980	Roofs	
0	8,687	0	0	0	8,687	Unconnected pavement	
0	103,504	0	0	0	103,504	Water Surface	
0	102,662	0	0	0	102,662	Woods, Good	
0	**1,119,438**	**0**	**0**	**0**	**1,119,438**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	E-1	0.00	0.00	184.0	0.0155	0.013	0.0	12.0	0.0
2	1P	346.75	346.25	50.0	0.0100	0.012	0.0	18.0	0.0
3	2P	338.90	338.40	50.0	0.0100	0.012	0.0	18.0	0.0

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=312,214 sf 53.40% Impervious Runoff Depth>1.45"
Flow Length=405' Tc=10.4 min CN=80 Runoff=10.44 cfs 37,793 cf

Subcatchment E-3: To Great Brook Runoff Area=339,925 sf 2.91% Impervious Runoff Depth>0.47"
Flow Length=420' Tc=6.0 min UI Adjusted CN=61 Runoff=2.81 cfs 13,367 cf

Subcatchment E-4: To Rear Pond Runoff Area=121,952 sf 41.73% Impervious Runoff Depth>1.14"
Flow Length=197' Tc=6.3 min CN=75 Runoff=3.56 cfs 11,584 cf

Subcatchment P-5A: Subsurface Drainage Runoff Area=137,534 sf 78.66% Impervious Runoff Depth>2.23"
Tc=6.0 min CN=90 Runoff=8.17 cfs 25,573 cf

Subcatchment P-5B: Subsurface Drainage Runoff Area=207,813 sf 70.21% Impervious Runoff Depth>1.97"
Tc=6.0 min CN=87 Runoff=11.04 cfs 34,198 cf

Pond 1P: SubSurface Sys 1 Peak Elev=348.03' Storage=11,079 cf Inflow=8.17 cfs 25,573 cf
Discarded=0.50 cfs 24,914 cf Primary=0.14 cfs 637 cf Outflow=0.65 cfs 25,551 cf

Pond 2P: SubSurface Sys 2 Peak Elev=339.48' Storage=8,304 cf Inflow=11.04 cfs 34,198 cf
Discarded=2.31 cfs 34,005 cf Primary=0.19 cfs 184 cf Outflow=2.50 cfs 34,189 cf

Link 3L: Combined Flow Rear Pond Inflow=3.56 cfs 12,221 cf
Primary=3.56 cfs 12,221 cf

Link 4L: Combined to Great Brook Inflow=2.81 cfs 13,552 cf
Primary=2.81 cfs 13,552 cf

Total Runoff Area = 1,119,438 sf Runoff Volume = 122,514 cf Average Runoff Depth = 1.31"
56.98% Pervious = 637,842 sf 43.02% Impervious = 481,596 sf

Summary for Subcatchment E-1: To Front Pond

[47] Hint: Peak is 235% of capacity of segment #4

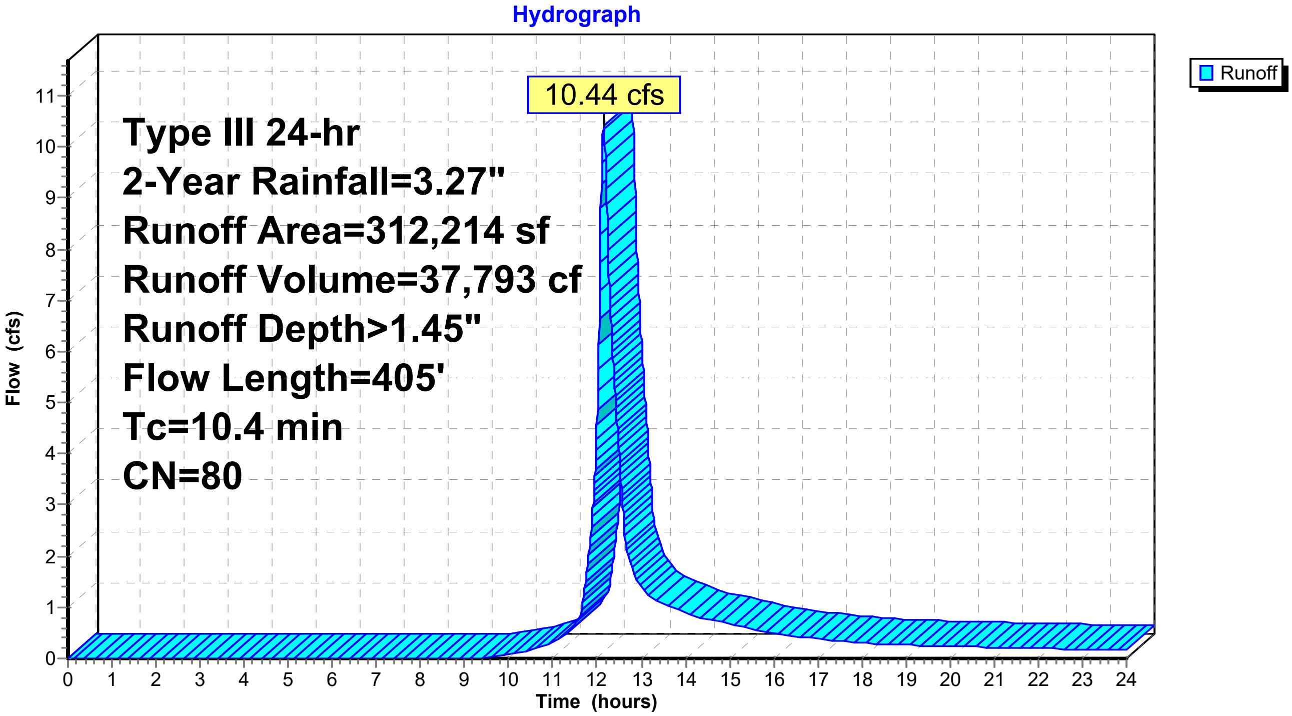
Runoff = 10.44 cfs @ 12.15 hrs, Volume= 37,793 cf, Depth> 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

Area (sf)	CN	Description
22,632	55	Woods, Good, HSG B
122,869	61	>75% Grass cover, Good, HSG B
80,603	98	Paved parking, HSG B
33,494	98	Roofs, HSG B
52,616	98	Water Surface, HSG B
312,214	80	Weighted Average
145,501		46.60% Pervious Area
166,713		53.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0060	0.09		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.4	58	0.0190	2.22		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	20	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.5	184	0.0155	5.65	4.44	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	93	0.0699	3.97		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
10.4	405	Total			

Subcatchment E-1: To Front Pond



Summary for Subcatchment E-3: To Great Brook

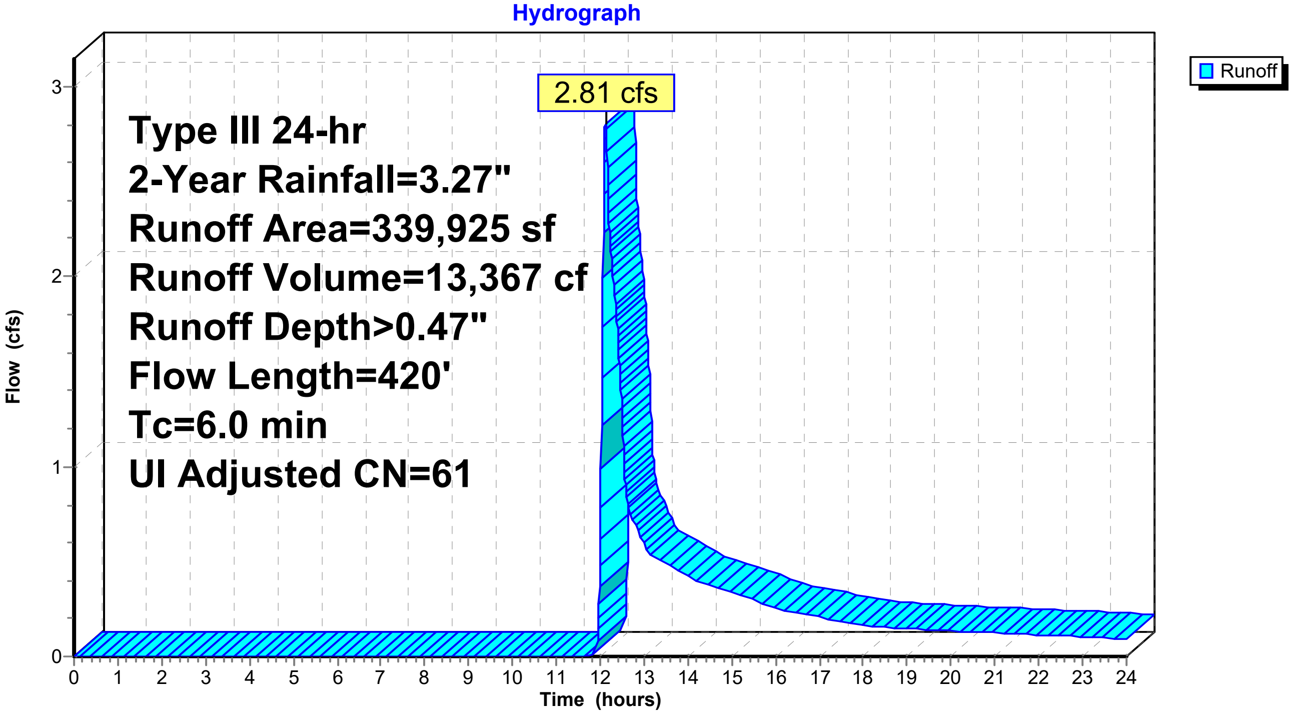
Runoff = 2.81 cfs @ 12.12 hrs, Volume= 13,367 cf, Depth> 0.47"
Routed to Link 4L : Combined to Great Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

Area (sf)	CN	Adj	Description
59,070	55		Woods, Good, HSG B
263,621	61		>75% Grass cover, Good, HSG B
7,327	96		Gravel surface, HSG B
8,687	98		Unconnected pavement, HSG B
1,220	98		Roofs, HSG B
339,925	62	61	Weighted Average, UI Adjusted
330,018			97.09% Pervious Area
9,907			2.91% Impervious Area
8,687			87.69% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
2.4	370	0.0250	2.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.0	420	Total			

Subcatchment E-3: To Great Brook



Summary for Subcatchment E-4: To Rear Pond

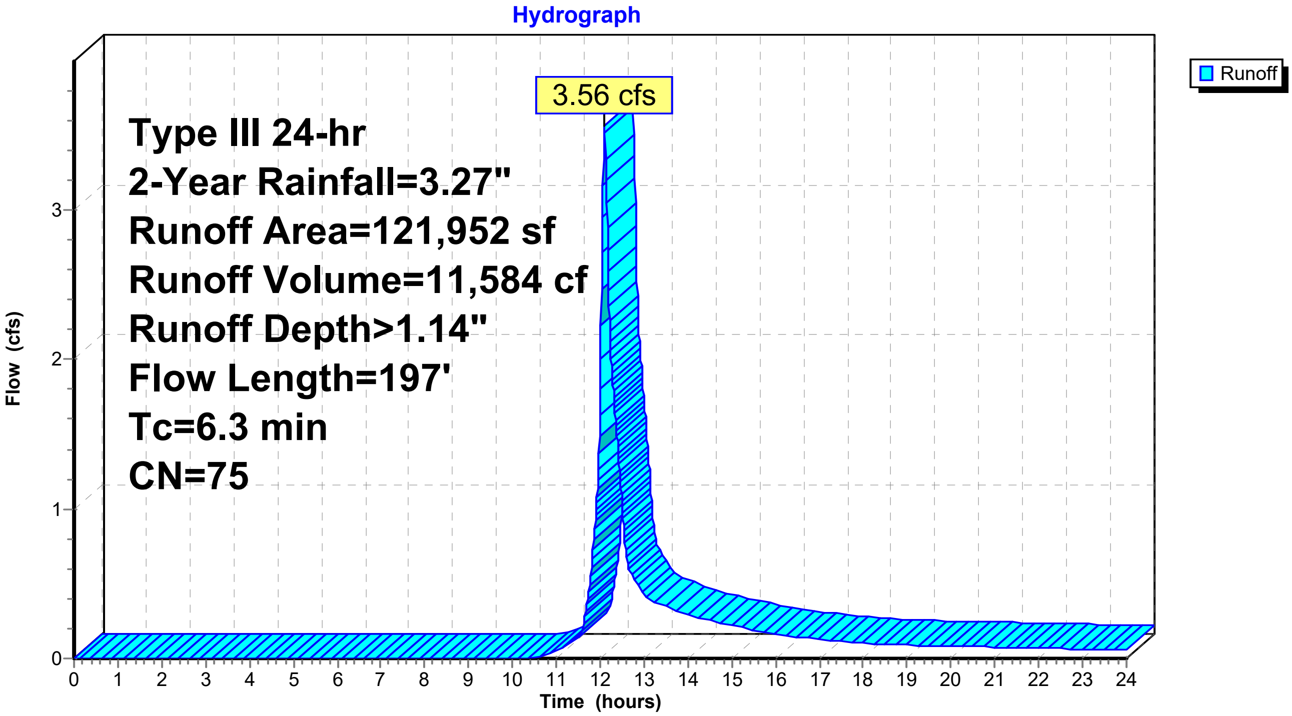
Runoff = 3.56 cfs @ 12.10 hrs, Volume= 11,584 cf, Depth> 1.14"
Routed to Link 3L : Combined Flow Rear Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

Area (sf)	CN	Description
20,960	55	Woods, Good, HSG B
50,104	61	>75% Grass cover, Good, HSG B
50,888	98	Water Surface, HSG B
121,952	75	Weighted Average
71,064		58.27% Pervious Area
50,888		41.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.7	147	0.0500	3.60		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.3	197	Total			

Subcatchment E-4: To Rear Pond



Summary for Subcatchment P-5A: Subsurface Drainage

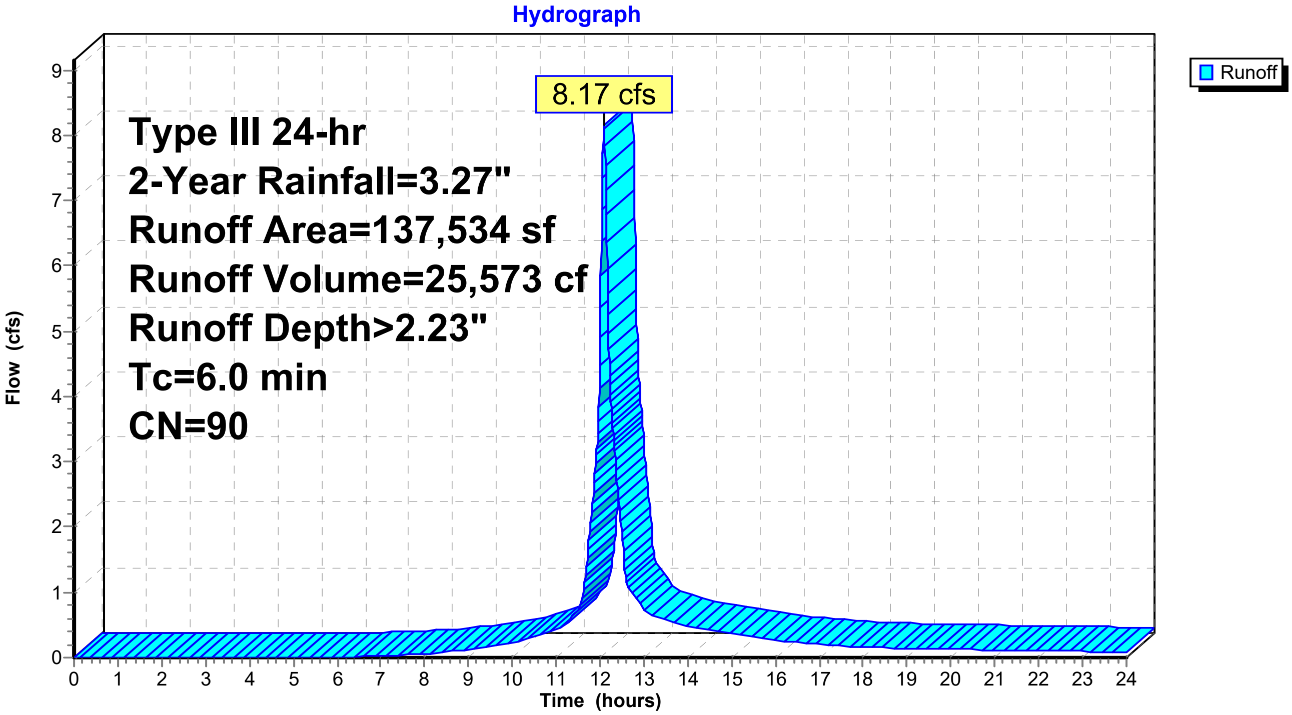
Runoff = 8.17 cfs @ 12.09 hrs, Volume= 25,573 cf, Depth> 2.23"
Routed to Pond 1P : SubSurface Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

Area (sf)	CN	Description
29,348	61	>75% Grass cover, Good, HSG B
34,413	98	Roofs, HSG B
73,773	98	Paved parking, HSG B
137,534	90	Weighted Average
29,348		21.34% Pervious Area
108,186		78.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5A: Subsurface Drainage



Summary for Subcatchment P-5B: Subsurface Drainage

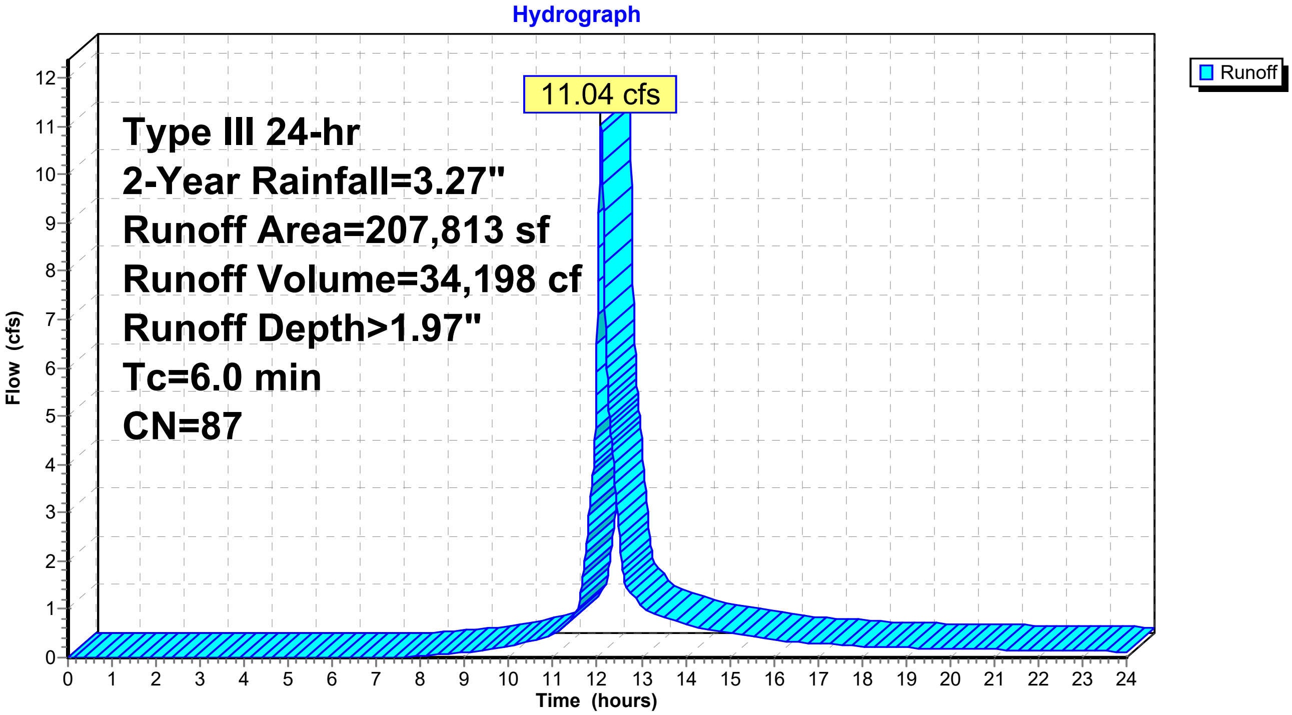
Runoff = 11.04 cfs @ 12.09 hrs, Volume= 34,198 cf, Depth> 1.97"
Routed to Pond 2P : SubSurface Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.27"

Area (sf)	CN	Description
61,911	61	>75% Grass cover, Good, HSG B
62,853	98	Roofs, HSG B
83,049	98	Paved parking, HSG B
207,813	87	Weighted Average
61,911		29.79% Pervious Area
145,902		70.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5B: Subsurface Drainage



Summary for Pond 1P: SubSurface Sys 1

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Inflow Area =       137,534 sf,  78.66% Impervious,  Inflow Depth >   2.23"    for  2-Year event
Inflow      =      8.17 cfs @  12.09 hrs,  Volume=         25,573 cf
Outflow     =      0.65 cfs @  13.24 hrs,  Volume=         25,551 cf,  Atten= 92%,  Lag= 69.2 min
Discarded   =      0.50 cfs @  11.26 hrs,  Volume=         24,914 cf
Primary     =      0.14 cfs @  13.24 hrs,  Volume=            637 cf
   Routed to Link 3L : Combined Flow Rear Pond

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 348.03' @ 13.24 hrs   Surf.Area= 8,982 sf   Storage= 11,079 cf

Plug-Flow detention time= 191.9 min calculated for 25,551 cf (100% of inflow)
Center-of-Mass det. time= 191.4 min ( 996.8 - 805.4 )

Volume      Invert    Avail.Storage   Storage Description
  #1A      346.25'         7,944 cf   44.25'W x 202.98'L x 3.50'H Field A
                                      31,436 cf Overall - 11,577 cf Embedded = 19,859 cf  x 40.0% Voids
  #2A      346.75'        11,577 cf   ADS_StormTech SC-740 +Cap x 252  Inside #1
                                      Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                      Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                      252 Chambers in 9 Rows
                          19,521 cf   Total Available Storage

   Storage Group A created with Chamber Wizard

Device  Routing        Invert   Outlet Devices
   #1   Discarded     346.25'   2.410 in/hr Exfiltration over Surface area
   #2   Primary       346.75'   18.0"  Round Culvert X 2.00
                                L= 50.0'   CPP, square edge headwall,  Ke= 0.500
                                Inlet / Outlet Invert= 346.75' / 346.25'   S= 0.0100 '/'   Cc= 0.900
                                n= 0.012,  Flow Area= 1.77 sf
   #3   Primary       347.95'   8.0" Vert. Orifice/Grate X 6.00   C= 0.600
                                Limited to weir flow at low heads
   #4   Device 2      348.85'   10.0' long  x 0.5' breadth Broad-Crested Rectangular Weir
                                Head (feet)  0.20  0.40  0.60  0.80  1.00
                                Coef. (English)  2.80  2.92  3.08  3.30  3.32

Discarded OutFlow  Max=0.50 cfs @ 11.26 hrs  HW=346.29'   (Free Discharge)
└─1=Exfiltration  (Exfiltration Controls 0.50 cfs)

Primary OutFlow  Max=0.14 cfs @ 13.24 hrs  HW=348.03'   (Free Discharge)
├─2=Culvert  (Passes 0.00 cfs of 11.86 cfs potential flow)
│  └─4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)
└─3=Orifice/Grate  (Orifice Controls 0.14 cfs @ 0.97 fps)
```

Pond 1P: SubSurface Sys 1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

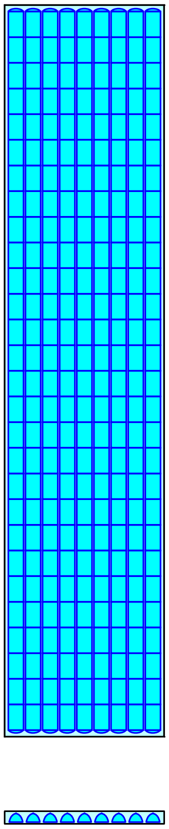
28 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 200.98' Row Length +12.0" End Stone x 2 = 202.98' Base Length
9 Rows x 51.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 44.25' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

252 Chambers x 45.9 cf = 11,576.9 cf Chamber Storage

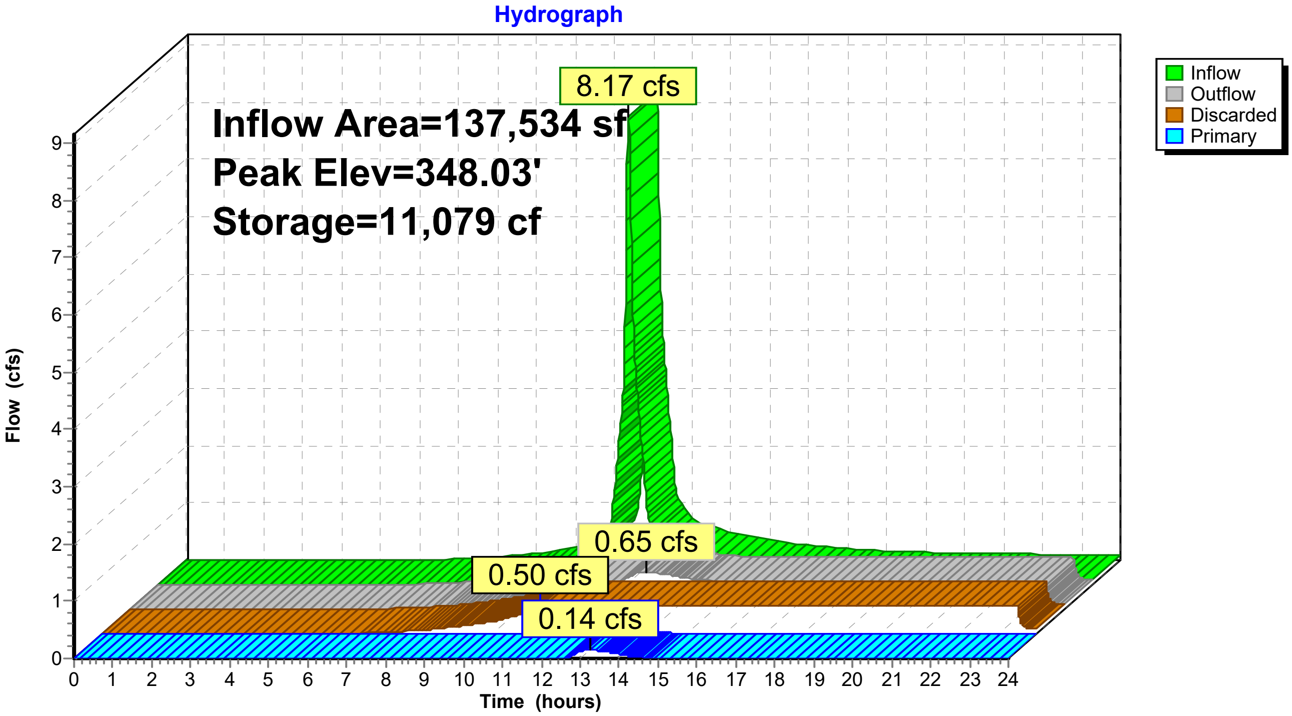
31,436.0 cf Field - 11,576.9 cf Chambers = 19,859.1 cf Stone x 40.0% Voids = 7,943.7 cf Stone Storage

Chamber Storage + Stone Storage = 19,520.5 cf = 0.448 af
Overall Storage Efficiency = 62.1%
Overall System Size = 202.98' x 44.25' x 3.50'

252 Chambers
1,164.3 cy Field
735.5 cy Stone



Pond 1P: SubSurface Sys 1



Summary for Pond 2P: SubSurface Sys 2

Inflow Area = 207,813 sf, 70.21% Impervious, Inflow Depth > 1.97" for 2-Year event
Inflow = 11.04 cfs @ 12.09 hrs, Volume= 34,198 cf
Outflow = 2.50 cfs @ 12.51 hrs, Volume= 34,189 cf, Atten= 77%, Lag= 25.0 min
Discarded = 2.31 cfs @ 11.78 hrs, Volume= 34,005 cf
Primary = 0.19 cfs @ 12.51 hrs, Volume= 184 cf
Routed to Link 4L : Combined to Great Brook

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 339.48' @ 12.51 hrs Surf.Area= 12,084 sf Storage= 8,304 cf

Plug-Flow detention time= 20.3 min calculated for 34,175 cf (100% of inflow)
Center-of-Mass det. time= 20.1 min (837.4 - 817.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	338.40'	10,633 cf	**87.00'W x 138.90'L x 3.50'H Field A** 42,294 cf Overall - 15,711 cf Embedded = 26,583 cf x 40.0% Voids
#2A	338.90'	15,711 cf	**ADS_StormTech SC-740 +Cap** x 342 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 342 Chambers in 18 Rows
		26,345 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.40'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	338.90'	**18.0" Round Culvert X 2.00** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 338.90' / 338.40' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	339.38'	**6.0" Vert. Orifice/Grate X 6.00** C= 0.600 Limited to weir flow at low heads
#4	Device 2	341.30'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=2.31 cfs @ 11.78 hrs HW=338.44' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 2.31 cfs)

Primary OutFlow Max=0.19 cfs @ 12.51 hrs HW=339.48' (Free Discharge)
└─**2=Culvert** (Passes 0.19 cfs of 3.27 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.19 cfs @ 1.08 fps)
  └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: SubSurface Sys 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

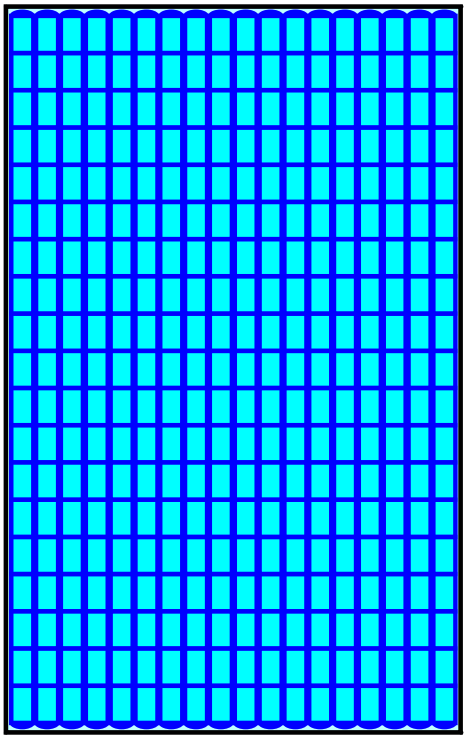
19 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 136.90' Row Length +12.0" End Stone x 2 = 138.90' Base Length
18 Rows x 51.0" Wide + 6.0" Spacing x 17 + 12.0" Side Stone x 2 = 87.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

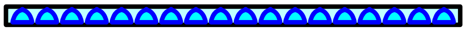
342 Chambers x 45.9 cf = 15,711.5 cf Chamber Storage

42,294.0 cf Field - 15,711.5 cf Chambers = 26,582.5 cf Stone x 40.0% Voids = 10,633.0 cf Stone Storage

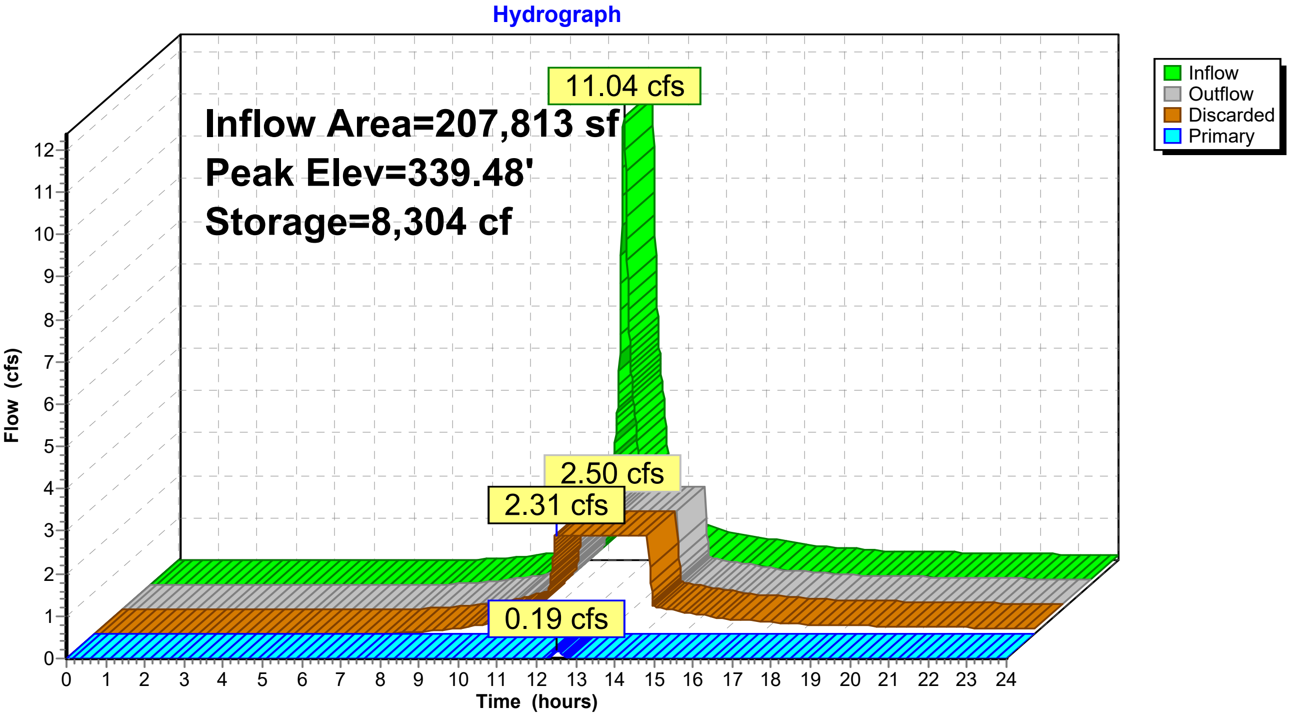
Chamber Storage + Stone Storage = 26,344.5 cf = 0.605 af
Overall Storage Efficiency = 62.3%
Overall System Size = 138.90' x 87.00' x 3.50'

342 Chambers
1,566.4 cy Field
984.5 cy Stone





Pond 2P: SubSurface Sys 2

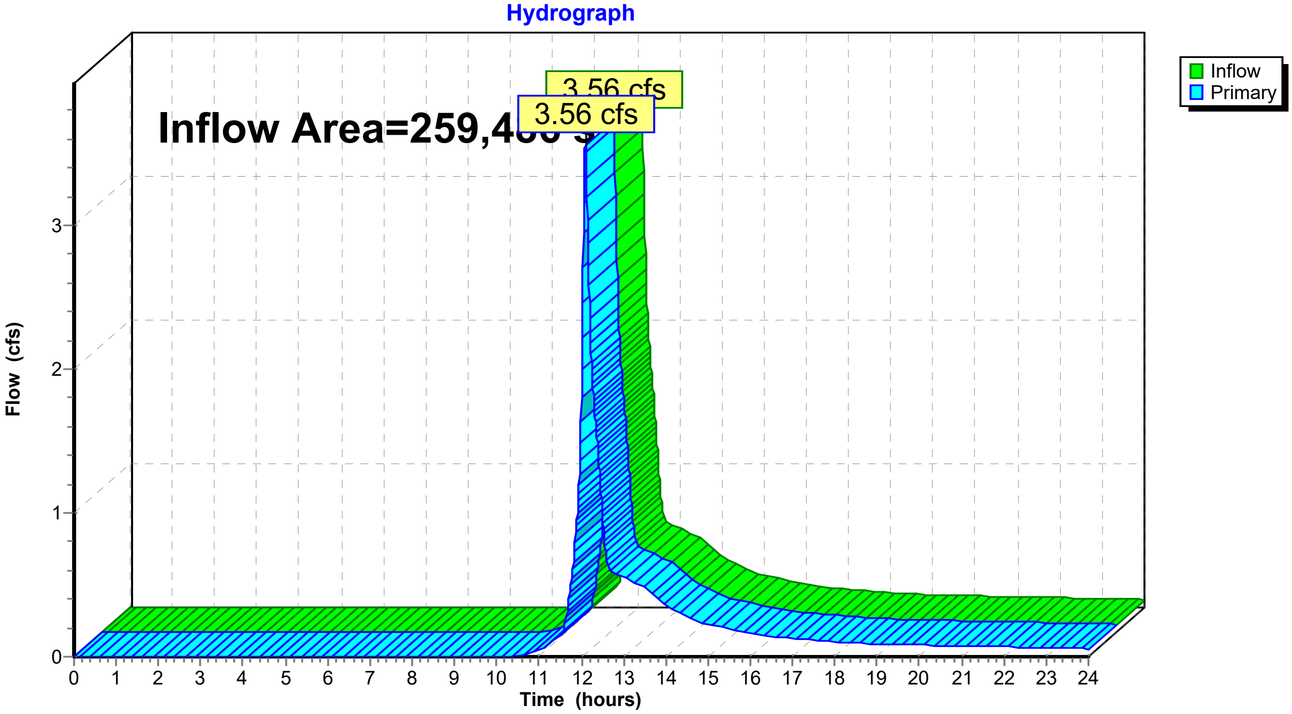


Summary for Link 3L: Combined Flow Rear Pond

```
Inflow Area =       259,486 sf,  61.30% Impervious,  Inflow Depth >   0.57"    for  2-Year event
Inflow      =      3.56 cfs @   12.10 hrs,  Volume=           12,221 cf
Primary     =      3.56 cfs @   12.10 hrs,  Volume=           12,221 cf,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 3L: Combined Flow Rear Pond

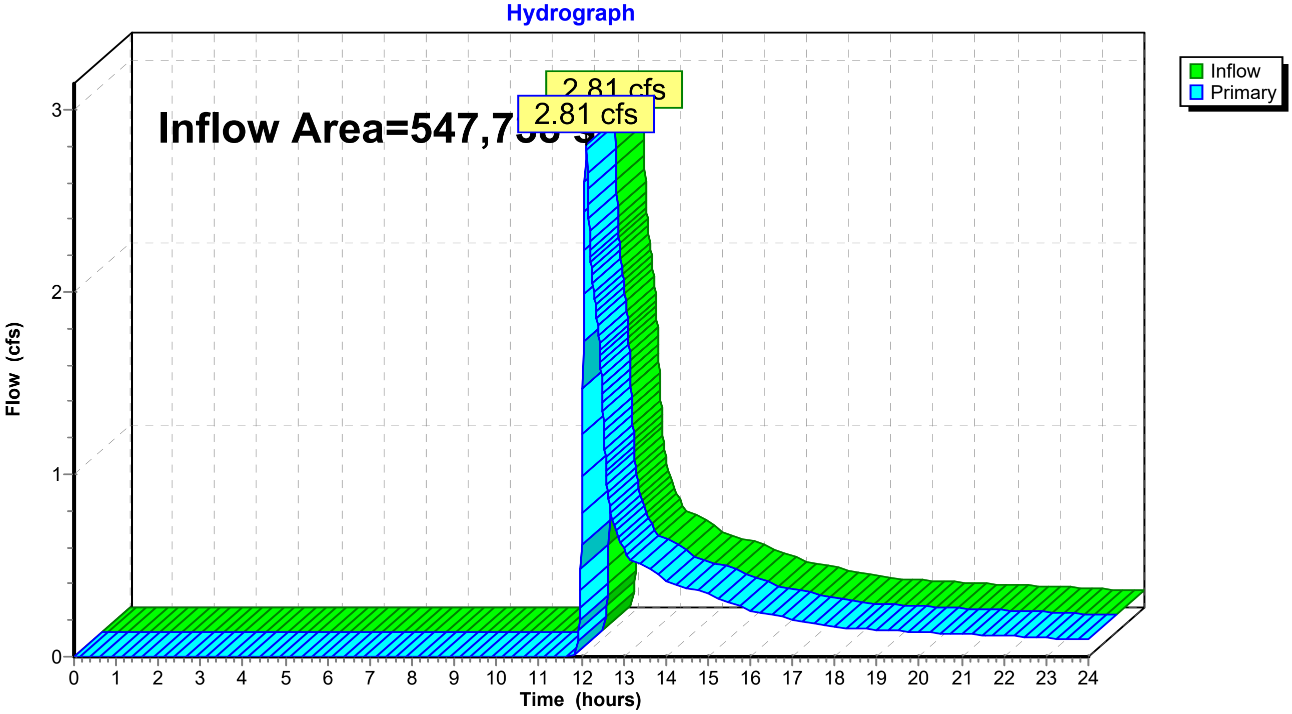


Summary for Link 4L: Combined to Great Brook

Inflow Area = 547,738 sf, 28.45% Impervious, Inflow Depth > 0.30" for 2-Year event
Inflow = 2.81 cfs @ 12.12 hrs, Volume= 13,552 cf
Primary = 2.81 cfs @ 12.12 hrs, Volume= 13,552 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 4L: Combined to Great Brook



```
                    Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
                   Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
          Reach routing by Stor-Ind+Trans method  -  Pond routing by Stor-Ind method

SubcatchmentE-1: To Front Pond         Runoff Area=312,214 sf   53.40% Impervious   Runoff Depth>2.90"
                                 Flow Length=405'   Tc=10.4 min   CN=80   Runoff=21.10 cfs  75,567 cf

SubcatchmentE-3: To Great Brook         Runoff Area=339,925 sf   2.91% Impervious   Runoff Depth>1.38"
                       Flow Length=420'   Tc=6.0 min   UI Adjusted CN=61   Runoff=11.51 cfs  39,059 cf

SubcatchmentE-4: To Rear Pond          Runoff Area=121,952 sf   41.73% Impervious   Runoff Depth>2.46"
                                   Flow Length=197'   Tc=6.3 min   CN=75   Runoff=7.99 cfs  25,023 cf

SubcatchmentP-5A: Subsurface DrainageRunoff Area=137,534 sf   78.66% Impervious   Runoff Depth>3.89"
                                                    Tc=6.0 min   CN=90   Runoff=13.91 cfs  44,606 cf

SubcatchmentP-5B: Subsurface DrainageRunoff Area=207,813 sf   70.21% Impervious   Runoff Depth>3.58"
                                                    Tc=6.0 min   CN=87   Runoff=19.69 cfs  62,042 cf

Pond 1P: SubSurface Sys 1            Peak Elev=348.56'  Storage=14,396 cf   Inflow=13.91 cfs  44,606 cf
                     Discarded=0.50 cfs  28,265 cf   Primary=5.30 cfs  13,633 cf   Outflow=5.80 cfs  41,897 cf

Pond 2P: SubSurface Sys 2            Peak Elev=340.20'  Storage=15,171 cf   Inflow=19.69 cfs  62,042 cf
                     Discarded=2.31 cfs  50,660 cf   Primary=4.30 cfs  11,368 cf   Outflow=6.61 cfs  62,028 cf

Link 3L: Combined Flow Rear Pond                                              Inflow=9.68 cfs  38,656 cf
                                                                             Primary=9.68 cfs  38,656 cf

Link 4L: Combined to Great Brook                                             Inflow=13.33 cfs  50,427 cf
                                                                            Primary=13.33 cfs  50,427 cf

       Total Runoff Area = 1,119,438 sf   Runoff Volume = 246,298 cf   Average Runoff Depth = 2.64"
                                   56.98% Pervious = 637,842 sf     43.02% Impervious = 481,596 sf
```

Summary for Subcatchment E-1: To Front Pond

[47] Hint: Peak is 476% of capacity of segment #4

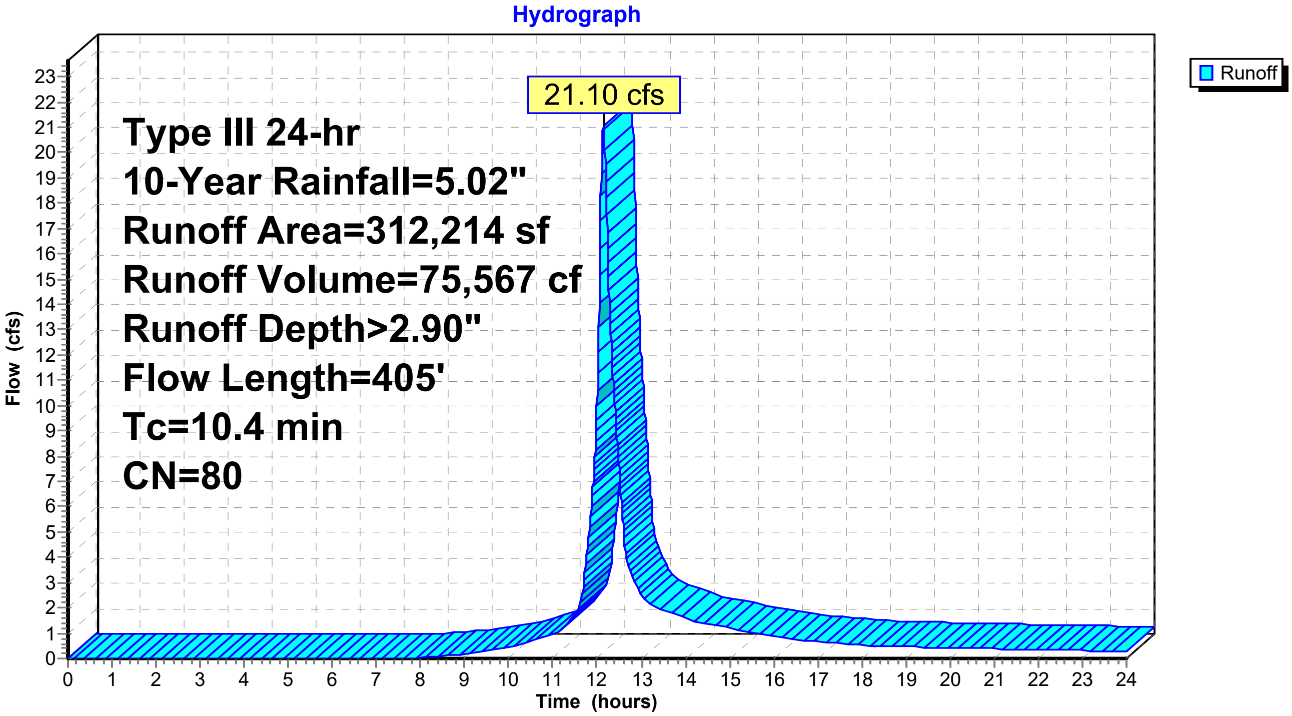
Runoff = 21.10 cfs @ 12.14 hrs, Volume= 75,567 cf, Depth> 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

Area (sf)	CN	Description
22,632	55	Woods, Good, HSG B
122,869	61	>75% Grass cover, Good, HSG B
80,603	98	Paved parking, HSG B
33,494	98	Roofs, HSG B
52,616	98	Water Surface, HSG B
312,214	80	Weighted Average
145,501		46.60% Pervious Area
166,713		53.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0060	0.09		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.4	58	0.0190	2.22		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	20	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.5	184	0.0155	5.65	4.44	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	93	0.0699	3.97		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
10.4	405	Total			

Subcatchment E-1: To Front Pond



Summary for Subcatchment E-3: To Great Brook

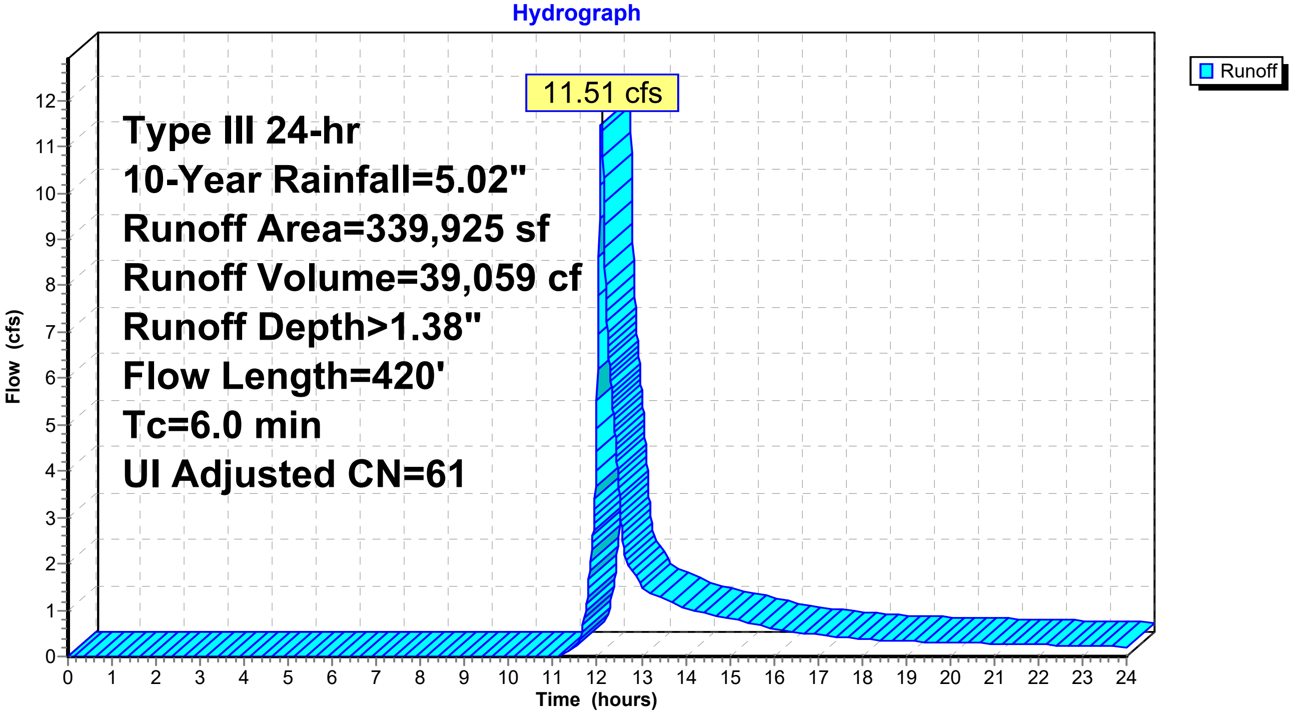
Runoff = 11.51 cfs @ 12.10 hrs, Volume= 39,059 cf, Depth> 1.38"
Routed to Link 4L : Combined to Great Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

Area (sf)	CN	Adj	Description
59,070	55		Woods, Good, HSG B
263,621	61		>75% Grass cover, Good, HSG B
7,327	96		Gravel surface, HSG B
8,687	98		Unconnected pavement, HSG B
1,220	98		Roofs, HSG B
339,925	62	61	Weighted Average, UI Adjusted
330,018			97.09% Pervious Area
9,907			2.91% Impervious Area
8,687			87.69% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
2.4	370	0.0250	2.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.0	420	Total			

Subcatchment E-3: To Great Brook



Summary for Subcatchment E-4: To Rear Pond

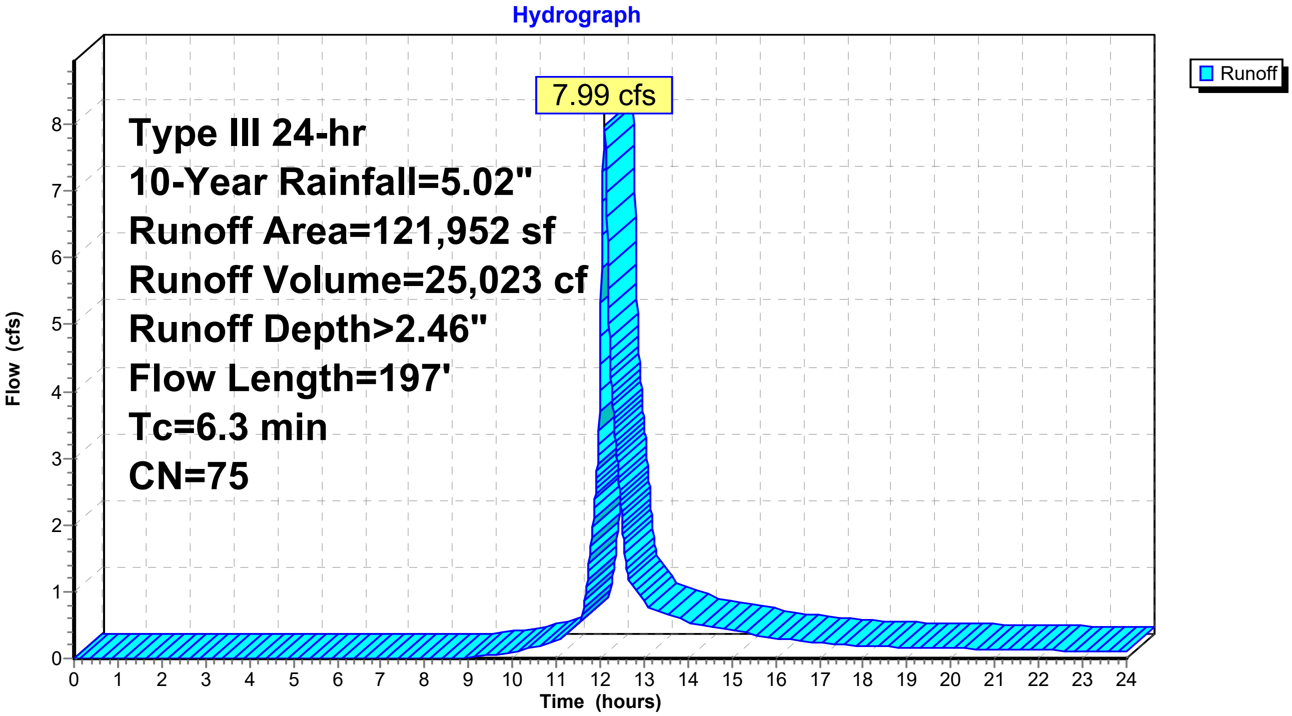
Runoff = 7.99 cfs @ 12.09 hrs, Volume= 25,023 cf, Depth> 2.46"
Routed to Link 3L : Combined Flow Rear Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

Area (sf)	CN	Description
20,960	55	Woods, Good, HSG B
50,104	61	>75% Grass cover, Good, HSG B
50,888	98	Water Surface, HSG B
121,952	75	Weighted Average
71,064		58.27% Pervious Area
50,888		41.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.7	147	0.0500	3.60		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.3	197	Total			

Subcatchment E-4: To Rear Pond



Summary for Subcatchment P-5A: Subsurface Drainage

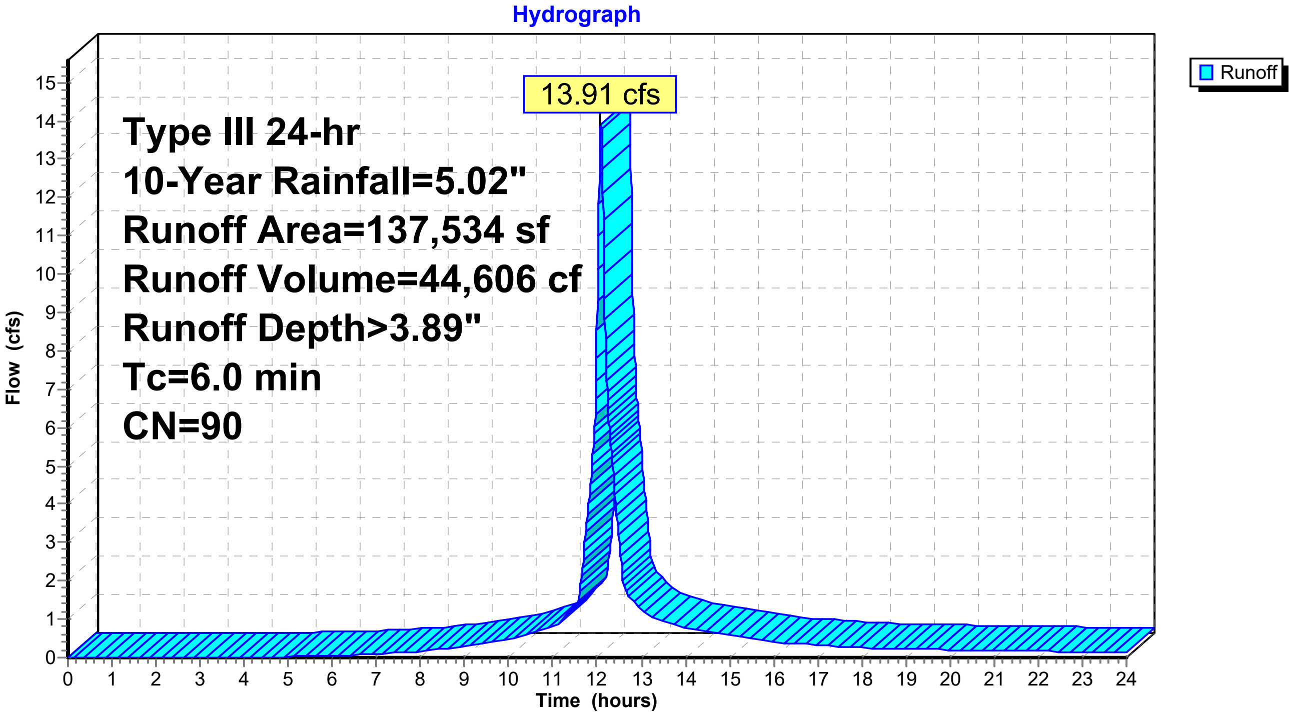
Runoff = 13.91 cfs @ 12.09 hrs, Volume= 44,606 cf, Depth> 3.89"
Routed to Pond 1P : SubSurface Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

Area (sf)	CN	Description
29,348	61	>75% Grass cover, Good, HSG B
34,413	98	Roofs, HSG B
73,773	98	Paved parking, HSG B
137,534	90	Weighted Average
29,348		21.34% Pervious Area
108,186		78.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5A: Subsurface Drainage



Summary for Subcatchment P-5B: Subsurface Drainage

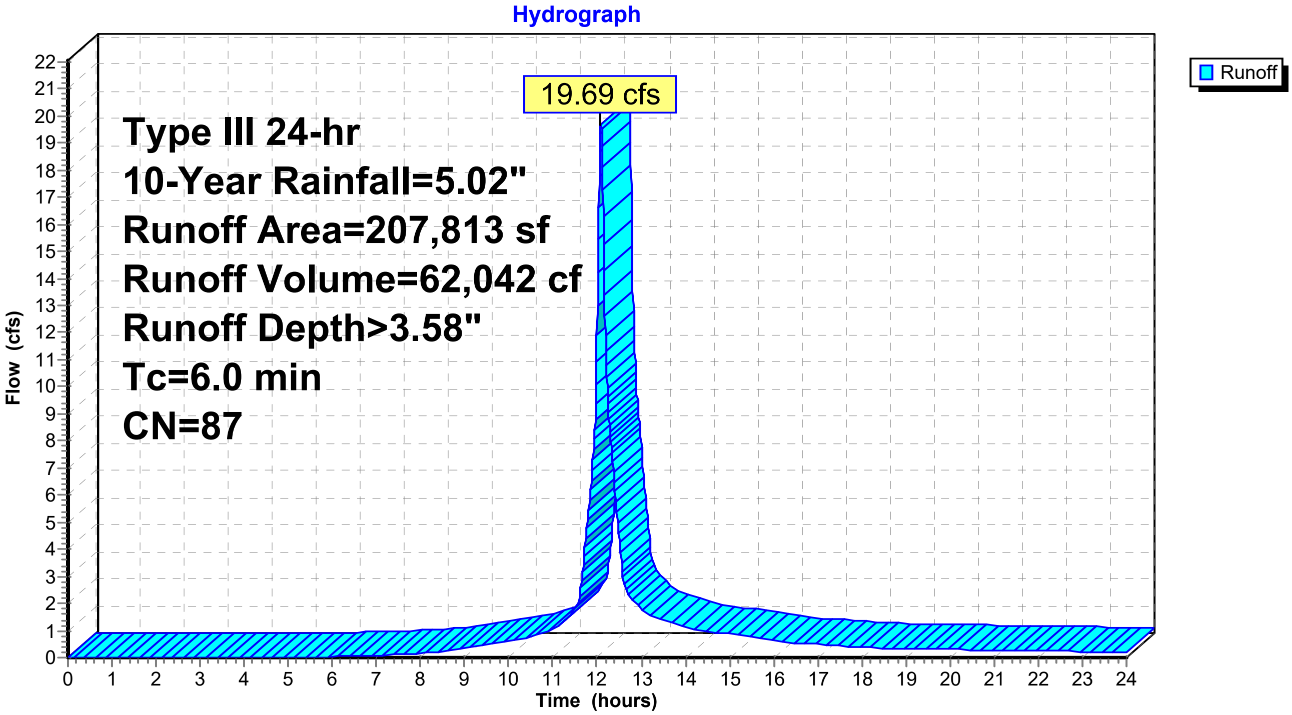
Runoff = 19.69 cfs @ 12.09 hrs, Volume= 62,042 cf, Depth> 3.58"
Routed to Pond 2P : SubSurface Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.02"

Area (sf)	CN	Description
61,911	61	>75% Grass cover, Good, HSG B
62,853	98	Roofs, HSG B
83,049	98	Paved parking, HSG B
207,813	87	Weighted Average
61,911		29.79% Pervious Area
145,902		70.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5B: Subsurface Drainage



Summary for Pond 1P: SubSurface Sys 1

Inflow Area = 137,534 sf, 78.66% Impervious, Inflow Depth > 3.89" for 10-Year event
Inflow = 13.91 cfs @ 12.09 hrs, Volume= 44,606 cf
Outflow = 5.80 cfs @ 12.29 hrs, Volume= 41,897 cf, Atten= 58%, Lag= 12.3 min
Discarded = 0.50 cfs @ 10.17 hrs, Volume= 28,265 cf
Primary = 5.30 cfs @ 12.29 hrs, Volume= 13,633 cf
Routed to Link 3L : Combined Flow Rear Pond

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 348.56' @ 12.29 hrs Surf.Area= 8,982 sf Storage= 14,396 cf

Plug-Flow detention time= 145.2 min calculated for 41,880 cf (94% of inflow)
Center-of-Mass det. time= 112.4 min (902.4 - 790.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	346.25'	7,944 cf	**44.25'W x 202.98'L x 3.50'H Field A** 31,436 cf Overall - 11,577 cf Embedded = 19,859 cf x 40.0% Voids
#2A	346.75'	11,577 cf	**ADS_StormTech SC-740 +Cap** x 252 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 252 Chambers in 9 Rows
		19,521 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	346.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	346.75'	**18.0" Round Culvert X 2.00** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 346.75' / 346.25' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Primary	347.95'	**8.0" Vert. Orifice/Grate X 6.00** C= 0.600 Limited to weir flow at low heads
#4	Device 2	348.85'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.50 cfs @ 10.17 hrs HW=346.29' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.50 cfs)

Primary OutFlow Max=5.30 cfs @ 12.29 hrs HW=348.56' (Free Discharge)
├—**2=Culvert** (Passes 0.00 cfs of 17.49 cfs potential flow)
│ └—**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└—**3=Orifice/Grate** (Orifice Controls 5.30 cfs @ 2.65 fps)

Pond 1P: SubSurface Sys 1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

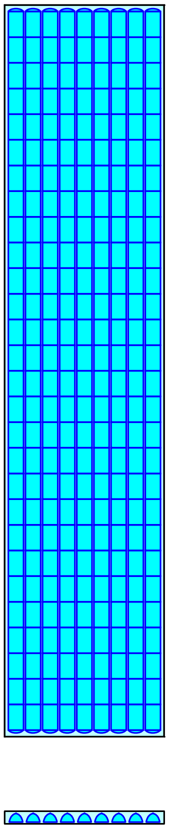
28 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 200.98' Row Length +12.0" End Stone x 2 = 202.98' Base Length
9 Rows x 51.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 44.25' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

252 Chambers x 45.9 cf = 11,576.9 cf Chamber Storage

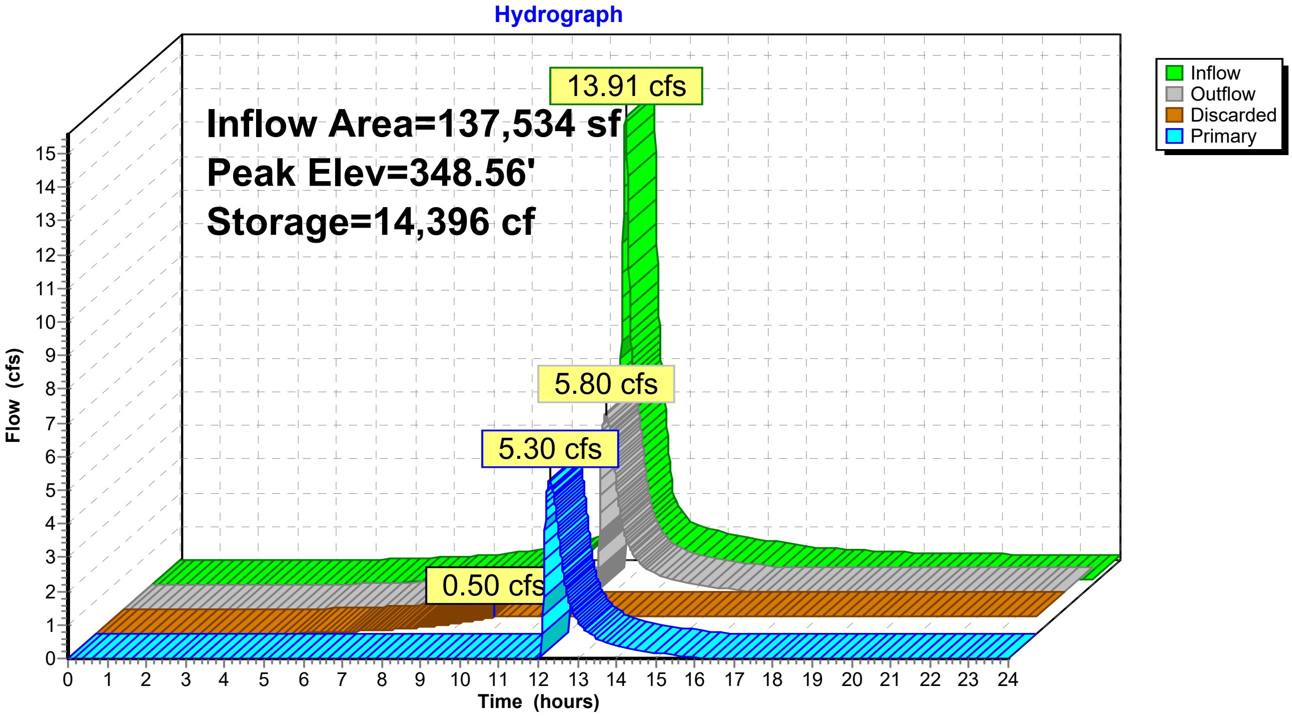
31,436.0 cf Field - 11,576.9 cf Chambers = 19,859.1 cf Stone x 40.0% Voids = 7,943.7 cf Stone Storage

Chamber Storage + Stone Storage = 19,520.5 cf = 0.448 af
Overall Storage Efficiency = 62.1%
Overall System Size = 202.98' x 44.25' x 3.50'

252 Chambers
1,164.3 cy Field
735.5 cy Stone



Pond 1P: SubSurface Sys 1



Summary for Pond 2P: SubSurface Sys 2

```
Inflow Area =        207,813 sf,  70.21% Impervious,  Inflow Depth >   3.58"    for  10-Year event
Inflow      =      19.69 cfs @   12.09 hrs,  Volume=          62,042 cf
Outflow     =       6.61 cfs @   12.38 hrs,  Volume=          62,028 cf,  Atten= 66%,  Lag= 17.5 min
Discarded   =       2.31 cfs @   11.63 hrs,  Volume=          50,660 cf
Primary     =       4.30 cfs @   12.38 hrs,  Volume=          11,368 cf
    Routed to Link 4L : Combined to Great Brook

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 340.20' @ 12.38 hrs   Surf.Area= 12,084 sf   Storage= 15,171 cf

Plug-Flow detention time= 24.4 min calculated for 62,028 cf (100% of inflow)
Center-of-Mass det. time= 24.2 min ( 824.7 - 800.4 )

Volume     Invert    Avail.Storage  Storage Description
   #1A     338.40'       10,633 cf  87.00'W x 138.90'L x 3.50'H Field A
                                    42,294 cf Overall - 15,711 cf Embedded = 26,583 cf  x 40.0% Voids
   #2A     338.90'       15,711 cf  ADS_StormTech SC-740 +Cap x 342  Inside #1
                                    Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                    Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                    342 Chambers in 18 Rows
                         26,345 cf  Total Available Storage

    Storage Group A created with Chamber Wizard

Device   Routing        Invert   Outlet Devices
   #1    Discarded     338.40'   8.270 in/hr Exfiltration over Surface area
   #2    Primary       338.90'   18.0"  Round Culvert X 2.00
                                 L= 50.0'   CPP, square edge headwall,  Ke= 0.500
                                 Inlet / Outlet Invert= 338.90' / 338.40'   S= 0.0100 '/'   Cc= 0.900
                                 n= 0.012,  Flow Area= 1.77 sf
   #3    Device 2      339.38'   6.0" Vert. Orifice/Grate X 6.00   C= 0.600
                                 Limited to weir flow at low heads
   #4    Device 2      341.30'   10.0' long  x 0.5' breadth Broad-Crested Rectangular Weir
                                 Head (feet)  0.20  0.40  0.60  0.80  1.00
                                 Coef. (English)  2.80  2.92  3.08  3.30  3.32

Discarded OutFlow  Max=2.31 cfs @ 11.63 hrs  HW=338.44'   (Free Discharge)
└─1=Exfiltration  (Exfiltration Controls 2.31 cfs)

Primary OutFlow  Max=4.30 cfs @ 12.38 hrs  HW=340.20'   (Free Discharge)
└─2=Culvert  (Passes 4.30 cfs of 12.16 cfs potential flow)
   ├─3=Orifice/Grate  (Orifice Controls 4.30 cfs @ 3.65 fps)
   └─4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)
```

Pond 2P: SubSurface Sys 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

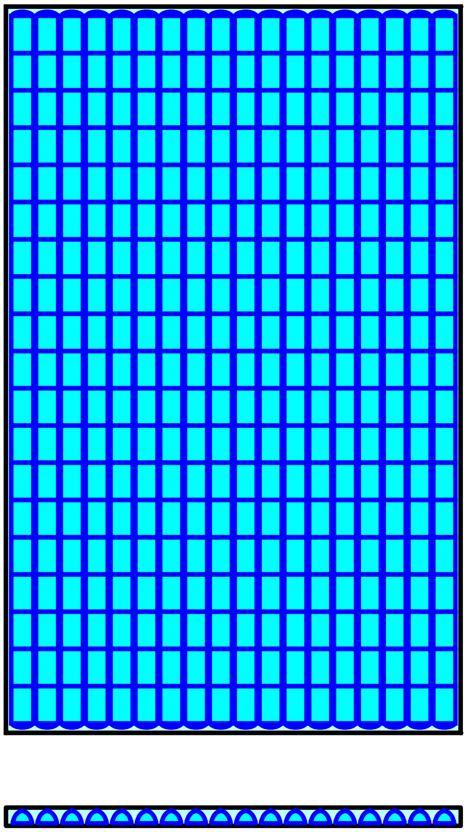
19 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 136.90' Row Length +12.0" End Stone x 2 = 138.90' Base Length
18 Rows x 51.0" Wide + 6.0" Spacing x 17 + 12.0" Side Stone x 2 = 87.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

342 Chambers x 45.9 cf = 15,711.5 cf Chamber Storage

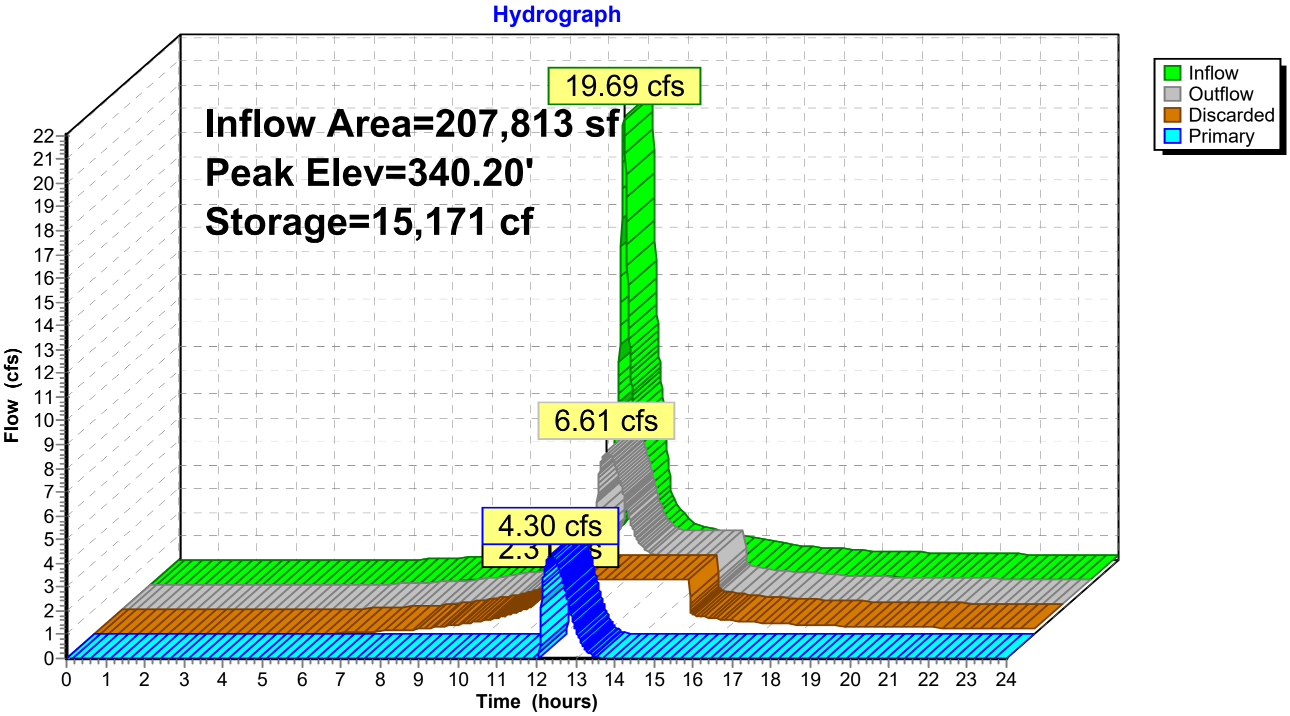
42,294.0 cf Field - 15,711.5 cf Chambers = 26,582.5 cf Stone x 40.0% Voids = 10,633.0 cf Stone Storage

Chamber Storage + Stone Storage = 26,344.5 cf = 0.605 af
Overall Storage Efficiency = 62.3%
Overall System Size = 138.90' x 87.00' x 3.50'

342 Chambers
1,566.4 cy Field
984.5 cy Stone



Pond 2P: SubSurface Sys 2

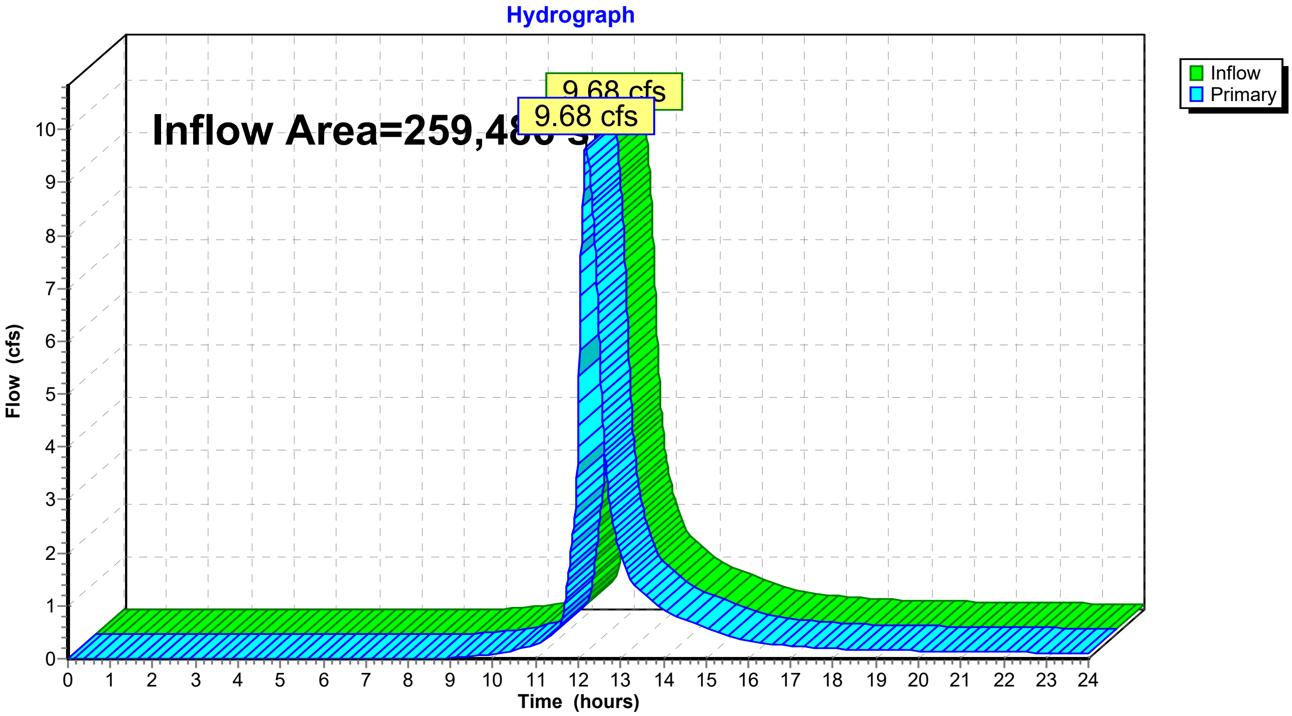


Summary for Link 3L: Combined Flow Rear Pond

Inflow Area = 259,486 sf, 61.30% Impervious, Inflow Depth > 1.79" for 10-Year event
Inflow = 9.68 cfs @ 12.18 hrs, Volume= 38,656 cf
Primary = 9.68 cfs @ 12.18 hrs, Volume= 38,656 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 3L: Combined Flow Rear Pond

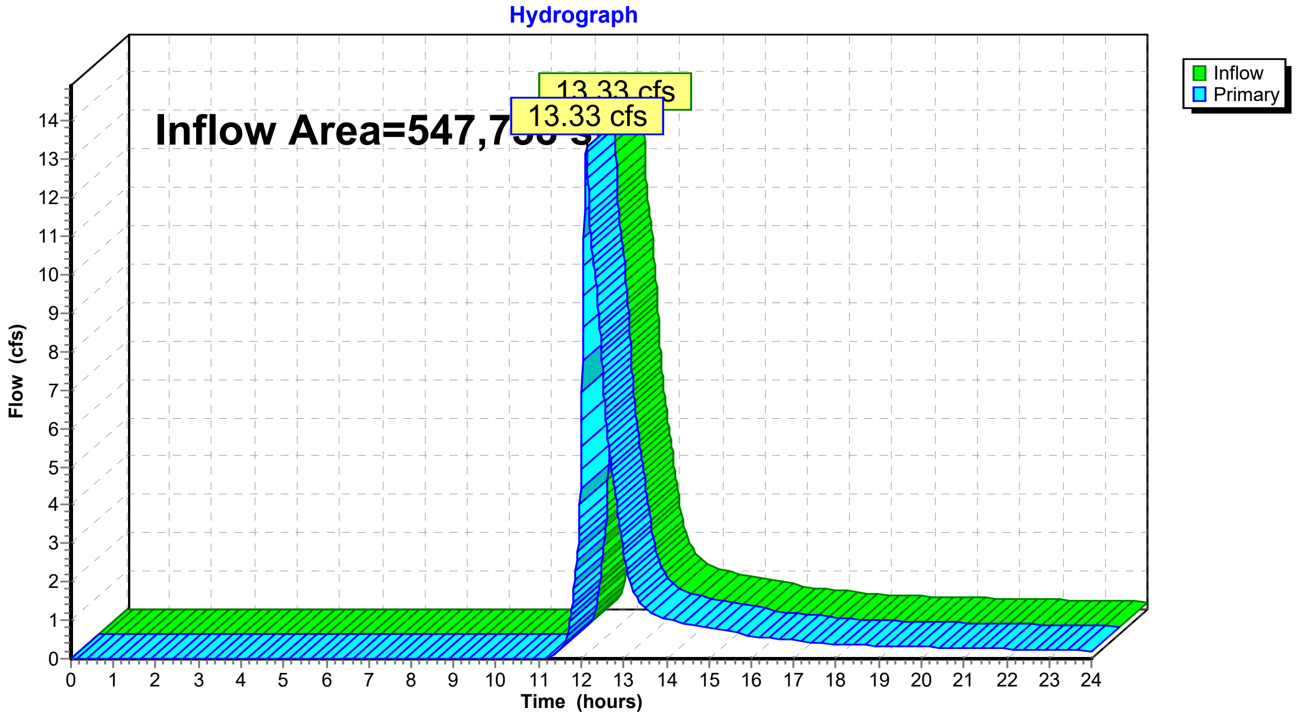


Summary for Link 4L: Combined to Great Brook

Inflow Area = 547,738 sf, 28.45% Impervious, Inflow Depth > 1.10" for 10-Year event
Inflow = 13.33 cfs @ 12.12 hrs, Volume= 50,427 cf
Primary = 13.33 cfs @ 12.12 hrs, Volume= 50,427 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 4L: Combined to Great Brook



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=312,214 sf 53.40% Impervious Runoff Depth>3.87"
Flow Length=405' Tc=10.4 min CN=80 Runoff=28.04 cfs 100,773 cf

Subcatchment E-3: To Great Brook Runoff Area=339,925 sf 2.91% Impervious Runoff Depth>2.08"
Flow Length=420' Tc=6.0 min UI Adjusted CN=61 Runoff=18.20 cfs 58,818 cf

Subcatchment E-4: To Rear Pond Runoff Area=121,952 sf 41.73% Impervious Runoff Depth>3.37"
Flow Length=197' Tc=6.3 min CN=75 Runoff=10.97 cfs 34,267 cf

Subcatchment P-5A: Subsurface Drainage Runoff Area=137,534 sf 78.66% Impervious Runoff Depth>4.95"
Tc=6.0 min CN=90 Runoff=17.45 cfs 56,717 cf

Subcatchment P-5B: Subsurface Drainage Runoff Area=207,813 sf 70.21% Impervious Runoff Depth>4.62"
Tc=6.0 min CN=87 Runoff=25.09 cfs 79,976 cf

Pond 1P: SubSurface Sys 1 Peak Elev=348.97' Storage=16,616 cf Inflow=17.45 cfs 56,717 cf
Discarded=0.50 cfs 29,626 cf Primary=9.57 cfs 22,832 cf Outflow=10.07 cfs 52,458 cf

Pond 2P: SubSurface Sys 2 Peak Elev=340.78' Storage=20,001 cf Inflow=25.09 cfs 79,976 cf
Discarded=2.31 cfs 59,871 cf Primary=6.08 cfs 20,087 cf Outflow=8.39 cfs 79,958 cf

Link 3L: Combined Flow Rear Pond Inflow=17.44 cfs 57,099 cf
Primary=17.44 cfs 57,099 cf

Link 4L: Combined to Great Brook Inflow=21.97 cfs 78,904 cf
Primary=21.97 cfs 78,904 cf

Total Runoff Area = 1,119,438 sf Runoff Volume = 330,550 cf Average Runoff Depth = 3.54"
56.98% Pervious = 637,842 sf 43.02% Impervious = 481,596 sf

Summary for Subcatchment E-1: To Front Pond

[47] Hint: Peak is 632% of capacity of segment #4

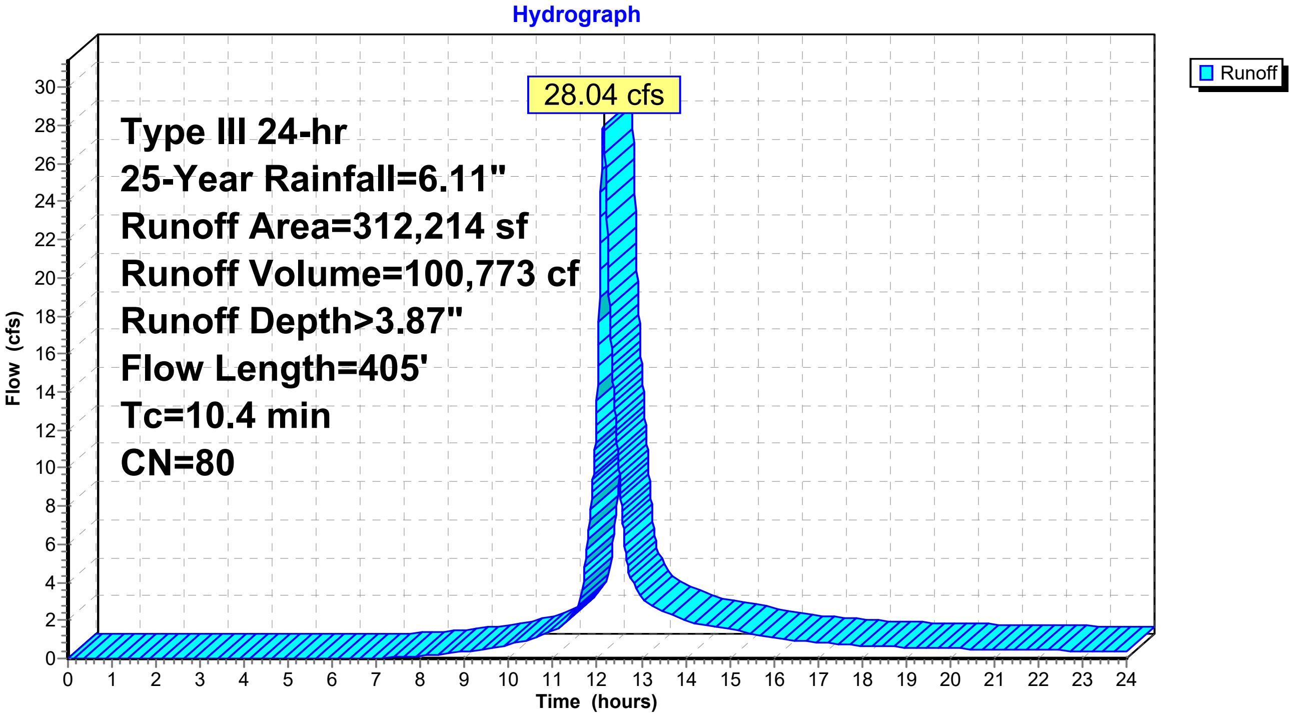
Runoff = 28.04 cfs @ 12.14 hrs, Volume= 100,773 cf, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

Area (sf)	CN	Description
22,632	55	Woods, Good, HSG B
122,869	61	>75% Grass cover, Good, HSG B
80,603	98	Paved parking, HSG B
33,494	98	Roofs, HSG B
52,616	98	Water Surface, HSG B
312,214	80	Weighted Average
145,501		46.60% Pervious Area
166,713		53.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0060	0.09		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.4	58	0.0190	2.22		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	20	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.5	184	0.0155	5.65	4.44	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	93	0.0699	3.97		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
10.4	405	Total			

Subcatchment E-1: To Front Pond



Summary for Subcatchment E-3: To Great Brook

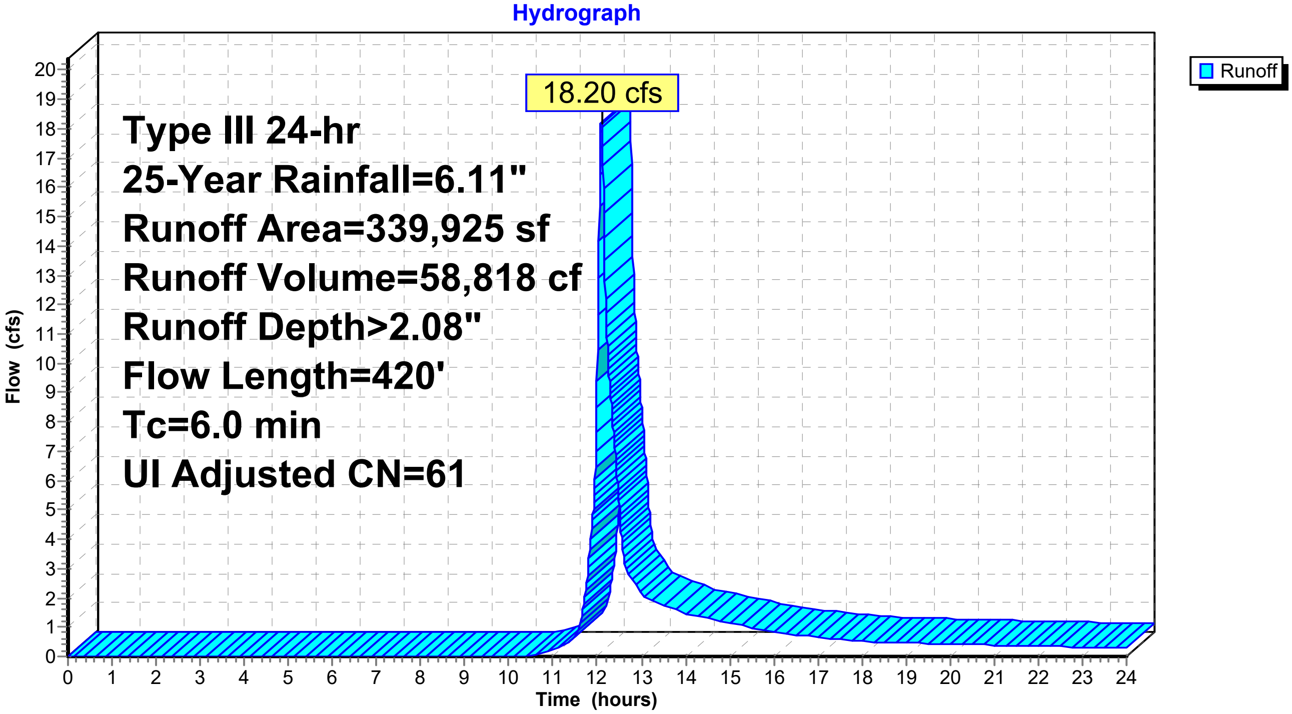
Runoff = 18.20 cfs @ 12.10 hrs, Volume= 58,818 cf, Depth> 2.08"
Routed to Link 4L : Combined to Great Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

Area (sf)	CN	Adj	Description
59,070	55		Woods, Good, HSG B
263,621	61		>75% Grass cover, Good, HSG B
7,327	96		Gravel surface, HSG B
8,687	98		Unconnected pavement, HSG B
1,220	98		Roofs, HSG B
339,925	62	61	Weighted Average, UI Adjusted
330,018			97.09% Pervious Area
9,907			2.91% Impervious Area
8,687			87.69% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
2.4	370	0.0250	2.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.0	420	Total			

Subcatchment E-3: To Great Brook



Summary for Subcatchment E-4: To Rear Pond

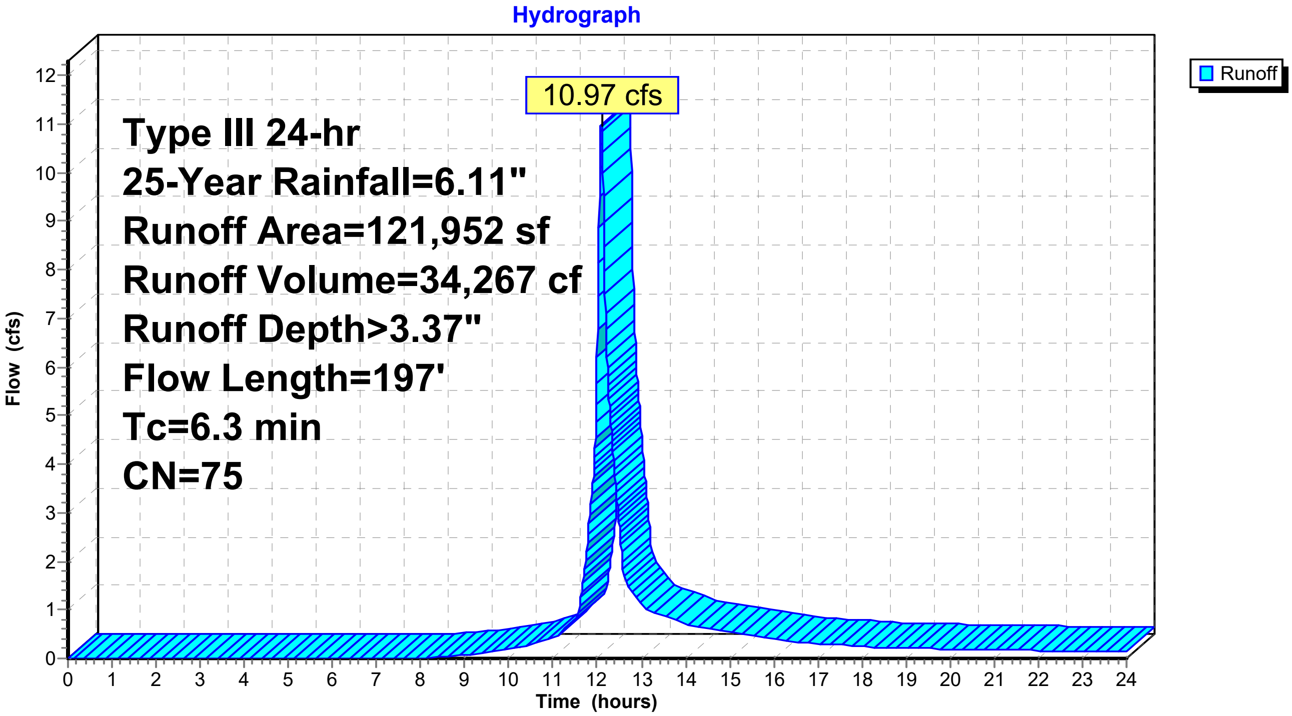
Runoff = 10.97 cfs @ 12.09 hrs, Volume= 34,267 cf, Depth> 3.37"
Routed to Link 3L : Combined Flow Rear Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

Area (sf)	CN	Description
20,960	55	Woods, Good, HSG B
50,104	61	>75% Grass cover, Good, HSG B
50,888	98	Water Surface, HSG B
121,952	75	Weighted Average
71,064		58.27% Pervious Area
50,888		41.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.7	147	0.0500	3.60		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.3	197	Total			

Subcatchment E-4: To Rear Pond



Summary for Subcatchment P-5A: Subsurface Drainage

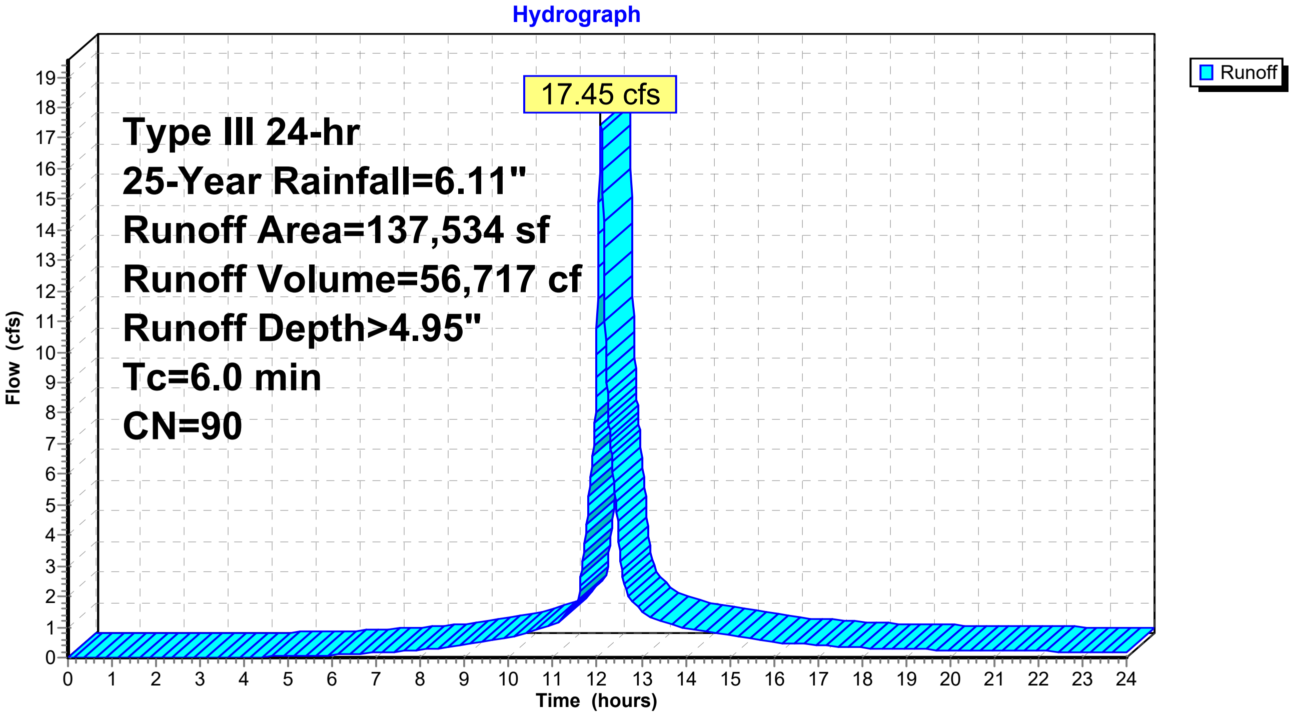
Runoff = 17.45 cfs @ 12.08 hrs, Volume= 56,717 cf, Depth> 4.95"
Routed to Pond 1P : SubSurface Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

Area (sf)	CN	Description
29,348	61	>75% Grass cover, Good, HSG B
34,413	98	Roofs, HSG B
73,773	98	Paved parking, HSG B
137,534	90	Weighted Average
29,348		21.34% Pervious Area
108,186		78.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5A: Subsurface Drainage



Summary for Subcatchment P-5B: Subsurface Drainage

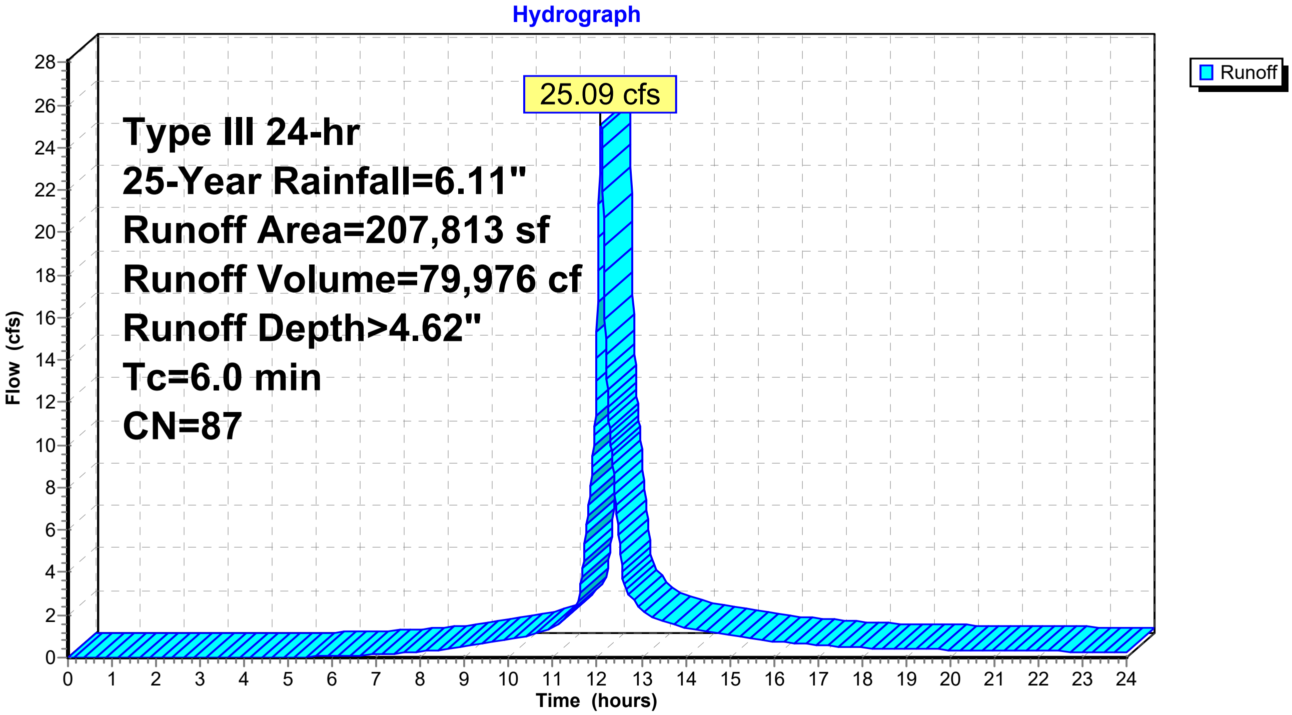
Runoff = 25.09 cfs @ 12.09 hrs, Volume= 79,976 cf, Depth> 4.62"
Routed to Pond 2P : SubSurface Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.11"

Area (sf)	CN	Description
61,911	61	>75% Grass cover, Good, HSG B
62,853	98	Roofs, HSG B
83,049	98	Paved parking, HSG B
207,813	87	Weighted Average
61,911		29.79% Pervious Area
145,902		70.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5B: Subsurface Drainage



Summary for Pond 1P: SubSurface Sys 1

```
Inflow Area =        137,534 sf,  78.66% Impervious,  Inflow Depth >   4.95"    for  25-Year event
Inflow      =      17.45 cfs @  12.08 hrs,  Volume=          56,717 cf
Outflow     =      10.07 cfs @  12.20 hrs,  Volume=          52,458 cf,  Atten= 42%,  Lag= 6.7 min
Discarded   =       0.50 cfs @   9.43 hrs,  Volume=          29,626 cf
Primary     =       9.57 cfs @  12.20 hrs,  Volume=          22,832 cf
   Routed to Link 3L : Combined Flow Rear Pond

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 348.97' @ 12.20 hrs   Surf.Area= 8,982 sf   Storage= 16,616 cf

Plug-Flow detention time= 122.8 min calculated for 52,436 cf (92% of inflow)
Center-of-Mass det. time= 83.7 min ( 867.3 - 783.5 )

Volume      Invert    Avail.Storage   Storage Description
   #1A     346.25'         7,944 cf   44.25'W x 202.98'L x 3.50'H Field A
                                      31,436 cf Overall - 11,577 cf Embedded = 19,859 cf  x 40.0% Voids
   #2A     346.75'        11,577 cf   ADS_StormTech SC-740 +Cap x 252  Inside #1
                                      Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                      Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                      252 Chambers in 9 Rows
                          19,521 cf   Total Available Storage

   Storage Group A created with Chamber Wizard

Device   Routing        Invert   Outlet Devices
   #1    Discarded     346.25'   2.410 in/hr Exfiltration over Surface area
   #2    Primary       346.75'   18.0"  Round Culvert X 2.00
                                 L= 50.0'   CPP, square edge headwall,  Ke= 0.500
                                 Inlet / Outlet Invert= 346.75' / 346.25'   S= 0.0100 '/'   Cc= 0.900
                                 n= 0.012,  Flow Area= 1.77 sf
   #3    Primary       347.95'   8.0" Vert. Orifice/Grate X 6.00   C= 0.600
                                 Limited to weir flow at low heads
   #4    Device 2      348.85'   10.0' long  x 0.5' breadth Broad-Crested Rectangular Weir
                                 Head (feet)  0.20  0.40  0.60  0.80  1.00
                                 Coef. (English)  2.80  2.92  3.08  3.30  3.32

Discarded OutFlow  Max=0.50 cfs @ 9.43 hrs  HW=346.29'   (Free Discharge)
↑—1=Exfiltration  (Exfiltration Controls 0.50 cfs)

Primary OutFlow  Max=9.55 cfs @ 12.20 hrs  HW=348.97'   (Free Discharge)
↑—2=Culvert  (Passes 1.19 cfs of 20.64 cfs potential flow)
│  ↑—4=Broad-Crested Rectangular Weir (Weir Controls 1.19 cfs @ 0.98 fps)
└—3=Orifice/Grate  (Orifice Controls 8.37 cfs @ 3.99 fps)
```

Pond 1P: SubSurface Sys 1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

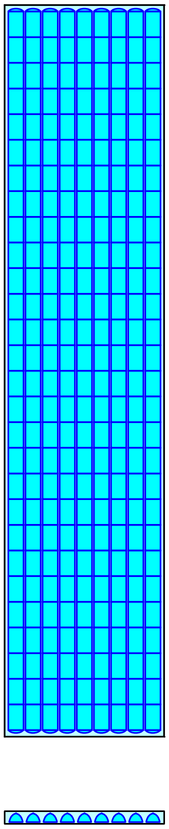
28 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 200.98' Row Length +12.0" End Stone x 2 = 202.98' Base Length
9 Rows x 51.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 44.25' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

252 Chambers x 45.9 cf = 11,576.9 cf Chamber Storage

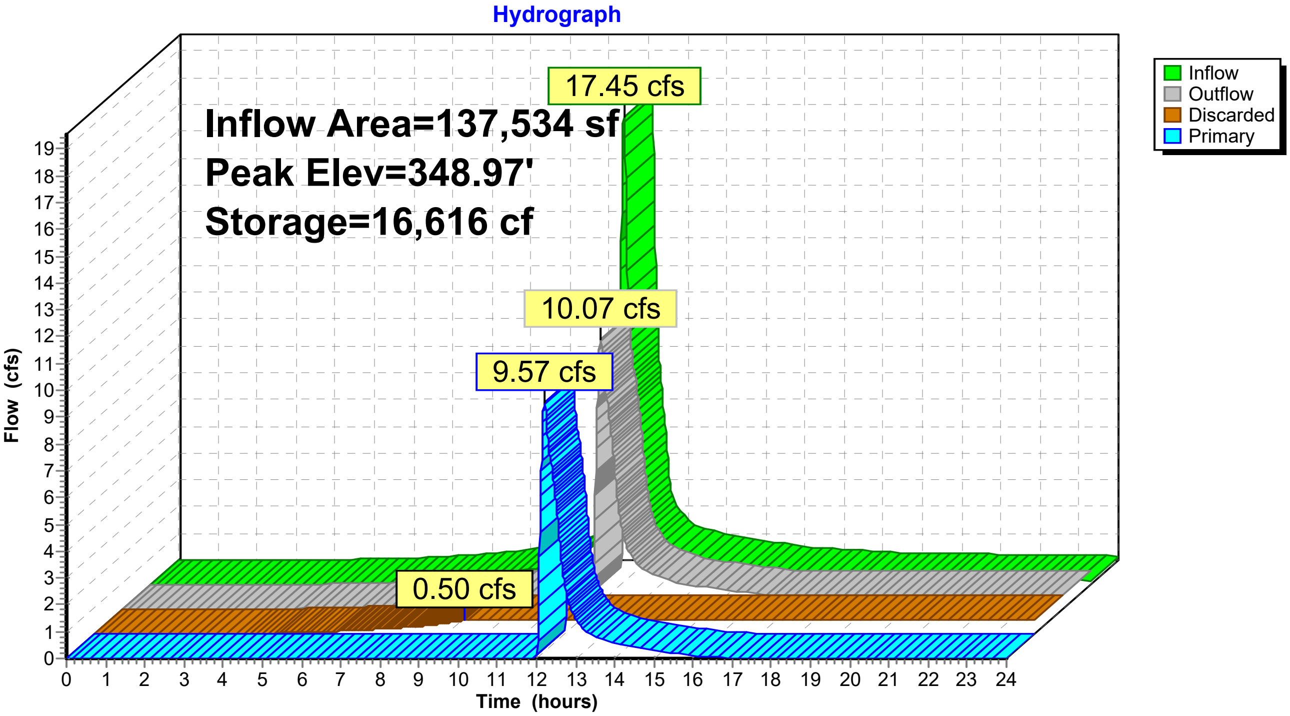
31,436.0 cf Field - 11,576.9 cf Chambers = 19,859.1 cf Stone x 40.0% Voids = 7,943.7 cf Stone Storage

Chamber Storage + Stone Storage = 19,520.5 cf = 0.448 af
Overall Storage Efficiency = 62.1%
Overall System Size = 202.98' x 44.25' x 3.50'

252 Chambers
1,164.3 cy Field
735.5 cy Stone



Pond 1P: SubSurface Sys 1



Summary for Pond 2P: SubSurface Sys 2

Inflow Area = 207,813 sf, 70.21% Impervious, Inflow Depth > 4.62" for 25-Year event
Inflow = 25.09 cfs @ 12.09 hrs, Volume= 79,976 cf
Outflow = 8.39 cfs @ 12.37 hrs, Volume= 79,958 cf, Atten= 67%, Lag= 17.4 min
Discarded = 2.31 cfs @ 11.48 hrs, Volume= 59,871 cf
Primary = 6.08 cfs @ 12.37 hrs, Volume= 20,087 cf
Routed to Link 4L : Combined to Great Brook

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 340.78' @ 12.37 hrs Surf.Area= 12,084 sf Storage= 20,001 cf

Plug-Flow detention time= 25.7 min calculated for 79,958 cf (100% of inflow)
Center-of-Mass det. time= 25.6 min (819.0 - 793.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	338.40'	10,633 cf	**87.00'W x 138.90'L x 3.50'H Field A** 42,294 cf Overall - 15,711 cf Embedded = 26,583 cf x 40.0% Voids
#2A	338.90'	15,711 cf	**ADS_StormTech SC-740 +Cap** x 342 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 342 Chambers in 18 Rows
		26,345 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.40'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	338.90'	**18.0" Round Culvert X 2.00** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 338.90' / 338.40' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	339.38'	**6.0" Vert. Orifice/Grate X 6.00** C= 0.600 Limited to weir flow at low heads
#4	Device 2	341.30'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=2.31 cfs @ 11.48 hrs HW=338.44' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 2.31 cfs)

Primary OutFlow Max=6.08 cfs @ 12.37 hrs HW=340.78' (Free Discharge)
└─**2=Culvert** (Passes 6.08 cfs of 18.07 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 6.08 cfs @ 5.16 fps)
  └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: SubSurface Sys 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

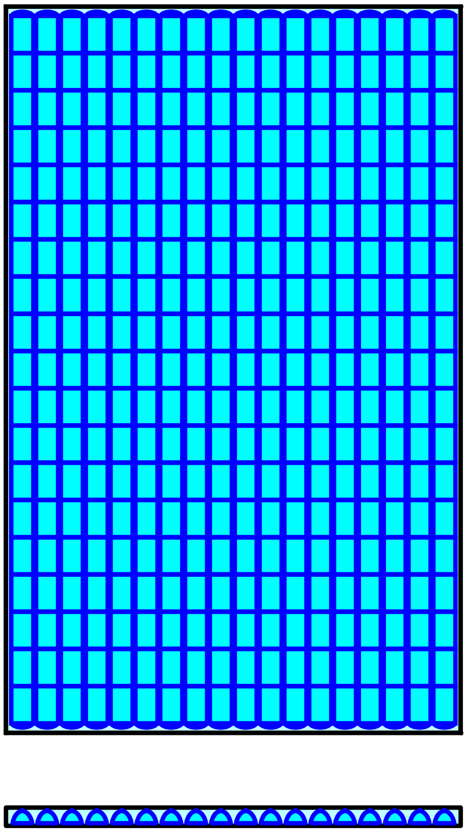
19 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 136.90' Row Length +12.0" End Stone x 2 = 138.90' Base Length
18 Rows x 51.0" Wide + 6.0" Spacing x 17 + 12.0" Side Stone x 2 = 87.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

342 Chambers x 45.9 cf = 15,711.5 cf Chamber Storage

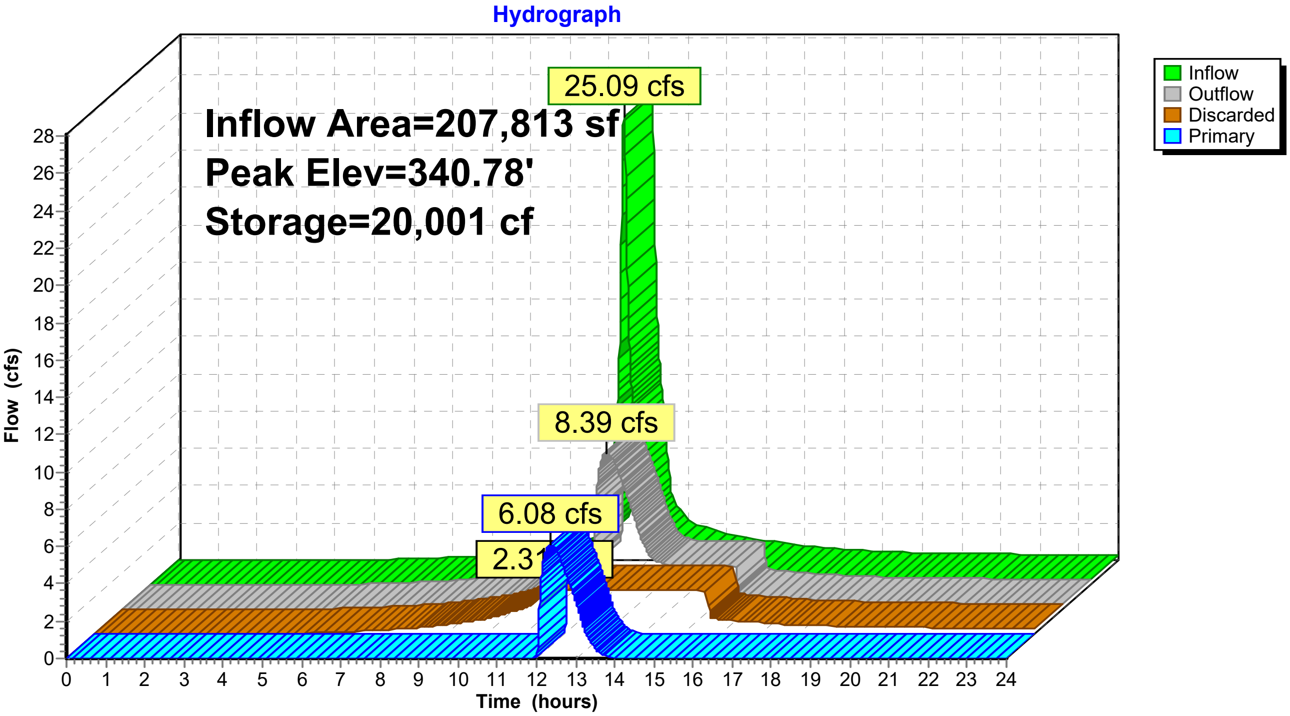
42,294.0 cf Field - 15,711.5 cf Chambers = 26,582.5 cf Stone x 40.0% Voids = 10,633.0 cf Stone Storage

Chamber Storage + Stone Storage = 26,344.5 cf = 0.605 af
Overall Storage Efficiency = 62.3%
Overall System Size = 138.90' x 87.00' x 3.50'

342 Chambers
1,566.4 cy Field
984.5 cy Stone



Pond 2P: SubSurface Sys 2

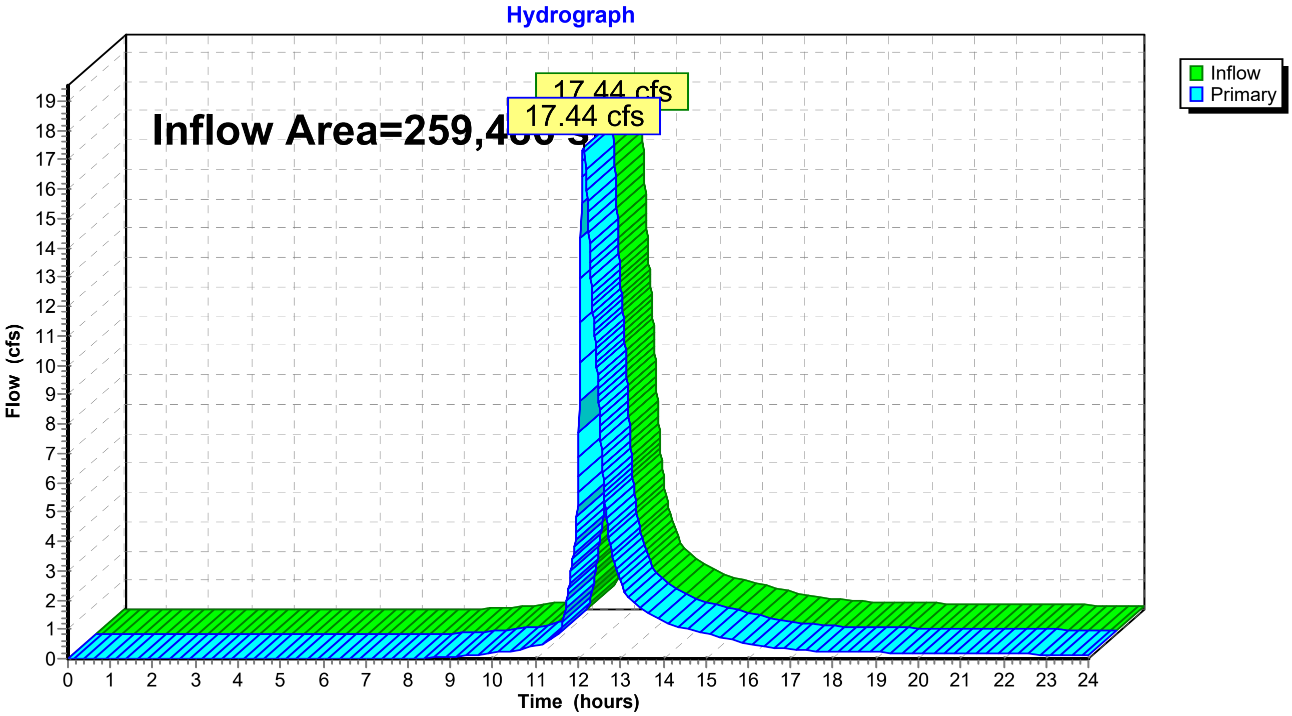


Summary for Link 3L: Combined Flow Rear Pond

```
Inflow Area =         259,486 sf,  61.30% Impervious,  Inflow Depth >   2.64"    for  25-Year event
Inflow      =       17.44 cfs @   12.12 hrs,  Volume=            57,099 cf
Primary     =       17.44 cfs @   12.12 hrs,  Volume=            57,099 cf,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 3L: Combined Flow Rear Pond

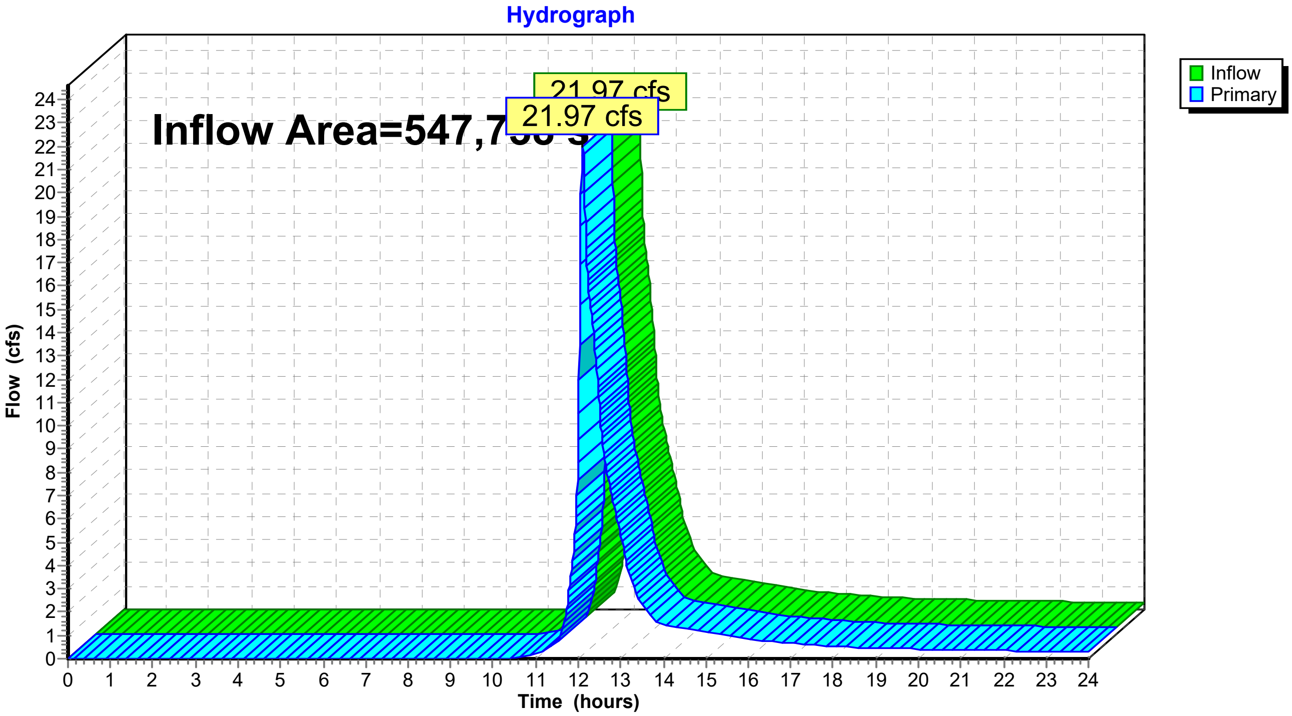


Summary for Link 4L: Combined to Great Brook

```
Inflow Area =       547,738 sf,  28.45% Impervious,  Inflow Depth >   1.73"    for  25-Year event
Inflow      =      21.97 cfs @   12.11 hrs,  Volume=           78,904 cf
Primary     =      21.97 cfs @   12.11 hrs,  Volume=           78,904 cf,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 4L: Combined to Great Brook



```
                 Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
                  Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
        Reach routing by Stor-Ind+Trans method  -  Pond routing by Stor-Ind method

SubcatchmentE-1: To Front Pond          Runoff Area=312,214 sf  53.40% Impervious  Runoff Depth>5.42"
                                Flow Length=405'  Tc=10.4 min  CN=80  Runoff=38.87 cfs  140,981 cf

SubcatchmentE-3: To Great Brook         Runoff Area=339,925 sf  2.91% Impervious  Runoff Depth>3.28"
                      Flow Length=420'  Tc=6.0 min  UI Adjusted CN=61  Runoff=29.65 cfs  92,941 cf

SubcatchmentE-4: To Rear Pond           Runoff Area=121,952 sf  41.73% Impervious  Runoff Depth>4.85"
                                 Flow Length=197'  Tc=6.3 min  CN=75  Runoff=15.72 cfs  49,259 cf

SubcatchmentP-5A: Subsurface DrainageRunoff Area=137,534 sf  78.66% Impervious  Runoff Depth>6.59"
                                                    Tc=6.0 min  CN=90  Runoff=22.88 cfs  75,565 cf

SubcatchmentP-5B: Subsurface DrainageRunoff Area=207,813 sf  70.21% Impervious  Runoff Depth>6.24"
                                                   Tc=6.0 min  CN=87  Runoff=33.37 cfs  108,058 cf

Pond 1P: SubSurface Sys 1              Peak Elev=349.33'  Storage=18,001 cf  Inflow=22.88 cfs  75,565 cf
                   Discarded=0.50 cfs  31,352 cf  Primary=20.13 cfs  38,015 cf  Outflow=20.63 cfs  69,366 cf

Pond 2P: SubSurface Sys 2             Peak Elev=341.67'  Storage=25,238 cf  Inflow=33.37 cfs  108,058 cf
                 Discarded=2.31 cfs  72,570 cf  Primary=14.67 cfs  35,465 cf  Outflow=16.99 cfs  108,035 cf

Link 3L: Combined Flow Rear Pond                                           Inflow=35.13 cfs  87,274 cf
                                                                          Primary=35.13 cfs  87,274 cf

Link 4L: Combined to Great Brook                                          Inflow=35.58 cfs  128,405 cf
                                                                         Primary=35.58 cfs  128,405 cf

      Total Runoff Area = 1,119,438 sf  Runoff Volume = 466,804 cf  Average Runoff Depth = 5.00"
                                  56.98% Pervious = 637,842 sf   43.02% Impervious = 481,596 sf
```

Summary for Subcatchment E-1: To Front Pond

[47] Hint: Peak is 876% of capacity of segment #4

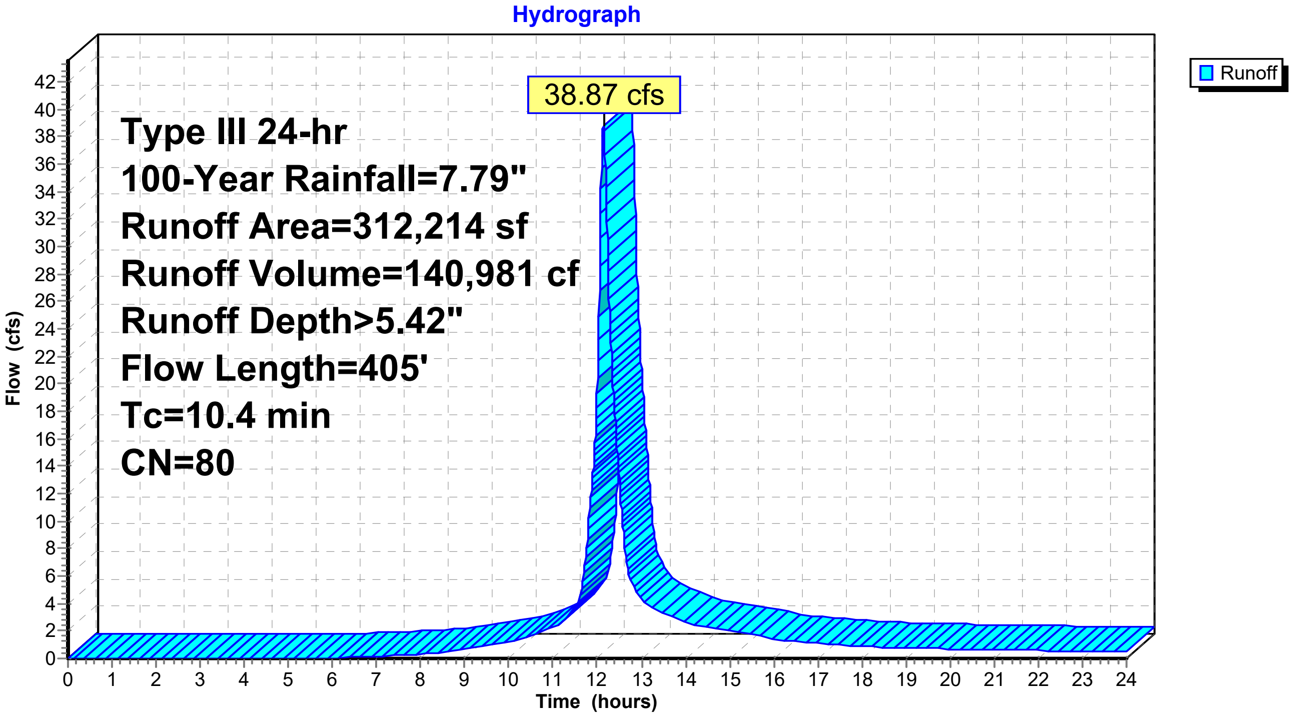
Runoff = 38.87 cfs @ 12.14 hrs, Volume= 140,981 cf, Depth> 5.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

Area (sf)	CN	Description
22,632	55	Woods, Good, HSG B
122,869	61	>75% Grass cover, Good, HSG B
80,603	98	Paved parking, HSG B
33,494	98	Roofs, HSG B
52,616	98	Water Surface, HSG B
312,214	80	Weighted Average
145,501		46.60% Pervious Area
166,713		53.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0060	0.09		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.4	58	0.0190	2.22		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	20	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.5	184	0.0155	5.65	4.44	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	93	0.0699	3.97		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
10.4	405	Total			

Subcatchment E-1: To Front Pond



Summary for Subcatchment E-3: To Great Brook

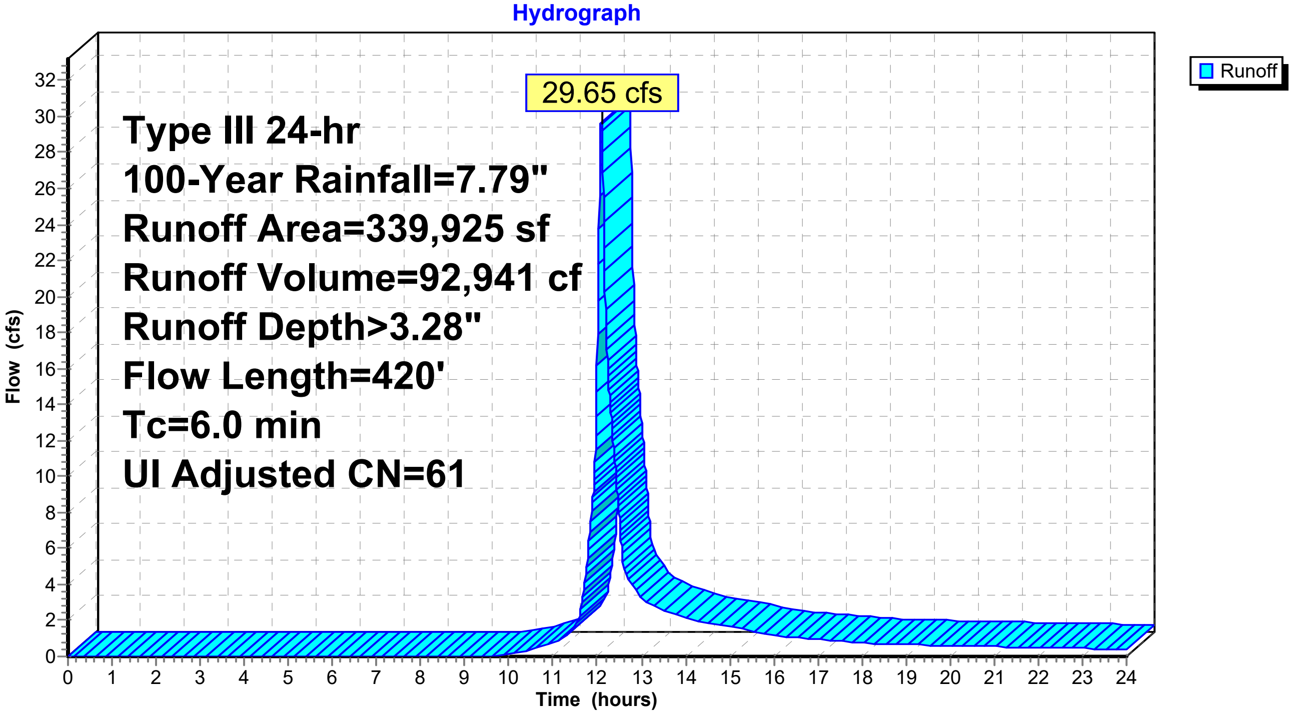
Runoff = 29.65 cfs @ 12.09 hrs, Volume= 92,941 cf, Depth> 3.28"
Routed to Link 4L : Combined to Great Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

Area (sf)	CN	Adj	Description
59,070	55		Woods, Good, HSG B
263,621	61		>75% Grass cover, Good, HSG B
7,327	96		Gravel surface, HSG B
8,687	98		Unconnected pavement, HSG B
1,220	98		Roofs, HSG B
339,925	62	61	Weighted Average, UI Adjusted
330,018			97.09% Pervious Area
9,907			2.91% Impervious Area
8,687			87.69% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
2.4	370	0.0250	2.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.0	420	Total			

Subcatchment E-3: To Great Brook



Summary for Subcatchment E-4: To Rear Pond

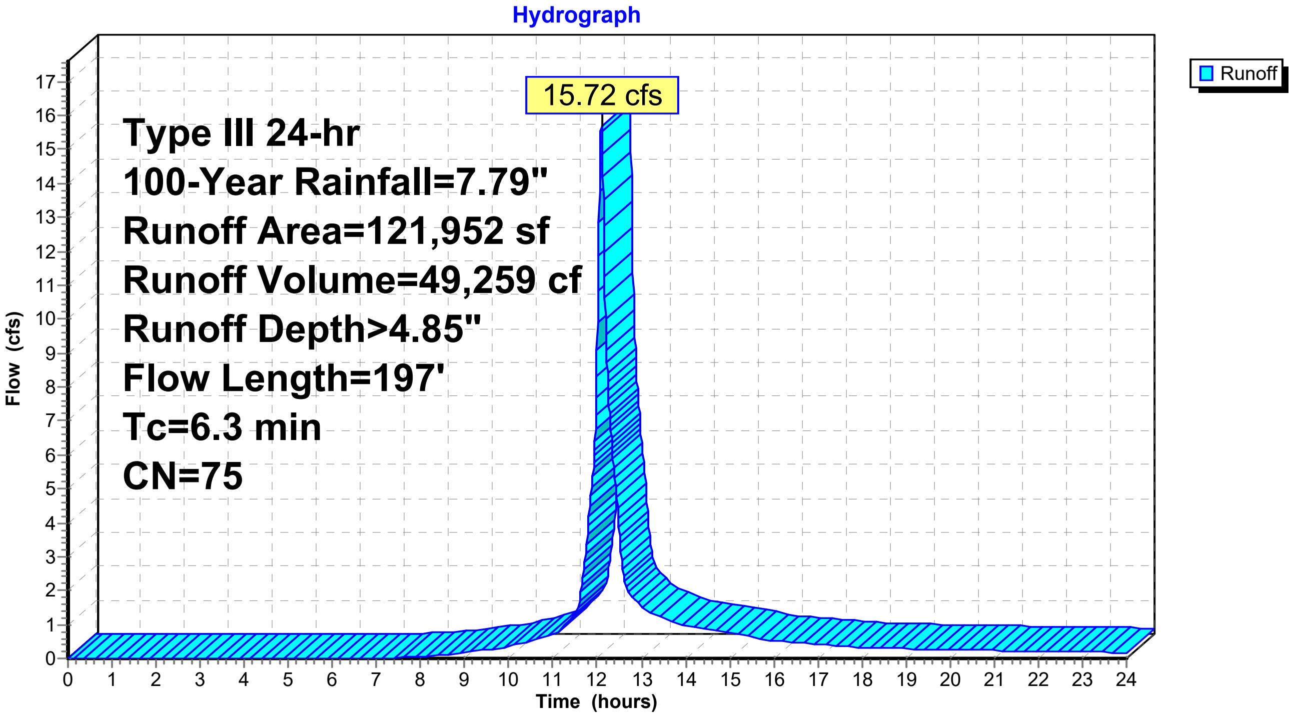
Runoff = 15.72 cfs @ 12.09 hrs, Volume= 49,259 cf, Depth> 4.85"
Routed to Link 3L : Combined Flow Rear Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

Area (sf)	CN	Description
20,960	55	Woods, Good, HSG B
50,104	61	>75% Grass cover, Good, HSG B
50,888	98	Water Surface, HSG B
121,952	75	Weighted Average
71,064		58.27% Pervious Area
50,888		41.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.27"
0.7	147	0.0500	3.60		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.3	197	Total			

Subcatchment E-4: To Rear Pond



Summary for Subcatchment P-5A: Subsurface Drainage

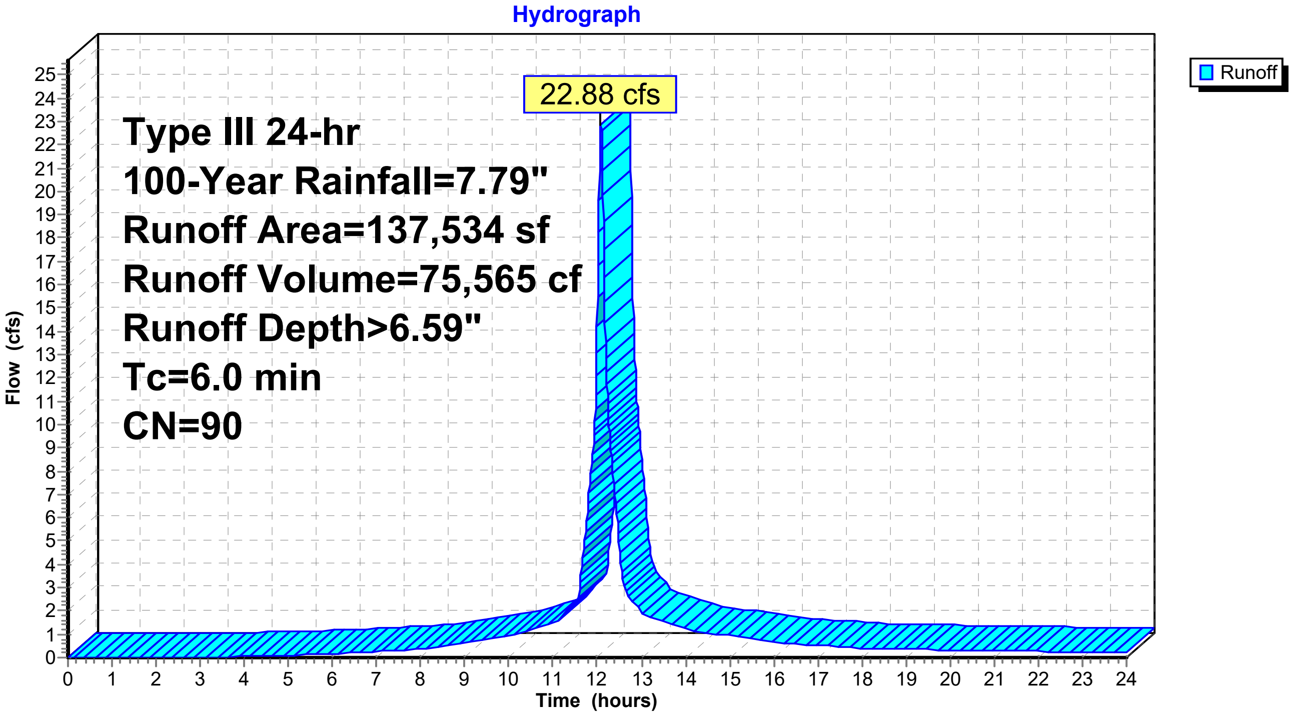
Runoff = 22.88 cfs @ 12.08 hrs, Volume= 75,565 cf, Depth> 6.59"
Routed to Pond 1P : SubSurface Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

Area (sf)	CN	Description
29,348	61	>75% Grass cover, Good, HSG B
34,413	98	Roofs, HSG B
73,773	98	Paved parking, HSG B
137,534	90	Weighted Average
29,348		21.34% Pervious Area
108,186		78.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5A: Subsurface Drainage



Summary for Subcatchment P-5B: Subsurface Drainage

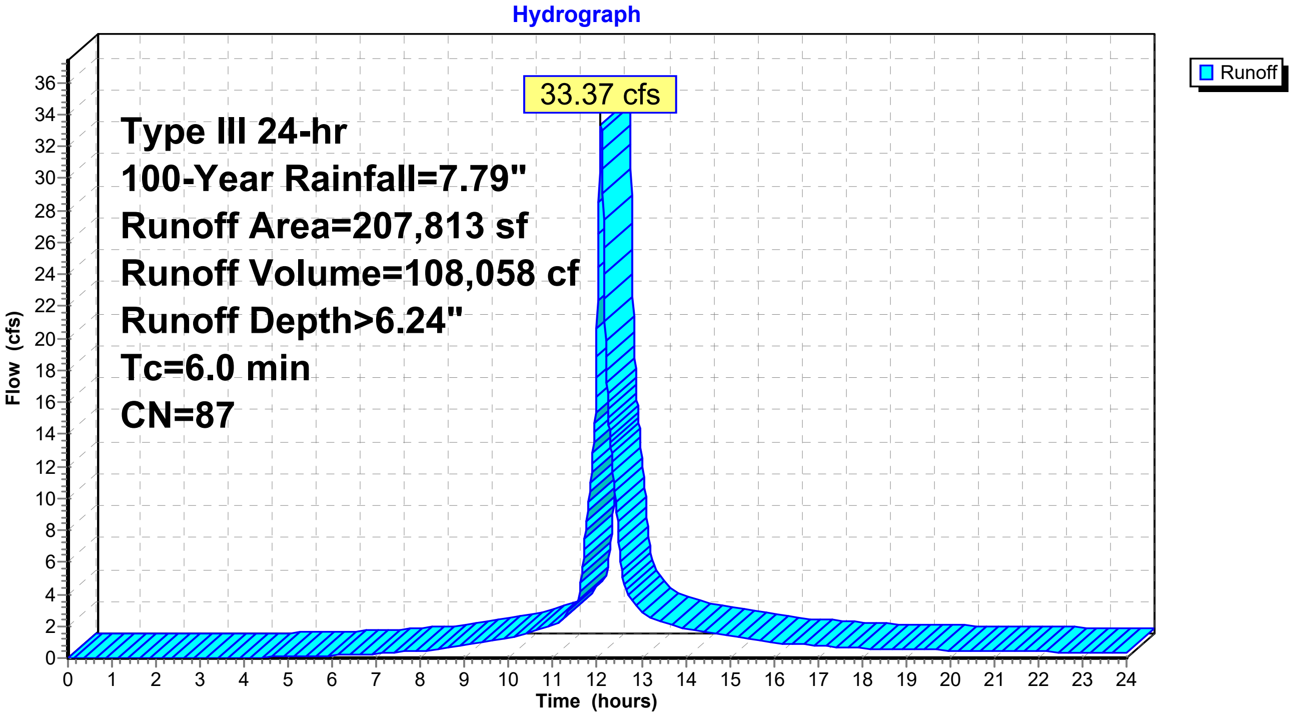
Runoff = 33.37 cfs @ 12.08 hrs, Volume= 108,058 cf, Depth> 6.24"
Routed to Pond 2P : SubSurface Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.79"

Area (sf)	CN	Description
61,911	61	>75% Grass cover, Good, HSG B
62,853	98	Roofs, HSG B
83,049	98	Paved parking, HSG B
207,813	87	Weighted Average
61,911		29.79% Pervious Area
145,902		70.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5B: Subsurface Drainage



Summary for Pond 1P: SubSurface Sys 1

```
Inflow Area =        137,534 sf, 78.66% Impervious,  Inflow Depth >  6.59"   for 100-Year event
Inflow      =      22.88 cfs @  12.08 hrs,  Volume=          75,565 cf
Outflow     =      20.63 cfs @  12.12 hrs,  Volume=          69,366 cf,  Atten= 10%,  Lag= 2.3 min
Discarded   =       0.50 cfs @   8.61 hrs,  Volume=          31,352 cf
Primary     =      20.13 cfs @  12.12 hrs,  Volume=          38,015 cf
   Routed to Link 3L : Combined Flow Rear Pond

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 349.33' @ 12.12 hrs   Surf.Area= 8,982 sf   Storage= 18,001 cf

Plug-Flow detention time= 99.6 min calculated for 69,337 cf (92% of inflow)
Center-of-Mass det. time= 57.7 min ( 833.8 - 776.1 )

Volume     Invert    Avail.Storage   Storage Description
  #1A     346.25'         7,944 cf   44.25'W x 202.98'L x 3.50'H Field A
                                     31,436 cf Overall - 11,577 cf Embedded = 19,859 cf  x 40.0% Voids
  #2A     346.75'        11,577 cf   ADS_StormTech SC-740 +Cap x 252  Inside #1
                                     Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                     Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                     252 Chambers in 9 Rows
                         19,521 cf   Total Available Storage

   Storage Group A created with Chamber Wizard

Device   Routing        Invert   Outlet Devices
  #1     Discarded     346.25'   2.410 in/hr Exfiltration over Surface area
  #2     Primary       346.75'   18.0"  Round Culvert X 2.00
                                 L= 50.0'   CPP, square edge headwall,  Ke= 0.500
                                 Inlet / Outlet Invert= 346.75' / 346.25'   S= 0.0100 '/'   Cc= 0.900
                                 n= 0.012,  Flow Area= 1.77 sf
  #3     Primary       347.95'   8.0" Vert. Orifice/Grate X 6.00   C= 0.600
                                 Limited to weir flow at low heads
  #4     Device 2      348.85'   10.0' long  x 0.5' breadth Broad-Crested Rectangular Weir
                                 Head (feet)  0.20  0.40  0.60  0.80  1.00
                                 Coef. (English)  2.80  2.92  3.08  3.30  3.32

Discarded OutFlow  Max=0.50 cfs @ 8.61 hrs  HW=346.29'   (Free Discharge)
└─1=Exfiltration  (Exfiltration Controls 0.50 cfs)

Primary OutFlow  Max=20.08 cfs @ 12.12 hrs  HW=349.33'   (Free Discharge)
├─2=Culvert  (Passes 9.79 cfs of 23.00 cfs potential flow)
│ └─4=Broad-Crested Rectangular Weir (Weir Controls 9.79 cfs @ 2.06 fps)
└─3=Orifice/Grate  (Orifice Controls 10.30 cfs @ 4.92 fps)
```

Pond 1P: SubSurface Sys 1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

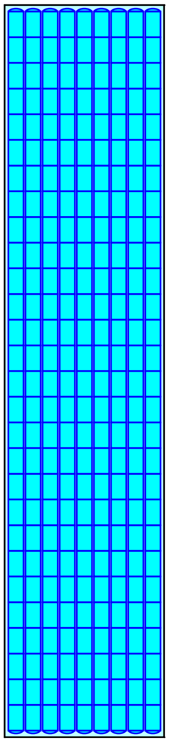
28 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 200.98' Row Length +12.0" End Stone x 2 = 202.98' Base Length
9 Rows x 51.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 44.25' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

252 Chambers x 45.9 cf = 11,576.9 cf Chamber Storage

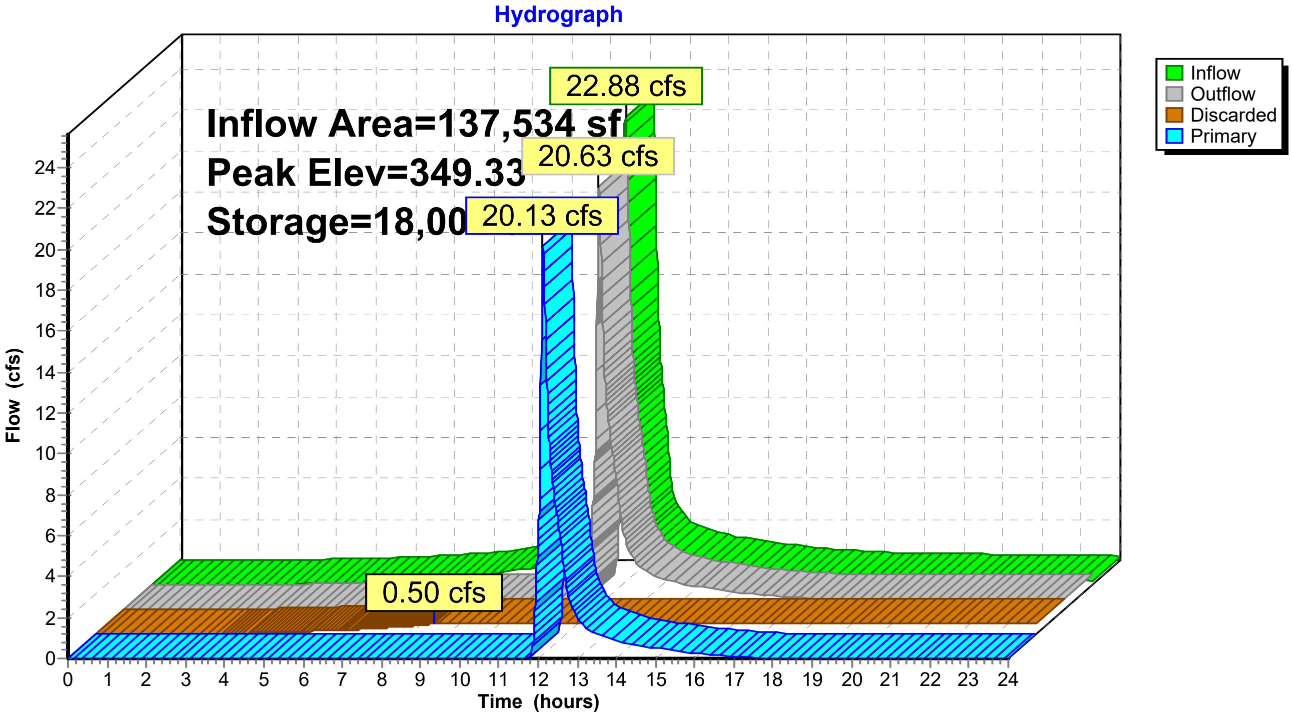
31,436.0 cf Field - 11,576.9 cf Chambers = 19,859.1 cf Stone x 40.0% Voids = 7,943.7 cf Stone Storage

Chamber Storage + Stone Storage = 19,520.5 cf = 0.448 af
Overall Storage Efficiency = 62.1%
Overall System Size = 202.98' x 44.25' x 3.50'

252 Chambers
1,164.3 cy Field
735.5 cy Stone



Pond 1P: SubSurface Sys 1



Summary for Pond 2P: SubSurface Sys 2

```
Inflow Area =        207,813 sf,  70.21% Impervious,  Inflow Depth >   6.24"    for  100-Year event
Inflow      =      33.37 cfs @   12.08 hrs,  Volume=          108,058 cf
Outflow     =      16.99 cfs @   12.22 hrs,  Volume=          108,035 cf,  Atten= 49%,  Lag= 8.4 min
Discarded  =        2.31 cfs @   11.18 hrs,  Volume=           72,570 cf
Primary     =      14.67 cfs @   12.22 hrs,  Volume=           35,465 cf
    Routed to Link 4L : Combined to Great Brook

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 341.67' @ 12.22 hrs   Surf.Area= 12,084 sf   Storage= 25,238 cf

Plug-Flow detention time= 26.0 min calculated for 107,990 cf (100% of inflow)
Center-of-Mass det. time= 25.8 min ( 811.1 - 785.2 )

Volume       Invert    Avail.Storage   Storage Description
   #1A      338.40'        10,633 cf   87.00'W x 138.90'L x 3.50'H Field A
                                       42,294 cf Overall - 15,711 cf Embedded = 26,583 cf  x 40.0% Voids
   #2A      338.90'        15,711 cf   ADS_StormTech SC-740 +Cap x 342  Inside #1
                                       Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                       Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                       342 Chambers in 18 Rows
                           26,345 cf   Total Available Storage

    Storage Group A created with Chamber Wizard

Device   Routing        Invert   Outlet Devices
   #1    Discarded     338.40'   8.270 in/hr Exfiltration over Surface area
   #2    Primary       338.90'   18.0"  Round Culvert X 2.00
                                 L= 50.0'   CPP, square edge headwall,  Ke= 0.500
                                 Inlet / Outlet Invert= 338.90' / 338.40'   S= 0.0100 '/'   Cc= 0.900
                                 n= 0.012,  Flow Area= 1.77 sf
   #3    Device 2      339.38'   6.0" Vert. Orifice/Grate X 6.00   C= 0.600
                                 Limited to weir flow at low heads
   #4    Device 2      341.30'   10.0' long  x 0.5' breadth Broad-Crested Rectangular Weir
                                 Head (feet)  0.20  0.40  0.60  0.80  1.00
                                 Coef. (English)  2.80  2.92  3.08  3.30  3.32

Discarded OutFlow Max=2.31 cfs @ 11.18 hrs  HW=338.44'   (Free Discharge)
└─1=Exfiltration  (Exfiltration Controls 2.31 cfs)

Primary OutFlow Max=14.64 cfs @ 12.22 hrs  HW=341.67'   (Free Discharge)
└─2=Culvert  (Passes 14.64 cfs of 24.19 cfs potential flow)
   ├─3=Orifice/Grate  (Orifice Controls 8.10 cfs @ 6.88 fps)
   └─4=Broad-Crested Rectangular Weir (Weir Controls 6.54 cfs @ 1.77 fps)
```

Pond 2P: SubSurface Sys 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

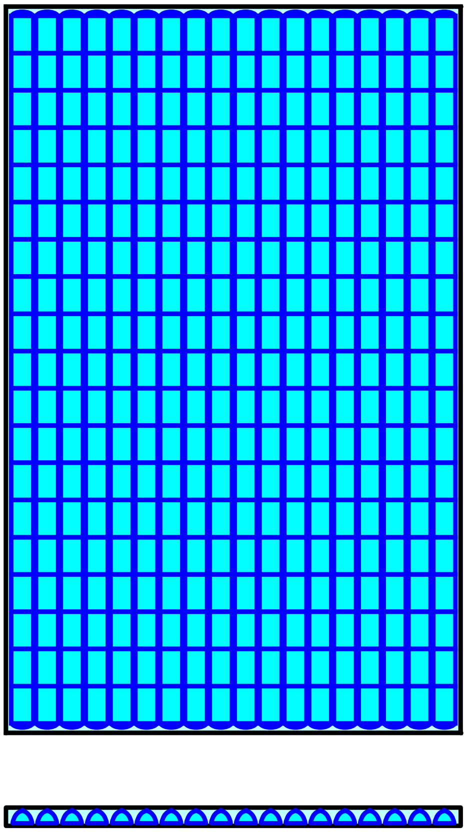
19 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 136.90' Row Length +12.0" End Stone x 2 = 138.90' Base Length
18 Rows x 51.0" Wide + 6.0" Spacing x 17 + 12.0" Side Stone x 2 = 87.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

342 Chambers x 45.9 cf = 15,711.5 cf Chamber Storage

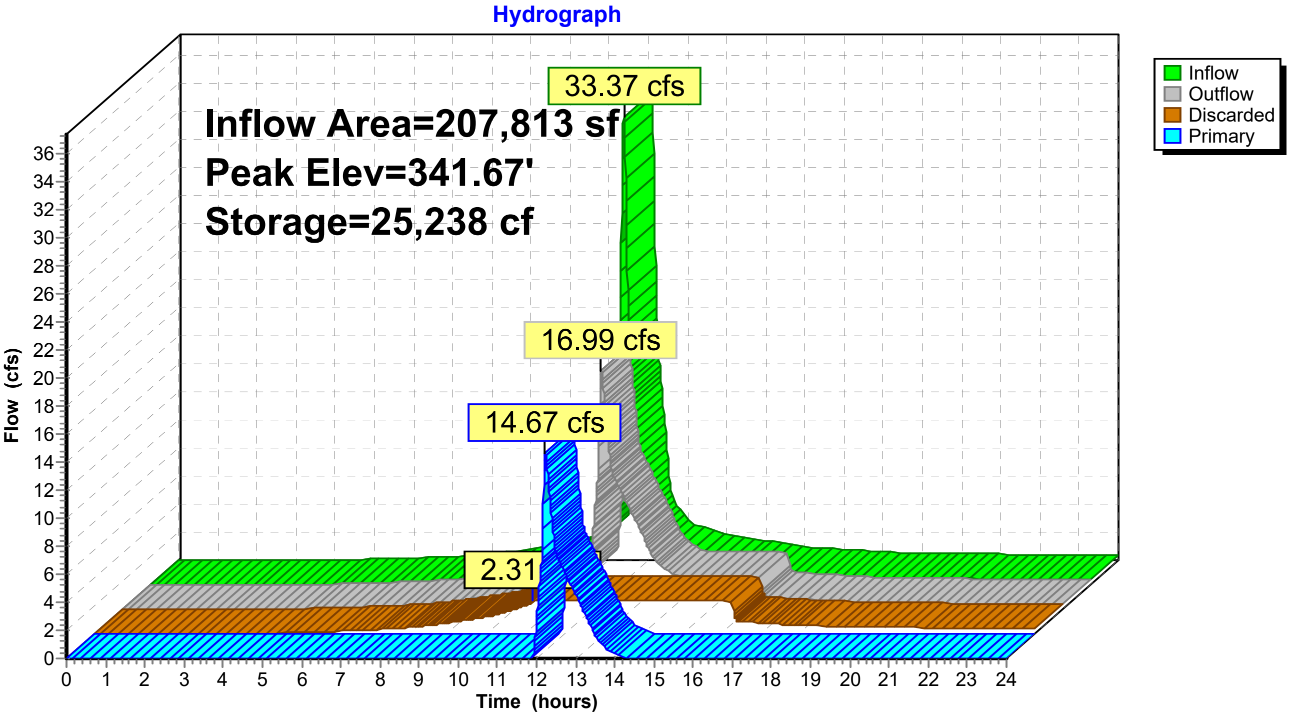
42,294.0 cf Field - 15,711.5 cf Chambers = 26,582.5 cf Stone x 40.0% Voids = 10,633.0 cf Stone Storage

Chamber Storage + Stone Storage = 26,344.5 cf = 0.605 af
Overall Storage Efficiency = 62.3%
Overall System Size = 138.90' x 87.00' x 3.50'

342 Chambers
1,566.4 cy Field
984.5 cy Stone



Pond 2P: SubSurface Sys 2

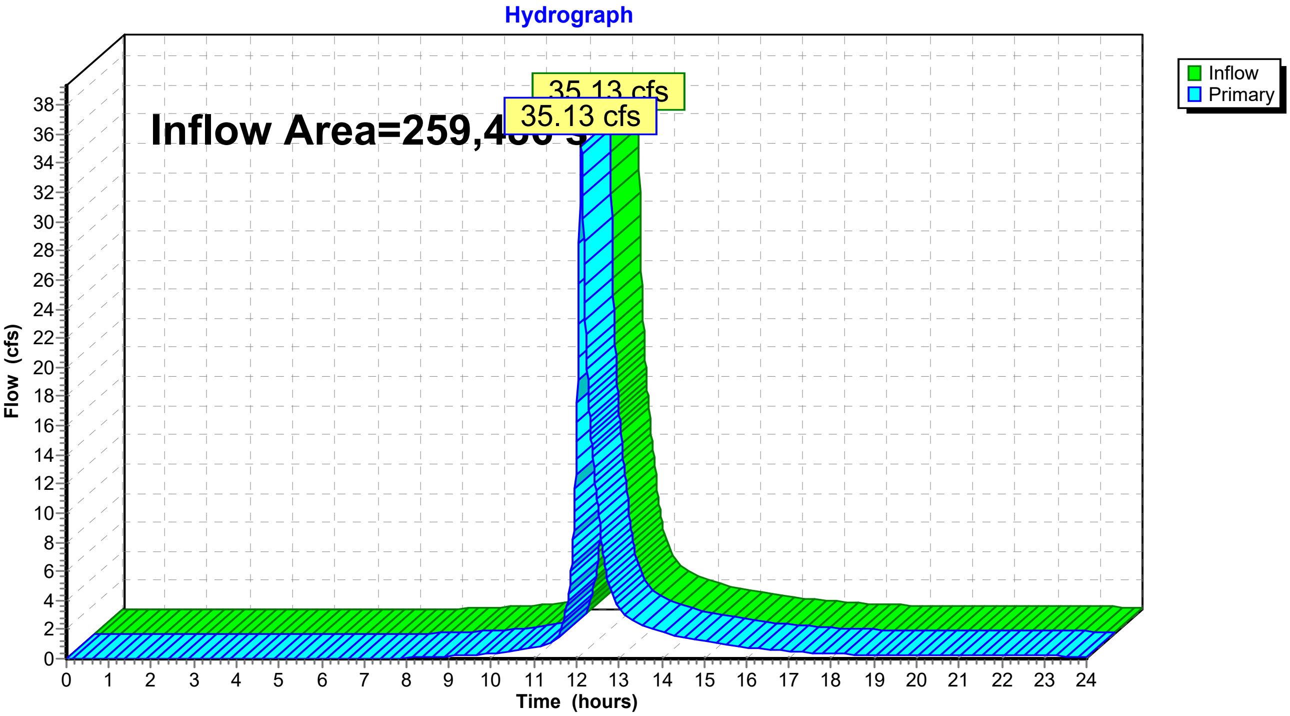


Summary for Link 3L: Combined Flow Rear Pond

```
Inflow Area =        259,486 sf,  61.30% Impervious,  Inflow Depth >   4.04"    for  100-Year event
Inflow      =       35.13 cfs @   12.11 hrs,  Volume=          87,274 cf
Primary     =       35.13 cfs @   12.11 hrs,  Volume=          87,274 cf,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 3L: Combined Flow Rear Pond

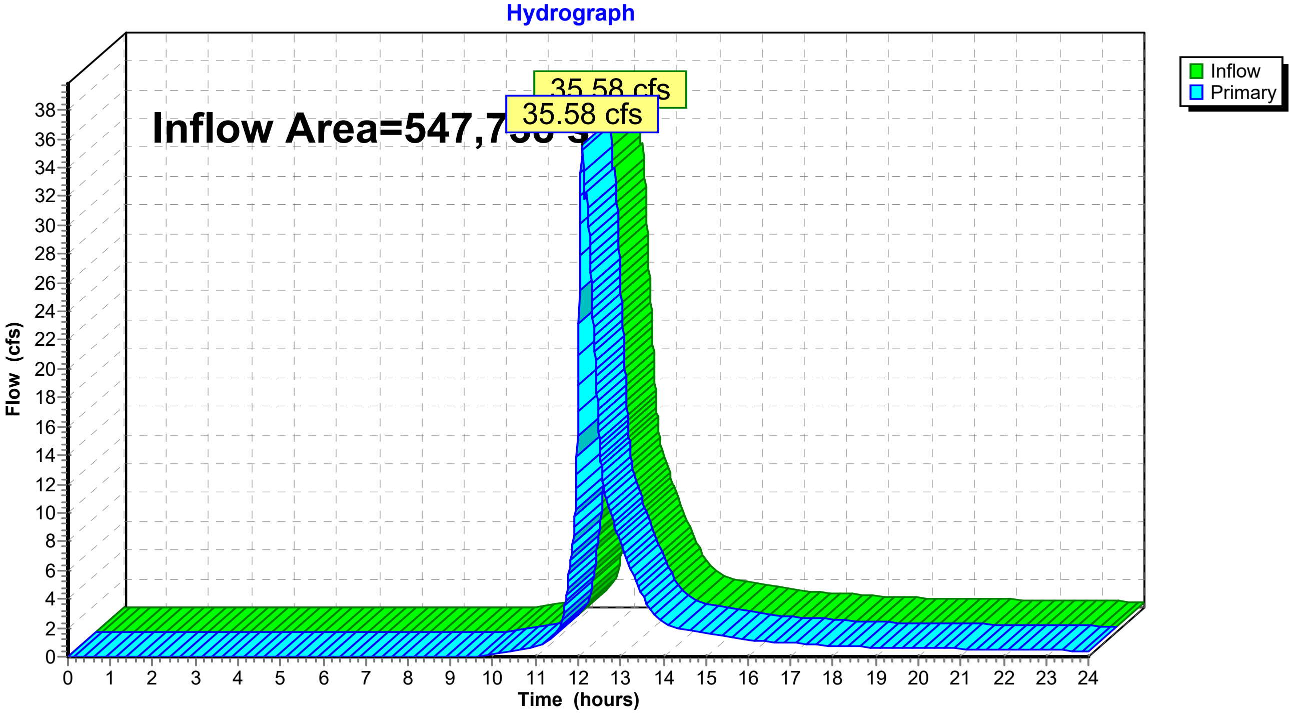


Summary for Link 4L: Combined to Great Brook

Inflow Area = 547,738 sf, 28.45% Impervious, Inflow Depth > 2.81" for 100-Year event
Inflow = 35.58 cfs @ 12.10 hrs, Volume= 128,405 cf
Primary = 35.58 cfs @ 12.10 hrs, Volume= 128,405 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 4L: Combined to Great Brook



SIMPLE DYNAMIC METHOD HYDROCAD MODEL

The Required Recharge Volume was done in accordance with the Massachusetts Stormwater Handbook, Volume 3 Chapter 1 – Documenting Compliance with the Massachusetts Stormwater Management Standards for the Simple Dynamic Method.

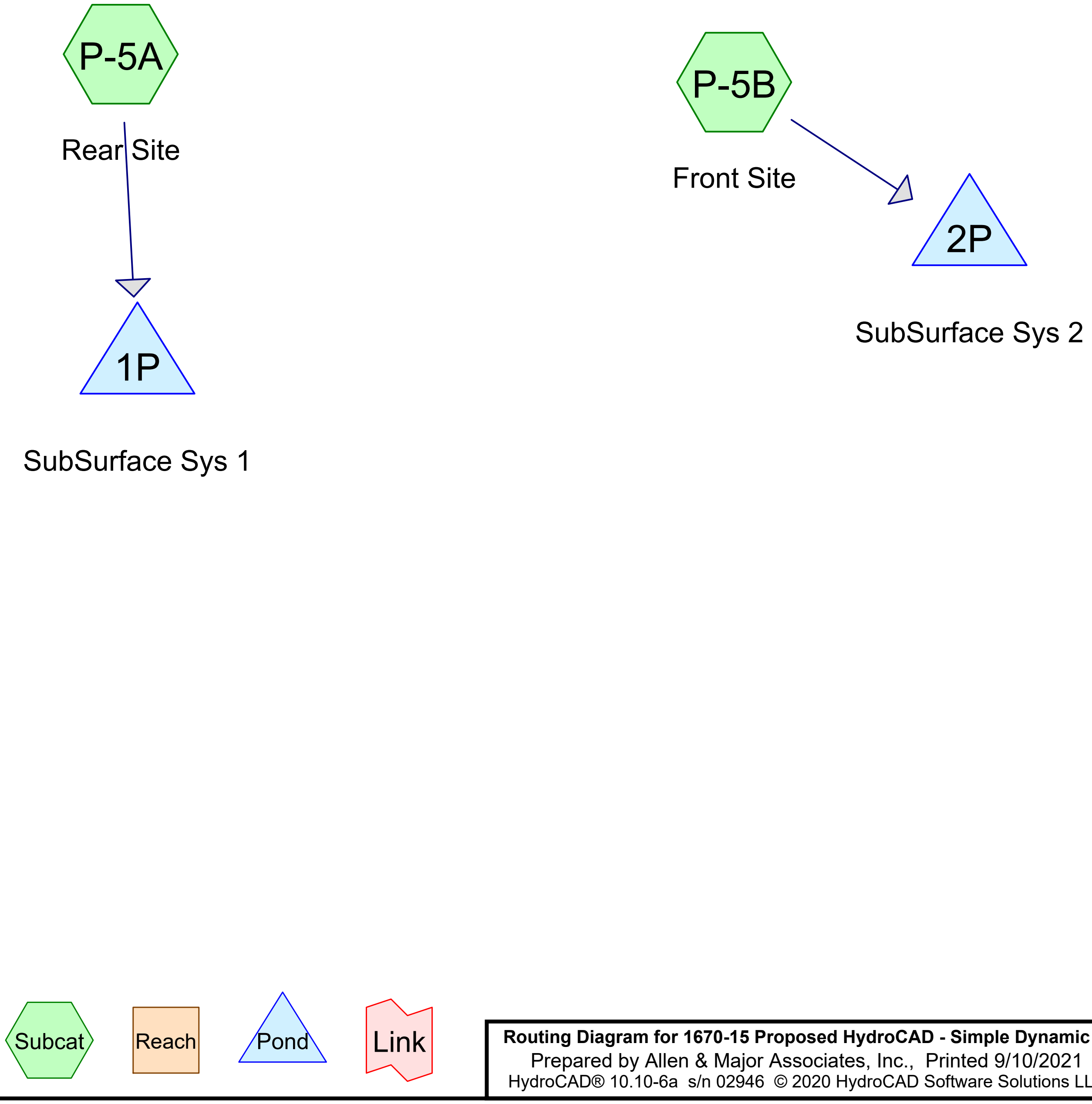
To size an infiltration BMP using the "Simple Dynamic" Method, applicants may also use a computer model based on TR-20 as described below. As more fully set forth below, this computer model assumes that the Required Water Quality Volume is entering the infiltration BMP during the peak two hours of the storm and that runoff is being discharged from the BMP during the same two hour period at the Rawls Rate. This contemporaneous exfiltration allows a proponent to reduce the size of the infiltration BMP.

a. *Use Equation 1 (Rv=F x impervious area) to determine the Required Recharge Volume*
b. *Select a 24-hour rainfall event that generates the Required Recharge Volume during the peak 2 hours. Use only the Site's impervious drainage area and the default NRCS Initial Abstraction of 0.2S and Type III storm. Set the storm duration for 24 hours, but use a start time of 11 hours and an end time of 13 hours. This creates a truncated hydrograph where most of the rainfall typical of a 24-hour Type III Storm occurs in just 2 hours. Selecting the correct precipitation depth is an iterative process. Various precipitation depths must be tested to determine which depth generates the Required Recharge Volume, using the Win TR-20 method (or other software based on TR-20). Each precipitation depth evaluated generates a runoff hydrograph. The area under the hydrograph is a volume. The correct result is achieved when the volume under the inflow hydrograph equals the Required Recharge Volume.*
c. *Using the resulting inflow hydrograph, choose an appropriate exfiltration structure with an appropriate bottom area and storage volume.*[1]
d. *Use recharge system bottom as maximum infiltrative surface area. Do not use sidewalls.*[2]
e. *Assume stormwater exfiltrates from the device over the peak 2-hour period of the rainfall event determined in step b above*
f. *Set exfiltration rates no higher than the Rawls Rates for the corresponding soil at the specific location where infiltration is proposed (see Table 2.3.3).*
g. *Assume exfiltration rate is constant.*
h. *Using the computer model, confirm adequate Storage Volume.*
i. *Go to STEP 5 to confirm that the bottom of the proposed infiltration BMP is large enough to ensure that the practice will drain completely in 72 hours or less. For purposes of the STEP 5 evaluation, assume the exfiltration rates are no higher than the Rawls Rates*

---

[1] An applicant may have to select several different size infiltration structures before s/he identifies a structure that is adequately sized.

[2] If the recharge system includes stone or other media, remember that the effective storage volume only includes the voids between the stone or other media.



Routing Diagram for 1670-15 Proposed HydroCAD - Simple Dynamic Tes
Prepared by Allen & Major Associates, Inc., Printed 9/10/2021
HydroCAD® 10.10-6a s/n 02946 © 2020 HydroCAD Software Solutions LLC

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 4092 MA Essex Essex County
Rainfall events imported from "NRCS-Rain.txt" for 4165 MA Manchester Essex County

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
57,049	98	Imp Area - Half from Front (P-5B)
57,049	98	Imp Surface - half from front (P-5A)
145,902	98	Impervious Areas (P-5B)
108,186	98	Impervious Surfaces (P-5A)
368,186	**98**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
0	HSG D	
368,186	Other	P-5A, P-5B
368,186		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	S N
0	0	0	0	57,049	57,049	Imp Area - Half from Front	
0	0	0	0	57,049	57,049	Imp Surface - half from front	
0	0	0	0	145,902	145,902	Impervious Areas	
0	0	0	0	108,186	108,186	Impervious Surfaces	
0	**0**	**0**	**0**	**368,186**	**368,186**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1P	346.75	346.25	50.0	0.0100	0.012	0.0	18.0	0.0
2	2P	338.90	338.40	50.0	0.0100	0.012	0.0	18.0	0.0

Time span=11.00-13.00 hrs, dt=0.01 hrs, 201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-5A: Rear Site Runoff Area=165,235 sf 100.00% Impervious Runoff Depth>1.00"
Tc=6.0 min CN=98 Runoff=7.54 cfs 13,802 cf

Subcatchment P-5B: Front Site Runoff Area=202,951 sf 100.00% Impervious Runoff Depth>1.00"
Tc=6.0 min CN=98 Runoff=9.26 cfs 16,953 cf

Pond 1P: SubSurface Sys 1 Peak Elev=347.91' Storage=10,279 cf Inflow=7.54 cfs 13,802 cf
Discarded=0.50 cfs 3,521 cf Primary=0.00 cfs 0 cf Outflow=0.50 cfs 3,521 cf

Pond 2P: SubSurface Sys 2 Peak Elev=339.27' Storage=6,148 cf Inflow=9.26 cfs 16,953 cf
Discarded=2.31 cfs 13,073 cf Primary=0.00 cfs 0 cf Outflow=2.31 cfs 13,073 cf

Total Runoff Area = 368,186 sf Runoff Volume = 30,755 cf Average Runoff Depth = 1.00"
0.00% Pervious = 0 sf 100.00% Impervious = 368,186 sf

Summary for Subcatchment P-5A: Rear Site

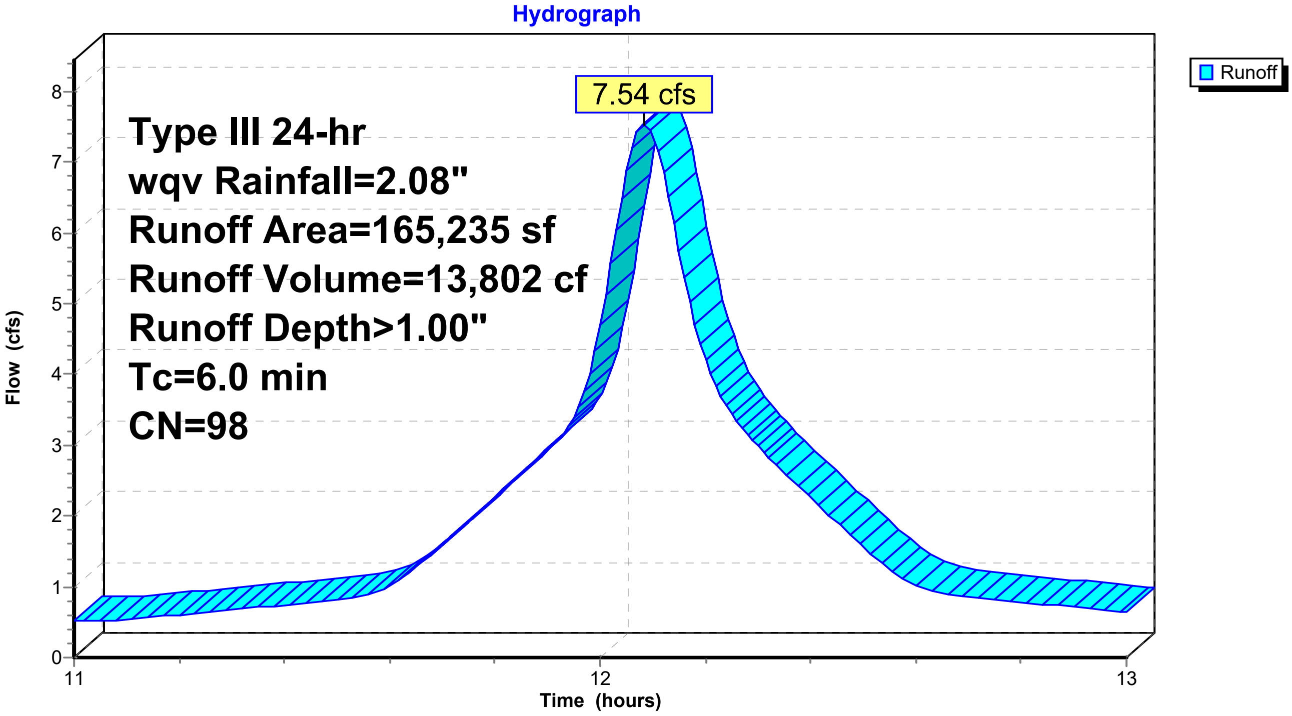
Runoff = 7.54 cfs @ 12.08 hrs, Volume= 13,802 cf, Depth> 1.00"
Routed to Pond 1P : SubSurface Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Type III 24-hr wqv Rainfall=2.08"

	Area (sf)	CN	Description
*	108,186	98	Impervious Surfaces
*	57,049	98	Imp Surface - half from front
	165,235	98	Weighted Average
	165,235		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5A: Rear Site



Summary for Subcatchment P-5B: Front Site

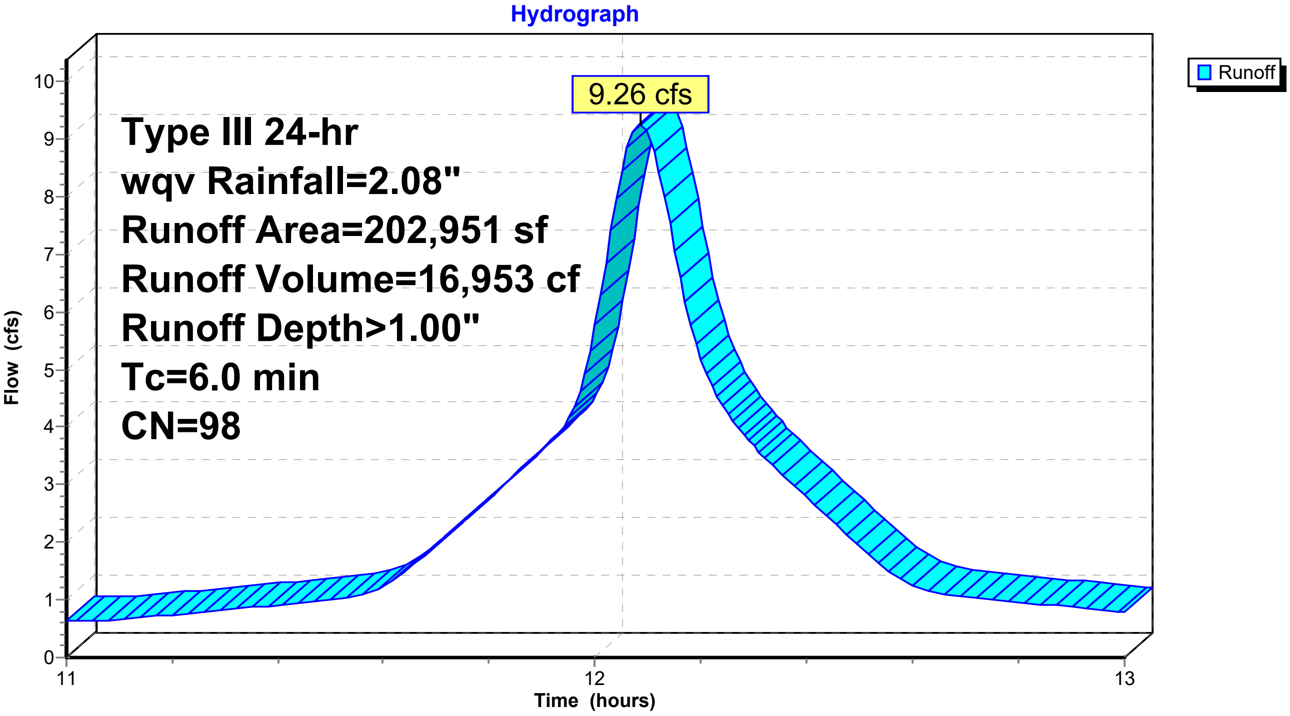
Runoff = 9.26 cfs @ 12.08 hrs, Volume= 16,953 cf, Depth> 1.00"
Routed to Pond 2P : SubSurface Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Type III 24-hr wqv Rainfall=2.08"

	Area (sf)	CN	Description
*	145,902	98	Impervious Areas
*	57,049	98	Imp Area - Half from Front
	202,951	98	Weighted Average
	202,951		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5B: Front Site



Summary for Pond 1P: SubSurface Sys 1

[82] Warning: Early inflow requires earlier time span

Inflow Area = 165,235 sf,100.00% Impervious, Inflow Depth > 1.00" for wqv event
Inflow = 7.54 cfs @ 12.08 hrs, Volume= 13,802 cf
Outflow = 0.50 cfs @ 11.17 hrs, Volume= 3,521 cf, Atten= 93%, Lag= 0.0 min
Discarded = 0.50 cfs @ 11.17 hrs, Volume= 3,521 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf
Routed to nonexistent node 3L

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Peak Elev= 347.91' @ 13.00 hrs Surf.Area= 8,982 sf Storage= 10,279 cf

Plug-Flow detention time= 26.6 min calculated for 3,495 cf (25% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1A	346.25'	7,944 cf	**44.25'W x 202.98'L x 3.50'H Field A** 31,436 cf Overall - 11,577 cf Embedded = 19,859 cf x 40.0% Voids
#2A	346.75'	11,577 cf	**ADS_StormTech SC-740 +Cap** x 252 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 252 Chambers in 9 Rows
		19,521 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	346.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	346.75'	**18.0" Round Culvert X 2.00** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 346.75' / 346.25' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Primary	347.95'	**8.0" Vert. Orifice/Grate X 6.00** C= 0.600 Limited to weir flow at low heads
#4	Device 2	348.85'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.50 cfs @ 11.17 hrs HW=346.29' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.50 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=346.25' (Free Discharge)
├─**2=Culvert** (Controls 0.00 cfs)
│ └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 1P: SubSurface Sys 1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

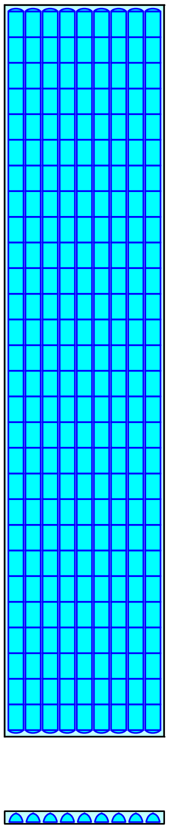
28 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 200.98' Row Length +12.0" End Stone x 2 = 202.98' Base Length
9 Rows x 51.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 44.25' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

252 Chambers x 45.9 cf = 11,576.9 cf Chamber Storage

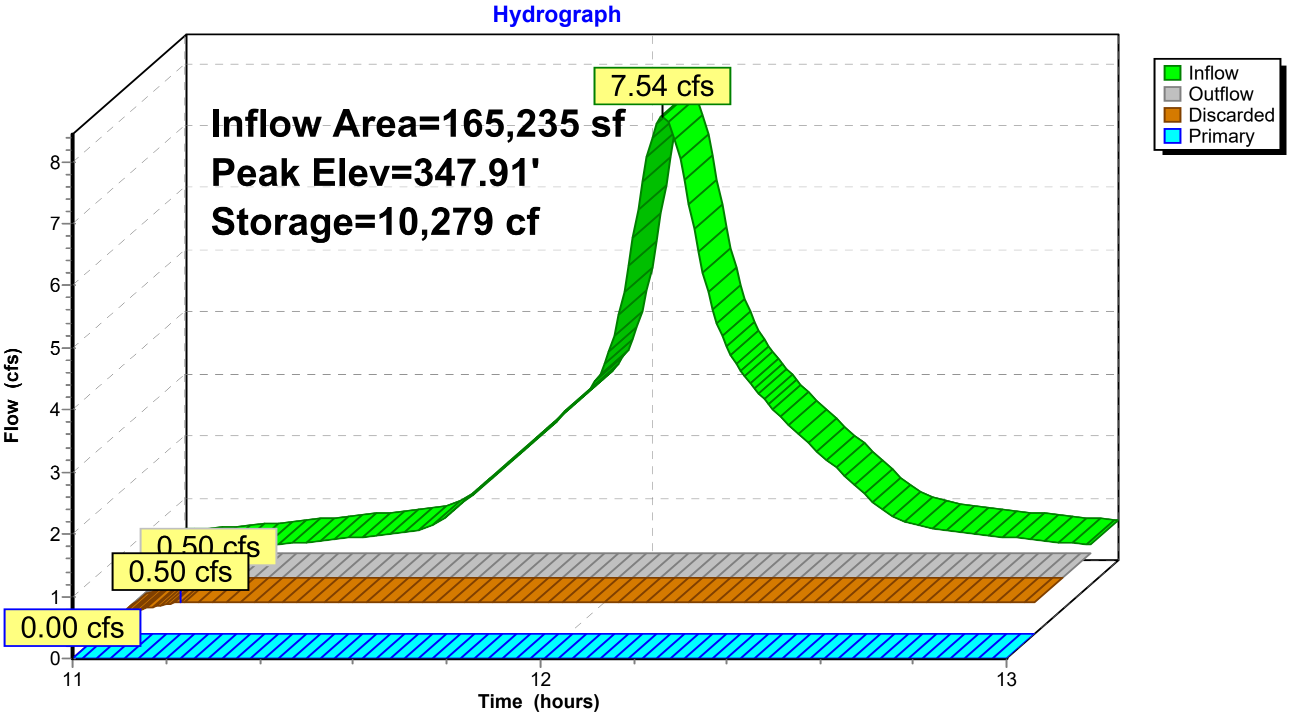
31,436.0 cf Field - 11,576.9 cf Chambers = 19,859.1 cf Stone x 40.0% Voids = 7,943.7 cf Stone Storage

Chamber Storage + Stone Storage = 19,520.5 cf = 0.448 af
Overall Storage Efficiency = 62.1%
Overall System Size = 202.98' x 44.25' x 3.50'

252 Chambers
1,164.3 cy Field
735.5 cy Stone



Pond 1P: SubSurface Sys 1



Summary for Pond 2P: SubSurface Sys 2

[82] Warning: Early inflow requires earlier time span

Inflow Area = 202,951 sf,100.00% Impervious, Inflow Depth > 1.00" for wqv event
Inflow = 9.26 cfs @ 12.08 hrs, Volume= 16,953 cf
Outflow = 2.31 cfs @ 11.77 hrs, Volume= 13,073 cf, Atten= 75%, Lag= 0.0 min
Discarded = 2.31 cfs @ 11.77 hrs, Volume= 13,073 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf
Routed to nonexistent node 4L

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Peak Elev= 339.27' @ 12.45 hrs Surf.Area= 12,084 sf Storage= 6,148 cf

Plug-Flow detention time= 15.8 min calculated for 12,999 cf (77% of inflow)
Center-of-Mass det. time= 7.2 min (731.5 - 724.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	338.40'	10,633 cf	**87.00'W x 138.90'L x 3.50'H Field A** 42,294 cf Overall - 15,711 cf Embedded = 26,583 cf x 40.0% Voids
#2A	338.90'	15,711 cf	**ADS_StormTech SC-740 +Cap** x 342 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 342 Chambers in 18 Rows
		26,345 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.40'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	338.90'	**18.0" Round Culvert X 2.00** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 338.90' / 338.40' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	339.30'	**8.0" Vert. Orifice/Grate X 6.00** C= 0.600 Limited to weir flow at low heads
#4	Device 2	341.20'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=2.31 cfs @ 11.77 hrs HW=338.44' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 2.31 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=338.40' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: SubSurface Sys 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

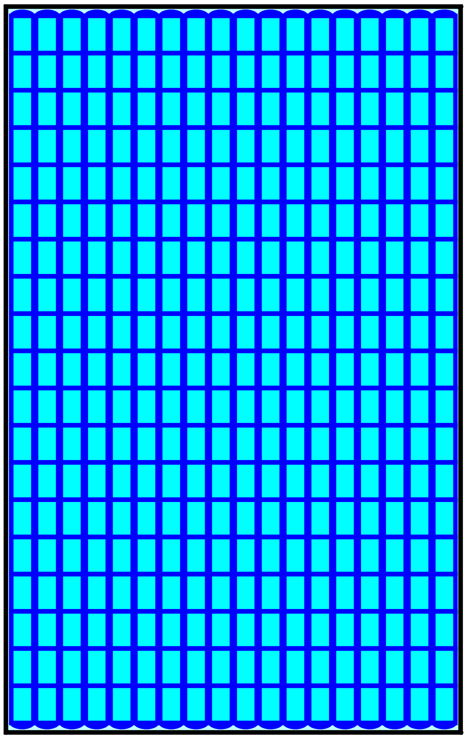
19 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 136.90' Row Length +12.0" End Stone x 2 = 138.90' Base Length
18 Rows x 51.0" Wide + 6.0" Spacing x 17 + 12.0" Side Stone x 2 = 87.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

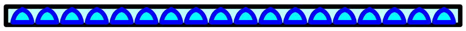
342 Chambers x 45.9 cf = 15,711.5 cf Chamber Storage

42,294.0 cf Field - 15,711.5 cf Chambers = 26,582.5 cf Stone x 40.0% Voids = 10,633.0 cf Stone Storage

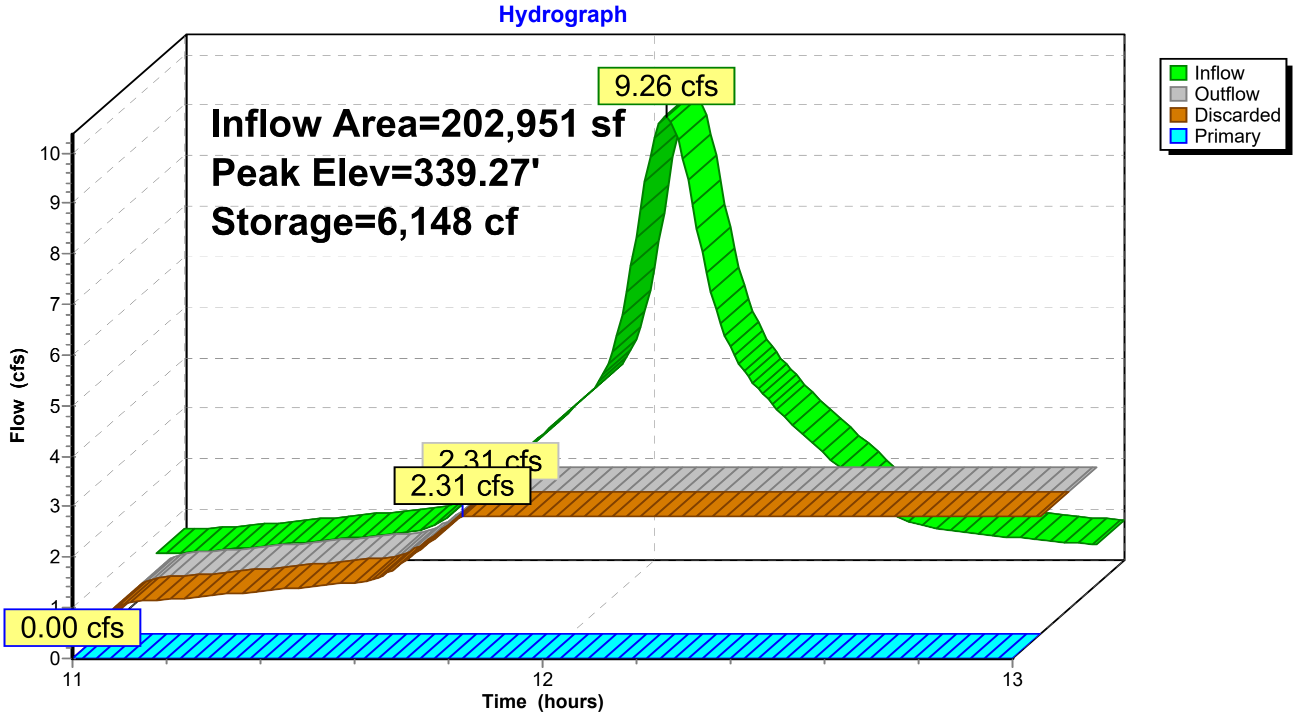
Chamber Storage + Stone Storage = 26,344.5 cf = 0.605 af
Overall Storage Efficiency = 62.3%
Overall System Size = 138.90' x 87.00' x 3.50'

342 Chambers
1,566.4 cy Field
984.5 cy Stone





Pond 2P: SubSurface Sys 2



APPENDIX E

SUPPORTING INFORMATION

ILLICIT DISCHARGE STATEMENT

Project: Multi-Family Residential Development
ALTA Nashoba Valley
580 Main Street
Bolton, MA

Date: September 10, 2021

The stormwater management system proposed shall not be connected to the wastewater management system and shall not be contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease per Massachusetts DEP stormwater standard 10.

Engineer:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, MA 02347

Print Name

Signature

Owner:
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PIPE SIZING

ALLEN & MAJOR
ASSOCIATES, INC.

DESIGN YEAR: 25.00
K= 230.00 B= 30

Title ***Stormwater Conveyance Sizing (25 YEAR STORM)***
Project ***Multi-Family Development - Bolton, MA***
Date 09-10-2021
A&M Project Number: 1670-15

Minimum Slope: 0.005
Minimum Size: 12.000 inch
Rainfall Intensity (in/hr): 6.389 (25 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.000 fps
Max. Velocity: 12.000 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
To Sub-Surface System No. 1																
PCB 14A	PDMH 14	85.2	349.69	349.26	0.50	CIRCULAR	12	0.012	0.66	0 00:06	4.08	0.35	2.73	0.24	0.33	OK
PCB 14B	PDMH 14	7.2	349.30	349.26	0.50	CIRCULAR	12	0.012	0.93	0 00:06	3.15	0.04	2.74	0.34	0.40	OK
PDMH 14	PDMH 15	106.7	349.26	348.73	0.50	CIRCULAR	12	0.012	1.55	0 00:06	3.64	0.49	2.73	0.57	0.54	OK
PCB 15A	PDMH 15	8.2	348.77	348.73	0.50	CIRCULAR	12	0.012	0.87	0 00:06	3.09	0.04	2.73	0.32	0.39	OK
GA ROOF	PDMH 15	10.9	349.34	349.23	1.00	CIRCULAR	6	0.012	0.41	0 00:06	3.32	0.05	0.61	0.67	0.30	OK
PDMH 15	PDMH 16	96.6	348.63	348.15	0.50	CIRCULAR	15	0.012	2.74	0 00:06	4.18	0.39	4.95	0.55	0.66	OK
PCB 16A	PDMH 16	13.4	348.53	348.40	1.00	CIRCULAR	12	0.012	0.97	0 00:06	4.10	0.05	3.86	0.25	0.34	OK
PDMH 16	PDMH 17	93.4	348.15	347.68	0.50	CIRCULAR	15	0.012	3.64	0 00:06	4.45	0.35	4.95	0.74	0.80	OK
PCB 17A	PDMH 17	3.1	348.21	348.18	0.98	CIRCULAR	12	0.012	1.01	0 00:06	4.12	0.01	3.83	0.26	0.35	OK
PDMH 17	PDMH 18	58.3	347.68	347.39	0.50	CIRCULAR	18	0.012	4.54	0 00:06	4.69	0.21	8.02	0.57	0.81	OK
B3 ROOF	PDMH 18	56.0	348.66	348.38	0.50	CIRCULAR	12	0.012	1.76	0 00:06	4.89	0.19	2.73	0.65	0.58	OK
PCB 18A	PDMH 18	5.4	348.41	348.38	0.50	CIRCULAR	12	0.012	0.36	0 00:06	2.41	0.04	2.73	0.13	0.24	OK
PCB 18B	PDMH 18	103.9	348.90	348.38	0.50	CIRCULAR	12	0.012	1.12	0 00:06	4.76	0.36	2.73	0.41	0.44	OK
PDMH 18	PDMH 19	94.7	347.39	347.10	0.31	CIRCULAR	24	0.012	7.59	0 00:06	4.47	0.35	13.59	0.56	1.07	OK
PCB 19A	PDMH 19	15.7	348.18	348.10	0.50	CIRCULAR	12	0.012	0.76	0 00:06	2.97	0.09	2.72	0.28	0.36	OK
PDMH 19	PDMH 20	93.5	347.10	346.79	0.33	CIRCULAR	24	0.012	8.24	0 00:07	4.69	0.33	14.09	0.59	1.10	OK
PDMH 20	PDMH 20A	6.4	346.79	346.77	0.33	CIRCULAR	24	0.012	9.19	0 00:07	4.75	0.02	14.00	0.66	1.18	OK
PCB 20A	PDMH 20	28.1	347.93	347.79	0.50	CIRCULAR	12	0.012	1.08	0 00:06	3.29	0.14	2.73	0.40	0.44	OK
PDMH 20A	IR 1A	3.2	346.77	346.76	0.35	CIRCULAR	24	0.012	9.19	0 00:07	4.86	0.01	14.41	0.64	1.16	OK
PCB 21A	PDMH 21	37.5	347.70	347.51	0.50	CIRCULAR	12	0.012	1.69	0 00:06	3.71	0.17	2.73	0.62	0.57	OK
PDMH 21	IR 1C	5.1	346.79	346.76	0.50	CIRCULAR	24	0.012	1.68	0 00:06	3.50	0.02	17.33	0.10	0.42	OK
PCB 11B	PDMH 11	118.7	348.37	347.78	0.50	CIRCULAR	12	0.012	0.94	0 00:06	4.82	0.41	2.73	0.34	0.40	OK
PCB 11A	PDMH 11	9.1	347.82	347.78	0.50	CIRCULAR	12	0.012	0.75	0 00:06	2.97	0.05	2.73	0.28	0.36	OK
PDMH 11	PDMH 12	103.8	347.78	347.26	0.50	CIRCULAR	12	0.012	1.65	0 00:06	3.68	0.47	2.73	0.60	0.56	OK
PDMH 12	PDMH 13	107.8	347.26	346.92	0.32	CIRCULAR	15	0.012	1.63	0 00:07	3.10	0.58	3.93	0.41	0.56	OK
PDMH 13	IR 1D	4.8	346.80	346.76	0.83	CIRCULAR	24	0.012	1.63	0 00:07	4.15	0.02	22.36	0.07	0.36	OK
POCS 1A	PFES 1A	17.0	346.75	346.58	1.00	CIRCULAR	18	0.012	4.79	0 00:00	6.16	0.05	11.38	0.42	0.68	OK
POCS 1B	PFES 1B	14.9	346.75	346.60	1.00	CIRCULAR	18	0.012	4.79	0 00:00	6.16	0.04	11.38	0.42	0.68	OK

To Sub-Surface System No. 2																
PAD 3	PAD 3B	135.7	347.28	346.60	0.50	CIRCULAR	12	0.012	0.20	0 00:06	3.72	0.61	2.73	0.07	0.18	OK

AutoDesk Storm and Sanitary Analysis 2019

ALLEN & MAJOR
ASSOCIATES, INC.

DESIGN YEAR: **25.00**
K= 230.00 B= 30

Title ***Stormwater Conveyance Sizing (25 YEAR STORM)***
Project ***Multi-Family Development - Bolton, MA***
Date 09-10-2021
A&M Project Number: 1670-15

Minimum Slope: 0.005
Minimum Size: 12.000 inch
Rainfall Intensity (in/hr): 6.389 (25 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.000 fps
Max. Velocity: 12.000 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
PAD 3B	PDMH 3	61.3	346.50	346.19	0.50	CIRCULAR	12	0.012	0.33	0 00:06	2.36	0.43	2.73	0.12	0.23	OK
GB ROOF	PDMH 3	34.9	348.19	347.24	2.70	CIRCULAR	6	0.012	0.40	0 00:06	5.32	0.11	1.00	0.40	0.22	OK
PCB 3A	PDMH 3	6.3	346.50	346.44	1.00	CIRCULAR	12	0.012	1.09	0 00:06	4.22	0.02	3.86	0.28	0.36	OK
C1 ROOF	C1 WYE	31.9	346.64	346.00	2.01	CIRCULAR	6	0.012	0.29	0 00:06	4.41	0.12	0.86	0.33	0.20	OK
PDMH 3	PDMH 4	165.3	346.09	344.44	1.00	CIRCULAR	12	0.012	1.74	0 00:06	4.85	0.57	3.86	0.45	0.47	OK
PCB 4A	PDMH 4	4.2	345.50	345.46	1.00	CIRCULAR	12	0.012	1.77	0 00:06	4.81	0.01	3.86	0.46	0.47	OK
B1 ROOF	PDMH 4	50.4	347.05	344.29	5.48	CIRCULAR	12	0.012	3.66	0 00:06	10.93	0.08	9.04	0.41	0.44	OK
PDMH 4	PDMH 5	224.1	343.94	341.70	1.00	CIRCULAR	18	0.012	6.92	0 00:06	6.86	0.54	11.38	0.61	0.84	OK
B2C ROOF	PDMH 5	48.8	343.99	343.50	1.00	CIRCULAR	12	0.012	1.79	0 00:06	5.69	0.14	3.86	0.46	0.48	OK
PCB 5A	PDMH 5	3.4	342.27	342.20	1.99	CIRCULAR	12	0.012	2.39	0 00:06	6.71	0.01	5.45	0.44	0.46	OK
PDMH 5	PDMH 6	79.9	341.60	340.00	2.00	CIRCULAR	18	0.012	10.87	0 00:06	9.79	0.14	16.10	0.68	0.90	OK
PCB 6A	PDMH 6	13.0	340.57	340.50	0.50	CIRCULAR	12	0.012	1.02	0 00:06	3.23	0.07	2.73	0.38	0.42	OK
PDMH 6	PDMH 7	76.2	339.32	338.94	0.50	CIRCULAR	24	0.012	11.82	0 00:06	5.96	0.21	17.33	0.68	1.21	OK
PDMH 7	PDMH 7A	2.3	338.94	338.92	0.49	CIRCULAR	24	0.012	13.12	0 00:06	6.01	0.01	17.13	0.77	1.31	OK
PCB 7A	PDMH 7	3.1	340.00	339.94	2.01	CIRCULAR	12	0.012	1.43	0 00:06	5.86	0.01	5.47	0.26	0.35	OK
PDMH 7A	IR 2A	2.8	338.92	338.91	0.50	CIRCULAR	24	0.012	13.12	0 00:06	6.06	0.01	17.32	0.76	1.30	OK
PCB 10B	PDMH 10	8.3	344.08	344.00	1.00	CIRCULAR	12	0.012	0.53	0 00:06	3.45	0.04	3.86	0.14	0.25	OK
PCB 10A	PDMH 10	27.1	344.27	344.00	1.00	CIRCULAR	12	0.012	0.59	0 00:06	3.62	0.12	3.86	0.15	0.26	OK
PDMH 10	PDMH 9	147.8	343.27	340.31	2.00	CIRCULAR	12	0.012	2.87	0 00:06	7.11	0.35	5.46	0.53	0.51	OK
B2B ROOF	PDMH 9	39.1	340.51	340.31	0.50	CIRCULAR	12	0.012	0.00	0 00:00	0.00		2.73	0.00	0.00	OK
B2A ROOF	PDMH 10	30.0	344.60	344.00	2.00	CIRCULAR	12	0.012	1.80	0 00:06	6.27	0.08	5.46	0.33	0.40	OK
PCB 9A	PDMH 9	8.4	340.35	340.31	0.50	CIRCULAR	12	0.012	1.52	0 00:06	3.58	0.04	2.73	0.56	0.53	OK
PDMH 9	PDMH 8	62.1	340.06	339.69	0.60	CIRCULAR	15	0.012	4.32	0 00:06	4.93	0.21	5.40	0.80	0.85	OK
PDMH 8	PDMH 8A	1.5	339.44	339.43	0.53	CIRCULAR	18	0.012	5.85	0 00:06	5.09	0	8.30	0.70	0.93	OK
PCB 8A	PDMH 8	4.2	339.98	339.94	0.99	CIRCULAR	12	0.012	1.61	0 00:06	4.68	0.02	3.84	0.42	0.45	OK
PDMH 8A	IR 2B	3.4	338.93	338.91	0.50	CIRCULAR	24	0.012	5.85	0 00:06	4.99	0.01	17.41	0.34	0.80	OK
GC ROOF	PINF 2C	16.4	339.58	339.25	2.00	CIRCULAR	6	0.012	0.29	0 00:06	3.94	0.07	0.86	0.33	0.20	OK
POCS 2A	PFES 2A	35.1	338.90	338.55	1.00	CIRCULAR	18	0.012	3.04	0 00:01	5.45	0.11	11.38	0.27	0.53	OK
POCS 2B	PFES 2B	25.3	338.91	338.65	1.04	CIRCULAR	18	0.012	3.04	0 00:01	5.53	0.08	11.60	0.26	0.52	OK

To Existing Collection System																
ECB-1C	ECB 1A	38.0	348.29	346.69	4.21	CIRCULAR	12	0.012	0.10	0 00:06	3.89	0.16	7.92	0.01	0.08	OK

AutoDesk Storm and Sanitary Analysis 2019

ALLEN & MAJOR
ASSOCIATES, INC.

DESIGN YEAR: **25.00**
K= 230.00 B= 30

Title ***Stormwater Conveyance Sizing (25 YEAR STORM)***
Project ***Multi-Family Development - Bolton, MA***
Date 09-10-2021
A&M Project Number: 1670-15

Minimum Slope: 0.005
Minimum Size: 12.000 inch
Rainfall Intensity (in/hr): 6.389 (25 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.000 fps
Max. Velocity: 12.000 fps

From (Inlet) Node	**To (Outlet) Node**	**Length (ft)**	**Inlet Invert Elevation (ft)**	**Outlet Invert Elevation (ft)**	**Average Slope (%)**	**Pipe Shape**	**Pipe Diameter or Height (inches)**	**Manning's Roughness**	**Peak Flow (cfs)**	**Time of Peak Flow (days hh:mm)**	**Max Flow Velocity (ft/sec)**	**Travel Time (min)**	**Design Flow Capacity (cfs)**	**Max Flow / Design Flow Ratio**	**Max Flow Depth (ft)**	**Reported Condition**
ECB 1A	PDMH 1	35.8	346.50	346.14	1.00	CIRCULAR	12	0.012	1.63	0 00:06	4.72	0.13	3.86	0.42	0.45	OK
PCB 1B	PDMH 1	19.1	346.33	346.14	1.00	CIRCULAR	12	0.012	0.65	0 00:06	3.66	0.09	3.86	0.17	0.28	OK
M ROOF	PDMH 1	71.4	348.07	346.64	2.00	CIRCULAR	6	0.012	0.11	0 00:06	4.35	0.27	0.86	0.13	0.12	OK
PDMH 1	PDMH 2	152.4	345.89	345.13	0.50	CIRCULAR	15	0.012	2.32	0 00:06	4.05	0.63	4.95	0.47	0.60	OK
C2 ROOF	C2 WYE	7.4	346.65	346.50	2.00	CIRCULAR	6	0.012	0.46	0 00:06	4.45	0.03	0.86	0.53	0.26	OK
PCB 2A	PDMH 2	10.1	345.60	345.50	1.00	CIRCULAR	12	0.012	0.36	0 00:06	3.09	0.05	3.86	0.09	0.21	OK
PDMH 2	EDMH	105.6	345.00	344.47	0.50	CIRCULAR	15	0.012	2.63	0 00:07	4.14	0.43	4.95	0.53	0.65	OK

ALLEN & MAJOR
ASSOCIATES, INC.

Title ***Stormwater Conveyance Sizing (25 YEAR STORM)***
Project ***Multi-Family Development - Canton, MA***
Date 09-10-2021
A&M Project Number: 1670-15

Watershed	Drainage Node ID	Area (acres)	Weighted Runoff Coefficient	Accumulated Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Rainfall Intensity (inches/hr)	Time of Concentration (days hh:mm:ss)
1	PCB 14A	0.14	0.7500	0.64	0.48	0.67	6.389	0 00:06:00
2	PCB 14B	0.19	0.7700	0.64	0.49	0.94	6.389	0 00:06:00
3	PCB 15A	0.18	0.7600	0.64	0.49	0.87	6.389	0 00:06:00
4	PCB 16A	0.21	0.7300	0.64	0.47	0.98	6.389	0 00:06:00
5	PCB 17A	0.23	0.6900	0.64	0.44	1.01	6.389	0 00:06:00
6	PCB 18A	0.07	0.8100	0.64	0.52	0.36	6.389	0 00:06:00
7	PCB 11B	0.22	0.6900	0.64	0.44	0.97	6.389	0 00:06:00
8	PCB 11A	0.16	0.7400	0.64	0.47	0.76	6.389	0 00:06:00
9	PCB 18B	0.25	0.7200	0.64	0.46	1.15	6.389	0 00:06:00
10	PCB 19A	0.17	0.7000	0.64	0.45	0.76	6.389	0 00:06:00
11	PCB 20A	0.23	0.7400	0.64	0.47	1.09	6.389	0 00:06:00
12	PCB 21A	0.35	0.7600	0.64	0.49	1.70	6.389	0 00:06:00
13	GA ROOF	0.07	0.9000	0.64	0.58	0.41	6.389	0 00:06:00
14	B3 ROOF	0.31	0.9000	0.64	0.58	1.78	6.389	0 00:06:00
16	PCB 3A	0.23	0.7400	0.64	0.47	1.09	6.389	0 00:06:00
17	PCB 4A	0.39	0.7100	0.64	0.45	1.77	6.389	0 00:06:00
18	PCB 5A	0.52	0.7200	0.64	0.46	2.39	6.389	0 00:06:00
19	PCB 6A	0.24	0.6700	0.64	0.43	1.03	6.389	0 00:06:00
20	PCB 7A	0.28	0.8000	0.64	0.51	1.43	6.389	0 00:06:00
21	PCB 8A	0.32	0.7900	0.64	0.51	1.62	6.389	0 00:06:00
22	PCB 9A	0.34	0.7000	0.64	0.45	1.52	6.389	0 00:06:00
23	PCB 10A	0.14	0.6600	0.64	0.42	0.59	6.389	0 00:06:00
24	PCB 10B	0.13	0.6400	0.64	0.41	0.53	6.389	0 00:06:00
25	GB ROOF	0.07	0.9000	0.64	0.58	0.40	6.389	0 00:06:00
26	C1 ROOF	0.05	0.9000	0.64	0.58	0.29	6.389	0 00:06:00
27	B1 ROOF	0.64	0.9000	0.64	0.58	3.68	6.389	0 00:06:00
28	B2A ROOF	0.32	0.9000	0.64	0.58	1.81	6.389	0 00:06:00
28	B2C ROOF	0.32	0.9000	0.64	0.58	1.81	6.389	0 00:06:00
29	GC ROOF	0.05	0.9000	0.64	0.58	0.29	6.389	0 00:06:00
30	ECB 1A	0.35	0.6900	0.64	0.44	1.54	6.389	0 00:06:00
31	PCB 1B	0.13	0.7900	0.64	0.51	0.66	6.389	0 00:06:00
32	M ROOF	0.02	0.9000	0.64	0.58	0.12	6.389	0 00:06:00
33	C2 ROOF	0.08	0.9000	0.64	0.58	0.46	6.389	0 00:06:00
34	PCB 2A	0.08	0.7100	0.64	0.45	0.36	6.389	0 00:06:00
36	PAD 3	0.11	0.3000	0.64	0.19	0.21	6.389	0 00:06:00
37	PAD 3B	0.07	0.3000	0.64	0.19	0.13	6.389	0 00:06:00
38	ECB-1C	0.05	0.3000	0.64	0.19	0.10	6.389	0 00:06:00

ALLEN & MAJOR
ASSOCIATES, INC.

DESIGN YEAR: **100.00**
K= 290.00 B= 31

Title ***Stormwater Conveyance Sizing (100 YEAR STORM)***
Project ***Multi-Family Development - Bolton, MA***
Date 09-10-2021
A&M Project Number: 1670-15

Minimum Slope: 0.005
Minimum Size: 12.000 inch
Rainfall Intensity (in/hr): 7.840 (100 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.000 fps
Max. Velocity: 12.000 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
To Sub-Surface System No. 1																
PCB 14A	PDMH 14	85.20	349.69	349.26	0.5000	CIRCULAR	12.000	0.0120	0.80	0 00:06	4.32	0.33	2.73	0.29	0.37	OK
PCB 14B	PDMH 14	7.16	349.30	349.26	0.5000	CIRCULAR	12.000	0.0120	1.15	0 00:06	3.33	0.04	2.74	0.42	0.45	OK
PDMH 14	PDMH 15	106.66	349.26	348.73	0.5000	CIRCULAR	12.000	0.0120	1.89	0 00:06	3.81	0.47	2.73	0.69	0.61	OK
PCB 15A	PDMH 15	8.22	348.77	348.73	0.5000	CIRCULAR	12.000	0.0120	1.07	0 00:06	3.27	0.04	2.73	0.39	0.44	OK
GA ROOF	PDMH 15	10.85	349.34	349.23	1.0000	CIRCULAR	6.000	0.0120	0.50	0 00:06	3.46	0.05	0.61	0.82	0.35	OK
PDMH 15	PDMH 16	96.64	348.63	348.15	0.5000	CIRCULAR	15.000	0.0120	3.36	0 00:06	4.38	0.37	4.95	0.68	0.76	OK
PCB 16A	PDMH 16	13.37	348.53	348.40	1.0000	CIRCULAR	12.000	0.0120	1.20	0 00:06	4.35	0.05	3.86	0.31	0.38	OK
PDMH 16	PDMH 17	93.42	348.15	347.68	0.5000	CIRCULAR	15.000	0.0120	4.46	0 00:06	4.62	0.34	4.95	0.90	0.93	OK
PCB 17A	PDMH 17	3.05	348.21	348.18	0.9800	CIRCULAR	12.000	0.0120	1.24	0 00:06	4.35	0.01	3.83	0.32	0.39	OK
PDMH 17	PDMH 18	58.34	347.68	347.39	0.5000	CIRCULAR	18.000	0.0120	5.57	0 00:06	4.91	0.20	8.02	0.69	0.92	OK
B3 ROOF	PDMH 18	55.99	348.66	348.38	0.5000	CIRCULAR	12.000	0.0120	2.16	0 00:06	5.10	0.18	2.73	0.79	0.67	OK
PCB 18A	PDMH 18	5.40	348.41	348.38	0.5000	CIRCULAR	12.000	0.0120	0.44	0 00:06	2.56	0.04	2.73	0.16	0.27	OK
PCB 18B	PDMH 18	103.86	348.90	348.38	0.5000	CIRCULAR	12.000	0.0120	1.37	0 00:06	4.93	0.35	2.73	0.50	0.50	OK
PDMH 18	PDMH 19	94.66	347.39	347.10	0.3100	CIRCULAR	24.000	0.0120	9.35	0 00:06	4.70	0.34	13.59	0.69	1.22	OK
PCB 19A	PDMH 19	15.67	348.18	348.10	0.5000	CIRCULAR	12.000	0.0120	0.93	0 00:06	3.14	0.08	2.72	0.34	0.40	OK
PDMH 19	PDMH 20	93.50	347.10	346.79	0.3300	CIRCULAR	24.000	0.0120	10.16	0 00:07	4.92	0.32	14.09	0.72	1.26	OK
PDMH 20	PDMH 20A	6.43	346.79	346.77	0.3300	CIRCULAR	24.000	0.0120	11.32	0 00:07	4.96	0.02	14.00	0.81	1.36	OK
PCB 20A	PDMH 20	28.14	347.93	347.79	0.5000	CIRCULAR	12.000	0.0120	1.32	0 00:06	3.46	0.14	2.73	0.48	0.49	OK
PDMH 20A	IR 1A	3.18	346.77	346.76	0.3500	CIRCULAR	24.000	0.0120	11.32	0 00:07	5.08	0.01	14.41	0.79	1.34	OK
PCB 21A	PDMH 21	37.45	347.70	347.51	0.5000	CIRCULAR	12.000	0.0120	2.07	0 00:06	3.85	0.16	2.73	0.76	0.65	OK
PDMH 21	IR 1C	5.12	346.79	346.76	0.5000	CIRCULAR	24.000	0.0120	2.07	0 00:06	3.71	0.02	17.33	0.12	0.47	OK
PCB 11B	PDMH 11	118.72	348.37	347.78	0.5000	CIRCULAR	12.000	0.0120	1.15	0 00:06	4.95	0.40	2.73	0.42	0.45	OK
PCB 11A	PDMH 11	9.07	347.82	347.78	0.5000	CIRCULAR	12.000	0.0120	0.92	0 00:06	3.14	0.05	2.73	0.34	0.40	OK
PDMH 11	PDMH 12	103.82	347.78	347.26	0.5000	CIRCULAR	12.000	0.0120	2.03	0 00:06	3.86	0.45	2.73	0.74	0.64	OK
PDMH 12	PDMH 13	107.75	347.26	346.92	0.3200	CIRCULAR	15.000	0.0120	2.00	0 00:07	3.27	0.55	3.93	0.51	0.63	OK
PDMH 13	IR 1D	4.81	346.80	346.76	0.8300	CIRCULAR	24.000	0.0120	2.00	0 00:07	4.41	0.02	22.36	0.09	0.40	OK
POCS 1A	PFES 1A	16.95	346.75	346.58	1.0000	CIRCULAR	18.000	0.0120	10.07	0 00:00	7.27	0.04	11.38	0.88	1.10	OK
POCS 1B	PFES 1B	14.85	346.75	346.60	1.0000	CIRCULAR	18.000	0.0120	10.07	0 00:00	7.27	0.03	11.38	0.88	1.10	OK
To Sub-Surface System No. 2																
PAD 3	PAD 3B	135.66	347.28	346.60	0.5000	CIRCULAR	12.000	0.0120	0.25	0 00:06	3.89	0.58	2.73	0.09	0.20	OK

ALLEN & MAJOR ASSOCIATES, INC.

DESIGN YEAR: **100.00**
K= 290.00 B= 31

Title ***Stormwater Conveyance Sizing (100 YEAR STORM)***
Project ***Multi-Family Development - Bolton, MA***
Date 09-10-2021
A&M Project Number: 1670-15

Minimum Slope: 0.005
Minimum Size: 12.000 inch
Rainfall Intensity (in/hr): 7.840 (100 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.000 fps
Max. Velocity: 12.000 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
PAD 3B	PDMH 3	61.30	346.50	346.19	0.5000	CIRCULAR	12.000	0.0120	0.40	0 00:06	2.50	0.41	2.73	0.15	0.26	OK
GB ROOF	PDMH 3	34.92	348.19	347.24	2.7000	CIRCULAR	6.000	0.0120	0.49	0 00:06	5.58	0.10	1.00	0.49	0.25	OK
PCB 3A	PDMH 3	6.28	346.50	346.44	1.0000	CIRCULAR	12.000	0.0120	1.33	0 00:06	4.46	0.02	3.86	0.35	0.41	OK
C1 ROOF	C1 WYE	31.90	346.64	346.00	2.0100	CIRCULAR	6.000	0.0120	0.35	0 00:06	4.62	0.12	0.86	0.41	0.22	OK
PDMH 3	PDMH 4	165.32	346.09	344.44	1.0000	CIRCULAR	12.000	0.0120	2.14	0 00:06	5.11	0.54	3.86	0.55	0.53	OK
PCB 4A	PDMH 4	4.15	345.50	345.46	1.0000	CIRCULAR	12.000	0.0120	2.17	0 00:06	5.06	0.01	3.86	0.56	0.54	OK
B1 ROOF	PDMH 4	50.40	347.05	344.29	5.4800	CIRCULAR	12.000	0.0120	4.49	0 00:06	11.51	0.07	9.04	0.50	0.50	OK
PDMH 4	PDMH 5	224.08	343.94	341.70	1.0000	CIRCULAR	18.000	0.0120	8.52	0 00:06	7.19	0.52	11.38	0.75	0.96	OK
B2C ROOF	PDMH 5	48.77	343.99	343.50	1.0000	CIRCULAR	12.000	0.0120	2.21	0 00:06	6.02	0.14	3.86	0.57	0.54	OK
PCB 5A	PDMH 5	3.41	342.27	342.20	1.9900	CIRCULAR	12.000	0.0120	2.93	0 00:06	7.06	0.01	5.45	0.54	0.52	OK
PDMH 5	PDMH 6	79.93	341.60	340.00	2.0000	CIRCULAR	18.000	0.0120	13.38	0 00:06	10.21	0.13	16.10	0.83	1.04	OK
PCB 6A	PDMH 6	13.02	340.57	340.50	0.5000	CIRCULAR	12.000	0.0120	1.26	0 00:06	3.41	0.06	2.73	0.46	0.48	OK
PDMH 6	PDMH 7	76.19	339.32	338.94	0.5000	CIRCULAR	24.000	0.0120	14.54	0 00:06	6.21	0.20	17.33	0.84	1.40	OK
PDMH 7	PDMH 7A	2.25	338.94	338.92	0.4900	CIRCULAR	24.000	0.0120	16.14	0 00:06	6.20	0.01	17.13	0.94	1.55	OK
PCB 7A	PDMH 7	3.09	340.00	339.94	2.0100	CIRCULAR	12.000	0.0120	1.76	0 00:06	6.19	0.01	5.47	0.32	0.39	OK
PDMH 7A	IR 2A	2.80	338.92	338.91	0.5000	CIRCULAR	24.000	0.0120	16.14	0 00:06	6.26	0.01	17.32	0.93	1.53	OK
PCB 10B	PDMH 10	8.28	344.08	344.00	1.0000	CIRCULAR	12.000	0.0120	0.65	0 00:06	3.65	0.04	3.86	0.17	0.28	OK
PCB 10A	PDMH 10	27.12	344.27	344.00	1.0000	CIRCULAR	12.000	0.0120	0.72	0 00:06	3.77	0.12	3.86	0.19	0.29	OK
B2A ROOF	PDMH 10	29.99	344.60	344.00	2.0000	CIRCULAR	12.000	0.0120	2.21	0 00:06	6.60	0.08	5.46	0.41	0.44	OK
PDMH 10	PDMH 9	147.77	343.27	340.31	2.0000	CIRCULAR	12.000	0.0120	3.53	0 00:06	7.47	0.33	5.46	0.65	0.58	OK
B2B ROOF	PDMH 9	39.10	340.51	340.31	0.5000	CIRCULAR	12.000	0.0120	0.00	0 00:00	0.00		2.73	0.00	0.00	OK
PCB 9A	PDMH 9	8.37	340.35	340.31	0.5000	CIRCULAR	12.000	0.0120	1.86	0 00:06	3.75	0.04	2.73	0.68	0.60	OK
PDMH 9	PDMH 8	62.10	340.06	339.69	0.6000	CIRCULAR	15.000	0.0120	5.31	0 00:06	5.08	0.20	5.40	0.98	1.00	OK
PDMH 8	PDMH 8A	1.50	339.44	339.43	0.5300	CIRCULAR	18.000	0.0120	7.18	0 00:06	5.28	0.00	8.30	0.86	1.08	OK
PCB 8A	PDMH 8	4.24	339.98	339.94	0.9900	CIRCULAR	12.000	0.0120	1.98	0 00:06	4.93	0.01	3.84	0.51	0.51	OK
PDMH 8A	IR 2B	3.37	338.93	338.91	0.5000	CIRCULAR	24.000	0.0120	7.18	0 00:06	5.28	0.01	17.41	0.41	0.89	OK
GC ROOF	PINF 2C	16.37	339.58	339.25	2.0000	CIRCULAR	6.000	0.0120	0.35	0 00:06	4.17	0.07	0.86	0.41	0.22	OK
POCS 2A	PFES 2A	35.06	338.90	338.55	1.0000	CIRCULAR	18.000	0.0120	7.33	0 00:01	6.84	0.09	11.38	0.64	0.88	OK
POCS 2B	PFES 2B	25.34	338.91	338.65	1.0400	CIRCULAR	18.000	0.0120	7.33	0 00:01	6.94	0.06	11.60	0.63	0.87	OK

To Existing Collection System																
ECB-1C	ECB 1A	37.98	348.29	346.69	4.2100	CIRCULAR	12.000	0.0120	0.12	0 00:06	4.01	0.16	7.92	0.01	0.08	OK

AutoDesk Storm and Sanitary Analysis 2019

ALLEN & MAJOR
ASSOCIATES, INC.

DESIGN YEAR: **100.00**
K= 290.00 B= 31

Title ***Stormwater Conveyance Sizing (100 YEAR STORM)***
Project ***Multi-Family Development - Bolton, MA***
Date 09-10-2021
A&M Project Number: 1670-15

Minimum Slope: 0.005
Minimum Size: 12.000 inch
Rainfall Intensity (in/hr): 7.840 (100 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.000 fps
Max. Velocity: 12.000 fps

From (Inlet) Node	**To (Outlet) Node**	**Length (ft)**	**Inlet Invert Elevation (ft)**	**Outlet Invert Elevation (ft)**	**Average Slope (%)**	**Pipe Shape**	**Pipe Diameter or Height (inches)**	**Manning's Roughness**	**Peak Flow (cfs)**	**Time of Peak Flow (days hh:mm)**	**Max Flow Velocity (ft/sec)**	**Travel Time (min)**	**Design Flow Capacity (cfs)**	**Max Flow / Design Flow Ratio**	**Max Flow Depth (ft)**	**Reported Condition**
ECB 1A	PDMH 1	35.80	346.50	346.14	1.0000	CIRCULAR	12.000	0.0120	2.00	0 00:06	4.98	0.12	3.86	0.52	0.51	OK
PCB 1B	PDMH 1	19.13	346.33	346.14	1.0000	CIRCULAR	12.000	0.0120	0.80	0 00:06	3.88	0.08	3.86	0.21	0.31	OK
M ROOF	PDMH 1	71.40	348.07	346.64	2.0000	CIRCULAR	6.000	0.0120	0.14	0 00:06	4.59	0.26	0.86	0.16	0.14	OK
PDMH 1	PDMH 2	152.42	345.89	345.13	0.5000	CIRCULAR	15.000	0.0120	2.86	0 00:06	4.27	0.59	4.95	0.58	0.68	OK
C2 ROOF	C2 WYE	7.41	346.65	346.50	2.0000	CIRCULAR	6.000	0.0120	0.56	0 00:06	4.67	0.03	0.86	0.65	0.30	OK
PCB 2A	PDMH 2	10.11	345.60	345.50	1.0000	CIRCULAR	12.000	0.0120	0.44	0 00:06	3.27	0.05	3.86	0.11	0.23	OK
PDMH 2	EDMH	105.59	345.00	344.47	0.5000	CIRCULAR	15.000	0.0120	3.25	0 00:06	4.35	0.40	4.95	0.66	0.74	OK

Title ***Stormwater Conveyance Sizing (100 YEAR STORM)***
Project ***Multi-Family Development - Bolton, MA***
Date 09-10-2021
A&M Project Number: 1670-15

Watershed	Drainage Node ID	Area (acres)	Weighted Runoff Coefficient	Accumulated Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Rainfall Intensity (inches/hr)	Time of Concentration (days hh:mm:ss)
1	PCB 14A	0.14	0.7500	0.78	0.59	0.82	7.838	0 00:06:00
2	PCB 14B	0.19	0.7700	0.78	0.60	1.15	7.838	0 00:06:00
3	PCB 15A	0.18	0.7600	0.78	0.60	1.07	7.838	0 00:06:00
4	PCB 16A	0.21	0.7300	0.78	0.57	1.20	7.838	0 00:06:00
5	PCB 17A	0.23	0.6900	0.78	0.54	1.24	7.838	0 00:06:00
6	PCB 18A	0.07	0.8100	0.78	0.64	0.44	7.838	0 00:06:00
7	PCB 11B	0.22	0.6900	0.78	0.54	1.19	7.838	0 00:06:00
8	PCB 11A	0.16	0.7400	0.78	0.58	0.93	7.838	0 00:06:00
9	PCB 18B	64	0.7200	0.78	0.56	1.41	7.838	0 00:06:00
10	PCB 19A	64	0.7000	0.78	0.55	0.93	7.838	0 00:06:00
11	PCB 20A	64	0.7400	0.78	0.58	1.33	7.838	0 00:06:00
12	PCB 21A	64	0.7600	0.78	0.60	2.09	7.838	0 00:06:00
13	GA ROOF	64	0.9000	0.78	0.71	0.50	7.838	0 00:06:00
14	B3 ROOF	64	0.9000	0.78	0.71	2.19	7.838	0 00:06:00
16	PCB 3A	64	0.7400	0.78	0.58	1.33	7.838	0 00:06:00
17	PCB 4A	64	0.7100	0.78	0.56	2.17	7.838	0 00:06:00
18	PCB 5A	64	0.7200	0.78	0.56	2.93	7.838	0 00:06:00
19	PCB 6A	64	0.6700	0.78	0.53	1.26	7.838	0 00:06:00
20	PCB 7A	64	0.8000	0.78	0.63	1.76	7.838	0 00:06:00
21	PCB 8A	64	0.7900	0.78	0.62	1.98	7.838	0 00:06:00
22	PCB 9A	64	0.7000	0.78	0.55	1.87	7.838	0 00:06:00
23	PCB 10A	64	0.6600	0.78	0.52	0.72	7.838	0 00:06:00
24	PCB 10B	64	0.6400	0.78	0.50	0.65	7.838	0 00:06:00
25	GB ROOF	64	0.9000	0.78	0.71	0.49	7.838	0 00:06:00
26	C1 ROOF	64	0.9000	0.78	0.71	0.35	7.838	0 00:06:00
27	B1 ROOF	64	0.9000	0.78	0.71	4.52	7.838	0 00:06:00
28	B2A ROOF	64	0.9000	0.78	0.71	2.22	7.838	0 00:06:00
28	B2C ROOF	64	0.9000	0.78	0.71	2.22	7.838	0 00:06:00
29	GC ROOF	64	0.9000	0.78	0.71	0.35	7.838	0 00:06:00
30	ECB 1A	64	0.6900	0.78	0.54	1.89	7.838	0 00:06:00
31	PCB 1B	64	0.7900	0.78	0.62	0.81	7.838	0 00:06:00
32	M ROOF	64	0.9000	0.78	0.71	0.14	7.838	0 00:06:00
33	C2 ROOF	64	0.9000	0.78	0.71	0.56	7.838	0 00:06:00
34	PCB 2A	64	0.7100	0.78	0.56	0.45	7.838	0 00:06:00
36	PAD 3	64	0.3000	0.78	0.24	0.26	7.838	0 00:06:00
37	PAD 3B	64	0.3000	0.78	0.24	0.17	7.838	0 00:06:00
38	ECB-1C	64	0.3000	0.78	0.24	0.12	7.838	0 00:06:00

SOIL INFORMATION

United States
Department of
Agriculture

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 Worcester County, Massachusetts, Northeastern Part

January 20, 2021

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

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

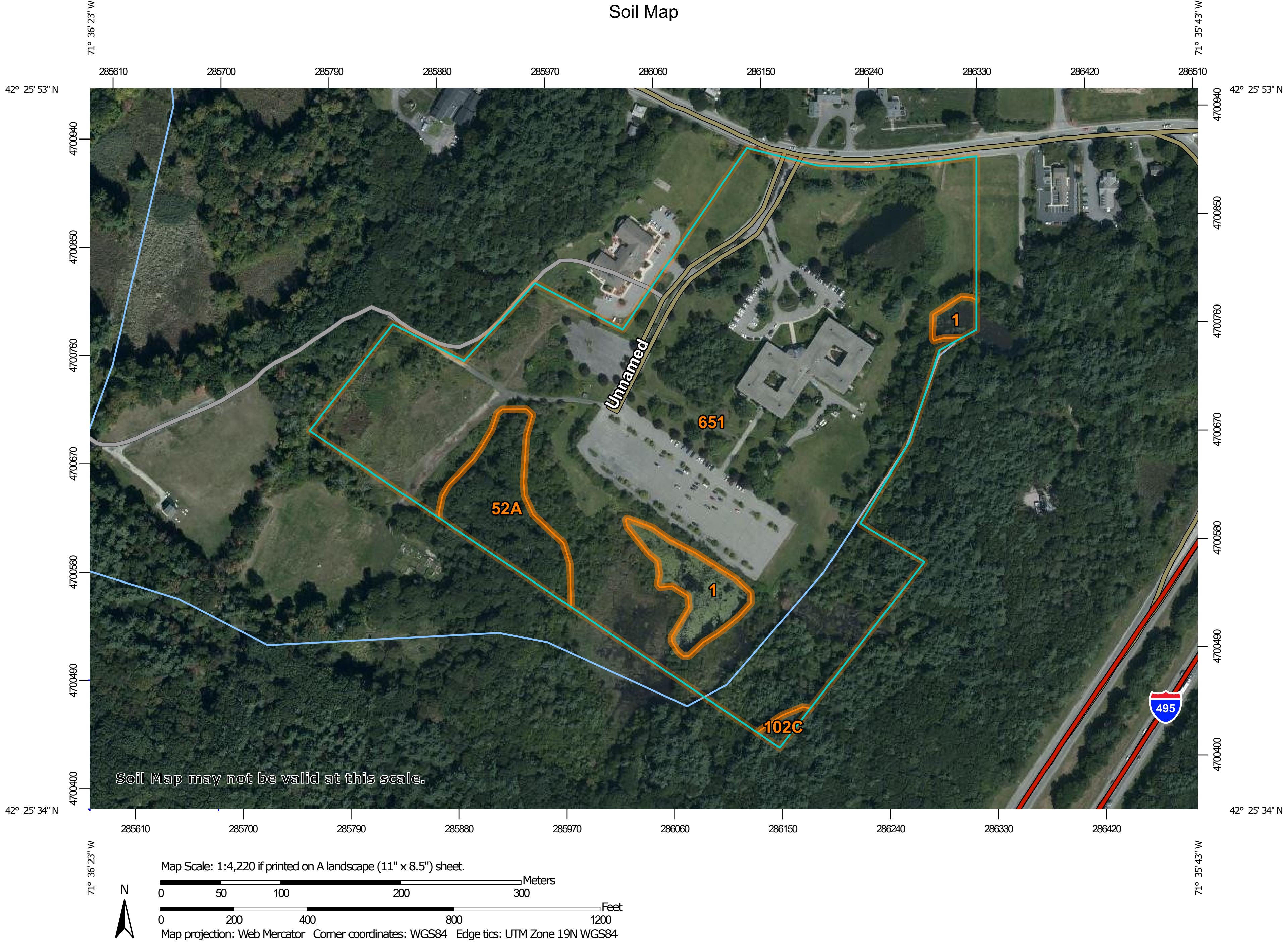
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

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: 1:4,220 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N 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
- ø 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 1:20,000.

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: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 15, Jun 10, 2020

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

Date(s) aerial images were photographed: Aug 12, 2019—Sep 29, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	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
1	Water	1.4	3.7%
52A	Freetown muck, 0 to 1 percent slopes	2.0	5.5%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	0.2	0.4%
651	Udorthents, smoothed	33.1	90.4%
Totals for Area of Interest		**36.6**	**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.

Worcester County, Massachusetts, Northeastern Part

1—Water

Map Unit Setting

National map unit symbol: w3qb
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Depressions, kettles, swamps, bogs, marshes, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)

Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 19.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Swansea
Percent of map unit: 5 percent
Landform: Swamps, bogs, marshes, depressions, depressions, kettles
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro
Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman
Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

102C—Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2w69g
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Chatfield, extremely stony, and similar soils: 39 percent
Hollis, extremely stony, and similar soils: 26 percent
Rock outcrop: 17 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Nose slope, crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 12 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Sutton, extremely stony

Percent of map unit: 3 percent
Landform: Hills, ground moraines

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Leicester, extremely stony

Percent of map unit: 1 percent
Landform: Drainageways, depressions, hills, ground moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

651—Udorthents, smoothed

Map Unit Setting

National map unit symbol: w3q6
Elevation: 180 to 1,020 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 80 percent
Urban land: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Made land over firm loamy basal till

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None

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RAINFALL DATA

NOAA Atlas 14, Volume 10, Version 3
Location name: Bolton, Massachusetts, USA*
Latitude: 42.4295°, Longitude: -71.5989°
Elevation: 337.73 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.341** (0.263-0.431)	**0.403** (0.310-0.510)	**0.504** (0.387-0.640)	**0.588** (0.449-0.751)	**0.703** (0.521-0.936)	**0.791** (0.574-1.07)	**0.882** (0.622-1.24)	**0.982** (0.660-1.42)	**1.12** (0.728-1.67)	**1.24** (0.783-1.88)
10-min	**0.483** (0.373-0.611)	**0.571** (0.440-0.723)	**0.715** (0.548-0.908)	**0.833** (0.636-1.07)	**0.997** (0.738-1.33)	**1.12** (0.813-1.52)	**1.25** (0.881-1.76)	**1.39** (0.935-2.00)	**1.59** (1.03-2.37)	**1.75** (1.11-2.66)
15-min	**0.568** (0.438-0.719)	**0.672** (0.517-0.850)	**0.841** (0.646-1.07)	**0.980** (0.748-1.25)	**1.17** (0.868-1.56)	**1.32** (0.957-1.79)	**1.47** (1.04-2.06)	**1.64** (1.10-2.36)	**1.87** (1.21-2.79)	**2.06** (1.30-3.13)
30-min	**0.768** (0.592-0.971)	**0.907** (0.698-1.15)	**1.13** (0.871-1.44)	**1.32** (1.01-1.69)	**1.58** (1.17-2.11)	**1.78** (1.29-2.41)	**1.98** (1.40-2.79)	**2.21** (1.48-3.18)	**2.52** (1.63-3.76)	**2.78** (1.76-4.22)
60-min	**0.967** (0.745-1.22)	**1.14** (0.879-1.45)	**1.43** (1.10-1.81)	**1.67** (1.27-2.13)	**1.99** (1.48-2.65)	**2.24** (1.63-3.04)	**2.50** (1.76-3.51)	**2.78** (1.87-4.00)	**3.18** (2.06-4.73)	**3.50** (2.21-5.31)
2-hr	**1.21** (0.943-1.52)	**1.45** (1.13-1.83)	**1.85** (1.43-2.33)	**2.18** (1.68-2.76)	**2.63** (1.97-3.48)	**2.97** (2.18-4.02)	**3.33** (2.38-4.68)	**3.74** (2.53-5.35)	**4.36** (2.83-6.44)	**4.87** (3.09-7.34)
3-hr	**1.39** (1.09-1.74)	**1.68** (1.31-2.10)	**2.15** (1.67-2.70)	**2.54** (1.97-3.21)	**3.08** (2.31-4.07)	**3.48** (2.57-4.70)	**3.91** (2.81-5.49)	**4.42** (2.99-6.29)	**5.18** (3.37-7.62)	**5.82** (3.70-8.73)
6-hr	**1.77** (1.40-2.20)	**2.15** (1.69-2.67)	**2.77** (2.17-3.45)	**3.28** (2.56-4.11)	**3.99** (3.02-5.23)	**4.51** (3.35-6.05)	**5.07** (3.67-7.08)	**5.75** (3.90-8.12)	**6.76** (4.42-9.88)	**7.63** (4.87-11.4)
12-hr	**2.25** (1.79-2.77)	**2.73** (2.17-3.36)	**3.51** (2.78-4.33)	**4.15** (3.27-5.16)	**5.04** (3.85-6.56)	**5.70** (4.26-7.58)	**6.41** (4.67-8.87)	**7.26** (4.95-10.2)	**8.53** (5.59-12.4)	**9.61** (6.15-14.2)
24-hr	**2.69** (2.16-3.28)	**3.27** (2.62-3.99)	**4.23** (3.38-5.18)	**5.02** (3.99-6.18)	**6.11** (4.70-7.88)	**6.91** (5.21-9.13)	**7.79** (5.71-10.7)	**8.84** (6.06-12.3)	**10.4** (6.87-15.0)	**11.8** (7.58-17.3)
2-day	**3.00** (2.43-3.63)	**3.70** (2.99-4.47)	**4.83** (3.90-5.87)	**5.77** (4.63-7.05)	**7.07** (5.49-9.07)	**8.02** (6.11-10.5)	**9.07** (6.72-12.4)	**10.4** (7.13-14.3)	**12.4** (8.16-17.6)	**14.1** (9.07-20.4)
3-day	**3.26** (2.65-3.92)	**4.00** (3.26-4.83)	**5.22** (4.24-6.32)	**6.24** (5.03-7.58)	**7.63** (5.95-9.75)	**8.66** (6.62-11.3)	**9.78** (7.27-13.3)	**11.2** (7.71-15.3)	**13.3** (8.82-18.9)	**15.2** (9.80-21.9)
4-day	**3.50** (2.87-4.20)	**4.28** (3.50-5.14)	**5.56** (4.52-6.69)	**6.61** (5.35-8.01)	**8.06** (6.31-10.3)	**9.14** (7.00-11.9)	**10.3** (7.67-14.0)	**11.7** (8.13-16.1)	**14.0** (9.25-19.7)	**15.9** (10.3-22.8)
7-day	**4.20** (3.47-5.01)	**5.04** (4.14-6.01)	**6.39** (5.24-7.65)	**7.52** (6.13-9.05)	**9.07** (7.13-11.4)	**10.2** (7.86-13.2)	**11.5** (8.54-15.4)	**12.9** (9.00-17.6)	**15.2** (10.1-21.3)	**17.1** (11.1-24.4)
10-day	**4.89** (4.05-5.80)	**5.75** (4.75-6.83)	**7.15** (5.89-8.53)	**8.32** (6.81-9.97)	**9.93** (7.83-12.4)	**11.1** (8.57-14.2)	**12.4** (9.24-16.5)	**13.9** (9.69-18.8)	**16.1** (10.7-22.4)	**17.9** (11.6-25.4)
20-day	**6.94** (5.80-8.16)	**7.86** (6.56-9.26)	**9.37** (7.79-11.1)	**10.6** (8.77-12.6)	**12.3** (9.79-15.2)	**13.7** (10.6-17.2)	**15.0** (11.1-19.5)	**16.4** (11.5-22.0)	**18.4** (12.3-25.4)	**19.9** (13.0-28.1)
30-day	**8.64** (7.27-10.1)	**9.61** (8.07-11.3)	**11.2** (9.35-13.2)	**12.5** (10.4-14.8)	**14.3** (11.4-17.5)	**15.7** (12.2-19.5)	**17.1** (12.7-21.9)	**18.4** (13.0-24.5)	**20.2** (13.6-27.8)	**21.6** (14.1-30.3)
45-day	**10.8** (9.10-12.5)	**11.8** (9.94-13.7)	**13.4** (11.3-15.7)	**14.8** (12.4-17.4)	**16.7** (13.4-20.3)	**18.2** (14.1-22.5)	**19.6** (14.6-24.9)	**21.0** (14.9-27.7)	**22.6** (15.3-30.9)	**23.7** (15.5-33.2)
60-day	**12.5** (10.6-14.5)	**13.6** (11.5-15.8)	**15.3** (12.9-17.9)	**16.7** (14.0-19.6)	**18.7** (15.0-22.6)	**20.3** (15.8-24.9)	**21.8** (16.2-27.5)	**23.1** (16.4-30.4)	**24.6** (16.7-33.5)	**25.6** (16.8-35.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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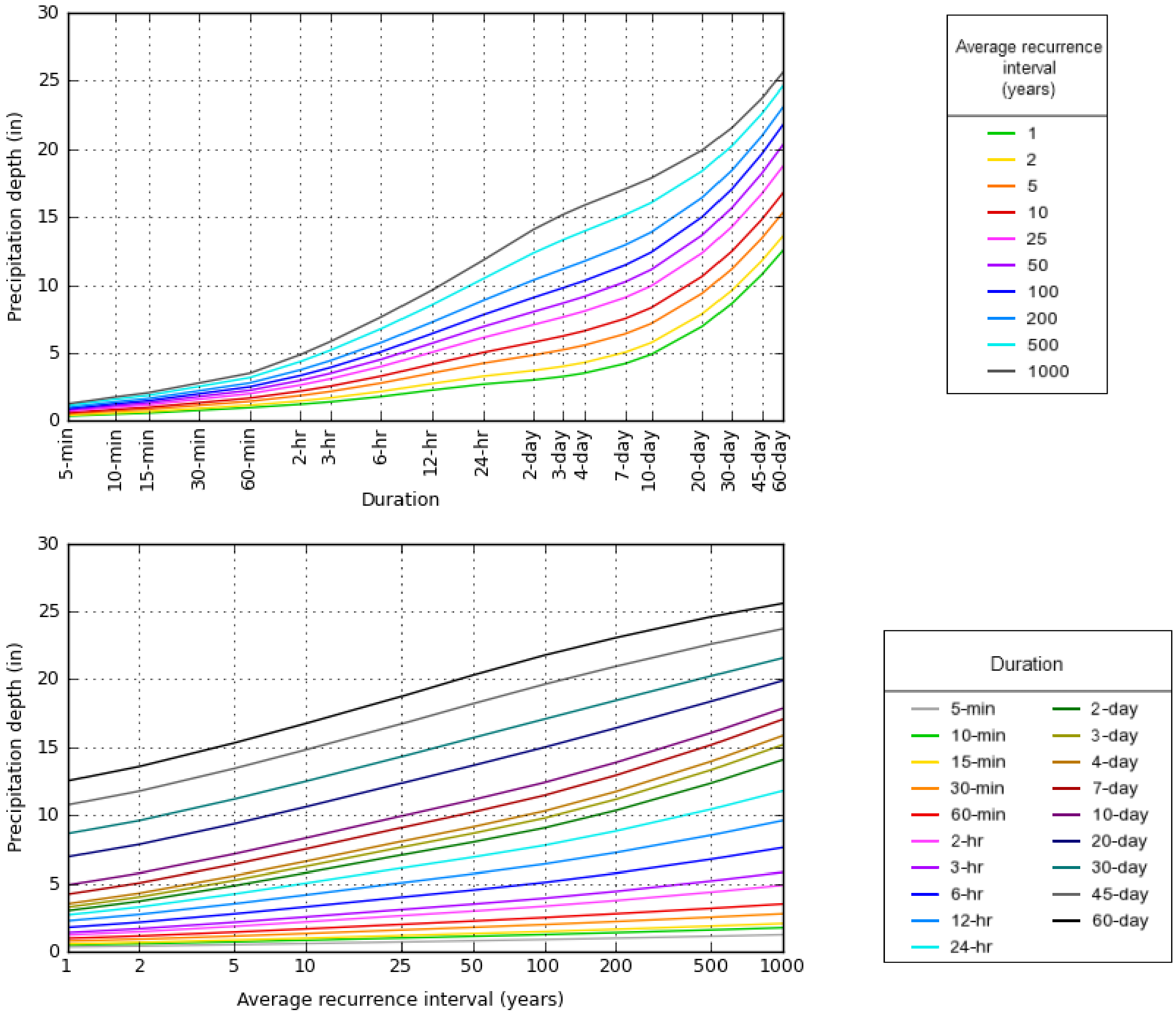
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 42.4295°, Longitude: -71.5989°



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Mon Aug 23 19:57:44 2021

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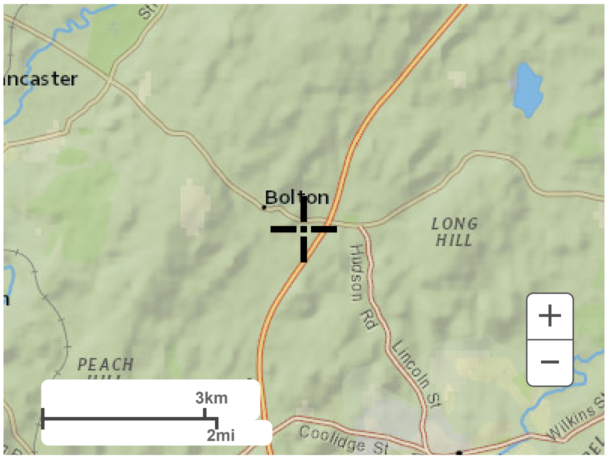
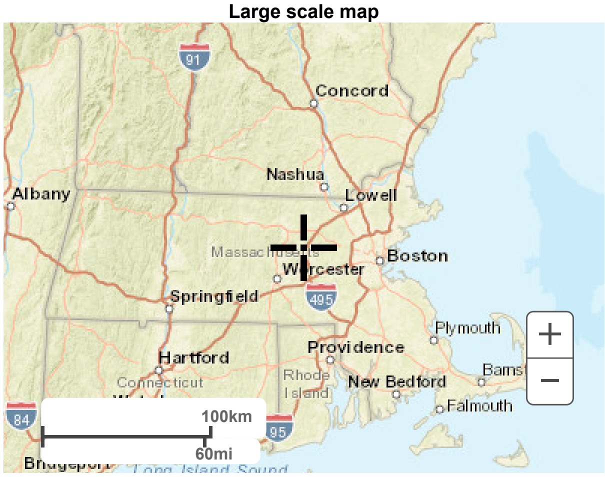
Maps & aerials

Small scale terrain

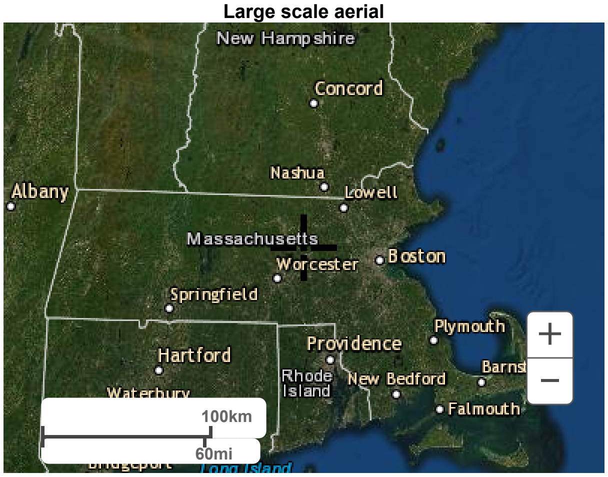


Large scale terrain

Large scale map



Large scale aerial



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WATER QUALITY SIZING (CONTECH)

Project: **Alta Nashoba Valley**
Location: **Bolton, MA**
Prepared For: **Allen & Major / Paul Matos**

CONTECH® ENGINEERED SOLUTIONS

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	**Impv. (acres)**	**A (miles^2)**	**t_c (min)**	**t_c (hr)**	**WQV (in)**	**qu (csm/in.)**	**Q (cfs)**
PDMH 2	0.65	0.0010156	6.0	0.100	1.00	774.00	0.79
PDMH 7	2.25	0.0035156	6.0	0.100	1.00	774.00	2.72
PDMH 8	0.96	0.0015000	6.0	0.100	1.00	774.00	1.16
PDMH 12	0.26	0.0004109	6.0	0.100	1.00	774.00	0.32
PDMH 20	1.59	0.0024844	6.0	0.100	1.00	774.00	1.92
PCB 21A	0.27	0.0004172	6.0	0.100	1.00	774.00	0.32

Brief Stormceptor Sizing Report - PCB 21A

Project Information & Location			
Project Name	Alta Nashoba Valley	**Project Number**	688805
City	Bolton	**State/ Province**	Massachusetts
Country	United States of America	**Date**	9/10/2021
Designer Information		**EOR Information (optional)**	
Name	Jim Lyons	**Name**	Paul Matos
Company	Contech ES	**Company**	Allen & Major
Phone #	413-246-5151	**Phone #**	508-923-1010
Email	jlyons@conteches.com	**Email**	pmatos@allenmajor.com

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	PCB 21A
Target TSS Removal (%)	80
TSS Removal (%) Provided	92
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	92
STC 900	96
STC 1200	96
STC 1800	96
STC 2400	97
STC 3600	98
STC 4800	98
STC 6000	98
STC 7200	99
STC 11000	99
STC 13000	99
STC 16000	99

Sizing Details

Drainage Area

Total Area (acres)	0.35
Imperviousness %	76.0

Rainfall

Station Name	EAST BRIMFIELD LAKE
State/Province	Massachusetts
Station ID #	2107
Years of Records	45
Latitude	42°7'0"N
Longitude	72°8'0"W

Water Quality Objective

TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.32

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

OK-110

Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Brief Stormceptor Sizing Report - PDMH 12

Project Information & Location			
Project Name	Alta Nashoba Valley	**Project Number**	688805
City	Bolton	**State/ Province**	Massachusetts
Country	United States of America	**Date**	9/10/2021
Designer Information		**EOR Information (optional)**	
Name	Jim Lyons	**Name**	Paul Matos
Company	Contech ES	**Company**	Allen & Major
Phone #	413-246-5151	**Phone #**	508-923-1010
Email	jlyons@conteches.com	**Email**	pmatos@allenmajor.com

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	PDMH 12
Target TSS Removal (%)	80
TSS Removal (%) Provided	92
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	92
STC 900	96
STC 1200	96
STC 1800	96
STC 2400	97
STC 3600	98
STC 4800	98
STC 6000	98
STC 7200	99
STC 11000	99
STC 13000	99
STC 16000	99

Sizing Details

Drainage Area

Total Area (acres)	0.38
Imperviousness %	69.0

Rainfall

Station Name	EAST BRIMFIELD LAKE
State/Province	Massachusetts
Station ID #	2107
Years of Records	45
Latitude	42°7'0"N
Longitude	72°8'0"W

Water Quality Objective

TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.32

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

OK-110

Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

ALTA NASHOBA VALLEY
BOLTON, MA

Area	0.65 ac	Unit Site Designation	PDMH 2
Weighted C	0.9	Rainfall Station #	71
t_c	6 min		
CDS Model	2015-4	CDS Treatment Capacity	**1.4 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.08	37.6%	37.6%	0.05	0.05	37.5
0.16	22.6%	60.2%	0.09	0.09	22.2
0.24	11.9%	72.1%	0.14	0.14	11.5
0.32	7.6%	79.7%	0.19	0.19	7.2
0.40	4.3%	84.1%	0.23	0.23	4.1
0.48	2.3%	86.4%	0.28	0.28	2.2
0.56	1.8%	88.2%	0.33	0.33	1.6
0.64	1.4%	89.6%	0.37	0.37	1.2
0.72	0.9%	90.4%	0.42	0.42	0.8
0.80	1.2%	91.6%	0.47	0.47	1.0
0.88	1.5%	93.1%	0.51	0.51	1.2
0.96	0.9%	94.0%	0.56	0.56	0.8
1.04	0.4%	94.4%	0.61	0.61	0.3
1.12	0.4%	94.8%	0.66	0.66	0.3
1.20	0.6%	95.4%	0.70	0.70	0.4
1.28	0.3%	95.7%	0.75	0.75	0.2
1.36	0.2%	95.9%	0.80	0.80	0.1
1.44	0.9%	96.7%	0.84	0.84	0.6
1.52	0.6%	97.3%	0.89	0.89	0.4
1.60	0.4%	97.7%	0.94	0.94	0.3
1.80	0.2%	97.9%	1.05	1.05	0.1
					94.7

Removal Efficiency Adjustment[2] =	0.0%
Predicted % Annual Rainfall Treated =	98.8%
Predicted Net Annual Load Removal Efficiency =	**94.7%**

1 - Based on 13 years of 15 minute precipitation data for Station 0666, Birch Hill Dam, Worcester County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

ALTA NASHOBA VALLEY
BOLTON, MA

Area	0.96 ac	Unit Site Designation	PDMH 8
Weighted C	0.9	Rainfall Station #	71
t_c	6 min		
CDS Model	2015-4	CDS Treatment Capacity	**1.4 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.08	37.6%	37.6%	0.07	0.07	37.2
0.16	22.6%	60.2%	0.14	0.14	21.9
0.24	11.9%	72.1%	0.21	0.21	11.2
0.32	7.6%	79.7%	0.28	0.28	7.0
0.40	4.3%	84.1%	0.35	0.35	3.9
0.48	2.3%	86.4%	0.41	0.41	2.0
0.56	1.8%	88.2%	0.48	0.48	1.5
0.64	1.4%	89.6%	0.55	0.55	1.1
0.72	0.9%	90.4%	0.62	0.62	0.7
0.80	1.2%	91.6%	0.69	0.69	0.9
0.88	1.5%	93.1%	0.76	0.76	1.1
0.96	0.9%	94.0%	0.83	0.83	0.7
1.04	0.4%	94.4%	0.90	0.90	0.3
1.12	0.4%	94.8%	0.97	0.97	0.3
1.20	0.6%	95.4%	1.04	1.04	0.4
1.28	0.3%	95.7%	1.11	1.11	0.2
1.36	0.2%	95.9%	1.18	1.18	0.1
1.44	0.9%	96.7%	1.24	1.24	0.5
1.52	0.6%	97.3%	1.31	1.31	0.3
1.60	0.4%	97.7%	1.38	1.38	0.2
1.80	0.2%	97.9%	1.56	1.40	0.1
					92.1

Removal Efficiency Adjustment[2] = 0.0%

Predicted % Annual Rainfall Treated = 98.6%

Predicted Net Annual Load Removal Efficiency = 92.1%

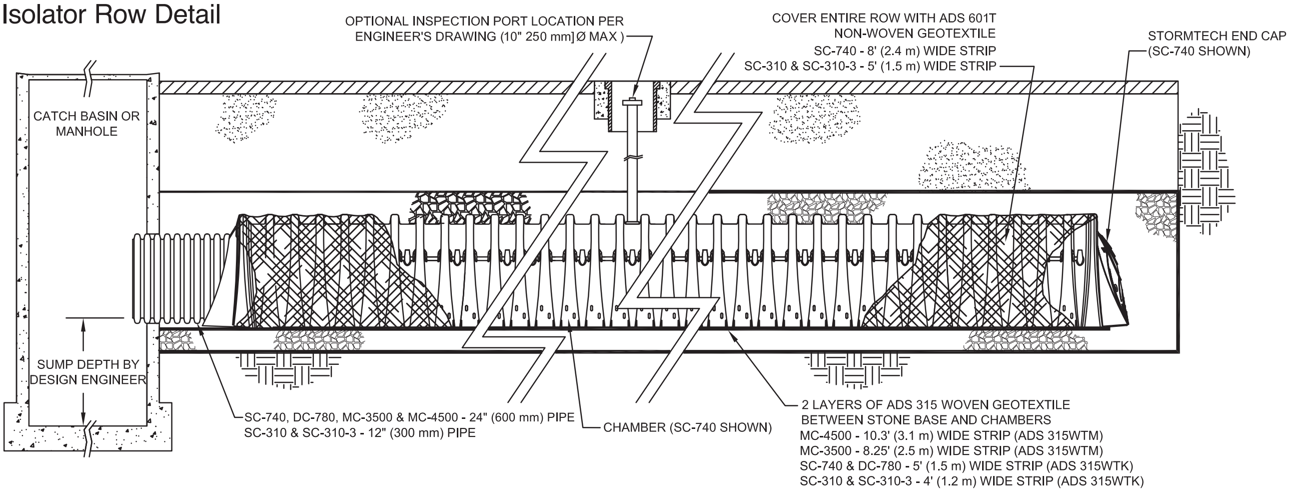
1 - Based on 13 years of 15 minute precipitation data for Station 0666, Birch Hill Dam, Worcester County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

StormTech and Stormwater Quality

StormTech's patented Isolator® Row is a row of chambers wrapped in a geotextile which filters the stormwater trapping pollutants in the row. The Isolator Row provides a way to inspect and maintain the system.

Isolator Row Detail



Note: For many applications, the non-woven geotextile over the DC-780, MC-3500 and MC-4500 Isolator Row chambers can be eliminated or substituted with the AASHTO Class 1 woven geotextile. Contact your StormTech representative for assistance.

Isolator Row Field Verification Testing at the University of New Hampshire Stormwater Center

- Lab and field (TARP tier II protocol) tested.
- Removal efficiencies for TSS have improved as the filter cake has built up on the bottom fabric of the Isolator Row.
- Current data shows a TSS removal efficiency which exceeds 80%.

Removal Efficiency Results:

- Total Suspended Solids = 80%
- Phosphorous = 49%
- Total Petroleum Hydrocarbons = 90%
- Zinc = 53%

This system achieves a removal efficiency of 80% for TSS which meets most municipal recommended levels for water quality treatment.

Inspection and Maintenance

The Isolator Row can be inspected through the upstream manhole or optional inspection port.

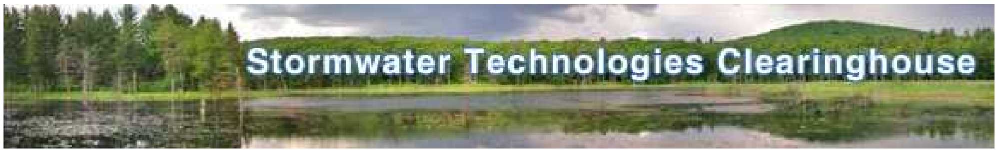
Maintenance is easily accomplished with the JetVac process.

The frequency of inspection and maintenance varies by location. Contact StormTech for assistance with inspection and maintenance scheduling.

University of Massachusetts Amherst

search UMass Go

Current User:
MASTEP GUEST



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Performance Evaluation

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StormTech Isolator Row :: A product from STORMTECH LLC ::

Performance information: (This product was evaluated in at least one third-party study. See MASTEP Evaluation Summary.)

The StormTech Isolator Row was tested several times at a laboratory at Tennessee Tech University and also in the field by the UNH Stormwater Center (initially reported on in 2008, expanded and updated in a 2010 report). UNH analyzed runoff from a 9 acre parking lot for TSS, TPH, nitrogen as nitrate (DIN), TZn, and TP. Samples were collected during 23 events (13.2" rainfall) from 2007- 2009. The following pollutants were monitored, with results obtained: TSS (81% Efficiency Ratio (ER), 69% mean Removal Efficiency (RE), 83% median RE); SSC (only 5 storms monitored (94% ER, 93% mean RE, 91% median RE); Zinc (61% ER, 60% mean RE, 57% median RE); Total Phosphorus (53% ER, 29% mean RE, 33% median RE); Dissolved Inorganic Nitrogen(-74% ER, -97% mean RE, -80% median RE); Total Petroleum Hydrocarbons (79% ER, 81% mean RE, 91% median RE). A full scale StormTech SC-740 isolator Row was tested in the laboratory at Tennessee Tech University. Three different influent mixes were used in the testing including a SIL-CO-SIL 106, SIL-CO-SIL250 and US Silica OK-110. The SIL-CO-SIL106 had a median particle size of 22 microns and was tested at a hydraulic loading rate of 3.2gpm/ft2 of filter area. The SIL-CO-SIL 250 had a median particle size of 45 microns and was tested at 3.2 and 1.7 gpm/ft2 of filter area. The OK-110 influent slurry had a median particle size of 110 microns and was tested at rates up to 4.8 and 8.1 gpm/ft2 in the four and two chamber configurations. Five runs were done with the SIL-CO-SIL 106 influent at 3.2gpm/ft2 (125% of treatment operating rate). One run was done with the SIL-CO-SIL 250 slurry at each of the two hydraulic loading rates (3.2, 1.7gpm/ft2-62.5% of treatment operating rate). Each run lasted 15 detention times, allowing 3 detention times prior to collecting samples. OK-110 tests were run for 11 treatment flows from 44.9-539gpm (0.1-1.2cfs) or hydraulic loading rates of 0.4-4.8gpm/ft2 with a four chamber Isolator row. They also ran tests with a two chamber model at 0.4, 1.0, and 1.2 cfs, up to a hydraulic loading rate of 8.1gpm/ft2. Results of SIL-CO-SIL 106 runs show an average influent of 270 +/-59mg/l (range 139-361mg/l). This influent was higher than expected and due to recirculation of sediments that were not trapped in the filter sock at the outlet. Average removal efficiency was 60% across all samples but average removal by sample number (1-5) shows that removal efficiency decreased with increasing detention time from 66% at sample 1 to 58% at sample 5. Results for the SIL-CO-SIL 250 test at 3.2gpm/ft2 an average removal of 71%. Recirculation in these tests would have reduced the D50 below 45microns in the influent but a PSD was not done as it was with the SIL-CO-SIL 106 influent mix. Results for SIL-CO-SIL 250 at 1.7gpm/ft2 found an average removal of 88%. Compared to the demonstrated results for the SIL-CO-SIL106, these values appear reasonable since higher removal efficiencies are expected when the particle size distribution is greater. Results from OK-110 testing demonstrated an average removal of 99.14% from discrete samples and 98.06% from the grab samples across all flow rates tested.

Pollutants addressed	Manufacturer's Removal Efficiency claim	Minimum particle size	Tested removal efficiency (*)	Test Data Status (**)	Notes
Suspended sediment concentration	60-95%	-	60-95 %	2	average removal for all rates and influent types from Tenn Tech studies verified by NJCAT
Total suspended solids	66%	-	69-83 %	2	UNH Stormwater Center field studies, removal efficiency and efficiency ratio methods.
Zinc	50%	-	57-61 %	2	UNH Stormwater Center field studies, removal efficiency and efficiency ratio methods.
Hydrocarbons	78%	-	79-91 %	2	UNH Stormwater Center field studies, removal efficiency and efficiency ratio methods.
Total Phosphorus	37%	-	29-53 %	2	UNH Stormwater Center field studies, removal efficiency and efficiency ratio methods.

***** - Pollution removal efficiency evaluated by MASTEP staff based on review of available performance evaluation reports.

****** - **1** = sufficient credible data to be able to evaluate pollution removal efficiency claims. **2** = sound field or laboratory performance studies exist for this technology. Some caveats exist regarding use of the study information. **3** = performance studies with some scientific merit exist for this technology. Significant caveats exist regarding use of the study information. **4** = There is insufficient reliable data available to evaluate the performance of this technology. **0** = data review not yet conducted.

Test reports: (click on link to view a summary of a test, click on disk icon to download the full report)

Title	Author/ Agency	Date	TARP compliancy	Test protocol compliancy	Documents
Hydraulic Performance and Sediment Trap Efficiency for the StormTech SC-740 Isolator Row	Andrew Christensen and Vince Neary	02/23/2005	No	-	💾 Hydraulic_Perf_Sed_Trap_Eff_StormTech_Isolator.pdf
PERFORMANCE EVALUATION OF SEDIMENT REMOVAL EFFICIENCY STORMTECH ISOLATOR ROW	Vincent Neary	10/20/2006	No	-	💾 Tenn Tech Oct 2006 Report.pdf
NJCAT Technology Verification of the StormTech Isolotor Row	-	08/01/2007	No	-	💾 NJCAT_Verification_StormTech_081507finalbdapprov-doc1.pdf
FINAL REPORT ON FIELD VERIFICATION TESTING OF THE STORMTECH ISOLATOR ROW TREATMENT UNIT	University of New Hampshire Stormwater Center	06/01/2008	No	The UNHSC QAPP was designed tobsubstantially comply with TARP and TAPE guidelines	💾 UNHSC_StormTech Isolator Row_Final Report_6_08.pdf
Performance Evaluation Report of the StormTech Isolator Row Treatment Unit	Roseen et al	09/01/2010	No	TARP and TAPE	💾 UNHSC_Stormtech PER_9_9_10-Final.pdf

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MA DEP
STORMWATER TECHNOLOGIES CLEARINGHOUSE © 2004
This project has been financed with Federal Funds from the Environmental Protection Agency (EPA) to the Massachusetts Department of Environmental Protection (the Department) under an s. 319 competitive grant. The contents do not necessarily reflect the views and policies of EPA or of the Department, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

APPENDIX F

OPERATION & MAINTENANCE PLAN

OPERATION & MAINTENANCE PLAN

Multi-Family Development
580 Main Street Bolton, MA

Prepared: September 10, 2021

Site Locus

CLIENT:
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

allenmajor.com

OPERATION & MAINTENANCE PLAN

Multi-Family Development
580 Main Street Bolton, MA

PROPONENT:
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

ISSUED:
September 10, 2021

REVISED:
-

A&M PROJECT NO.:
1670-15

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SECTION 1.0

OPERATIONS & MAINTENANCE PLAN

1.1 INTRODUCTION

In accordance with the standards set forth by the Stormwater Management Policy issued by the Massachusetts Department of Environmental Protection (MassDEP), Allen & Major Associates, Inc. has prepared the following Operations & Maintenance (O&M) Plan for the proposed stormwater management system for the Multi-Family Development located at 580 Main Street in Bolton, MA.

This plan focuses on post construction maintenance of the on-site drainage system. Operation and Maintenance (O&M) practices discussed below are recommendations made by the Design Engineer based on available reference material on Best Management Practices (BMP's) and experience. The property owner is responsible for implementation of the plan, and is encouraged to revise / supplement this plan accordingly based on actual site conditions.

The plan is broken down into two major sections. The first section describes the long-term pollution prevention measures (Long Term Pollution Prevention Plan). The second section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long Term Maintenance Plan).

1.2 NOTIFICATION PROCEDURES FOR CHANGE OF RESPONSIBILITY FOR O&M

The Stormwater Management System (SMS) for this project is owned by WP East Acquisitions, LLC (owner). The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance Plan.

The owner shall submit an annual summary report and the completed Operation & Maintenance Schedule & Checklist to the Conservation Commission (via email or print copy), highlighting inspection and maintenance activities including performances of BMPs. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the Commission that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the Commission of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the Commission.

1.3 CONTACT INFORMATION

Stormwater Management System Owner:	WP East Acquisitions, LLC 91 Hartwell Avenue Lexington, MA 02421 Phone: TBD

Emergency Contact Information:

WP East Acquisitions, LLC (Owner/Operator)	Phone: TBD
Bolton Department of Public Works	Phone: 978-779-6402
Bolton Fire Department (non-emergency line)	Phone: 978-779-2203
MassDEP Emergency Response	Phone: (888) 304-1133
Clean Harbors Inc (24-Hour Line)	Phone: (800) 645-8265

1.4 CONSTRUCTION PERIOD

1. Call Digsafe: 1-888-344-7233
2. Schedule a meeting with the various Town Departments, Design Engineer and Owner at least three (3) days prior to start of construction.
3. Install Erosion Control measures (construction entrance, wattles, straw bales, silt fence, silt sac, etc.) as shown on the Plans prepared by A&M. If required, by any special conditions, the Town shall review the installation of erosion control measures prior to the start of any site demolition work. Install Construction fencing if determined to be necessary at the commencement of construction.
4. All erosion and sedimentation controls shall be in accordance with MassDEP's Erosion and Sedimentation Control guidelines revised through May 2003 and the USDA SCS Erosion and Sedimentation Control in site development dated September 1983.
5. Site access shall be achieved only from the designated construction entrances.
6. Cut and clear trees in construction areas only (within the limit of work; see plans).
7. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.
8. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.

9. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on-site for review.
10. All erosion control measures shall be maintained, repaired, or replaced as required or at the direction of the owner’s engineer or the Town’s representative.
11. Sediment accumulation up-gradient of the straw bales, silt fence, and stone check dams greater than 6” in depth shall be removed and disposed of in accordance with all applicable regulations.
12. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.
13. Install stone check dam on-site during construction as needed. Refer to the erosion control details. Temporary sediment basins combined with stone check damns shall be installed on-site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.
14. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
15. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle’s tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
16. Dust pollution shall be controlled using on-site water trucks and/or an approved soil stabilization product.
17. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly. The report shall document any deficiencies and corrective actions taken by the applicant.
18. No overuse, over-compaction, or storage of materials shall occur within any areas defined as stormwater infiltration to prevent the incidental compaction of soils. The areas are to be constructed as soon as possible and protected from construction traffic. NO CONSTRUCTION WATERS are to be emptied into an infiltration system. An allowance may be accommodated for a temporary excavation of soils within the infiltration basin for collection and handling of construction water, but the entirety of the debris is to be removed in order to achieve the grades as shown on the construction drawings.

19. The entire drainage system, including but not limited to catch basin, manholes, piping, water quality structures and infiltration system should be cleaned prior to turnover to the Owner.

1.5 LONG-TERM POLLUTION PREVENTION PLAN

Standard #4 from the MassDEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance Plan of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures of the LTPPP.

- **Housekeeping**
  The existing development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland areas. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

- **Storing of Materials & Water Products**
  The trash and waste program for the site includes exterior dumpsters. There is a trash contractor used to pick up the waste material in the dumpsters. The stormwater drainage system has water quality inlets designed to capture trash and debris.

- **Vehicle Washing**
  Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The existing development does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

- **Spill Prevention & Response**
  Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the buildings and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

1. Spill hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
4. All spills shall be cleaned up immediately after discovery.
5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at (888) 304-1333.
6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

- **Maintenance of Lawns, Gardens, and Other Landscaped Areas**
  It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff/landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trees shall be planted over the drain lines or recharge area, and that only shallow rooted plants and shrubs will be allowed.

  - **Fertilizer**

    Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ration of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

Type:	LESCO® 28-0-12 (Lawn Fertilizer)
	MERIT® 0.2 Plus Turf Fertilizer
	MOMENTUM™ Force Weed & Feed

- **Suggested Aeration Program**

  In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

  Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

  The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

- **Landscape Maintenance Program Practices**:

  - **Lawn**

    1. Mow a minimum of once a week in spring, to a height of 2” to 2 1/2” high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cute, the less

the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.

2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
4. Do not remove grass clippings after mowing.
5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.

- **Shrubs**
  1. Mulch not more than 3" depth with shredded pine or fir bark.
  2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals are to occur within 6" of the ground to open up shrub and maintain two-year wood (the blooming wood).
  3. Hand-prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
- **Trees**
  1. Provide aftercare of new tree plantings for the first three years.
  2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
  3. Water once a week for the first year; twice a month for the second; once a month for the third year.
  4. Prune trees on a four-year cycle.
- **Invasive Species**
  1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

- **Storage and Use of Herbicides and Pesticides**
  Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and

water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) should be retained who is licensed with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Department of Agricultural Resources.

The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor household or structural pests, refer to 333 CMR 13.08.

Before beginning each application, the applicator must post a Department approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator’s best judgment. It is intended to give sufficient notice so that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

1. Name and phone number of pest control company;
2. Date and time of the application;
3. Name and license number of the applicator;
4. Target pests; and
5. Name and EPA Registration Number of pesticide products applied.

- **Pet Waste Management**
  The owner’s landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the development. The pet waste shall be disposed of in accordance with local and state regulations.

- **Operations and Management of Septic Systems**
  The private on-site wastewater treatment systems shall be inspected in accordance with the special conditions from the groundwater discharge permit issues by MassDEP.

- **Management of Deicing Chemicals and Snow**
  Snow will be stockpiled on site until the accumulated snow becomes a hazard to the daily operations of the site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to MassDEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations

  The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. If used, the de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. If used, de-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand.

1.6 LONG-TERM MAINTENANCE PLAN – FACILITIES DESCRIPTION

A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

The following is a description of the Stormwater Management System for the project site.

- **Stormwater Collection System – On-Site**: The stormwater collection system is comprised of deep sump hooded catch basins, Contech CDS 2015-4 water quality structures, Stormtech Isolator Row, a sub-surface infiltration system consisting of Stormtech SC-740 Chambers, wet basin, a closed gravity pipe network and several outlet control structures.
  The stormwater runoff from the building rooftops are collected using roof drains. The stormwater is conveyed to the discharge locations using internal building plumbing and external roof leaders. The building rooftop runoff discharges to one of several sub-surface infiltration systems.

1.7 INSPECTION AND MAINTENANCE FREQUENCY AND CORRECTIVE MEASURES

In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the following areas, facilities, and measures will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the footprint of the SMS.

Attached is an Operation and Maintenance Plan (OM-1) illustrating the location of the following SMS components that will require continuing inspection as outlined in the document:

- *Street Sweeping*
- *Deep Sump Hooded Catch Basin*
- *Contech CDS 2015-4 Water Quality Structures*
- *Stormtech Isolator Row*
- *Sub-Surface Infiltration Systems (Stormtech SC-740 Chambers)*
- *Pipe Ends*
- *Wet Basin*
- *Snow Storage (as outlined on plan)*

1.8 STRUCTURAL PRETREATMENT BMPS

Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

Deep Sump Catch Basins:

Deep sump catch basins, also known as oil and grease or hooded catch basins, are underground retention systems designed to remove trash, debris, and coarse sediment from stormwater runoff, and serve as temporary spill containment devices for floatables such as oils and greases.

Regular maintenance is essential. Deep sump catch basins remain effective by removing pollutants only if they are cleaned out frequently. One study found that once 50% of the sump volume is filled, the catch basin is not able to retain additional sediments.

Inspect or clean deep sump catch basins at least four times per year and at the end of the foliage and snow-removal seasons. Sediments must also be removed four times per year or whenever the depths of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

Clamshell buckets are typically used to remove sediment in Massachusetts. However, vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Always consider the safety of the staff cleaning deep sump catch basins. Cleaning a deep sump catch basin within a road with active traffic or even within a parking lot is dangerous, and a police detail may be necessary to safeguard workers.

Although catch basin debris often contains concentrations of oil and hazardous materials, such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Unless there is evidence that they have been contaminated by a spill or other means, MassDEP does not routinely require catch basin cleanings to be tested before disposal. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste, without any prior approval by MassDEP. However, some landfills require catch basin cleanings to be tested before they are accepted.

With prior MassDEP approval, catch basin cleanings may be used as grading and shaping materials at landfills undergoing closure (see Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites) or as daily cover at active landfills. MassDEP also encourages the beneficial reuse of catch basin cleanings whenever possible. A Beneficial Reuse Determination is required for such use.

MassDEP regulations prohibit landfills from accepting materials that contain free-draining liquids. One way to remove liquids is to use a hydraulic lift truck during cleaning operations so that the material can be decanted at the site. After loading material from several catch basins into a truck, elevate the truck so that any free-draining liquid can flow back into the structure. If there is no free water in the truck, the material may be deemed to be sufficiently dry. Otherwise catch basin cleanings must undergo a Paint Filter Liquids Test. Go to www.Mass.gov/dep/recycle/laws/cafacts.doc for information on all of the MassDEP requirements pertaining to the disposal of catch basin cleanings

Contech CDS 2015-4 450i Water Quality Structure:

Regular maintenance is essential. Inspect or clean water quality structure at least twice per year (e.g. spring & fall) and snow-removal seasons. Sediments must also be removed whenever the depths of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Please refer to the Stormceptor STC Operation and Maintenance Guide attached hereafter.

Vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Always consider the safety of the staff cleaning the structure. Cleaning structures within a road with active traffic or even within a parking lot is dangerous, and a police detail may be necessary to safeguard workers.

Although debris often contains concentrations of oil and hazardous materials, such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Unless there is evidence that they have been contaminated by a spill or other means, MassDEP does not routinely require catch basin cleanings to be tested before disposal. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

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1.9 TREATMENT BMPS

Stormtech Isolator Row:

Stormtech's Isolator Row is an isolated row of chambers wrapped in geotextile fabric which filters the stormwater, trapping pollutants in the row before entering the adjacent chambers. The Isolator Row inspection/maintenance should be done in accordance with the manufacturer's guidelines and documentation. A copy is attached hereafter.

Wet Basins:

Wet basins use a permanent pool of water as the primary mechanism to treat stormwater. The pool allows sediments to settle (including fine sediments) and removes soluble pollutants. Wet basins must have additional dry storage capacity to control peak discharge rates. Wet basins have a moderate to high capacity to remove most urban pollutants, depending on how large the volume of the permanent pool is in relation to the runoff from the surrounding watershed.

Inspect wet basins at least once per year to ensure they are operating as designed. Inspect the outlet structure for evidence of clogging or excessive outflow releases. Potential problems to check include: subsidence, erosion, cracking or tree growth on the embankment, damage to the emergency spillway, sediment accumulation around the outlet, inadequacy of the inlet/outlet channel erosion control measures, change in the condition of the pilot channel, erosion within the basin and banks, and the emergence of invasive species. During inspections, note any changes to the wet basin or the contributing watershed area because these may affect basin performance. At least twice a year, mow the upper-stage, side slopes, embankment and emergency spillway. At this time, also check the sediment in the forebay for accumulated material, sediment, trash, and debris and remove it. Remove sediment from the basin as necessary, and at least once every 10 years.

1.10 CONVEYANCE BMPS

Grass Swale:

Grass Drainage Channels should be inspected within the first three months after construction to ensure proper vegetation is established; thereafter, Inspect 2 times per year (preferably in Spring and Fall) to ensure they are working in their intended fashion and that they are free of sediment and debris. Remove any obstructions to flow, including accumulated sediments and debris and vegetated growth. Repair any erosion of the ditch lining. Vegetated ditches will be mowed at least annually or otherwise maintained to control the growth of woody vegetation and maintain flow capacity. Any woody vegetation growing through riprap linings must also be removed. Repair any slumping side slopes as soon as practicable and correct any erosion of the channel's bottom or side slopes.

1.11 INFILTRATION BMPS

Subsurface Structures:

Subsurface structures are underground systems that capture runoff, and gradually infiltrate it into the groundwater through rock and gravel.

Because subsurface structures are installed underground, they are extremely difficult to maintain. Inspect inlets at least twice a year. Remove any debris that might clog the system. Include mosquito controls in the Operation and Maintenance Plan.

Inspect outlet from subsurface structures to adjacent resource area for signs of scour and sediment accumulation at least twice annually. Remove sediment accumulation and add rip rap as necessary to prevent scour.

1.12 OTHER BMPS AND ACCESSORIES:

Outlet Control Structures:

Outlets of BMPs are devices that control the flow of stormwater out of the BMP to the conveyance system.

Inspect outlet structures twice per year. Remove any accumulated sediment and debris that could prevent flow at the outlet structure.

Culverts:

Inspect culverts 2 times per year (preferably in Spring and Fall) to ensure that the culverts are working in their intended fashion and that they are free of debris. Remove any obstructions to flow; remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit and repair any erosion damage at the culvert’s inlet and outlet.

Rip Rap and Level Spreaders:

Inspect twice per year for erosion, debris accumulation, and unwanted vegetation. Erosion areas shall be stabilized and sediment, debris, and woody vegetation will be removed.

Vegetated Areas:

Inspect slopes and embankments early in the growing season to identify active or potential erosion problems. Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

Roadway and Parking Surfaces:

Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Mosquito Control Plan:

MA Stormwater Handbook; Volume 2, Chapter 5 (Attached)

Both above ground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance, and treatment with larvicides can minimize this potential.

1.13 SUPPLEMENTAL INFORMATION

PROPOSED OPERATIONS AND MAINTENANCE LOG FORM

Based on site specific stormwater management system asset list. At a minimum, fields should be provided for:

- Date of inspection
- Name of inspector
- Condition of each BMP, including components such as:
    - Pretreatment devices
    - Vegetation
    - Other safety devices
    - Control structures
    - Embankments, slopes, and safety benches
    - Inlet and outlet channels and structures
    - Underground drainage
    - Sediment and debris accumulation in storage and forebay areas (including catch basins)
    - Any nonstructural practices
    - Any other item that could affect the proper function of the stormwater management system
- Description of the need for maintenance
- Description of maintenance performed

APPENDIX A

SUPPLEMENT INFORMATION

SNOW DISPOSAL GUIDANCE

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

Massachusetts Department of Environmental Protection
Bureau of Water Resources
Snow Disposal Guidance

Effective Date: December 23, 2019

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: Bureau of Resource Protection (BRP) Snow Disposal Guideline No. BRPG97-1 issued December 12, 1997 and BRPG01-01 issued March 8, 2001; Bureau of Water Resources (BWR) snow disposal guidance issued December 21, 2015 and December 12, 2018.

Approved by: Kathleen Baskin, Assistant Commissioner, Bureau of Water Resources

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are protective of wetlands, drinking water, and water bodies, and are acceptable to the Massachusetts Department of Environmental Protection (MassDEP), Bureau of Water Resources.

APPLICABILITY: These Guidelines are issued by MassDEP's Bureau of Water Resources on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to all federal agencies, state agencies, state authorities, municipal agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While MassDEP is aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything that occurs on the land has the potential to impact the Commonwealth's water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help federal agencies, state agencies, state authorities, municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter. Following these guidelines and obtaining the necessary approvals may also help municipalities in cases when seeking reimbursement for snow disposal costs from the Federal Emergency Management Agency is possible.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas or upland locations on impervious surfaces away from water resources and drinking water wells. At these locations, the snow meltwater can filter into the soil, leaving behind sand and debris which can be removed in the spring. The following conditions should be followed:

- Within water supply Zone A and Zone II, avoid storage or disposal of snow and ice containing deicing chemicals that has been collected from streets located outside these zones. Municipalities may have a water supply protection land use control that prohibits the disposal of snow and ice containing deicing chemicals from outside the Zone A and Zone II, subject to the Massachusetts Drinking Water Regulations at 310 CMR 22.20C and 310 CMR 22.21(2).
- Avoid storage or disposal of snow or ice in Interim Wellhead Protection Areas (IWPA) of public water supply wells, and within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater.
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage systems including detention basins, swales or ditches. Snow combined with sand and debris may block a stormwater drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Recommended Site Selection Procedures

It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

- Estimate how much snow disposal capacity may be needed for the season so that an adequate number of disposal sites can be selected and prepared.
- Identify sites that could potentially be used for snow disposal, such as municipal open space (e.g., parking lots or parks).
- Select sites located in upland locations that are not likely to impact sensitive environmental resources first.
- If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

Snow Disposal Mapping Assistance

MassDEP has an online mapping tool to assist in identifying possible locations to potentially dispose of snow. MassDEP encourages municipalities to use this tool to identify possible snow disposal options. The tool identifies wetland resource areas, public drinking water supplies and other sensitive locations where snow should not be disposed. The tool may be accessed through the Internet at the following web address:
https://maps.env.state.ma.us/dep/arcgis/js/templates/PSF/.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- Wherever possible maintain a 50-foot vegetated buffer between the disposal site and adjacent waterbodies to filter pollutants from the meltwater.
- Clear debris from the site prior to using the site for snow disposal.
- Clear debris from the site and properly dispose of it at the end of the snow season, and no later than May 15.

3. SNOW DISPOSAL APPROVALS

Proper snow disposal may be undertaken through one of the following approval procedures:

- Routine snow disposal – Minimal, if any, administrative review is required in these cases when upland and pervious snow disposal locations or upland locations on impervious surfaces that have functioning and maintained stormwater management systems have been identified, mapped, and used for snow disposal following ordinary snowfalls. Use of upland and pervious snow disposal sites avoids wetland resource areas and allows snow meltwater to recharge groundwater and will help filter pollutants, sand, and other debris. This process will address the majority of snow removal efforts until an entity exhausts all available upland snow disposal sites. The location and mapping of snow disposal sites will help facilitate each entity's routine snow management efforts.
- Emergency Certifications – If an entity demonstrates that there is no remaining capacity at upland snow disposal locations, local conservation commissions may issue an Emergency Certification under the Massachusetts Wetlands Protection regulations to authorize snow disposal in buffer zones to wetlands, certain open water areas, and certain wetland resource areas (i.e. within flood plains). Emergency Certifications can only be issued at the request of a public agency or by order of a public agency for the protection of the health or safety of citizens, and are limited to those activities necessary to abate the emergency. See 310 CMR 10.06(1)-(4). Use the following guidelines in these emergency situations:
    - Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
    - Do not dispose of snow in salt marshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
    - Do not dispose of snow where trucks may cause shoreline damage or erosion.
    - Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.

- Severe Weather Emergency Declarations – In the event of a large-scale severe weather event, MassDEP may issue a broader Emergency Declaration under the Wetlands Protection Act which allows federal agencies, state agencies, state authorities, municipalities, and businesses greater flexibility in snow disposal practices. Emergency Declarations typically authorize greater snow disposal options while protecting especially sensitive resources such as public drinking water supplies, vernal pools, land containing shellfish, FEMA designated floodways, coastal dunes, and salt marsh. In the event of severe winter storm emergencies, the snow disposal site maps created by municipalities will enable MassDEP and the Massachusetts Emergency Management Agency (MEMA) in helping communities identify appropriate snow disposal locations.

    If upland disposal sites have been exhausted, the Emergency Declaration issued by MassDEP allows for snow disposal near water bodies. In these situations, a buffer of at least 50 feet, preferably vegetated, should still be maintained between the site and the waterbody. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, the Emergency Declaration issued by MassDEP may allow disposal of snow in certain waterbodies under certain conditions. ***A federal agency, state agency, state authority, municipality or business seeking to dispose of snow in a waterbody should take the following steps***:

- Call the emergency contact phone number [(888) 304-1133)] and notify the MEMA of the municipality's intent.
- MEMA will ask for some information about where the requested disposal will take place.
- MEMA will confirm that the disposal is consistent with MassDEP's Severe Weather Emergency Declaration and these guidelines and is therefore approved.

During declared statewide snow emergency events, MassDEP's website will also highlight the emergency contact phone number [(888) 304-1133)] for authorizations and inquiries. For further non-emergency information about this Guidance you may contact your MassDEP Regional Office Service Center:

Northeast Regional Office, Wilmington, 978-694-3246
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7650
Western Regional Office, Springfield, 413-755-2114

MOSQUITO CONTROL

Chapter 5
Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within 3 days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

Some stormwater practices are designed to include permanent wet pools. These practices – if maintained properly – can limit mosquito breeding by providing habitat for mosquito predators. Additional measures that can be taken to reduce mosquito populations include increasing water circulation, attracting mosquito predators by adding suitable habitat, and applying larvicides.

The Massachusetts State Reclamation and Mosquito Control Board (SRMCB), through the Massachusetts Mosquito Control Districts, can undertake further mosquito control actions specifically for the purpose of mosquito control pursuant to Massachusetts General Law Chapter 252. The Mosquito Control Board, http://www.mass.gov/agr/mosquito/, describes mosquito control methods and is in the process of developing guidance documents that describe Best Management Practices for mosquito control projects.

The SRMCB and Mosquito Control Districts are not responsible for operating and maintaining stormwater BMPs to reduce mosquito populations. The owners of property that construct the stormwater BMPs or municipalities that “accept” them through local subdivision approval are responsible for their maintenance.[1] The SRMCB is composed of officials from MassDEP, Department of Agricultural Resources, and Department of Conservation and Recreation. The nine (9) Mosquito Control Districts overseen by the SRMCB are located throughout Massachusetts, covering 176 municipalities.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the following actions:

- ***Minimize Land Disturbance:*** Minimizing land disturbance reduces the likelihood of mosquito breeding by reducing silt in runoff that will cause construction period controls to clog and retain standing pools of water for more than 72 hours.
- ***Catch Basin inlets:*** Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads

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[1] MassDEP and MassHighway understand that the numerous stormwater BMPs along state highways pose a unique challenge. To address this challenge, the 2004 MassHighway Stormwater Handbook will provide additional information on appropriate operation and maintenance practices for mosquito control when the Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards..

caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (*Bs*) using a licensed pesticide applicator.

- ***Check Dams:*** If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- ***Design construction period sediment traps*** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide *Bs* after it rains from June through October, until the first frost occurs.
- ***Construction period open conveyances:*** When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- ***Revegetating Disturbed Surfaces:*** Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- ***Sediment fences/hay bale barriers:*** When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

Post-Construction Stormwater Treatment Practices

- Mosquito control begins with the environmentally sensitive site design. Environmentally sensitive site design that minimizes impervious surfaces reduces the amount of stormwater runoff. Disconnecting runoff using the LID Site Design credits outlined in the Massachusetts Stormwater Handbook reduces the amount of stormwater that must be conveyed to a treatment practice. Utilizing green roofs minimizes runoff from smaller storms. Storage media must be designed to dewater within 72 hours after precipitation.
- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
  - ***Bioretention Areas/Rain Gardens/Sand Filter:*** These practices tend not to result in mosquito breeding. If any level spreaders, weirs or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
  - ***Infiltration Trenches:*** This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
  - ***Constructed Stormwater Wetlands:*** Habitat features can be incorporated in constructed stormwater wetlands to attract dragonflies, amphibians, turtles, birds, bats, and other natural predators of mosquitoes.
  - ***Wet Basins:*** Wet basins can be designed to incorporate fish habitat features, such as deep pools. Introduce fish in consultation with Massachusetts Division of Fisheries and Wildlife. Vegetation within wet basins designed as fish habitat must be properly managed to ensure that vegetation does not overtake the habitat. Proper design to ensure that no low circulation or “dead” zones are created may reduce the potential for mosquito breeding. Introducing bubblers may increase water circulation in the wet basin.

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- ***Basins:*** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open.
- ***BMPs without a permanent pool of water:*** All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Wallace indicates that extended dry extended detention basins may breed more mosquitoes than wet basins. It is, therefore, imperative to design outlets from extended dry detention basins to completely dewater within the 72-hour period.
- ***Energy Dissipators and Flow Spreaders:*** Currier and Moeller, 2000 indicate that shallow recesses in energy dissipators and flow spreaders trap water where mosquitoes breed. Set the riprap in grout to reduce the shallow recesses and minimize mosquito breeding.
- ***Outlet control structures:*** Debris trapped in small orifices or on trash racks of outlet control structures such as multiple stage outlet risers may clog the orifices or the trash rack, causing a standing pool of water. Optimize the orifice size or trash rack mesh size to provide required peak rate attenuation/water quality detention/retention time while minimizing clogging.
- ***Rain Barrels and Cisterns:*** Seal lids to reduce the likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over inlets. The cistern system should be designed to ensure that all collected water is drained into it within 72 hours.
- ***Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins:*** Seal all manhole covers to reduce likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over the outlet (CALTRANS 2004).

The Operation and Maintenance Plan should provide for mosquito prevention and control.

- ***Check dams:*** Inspect permanent check dams on the schedule set forth in the O&M Plan. Inspect check dams 72 hours after storms for standing water ponding behind the dam. Take corrective action if standing water is found.
- ***Cisterns:*** Apply *Bs* larvicide in the cistern if any evidence of mosquitoes is found. The Operation and Maintenance Plan shall specify how often larvicides should be applied to waters in the cistern.
- ***Water quality swales:*** Remove and properly dispose of any accumulated sediment as scheduled in the Operation and Maintenance Plan.
- ***Larvicide Treatment:*** The Operation and Maintenance Plan must include measures to minimize mosquito breeding, including larviciding.
- The party identified in the Operation and Maintenance Plan as responsible for maintenance shall see that larvicides are applied as necessary to the following stormwater treatment practices: catch basins, oil/grit separators, wet basins, wet water quality swales, dry extended detention basins, infiltration basins, and constructed stormwater wetlands. The Operation and Maintenance Plan must ensure that all larvicides are applied by a licensed pesticide applicator and in compliance with all pesticide label requirements.
- The Operation and Maintenance Plan should identify the appropriate larvicide and the time and method of application. For example, *Bacillus sphaericus (Bs)*, the preferred

larvicide for stormwater BMPs, should be hand-broadcast.[2] Alternatively, Altosid, a Methopren product, may be used. Because some practices are designed to dewater between storms, such as dry extended detention and infiltration basins, the Operation and Maintenance Plan should provide that larviciding must be conducted during or immediately after wet weather, when the detention or infiltration basin has a standing pool of water, unless a product is used that can withstand extended dry periods.

REFERENCES

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[2] *Bacillus thuringienis israelensis* or *Bti* is usually applied by helicopter to wetlands and floodplains

Roads and Stormwater BMPs

In general, the stormwater BMPs used for land development projects can also be used for new roadways and roadway improvement projects. However, for improvement of existing roads, there are often constraints that limit the choice of BMP. These constraints derive from the linear configuration of the road, the limited area within the existing right-of-way, the structural and safety requirements attendant to good roadway design, and the long-term maintainability of the roadway drainage systems. The MassHighway Handbook provides strategies for dealing with the constraints associated with providing stormwater BMPs for roadway redevelopment projects.

Roadway design can minimize impacts caused by stormwater. Reducing roadway width reduces the total and peak volume of runoff. Designing a road with country drainage (no road shoulders or curbs) disconnects roadway runoff. Disconnection of roadway runoff is eligible for the Low Impact Site Design Credit provided the drainage is disconnected in accordance with specifications outlined in Volume 3.

Like other parties, municipalities that work within wetlands jurisdictional areas and adjacent buffer zones must design and implement structural stormwater best management practices in accordance with the Stormwater Management Standards and the Stormwater Management Handbook. In addition, in municipalities and areas where state agencies operate stormwater systems, the DPWs (or other town or state agencies) must meet the “good housekeeping“ requirement of the municipality’s or agency's MS4 permit.

MassHighway has taken stormwater management one step further by working with MassDEP to develop the MassHighway Storm Water Handbook for Highways and Bridges. The purpose of the MassHighway Handbook is to provide guidance for persons involved in the design, permitting, review and implementation of state highway projects, especially those involving existing roadways where physical constraints often limit the stormwater management options available. These constraints, like those common to redevelopment sites, may make it difficult to comply precisely with the requirements of the Stormwater Management Standards and the Massachusetts Stormwater Handbook.[3] In response to these constraints, MassDEP and MHD developed specific design, permitting, review and implementation practices that meet the unique challenges of providing environmental protection for existing state roads. The information in the MassHighway Handbook may also aid in the planning and design of projects to build new highways and to add lanes to existing highways, since they may face similar difficulties in meeting the requirements of the Stormwater Management Standards.

Although it is very useful, the MassHighway Handbook does not allow MassHighway projects to proceed without individual review and approval by the issuing authority when subject to the Wetlands Protection Act Regulations, 310 CMR 10.00, or the 401 Water Quality Certification Regulations, 314 CMR 9.00. For example, MassHighway must provide a Conservation Commission with a project-specific Operation and Maintenance Plan in accordance with Standard 9 that documents how the project’s post-construction BMPs will be operated and maintained.[4]

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[3] The 2004 MassHighway Handbook outlines standardized methods for dealing with these constraints as they apply to highway redevelopment projects. MassDEP and MassHighway intend to work together to provide guidance for add a lane projects when the 2004 Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards.

[4] The general permit for municipal separate storm sewer systems (the MS4 Permit) requires MassHighway to develop and implement procedures for the proper operation and maintenance of stormwater BMPs. To

Some municipalities have asked if the MassHighway Handbook governs municipal road projects. The answer is no.[5] The MassHighway Handbook was developed in response to the unique problems and challenges arising out of the management of the state highway system. Like other project proponents, cities and towns planning road or other projects in areas subject to jurisdiction under the Wetlands Protection Act must design and implement LID, non-structural and structural best management practices in accordance with the Stormwater Management Standards and the Massachusetts Stormwater Handbook.

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avoid duplication of effort, MassHighway may be able rely on the same procedures to fulfill the operation and maintenance requirements of Standard 9 and the MS 4 Permit.

[5] Although the MassHighway Handbook does not govern municipal road projects, cities and towns may find some of the information presented in the Handbook useful.

OPERATION & MAINTENANCE SUMMARY TABLE

OPERATION AND MAINTENANCE PLAN SCHEDULE

Date:

ALLEN & MAJOR
ASSOCIATES, INC.

Project: Multi-Family Development
Project Address: 580 Main Street Bolton, MA

Responsible for O&M Plan: WP East Acquisitions, LLC
Address: 91 Hartwell Avenue Lexington, MA 02421
Phone:

All information within table is derived from Massachussetts Stormwater Handbook: Volume 2, Chapter 2

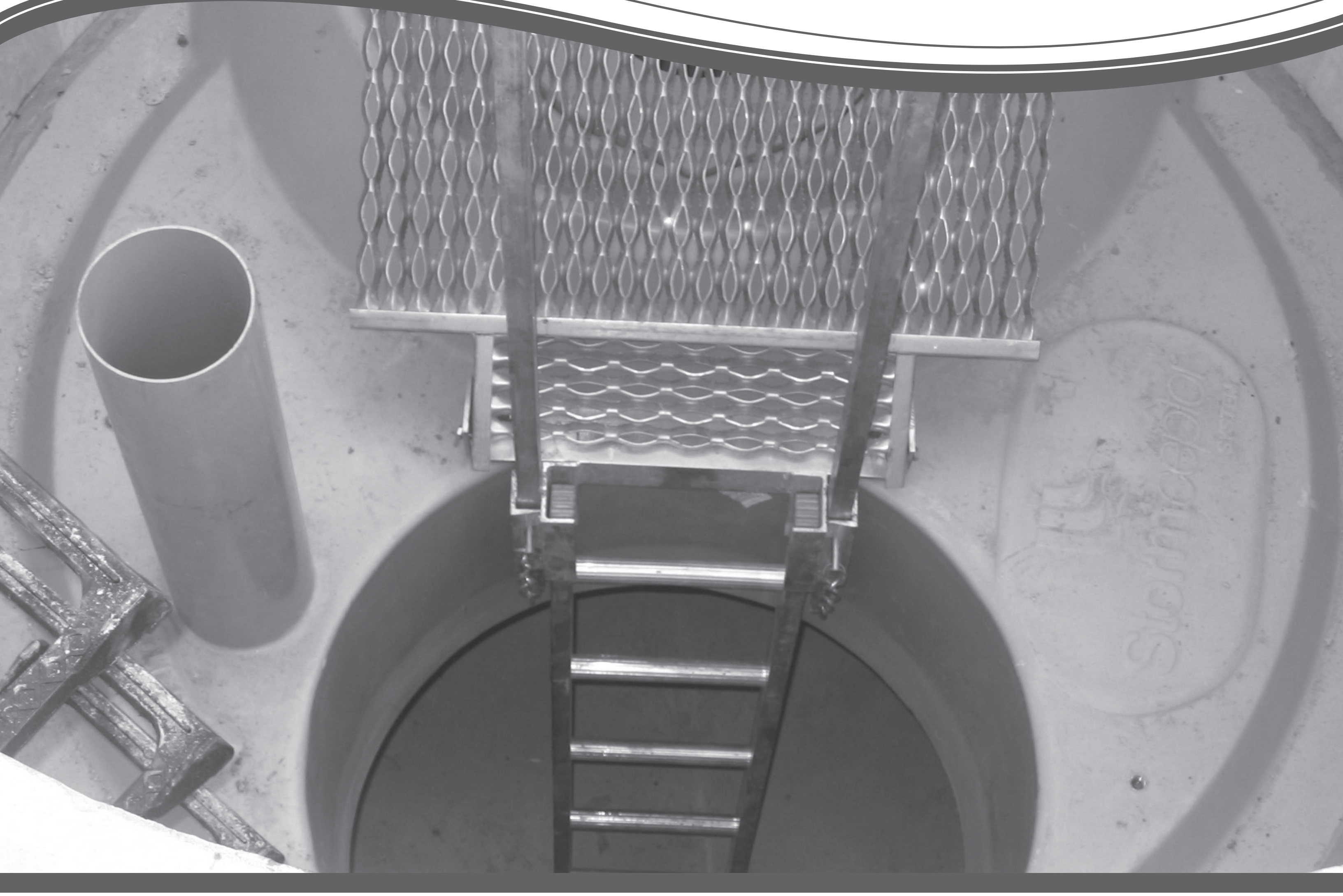
BMP CATEGORY	BMP OR MAINTENANCE ACTIVITY	SCHEDULE/ FREQUENCY	NOTES	ESTIMATED ANNUAL MAINTENANCE COST	INSPECTION PERFORMED	
					DATE:	BY:
STRUCTURAL PRETREATMENT BMPs	DEEP SUMP HOODED CATCH BASIN	Twice per year.	Inspect and clean catch basin units whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.	$1,000		
	PROPRIETARY SEPARATORS	In accordance with manufacturers requirements, but no less than twice a year following installation and once a year thereafter.	Remove sediment and other trapped pollutants at frequency or level specified by manufacturer.	$1,000		
TREATMENT BMP'S	PROPRIETARY STORMTECH ISOLATOR ROW	Twice per year minimum; follow manufacturer's schedule	Inspect for standing water, sediment, trash and debris and clogging. Inspect to determine if system drains in 72 hours once a year during wet season after a large storm.	$1,000		
	WET BASIN	Twice per year.	Inspect wet basins to ensure they are operating as designed. Mow the upper stage, side slopes, embankments and emergency spillway. Check the sediment forebay for accumulated sediment, trash, debris and remove it. Remove sediment from the basin as necessary and at least once evry 10 yrs.	$1,000		
CONVEYANCE BMPs	GRASS SWALE	Remove sediment annually. Mow once a month during growing season. Repair erosion no less than once per year.	Remove sediment from forebay and grass channel, mow, repair areas of erosion and revegetate.	$500		
INFILTRATION BMPs	SUBSURFACE STRUCTURES	Inspect structure inlets at least twice a year. Remove debris that may clog the system as needed.	Because subsurface structures are installed underground, they are extremely difficult to maintain. Remove any debris that might clog the system.	$1,000		

OTHER BMP's	**POROUS PAVEMENT**	Assess exfiltration capability at least once a year. Inspect for deterioration annually. Monitor if paving surface is draining properly as needed.	Monitor to ensure that the paving surface drains properly after storms. For porous asphalts and concretes, clean the surface using power washer to dislodge trapped particles and then vacuum sweep the area. Inspect the surface annually for deterioration.	$2,000		
BMP ACCESSORIES	**LEVEL SPREADERS**	Inspect regularly, especially after large rainfall events.	Inspect level spreaders regularly, especially after large rainfall events. Note and repair any erosion or low spots in the spreader.	$1,000		
	OUTLET STRUCTURES	Periodic cleaning of Outlet Control Structures as needed.	Clear trash and debris as necessary.	$500		
OTHER MAINTENANCE ACTIVITY	**MISQUITO CONTROL**	Inspect BMPs as needed to ensure the system's drainage time is less than the maximum 72 hour period.	Massachusetts stormwater handbook requires all stormwater practices that are designed to drain do so within 72 hours to reduce the number of mosquitos that mature to adults since the aquatic stage of a mosquito is 7-10 days.	$300		
	SNOW STORAGE	Clear and remove snow to approved storage locations as necessary to ensure systems are working properly and are protected from meltwater pollutants.	Carefully select snow disposal sites before winter. Avoid dumping removed snow over catch basins, or in detention ponds, sediment forebays, rivers, wetlands, and flood plains. It is also prohibited to dump snow in the bioretention basins or gravel swales.	$500		
	STREET SWEEPING	Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring.	Sweep, power broom or vacuum paved areas. Submit information that confirms that all street sweepings have been completed in accordance with state and local requirements	$2,000		

STORMCEPTOR OPERATION & MAINTENANCE

CONTECH®
ENGINEERED SOLUTIONS

Stormceptor® STC
Operation and Maintenance Guide



Stormceptor® STC

Stormceptor Design Notes

- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.

Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences			
Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in. (75 mm)	1 in. (25 mm)	3 in. (75 mm)
Multiple inlet pipes	3 in. (75 mm)	3 in. (75 mm)	Only one inlet pipe.

Maximum inlet and outlet pipe diameters:

Inlet/Outlet Configuration	Inlet Unit STC 450i	In-Line Unit STC 900 to STC 7200	Series* STC 11000 to STC 16000
Straight Through	24 inch (600 mm)	42 inch (1050 mm)	60 inch (1500 mm)
Bend (90 degrees)	18 inch (450 mm)	33 inch (825 mm)	33 inch (825 mm)

- The inlet and in-line Stormceptor units can accommodate turns to a maximum of 90 degrees.
- Minimum distance from top of grade to crown is 2 feet (0.6 m)
- Submerged conditions. A unit is submerged when the standing water elevation at the proposed location of the Stormceptor unit is greater than the outlet invert elevation during zero flow conditions. In these cases, please contact your local Stormceptor representative and provide the following information:
- Top of grade elevation
- Stormceptor inlet and outlet pipe diameters and invert elevations
- Standing water elevation
- Stormceptor head loss, K = 1.3 (for submerged condition, K = 4)

OPERATION AND MAINTENANCE GUIDE
Table of Content

1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 •2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

2. Stormceptor Design Overview

2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18” (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.

3. Key Operation Features

3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{SC} = \frac{H}{6_H} = \frac{Q}{A_S}$$

Where:

v_{SC} = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$\O_H$ = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft3/s (m3/s)

A_S = surface area, ft^2 (m^2)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

4. Stormceptor Product Line

4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

Table 1. Stormceptor Models

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft^3 (L)
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

4.2. Inline Stormceptor

The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.

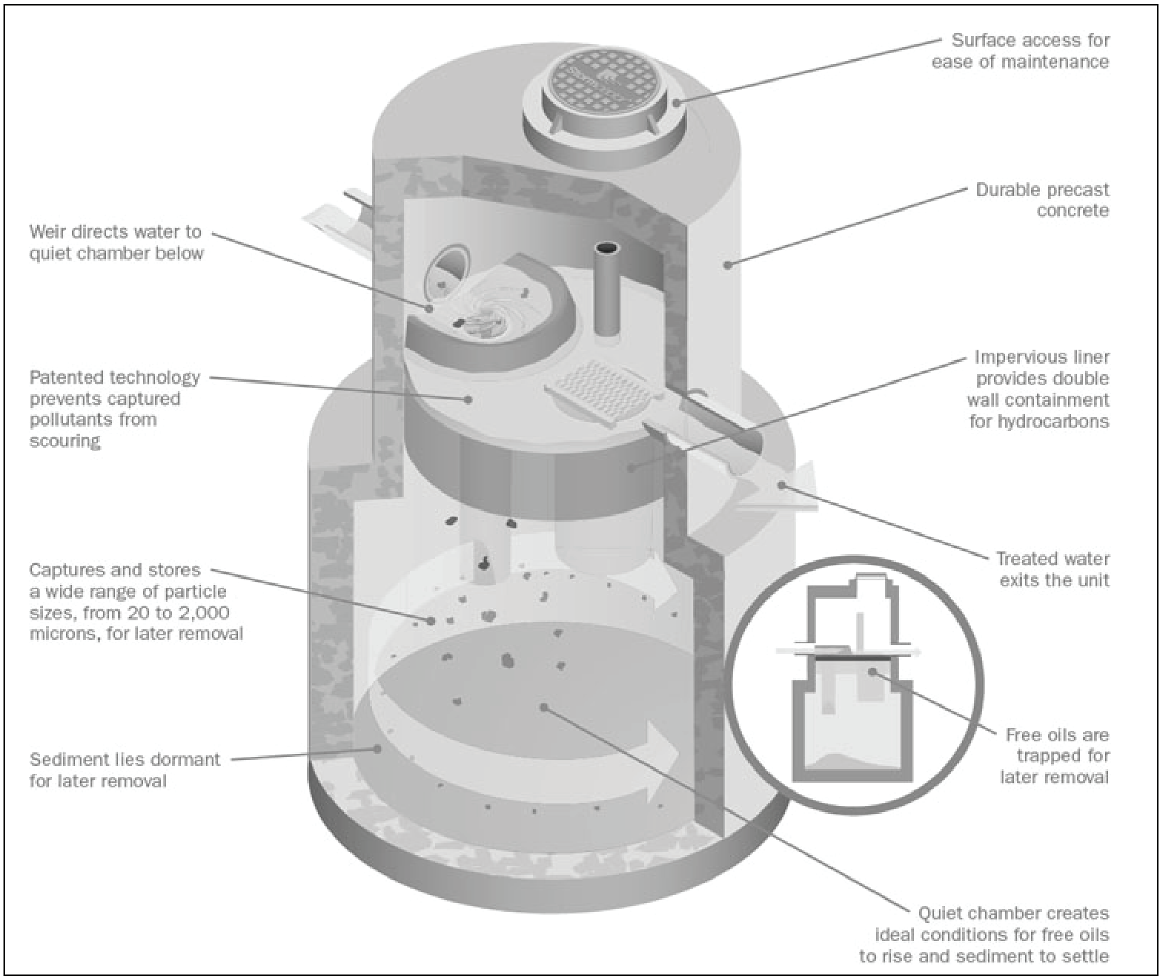


Figure 1. Inline Stormceptor

Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.

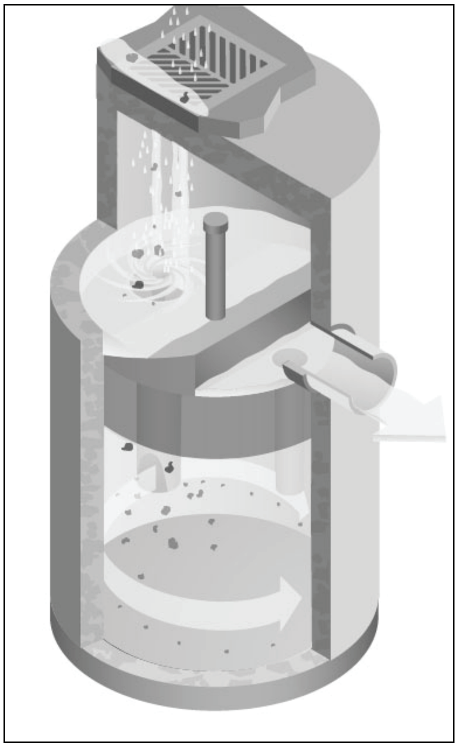


Figure 2. Inlet Stormceptor

4.3. Inlet Stormceptor

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

4.4. Series Stormceptor

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.

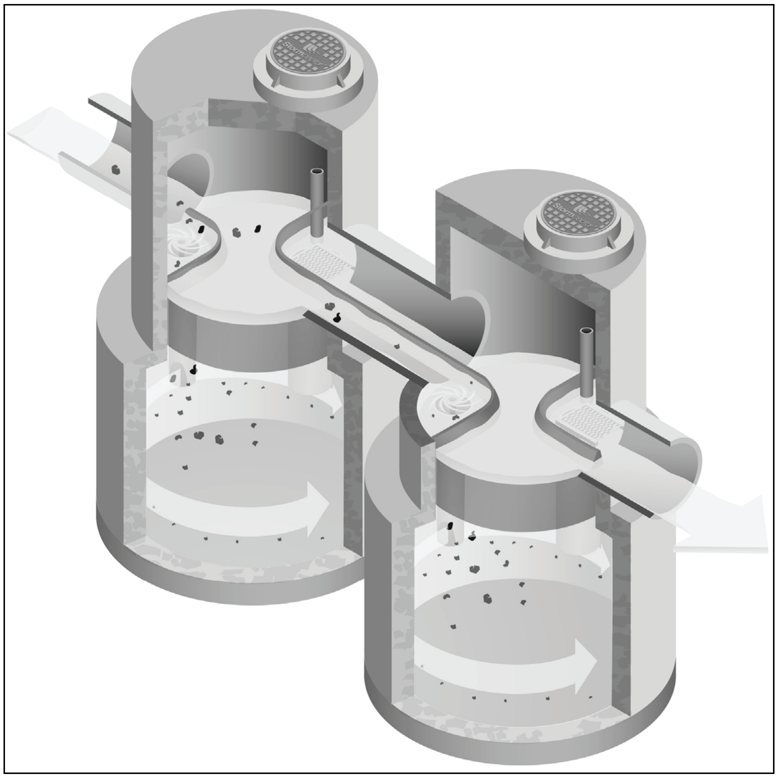


Figure 3. Series System

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

Table 2. Fine Distribution

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
    - The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
    - The distribution of TSS with the hydrology is properly and accurately considered in the sizing
    - Particle size distribution is properly considered in the sizing
    - The sizing can be optimized for TSS removal
    - The cost benefit of alternate TSS removal criteria can be easily assessed
    - The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit www.imbriumsystems.com to download a free copy of the program.

5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site's typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit's performance. As an integral part of the product's design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered "stable" surfaces which have non – erodible surfaces.

Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as "unstable". These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

'Oil Removal' describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

‘Spill Capture’ describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit’s available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

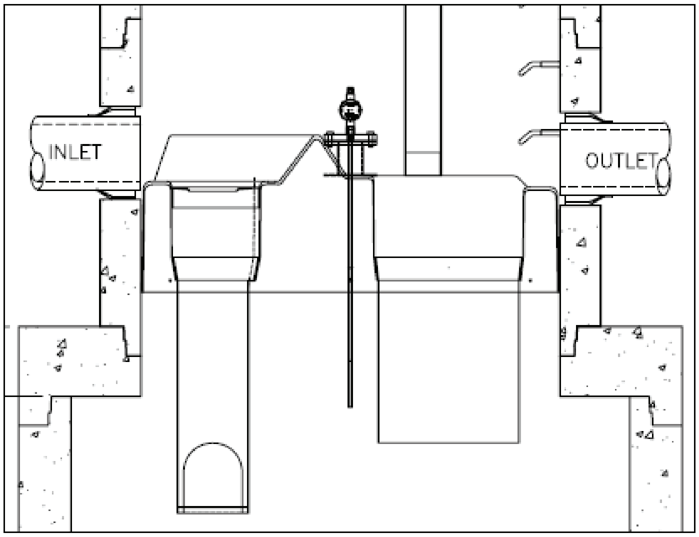


Figure 4. Oil level alarm

6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.

7. Stormceptor Options

The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

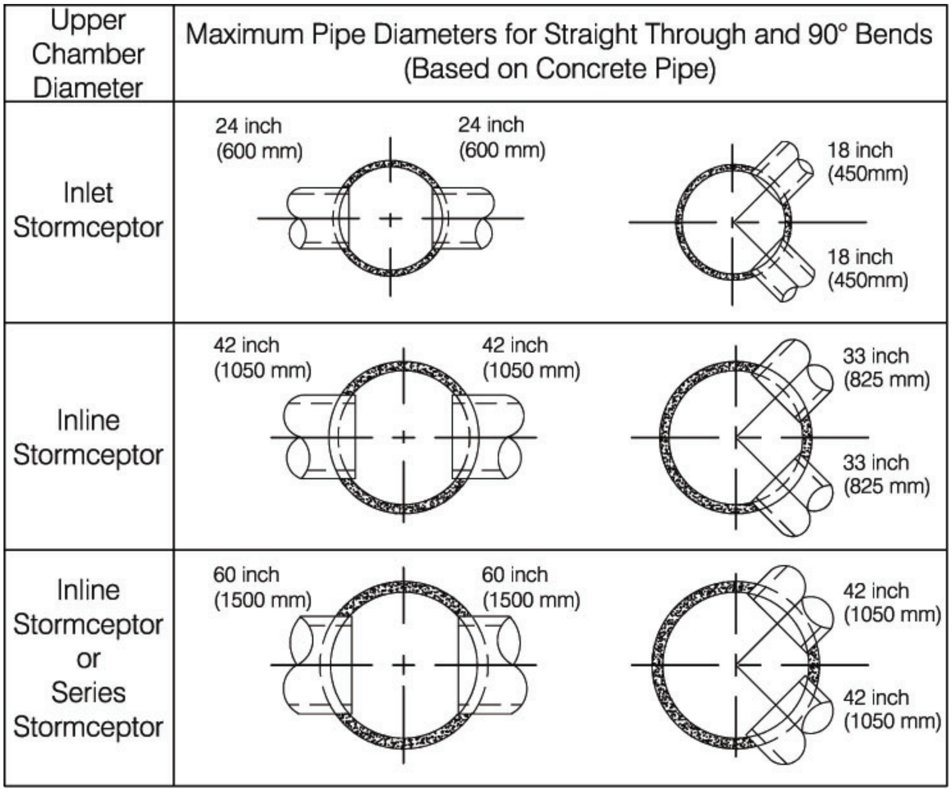


Figure 5. Maximum pipe diameters for straight through and bend applications

*The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.

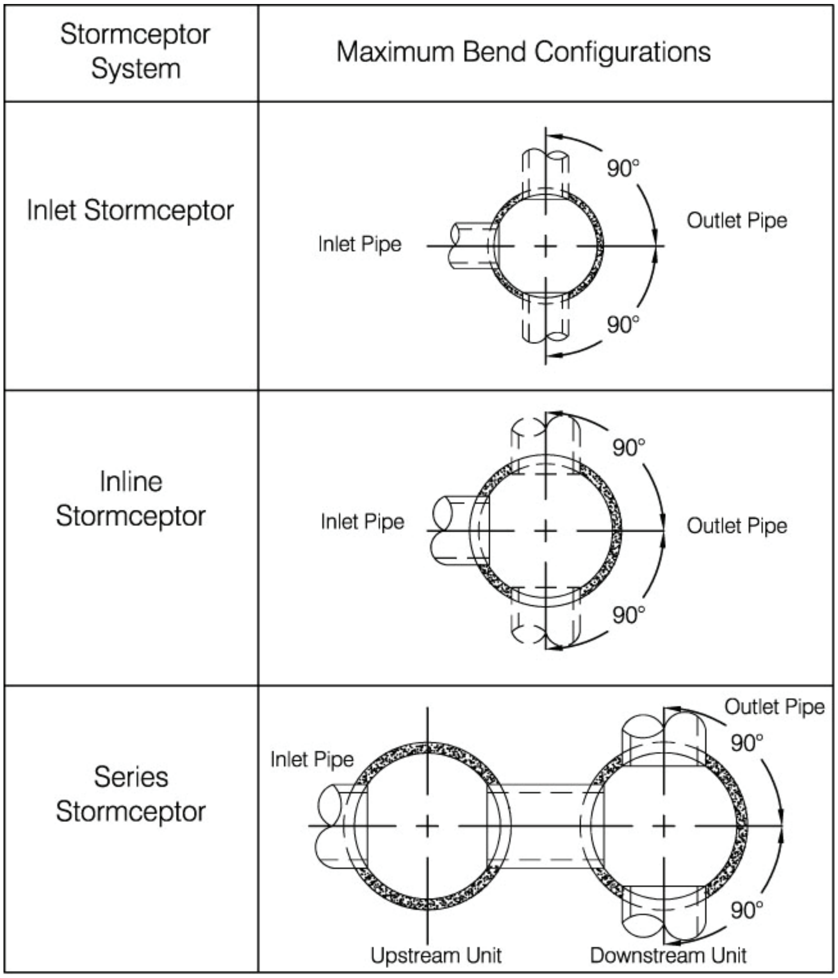


Figure 6. Maximum bend angles

7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life- cycle maintenance cost.

7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss = k*1.3v2/2g).

However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation

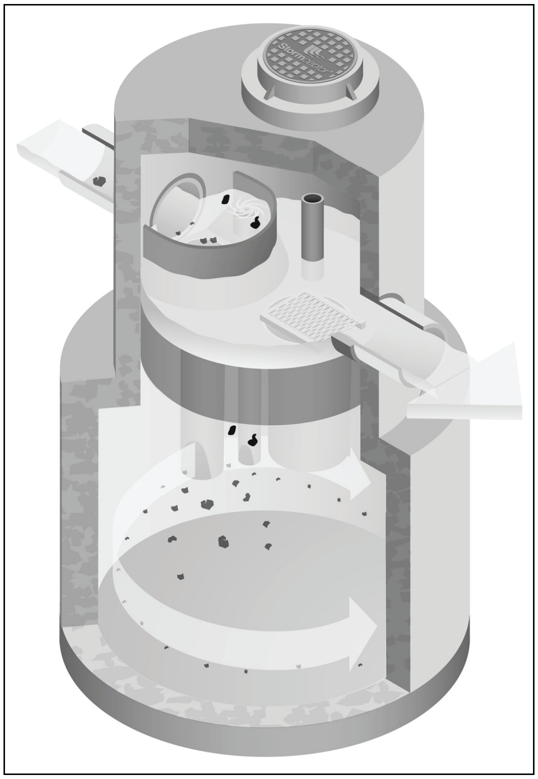


Figure 7. Submerged Stormceptor

8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between "approved alternatives". The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system's performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product's performance claims.

8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system's design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

12. Maintenance

12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well- established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

Table 4. Sediment Depths Indicating Required Servicing*

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit's total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10 mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.

SUPPORT

Drawings and specifications are available at www.ContechES.com.

Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, and earth stabilization products. For information, visit www.ContechES.com or call 800.338.1122

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Isolator® Row O&M Manual


SC-740


MC-3500


MC-4500

THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160LP, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

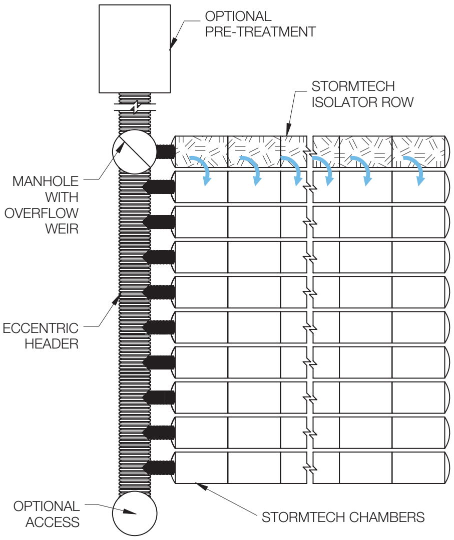
The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

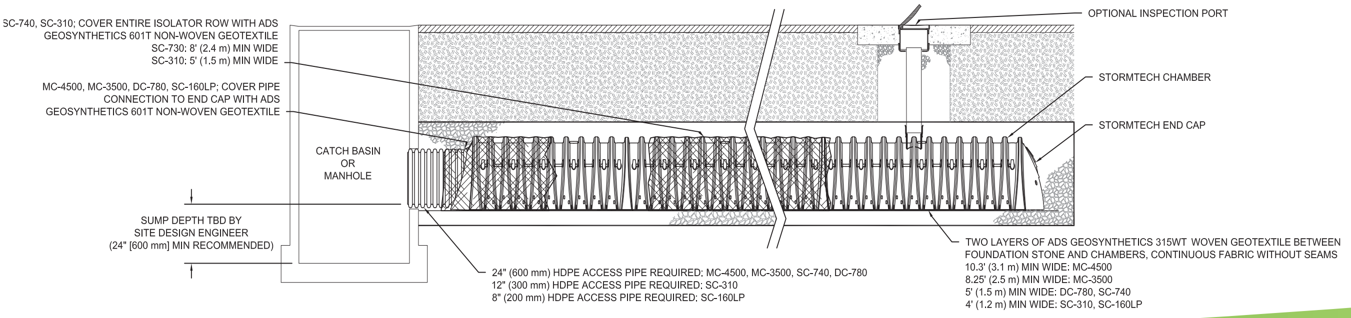
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1

Inspect Isolator Row for sediment.

A) Inspection ports (if present)
   i. Remove lid from floor box frame
   ii. Remove cap from inspection riser
   iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
   iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.

B) All Isolator Rows
   i. Remove cover from manhole at upstream end of Isolator Row
   ii. Using a flashlight, inspect down Isolator Row through outlet pipe
      1. Mirrors on poles or cameras may be used to avoid a confined space entry
      2. Follow OSHA regulations for confined space entry if entering manhole
   iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2

Clean out Isolator Row using the JetVac process.

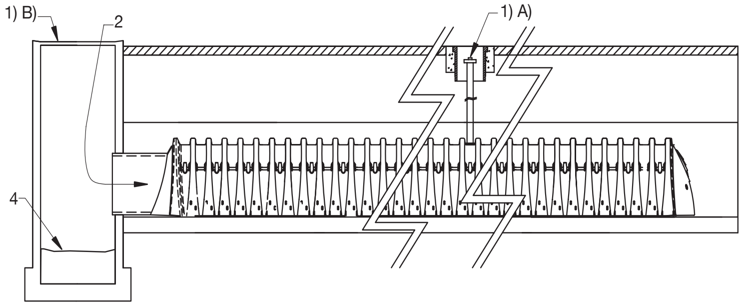
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

STEP 3

Replace all caps, lids and covers, record observations and actions.

STEP 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

StormTech Maintenance Log

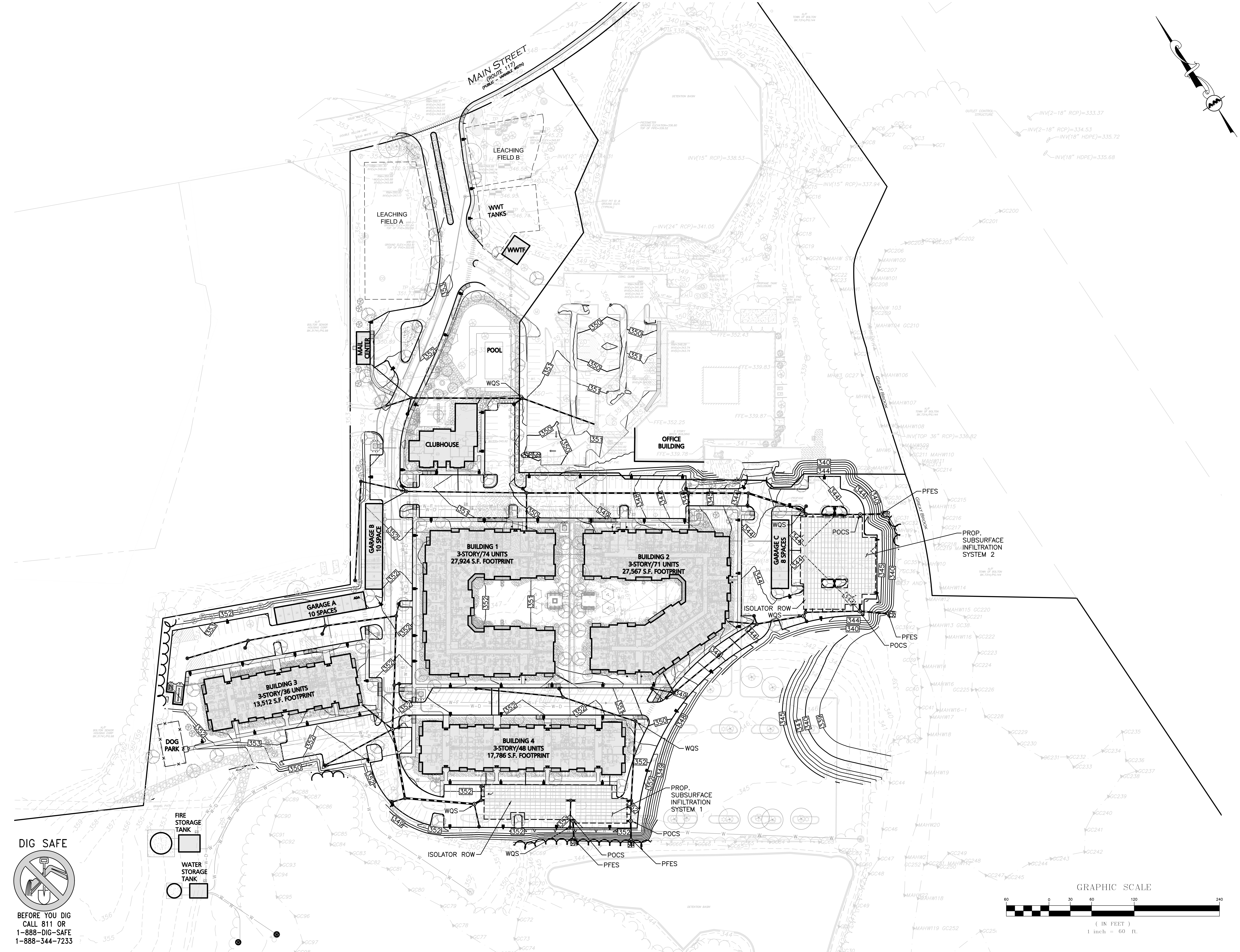
Project Name:
Location:

StormTech®
www.stormtech.com

	Stadia Rod Readings				
Date	**Fixed point to chamber bottom (1)**	**Fixed point to top of sediment (2)**	**Sediment Depth (1) - (2)**	**Observations / Actions**	**Inspector**

APPENDIX B SITE PLANS

SITE PLAN



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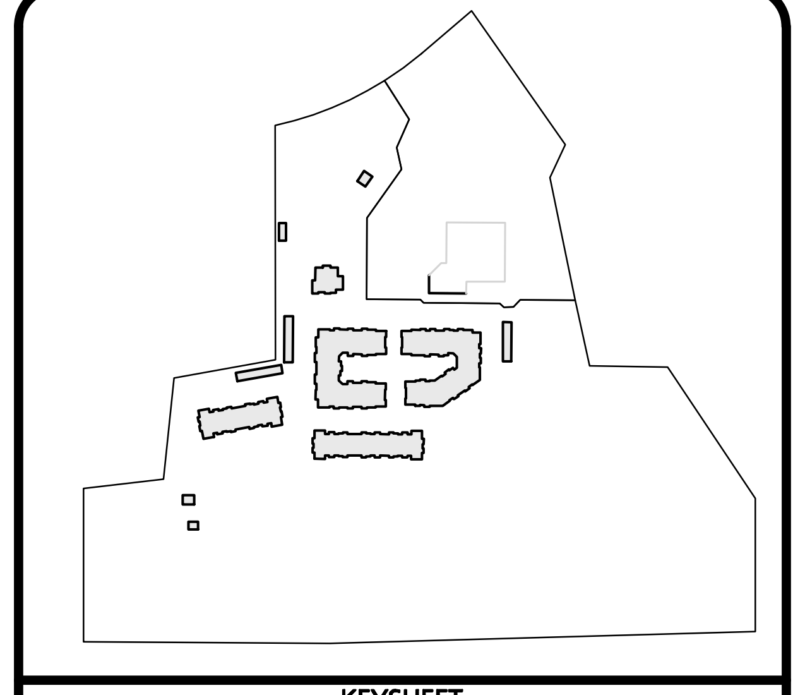

KEYSHEET

ISSUED FOR COMPREHENSIVE PERMIT APPLICATION
SEPTEMBER 10, 2021

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

APPLICANT\OWNER:

WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE, 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:

PRELIMINARY APPLICATION
FOR COMPREHENSIVE PERMIT
ALTA NASHOBA VALLEY
580 MAIN STREET BOLTON, MA

PROJECT NO.	1670-15	DATE:	09-10-2021
SCALE:	1" = 60'	DWG. NAME:	C1670-15
DESIGNED BY:	PGM	CHECKED BY:	PLC

PREPARED BY:

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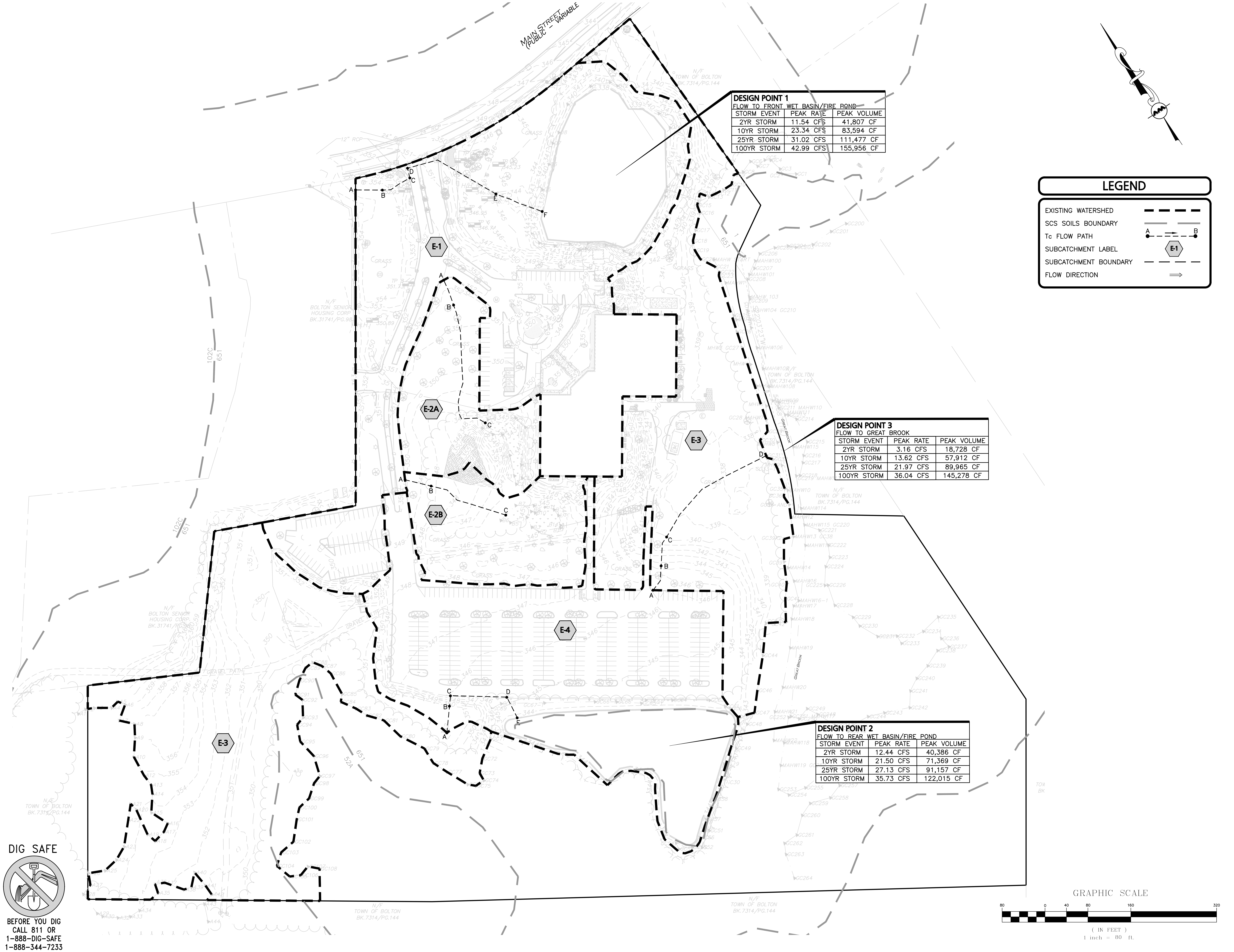
OPERATION & MAINTENANCE PLAN	O&M 1

APPENDIX G

WATERSHED PLANS

EXISTING WATERSHED PLAN EWS-1



DESIGN POINT 1
FLOW TO FRONT WET BASIN/FIRE POND

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	11.54 CFS	41,807 CF
10YR STORM	23.34 CFS	83,594 CF
25YR STORM	31.02 CFS	111,477 CF
100YR STORM	42.99 CFS	155,956 CF

DESIGN POINT 3
FLOW TO GREAT BROOK

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	3.16 CFS	18,728 CF
10YR STORM	13.62 CFS	57,912 CF
25YR STORM	21.97 CFS	89,965 CF
100YR STORM	36.04 CFS	145,278 CF

DESIGN POINT 2
FLOW TO REAR WET BASIN/FIRE POND

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	12.44 CFS	40,386 CF
10YR STORM	21.50 CFS	71,369 CF
25YR STORM	27.13 CFS	91,157 CF
100YR STORM	35.73 CFS	122,015 CF

LEGEND

EXISTING WATERSHED
SCS SOILS BOUNDARY
Tc FLOW PATH
SUBCATCHMENT LABEL
SUBCATCHMENT BOUNDARY
FLOW DIRECTION

DIG SAFE
BEFORE YOU DIG
CALL 811 OR
1-888-DIG-SAFE
1-888-344-7233

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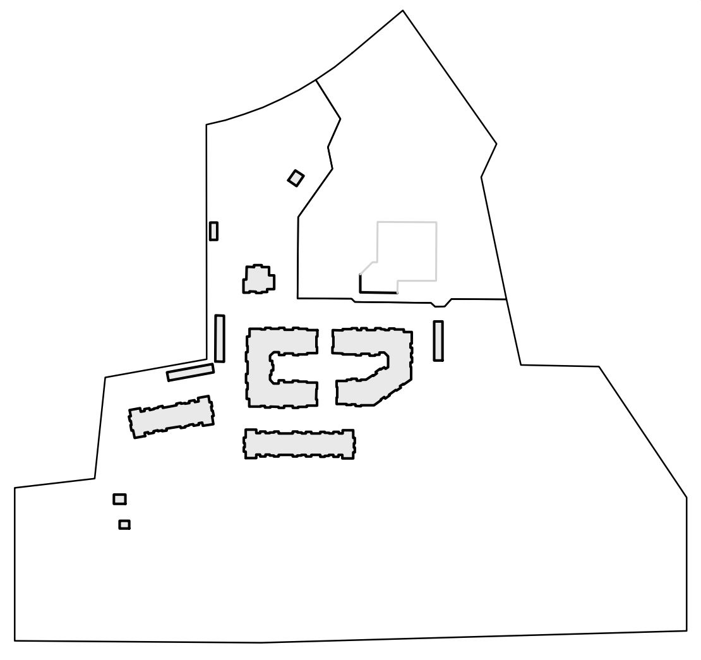

KEYSHEET

ISSUED FOR COMPREHENSIVE PERMIT APPLICATION
SEPTEMBER 10, 2021

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

APPLICANT\OWNER:

WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE, 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:

PRELIMINARY APPLICATION
FOR COMPREHENSIVE PERMIT
ALTA NASHOBA VALLEY
580 MAIN STREET BOLTON, MA

PROJECT NO.	1670-15	DATE:	09-10-2021
SCALE:	1" = 80'	DWG. NAME:	C1670-15
DESIGNED BY:	PGM	CHECKED BY:	PLC

PREPARED BY:

ALLEN & MAJOR
ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com

10 MAIN STREET
LAKEVILLE, MA 02347
TEL: (508) 923-1010
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WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

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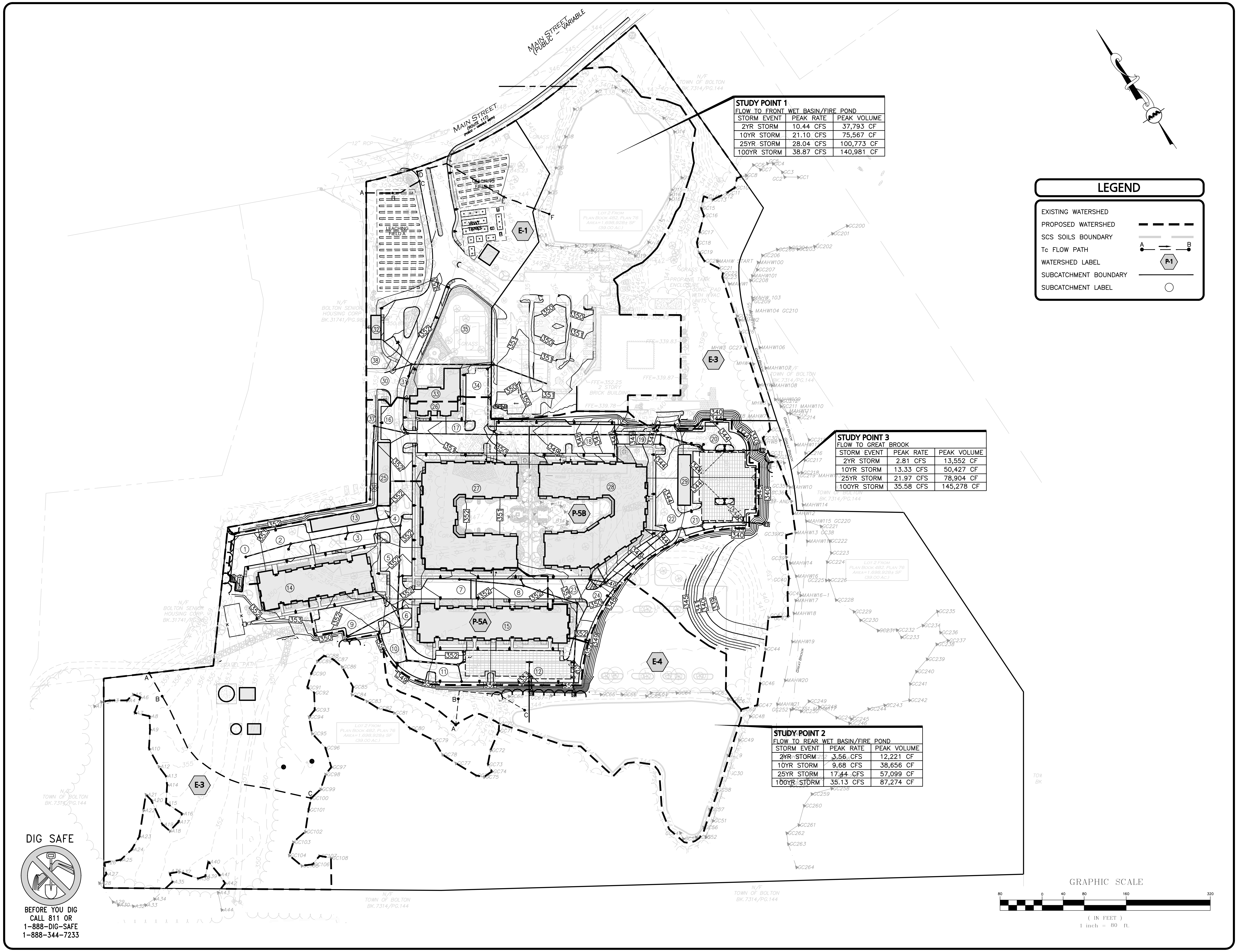
DRAWING TITLE:	SHEET No.
EXISTING WATERSHED PLAN	EWS-1

PROPOSED WATERSHED PLAN – PWS-1



STUDY POINT 1
FLOW TO FRONT WET BASIN/FIRE POND

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	10.44 CFS	37,793 CF
10YR STORM	21.10 CFS	75,567 CF
25YR STORM	28.04 CFS	100,773 CF
100YR STORM	38.87 CFS	140,981 CF

STUDY POINT 3
FLOW TO GREAT BROOK

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	2.81 CFS	13,552 CF
10YR STORM	13.33 CFS	50,427 CF
25YR STORM	21.97 CFS	78,904 CF
100YR STORM	35.58 CFS	145,278 CF

STUDY POINT 2
FLOW TO REAR WET BASIN/FIRE POND

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	3.56 CFS	12,221 CF
10YR STORM	9.68 CFS	38,656 CF
25YR STORM	17.44 CFS	57,099 CF
100YR STORM	35.13 CFS	87,274 CF

LEGEND

EXISTING WATERSHED	
PROPOSED WATERSHED	— — —
SCS SOILS BOUNDARY	▭ ▭
Tc FLOW PATH	A —●— B
WATERSHED LABEL	⬡ P-1
SUBCATCHMENT BOUNDARY	——
SUBCATCHMENT LABEL	○

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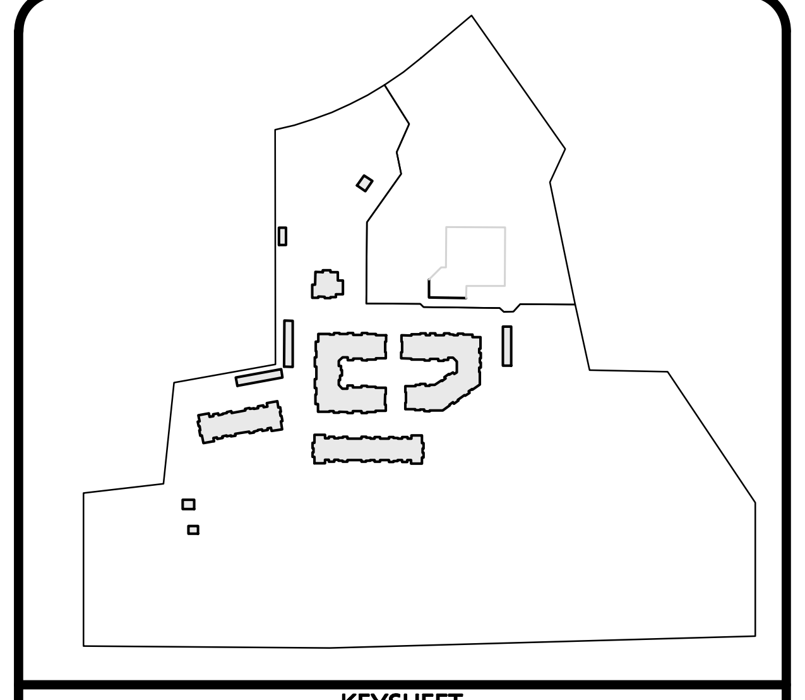

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WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:	SHEET No.
PROPOSED WATERSHED PLAN	PWS-1

APPENDIX D

PROJECT CORRESPONDENCE AND PEER REVIEWS

Horsley Witten Group
Sustainable Environmental Solutions
112 Water Street • 6th Floor • Boston, MA 02109
857-263-8193 • horsleywitten.com

February 4, 2022

Ms. Valerie Oorthuys, Town Planner
Bolton Town Hall
663 Main Street
Bolton, MA 01740

Re: Initial Stormwater & Wetlands Technical Peer Review
Comprehensive Permit Application – ALTA Nashoba Valley
580 Main Street, Bolton MA

Dear Ms. Oorthuys:

The Horsley Witten Group (HW) is pleased to provide the Bolton Zoning Board of Appeals (ZBA) with this letter report summarizing our initial technical peer review of the multi-family residential development proposed at 580 Main Street in Bolton, MA (Assessor's Map 4C Lot 24). Allen & Major Associates, Inc. has prepared the Comprehensive Permit Plan set and Project Narrative & Drainage Report on behalf of Limited Dividend Affiliate of WP East Acquisition, LLC (Applicant). The proposed development, submitted in accordance with Massachusetts General Law Chapter 40B, Section 20-23, includes four (4) three-story residential buildings (229 units), a clubhouse, a mail center, and access road, 382 parking spaces and supporting infrastructure. The project includes private on-site wells for water supply, and a private on-site wastewater treatment system.

The subject property contains approximately 39 acres of land and is the current location of the Bolton Office Park, which will be modified under a separate application to allow for the proposed development. The subject property is proposed to be divided into two parcels: Lot 1 will be created for the modified Bolton Office Park, and Lot 2 (comprised of 32.4 acres) will be created for the proposed residential development. The existing access driveway into the site will be preserved and will provide access for the proposed development, the existing senior housing facility, and the existing office building. Located within the Limited Business (LB) Zoning District and adjacent to the Residential Zoning District, the 39-acre parcel contains several resource areas including Bordering Vegetated Wetlands (BVW), Isolated Vegetated Wetlands (IVW), Riverfront Area, and Bordering Land Subject to Flooding (BLSF). HW understands that the Applicant will be required to file a Notice of Intent (NOI) with the Bolton Conservation Commission for work proposed within these resource areas as well as the wetland buffer zones.

Documents Reviewed

As part of this peer review, HW has received the following documents:

- Project Narrative & Drainage Report to Accompany Comprehensive Permit Application, Multi-Family Development, 580 Main Street, Bolton, MA prepared by Allen & Major

Associates, Inc., dated September 10, 2021, including the following sections and appendices:

- Section 1.0 – Project Summary
- Section 2.0 – Existing Conditions
- Section 3.0 – Proposed Conditions
- Section 4.0 – Stormwater Management
- Section 5.0 – Waivers
- Appendix A – Support Documents to Comprehensive Permit Application
- Appendix B – Wetland Report
- Appendix C – Water Supply & Wastewater
- Appendix D – Traffic Impact Assessment
- Appendix E – Architectural
- Appendix F – Geotechnical Report
- Appendix G – HydroCAD
- Appendix H – Supporting Information
- Appendix I – Operation & Maintenance Plan
- Appendix J – Watershed Plans

- Plan Set entitled “Preliminary Application for Comprehensive Permit, Alta Nashoba Valley, 580 Main Street, Bolton, MA” prepared by Allen & Major Associates, Inc., and Market Square Architects, dated September 10, 2021 (“Site Development Plans”), which includes:

Title Sheet	
Existing Conditions	V-101 – V-104
Notes & Abbreviations	C-001 – C-002
Conceptual Property Line Modification	C-003
Erosion Control Plan	C-100
Overall Layout and Materials Plan	C-101
Layout and Materials Plan	C-102 – C-104
Overall Grading and Drainage Plan	C-105
Grading & Drainage Plan	C-106 – C-108
Overall Utilities Plan	C-109
Utilities Plan	C-110 – C-112
Details	C-501 – C-507
Vehicle Movement Plan	C-601
Landscape Plan (by Grady Consulting, LLC)	1
Arch Plans – Building 1	B1.A1.01 – B1.A2.00
Arch Plans – Building 2	B2.A1.01 – B2.A2.00
Arch Plans – Building 3	B3.A1.01 – B3.A2.00
Arch Plans – Building 4	B4.A1.01 – B4.A2.00
Arch Plans – Clubhouse	CH.A1.01 – CH.A2.00
Arch Plans – Garages	GA.A1.01 – GC.A2.01
Arch Plans – Mail and Parcel	MP.A1.01 – MP.A2.01

In addition to the materials above, HW reviewed relevant source data from MassGIS to better understand site constraints and context.

Wetland Resources

The project narrative and supporting documentation provide a fairly comprehensive site description of the existing conditions, and indicates the following wetland resource areas associated with Great Brook to the east that are located on or adjacent to the site:

- Bordering Vegetated Wetlands (BVW);
- Isolated Vegetated Wetlands (IVWs);
- Bordering Land Subject to Flooding (BLSF); and
- Riverfront Area.

The Applicant has stated that it will seek confirmation of the wetland resource areas with the Bolton Conservation Commission through an Abbreviated Notice of Resource Area Delineation (ANRAD). HW notes a slight discrepancy between the written documents and the project plans with respect to the IVW areas located in the central portion of the Bolton Office Park, west and southwest of the existing buildings, the B-series and C-series wetlands.

The project narrative indicates that the B-series is a BVW “located between the existing building and parking area” and that the C-series is an IVW located “on the northwesterly side of the existing building” (p. 2-6). The wetland scientist’s report prepared by Goddard Consulting, LLC, (Appendix B) cites the presence of culverts within each of these two wetland areas, which would indicate the potential for both of these wetland areas to be BVW.

The Applicant purports that these wetland areas are non-jurisdictional, which appears to be an unsupported claim. The local bylaw includes all freshwater wetlands as defined in M.G.L. c. 131 s. 40, para. 7[8]. If these areas are determined to be BVW, then they would be regulated under the Massachusetts Wetlands Protection Act (M.G.L. Ch. 131 § 40). In addition, these areas may be protected under the Federal Clean Water Act (33 U.S.C. 1251, et seq.) and/or Section 27 of the Massachusetts Clean Waters Act (M.G.L. c. 21, §§ 26 through 53).

Further, using the Adobe measuring tool, HW estimates that these areas are approximately 3,200 SF (B-series) and 4,100 SF (C-series). The local bylaw also has jurisdiction over Lands Subject to Flooding or Inundation by Ground Water or Surface Water that are “1,000 square feet or greater in surface area and hold an average depth of six inches.”

1. HW recommends that the Applicant clarify the jurisdictional status of the two interior wetland areas.

Resource Area Alterations

The Applicant proposes to fill both of these wetland areas (B- and C-series), totaling approximately 7,300 SF, but does not indicate provisions for providing mitigation. The Applicant also proposes to fill BLSF and provide compensatory flood storage, although details are not provided. The project also proposes alterations within the 200-foot Riverfront Area. The Applicant indicates that there will be a future Notice of Intent (NOI) filing with the Conservation

Commission, at which time, the Applicant will be required to demonstrate compliance with the performance standards at 310 CMR 10.57(4)(a); 310 CMR 10.58(4) or 10.58(5) for a redevelopment project, and potentially, 310 CMR 10.55(4)(d) under the Massachusetts Wetlands Protection Act regulations.

2. HW recommends that the Applicant clarify the amount of wetland resource area fill and the jurisdictional status of the wetland resource areas.

Alterations are also proposed within the locally regulated 25-foot buffer zone in three locations:

a) Grading associated with the installation of Subsurface Infiltration System #1 located south of Building 4;
b) Grading associated with the installation of Subsurface Infiltration System #2 located east of Garage C; and
c) Grading associated with the provision of 2,500 CY of compensatory flood storage.

The close proximity of the proposed grading to the wetland boundary, which in each of these areas is within just a few feet has the potential for additional unintended wetland alterations.

Additional Permitting Considerations

Alterations of freshwater wetlands above 5,000 SF requires additional review and permitting per the Water Quality Certification (WQC) regulations at 314 CMR 9.04:

> *(6) More than 5000 Sq. Ft. of Isolated Vegetated Wetlands. Any activity in an area not subject to jurisdiction of M.G.L. c. 131, § 40 but which is subject to 33 U.S.C. 1251 (i.e., isolated vegetated wetlands) and which will result in the loss of more than 5000 square feet cumulatively of bordering and isolated vegetated wetlands and land under water.*

Additionally, alterations of greater than 5,000 SF cumulatively of bordering or isolated wetlands, or alteration of ½ or more acres of any other wetlands (e.g., BLSF or Riverfront Area) that require a Permit (as defined) would also require review under Massachusetts Environmental Policy Act, M.G.L. c. 30 §§ 61 through 62H, inclusive (MEPA).

3. HW recommends that the Applicant provide clarifications of the additional wetland permits and/or reviews required at a minimum, when filing the NOI with the Conservation Commission, so that the full extent of resource area alterations is understood by the Town, and we recommend that the Applicant provide copies of all wetland permits to the Town.

Waiver Requests

The Applicant has indicated that a waiver will be sought for provisions under the local Wetlands Bylaw and Regulations as part of the Comprehensive Permit Application. HW will reserve further comment specifically on whether the waiver requests are appropriate for the project or whether strict adherence to the additional provisions in the wetlands bylaw and regulations would be in the best interest of the Town towards protection of resource area interests.

4. However, at this time, given the extent of alterations within the 25-foot buffer and within just 2-3 feet of the BVW, and in the southernmost area, an outfall is proposed at the wetland boundary, HW recommends that the ZBA consider holding the local bylaw provisions for protection of local wetland areas (to be filled) as well as the 25-foot buffer.

Site Visit

Due to the current snow cover, HW has not yet had an opportunity to conduct a site visit. We will coordinate with the Town to determine an appropriate time to confirm the site conditions.

Stormwater Review

The proposed stormwater management design includes a closed drainage system consisting of deep sump hooded catch basins, drain manholes, and proprietary treatment units, and two (2) subsurface infiltration chamber systems. There are two existing stormwater wet basins on the property which also serve as fire ponds, and these will be preserved. The proposed disturbance is greater than one acre and a portion of the work is within the 100-foot buffer zone of a BVW, Riverfront Area associated with Great Brook, and Bordering Land Subject to Flooding. HW based our review on the Massachusetts Stormwater Handbook (MSH) dated February 2008 which includes ten stormwater performance standards that apply to the proposed project, the Massachusetts Wetlands Protection Act (310 CMR 10.00), and standard engineering practice.

According to the MSH, the project is considered to be a mix of redevelopment and new development due to the existing office building, parking lots and maintained landscape area currently occupying most of the project area. The Applicant has explained that the front portion of the project area is being considered redevelopment while the remainder of the project was designed as new development. HW agrees with the Applicant’s designations, which are consistent with the intent of the MSH. The new development portion(s) must fully comply with the Stormwater Standards, while the redevelopment portion is only required to comply with certain standards to the maximum extent practicable. Further information on the redevelopment requirements can be found in the discussion of Standard 7 below.

After reviewing the documents listed above, HW offers the following comments, which are presented in accordance with the ten Massachusetts Stormwater Standards:

1. ***Standard 1** states that no new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands of the Commonwealth.*

    a) The project includes two new outfalls for each subsurface infiltration system, which will discharge treated stormwater at stabilized outlets protected by riprap energy dissipators as detailed on Sheet C-503. The outlets for Subsurface Infiltration System 1 discharge treated stormwater to the south, into the BVW at the rear of the site. The outlets for Subsurface Infiltration System 2 discharge treated stormwater to the east toward Great Brook and the adjacent BVW. HW notes that the riprap energy dissipators do not appear to be drawn to scale on the Grading & Drainage Plans and recommends that the Applicant revise them for consistency with the detail on Sheet C-503.

    b) It does appear that both systems are discharging within feet of the edge of the adjacent BVWs. HW recommends that if feasible the Applicant pull back the outfalls to respect the local 25-foot buffer zone. It is not clear why the Applicant has chosen to create a parking lot on the east side of the site within an existing grassed area so close to the wetland and in turn remove an existing parking lot that is further from the wetland.

c) HW further recommends that the Applicant limit the area of disturbance on the south side of the project area to the edge of the existing parking lot.

d) The existing outfall location at the northern BVW at the front of the site will be maintained, which will receive runoff from the portion of the site being considered "redevelopment" as it relates to the MSH. The first 150 feet ± of the existing access drive will be preserved, including the drainage infrastructure which captures and conveys runoff to the northern BVW. Further discussion of the redevelopment aspects can be found under Standard 7.

2. ***Standard 2*** *requires that the stormwater management systems be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*

a) The Applicant provided a hydrologic analysis for the 2-year, 10-year, 25-year, and 100-year storm events, under both Existing and Proposed Conditions. The precipitation rates utilized were obtained from the NOAA Atlas 14 database for the Bolton area, which is currently the local industry standard. HW reviewed all components of the hydrologic analysis, which include Existing & Proposed Watershed Plans, Existing & Proposed HydroCAD models, and a Narrative summary of the hydrologic analysis.

The proposed subsurface infiltration systems were sized appropriately, such that the peak discharge rates under Proposed Conditions do not exceed those under Existing Conditions for all storm events analyzed. Additionally, the Applicant has documented that total runoff volumes are decreased in the Proposed Condition for all storm events.

b) There is a minor discrepancy between the total watershed areas reported in the Existing and Proposed models. HW recommends that the Applicant revise the models as necessary to ensure the total areas match.

c) The Applicant has chosen to include two separate areas within Subcatchment E-3, both technically are tributary to Great Brook, however one side flows into a large wetland before reaching Great Brook. HW recommends that the Applicant separate these two areas of Subcatchment E-3 and revise the HydroCAD model accordingly.

d) The peak discharge rates and volumes are controlled by the use of two outlet control structures for each subsurface infiltration system, which are located within the pavement areas. These outlet control structures discharge treated stormwater to the stabilized outlets described under Standard 1. HW notes that the inside diameter of the outlet control structures is listed as 4 feet on the detail on Sheet C-506, but the plan view appears to depict a larger diameter to accommodate the inlet and outlet pipe connections. HW recommends that the Applicant verify the required diameter of the outlet structures (and any other oversized manholes) and update the plans and/or details accordingly. As noted previously HW recommends that the outfalls be pulled further away from the edge of the adjacent wetlands.

e) Due to the large size of the subsurface infiltration systems, the Applicant included pipe manifolds on either end to facilitate even distribution of stormwater during large storm events. The manifold elevation is set approximately 12 inches above the primary inlet to the isolator row, which means that stormwater is forced to first enter the isolator row for treatment and will only enter the manifold pipe when the depth exceeds 12 inches. HW finds this to be an acceptable design but recommends that the Applicant adds text to the inlet manhole call-outs to clarify which pipe is meant to be higher.

f) The Applicant provided pipe sizing calculations for both the 25-year and 100-year storm events using the Rational Method, which document that all pipes within the closed drainage system are sized properly. No further action required.

3. ***Standard 3*** *requires that the annual recharge from the post-development site approximate the annual recharge from pre-development conditions based on soil type.*

a) The Applicant provides calculations for the required recharge volume using both the Hydrologic Soil Group (HSG B=0.35”) and the MA MS4 General Permit requirement of 1” rainfall over the total post-development impervious area. Based on the 1” rainfall depth over 377,668 square feet (SF) of impervious area, the required recharge volume is 31,472 cubic feet (CF). The Applicant utilized the Simple Dynamic Method for sizing the two subsurface infiltration systems to retain/infiltrate the required recharge volume. HW notes that there are minor discrepancies in the impervious area number used, between the Narrative, the Post-Development HydroCAD model and the Simple Dynamic Method HydroCAD model. These discrepancies should be rectified by the Applicant based on the final impervious area calculations.

HW further notes that the total recharge volume presented in the Simple Dynamic Method calculation is 30,755 CF, which is less than the required 31,472 CF. It is also noted that the Simple Dynamic Method HydroCAD model shows a minor amount of additional storage above the peak elevation and below the low outlets, which effectively adds storage volume to the numbers reported. HW recommends that the Applicant revisit this calculation or provide further explanation of its design methodology.

b) The Applicant included soil testing results in the application package, but the test locations are not depicted on the plans. HW notes that small symbols appear on the grading and drainage plans which appear to indicate the locations of TP-11,12 & 14, but the corresponding test pit logs were not found in the application package. In accordance with Volume 2, Chapter 2, page 97 of the MSH the Applicant is required to conduct a minimum of two test pits within each infiltration system. HW recommends that the Applicant revisit the soil testing information to ensure that all available test results are adequately documented on the plans and report(s).

c) In accordance with the previous comment, HW is unable to confirm the soil testing information used in the design of the subsurface infiltration systems. However, both systems are located within a “fill” area, which will likely provide adequate separation to the seasonal high groundwater table. Based on the narrative description, the infiltration rates used seem appropriate, but will need to be confirmed based on HW’s review of the additional soil testing information to be submitted by the Applicant.

d) HW recommends that the Applicant modify the construction detail for the subsurface infiltration systems to clearly state which existing soil layers must be removed prior to installation.

4. ***Standard 4*** *requires that the stormwater system be designed to remove 80% Total Suspended Solids (TSS) and to treat 1-inch of volume from the impervious area for water quality. The drainage system must also provide at least 44% TSS removal for pre-treatment of runoff from paved surfaces prior to entering any infiltration practices.*

   a) The Applicant has provided the required water quality calculations to verify compliance with Standard 4 on pages 4-4 through 4-6 of the Project Narrative & Drainage Report. The stormwater treatment train included deep-sump hooded catch basins, proprietary water quality structures (Contech CDS, Cascade, and Stormceptors), and subsurface infiltration systems (Stormtech SC-740 chambers) equipped with isolator rows. HW finds the selected best management practices (BMPs) and associated calculations reasonable and appropriate for the project. No further action required.

   b) HW notes that the Applicant has proposed a Contech CDS unit within the parking lot of the adjacent office building property, which treats runoff from the adjacent proposed pavement areas. HW finds this to be a reasonable design approach, but notes that an easement would likely need to be secured for future maintenance of the structure.

   The Applicant appears to comply with Standard 4.

5. ***Standard 5*** *relates to projects with a Land Use of Higher Potential Pollutant Loads (LUHPPL).*

   a) The Applicant explains that the proposed project is considered a LUHPPL because the parking area is “high intensity” (greater than 1,000 trips per day). As required, the Applicant documents that the stormwater management system was designed using the 1” Water Quality Volume and that proprietary water quality structures will provide greater than 44% pretreatment prior to conveyance to the subsurface infiltration systems. No further action required.

   The Applicant appears to comply with standard 5.

6. ***Standard 6*** *relates to projects with stormwater discharging into a critical area, a Zone II or an Interim Wellhead Protection Area of a public water supply. These discharges require the use of the specific source control and pollution prevention measures and the specific structure stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the MSH.*

   a) Standard 6 applies because the project development is located adjacent to several Zone I’s and within the Interim Wellhead Protection Area. The stormwater treatment train and infiltration practices described previously in this letter are suitable for use in these areas. No further action required.

   b) The Applicant states that the existing southerly wet basin/fire pond will be located within a Zone I to the proposed drinking water supply well. As a result, this pond is no longer considered as part of the stormwater management system but will continue to perform its function as a fire pond and receiving water body for the outlets from proposed subsurface infiltration system 1. Based upon the proposed stormwater design, HW finds this to be a reasonable assessment. No further action required.

7. ***Standard 7*** *relates to projects considered redevelopment. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best*

management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

a) The proposed development is considered a mix of redevelopment and new development. The main access road and existing driveway to the office building parking lot will generally be preserved, with proposed pavement resurfacing, sidewalks, and landscaping improvements. The redevelopment portion of the project also includes runoff from the proposed clubhouse roof and associated parking lot and amenity space. These flows will be treated by a proposed CDS unit prior to draining toward the front wet basin/fire pond. The overall impervious area draining to the front wet basin/fire pond will be reduced, which satisfies the requirement for the redevelopment classification.

b) HW notes that there are two existing catch basins at the existing driveway entrance off Main Street, with the westerly catch basin flowing through the easterly catch basin prior to discharging toward the existing BVW. The existing discharge pipe is a 12-inch reinforced concrete pipe which runs underneath proposed Leaching Field B. HW recommends that the Applicant review the drainpipe network in this area to confirm that it complies with Title 5, and also whether any drainage improvements could be made to provide additional treatment for this runoff from the high-intensity driveway entrance, prior to discharging into the existing BVW.

8. ***Standard 8** requires a plan to control construction related impacts including erosion, sedimentation or other pollutant sources.*

a) The Applicant prepared an Erosion Control Plan (Sheet C-100) and has also included Erosion Control Notes on Sheet C-002 and corresponding details on Sheet C-501. The design calls for “silt fence & tubular barrier” around the limit of work where warranted and shows the location of a stabilized construction entrance and proper protection for the existing catch basins on site. These erosion control measures, and associated documentation are consistent with standard engineering practice. The Applicant also notes that the project will require the preparation of a Stormwater Pollution Prevention Plan (SWPPP) prior to construction, which is a requirement of the EPA National Pollutant Discharge Elimination System (NPDES) Construction General Permit for construction sites which disturb more than one acre of land. HW recommends that the Town require receipt of the SWPPP a minimum of 14 days prior to land disturbance.

b) HW recommends that the Applicant confirm that the proposed grading and erosion control barrier along the Great Brook corridor can be constructed without disturbing the existing native trees or shrubs. There is a minor adjustment to the treeline in the proposed conditions, but it is unclear what type of vegetation will be affected. HW further recommends that trees greater than 10-inch diameter within the work area be located on the existing conditions plan, if not already shown, and recommends that the Applicant note any trees that will be removed because of the proposed development. It appears that the Applicant has chosen to protect the trees that are located within the islands of the existing southern parking lot. The parking lot is proposed to be removed and a meadow created with a number of the trees within the parking lot to remain.

c) HW recommends adding construction fence surrounding the infiltration areas during construction to protect from compaction due to heavy equipment.

d) A note on the Sheet C-002 describes basic instructions for dewatering. If the Applicant anticipates dewatering to be required, HW recommends that a detail for dewatering be provided along with proposed locations.

9. ***Standard 9** requires a Long-Term Operation and Maintenance (O&M) Plan be provided.*

The Applicant has provided an Operation & Maintenance Plan for this project, prepared by Allen & Major Associates, Inc. and dated September 10, 2021. HW has the following comments:

a) Under the "Structural Pretreatment BMPs" section, the reference to the various Contech water quality structures does not match the design plans. HW recommends that the Applicant revisit this section to clearly state the different types of structures and ensure that the corresponding manufacturer O&M Plans are included for each structure. References to cast iron hoods and deep sump catch basins should also be removed from this section as appropriate.

b) The "Subsurface Structures" section should be modified to include provisions for inspecting the systems at certain intervals following large rain events to ensure they are properly draining. HW notes that a detail is included for inspection ports, but their locations are not identified on the plan view. HW recommends that the Applicant identify the proposed inspection port locations on the plans, which are preferably located in drive aisles rather than parking spaces to facilitate access. A note should also be added for the inspection of outlet control structures on an annual basis.

c) The Applicant included plan sheet O&M 1 entitled "Operation & Maintenance Plan" which depicts the key elements of the stormwater management system for reference during long term maintenance activities. HW recommends that all water quality structure labels are updated to call out the specific Contech products being used, since each has individual O&M requirements. It may also be appropriate to coordinate further with Contech to see if future maintenance could be simplified by reducing the number of different Contech products being used in the design.

d) Sheet O&M 1 should be updated to call out the inlet and outlet locations for both of the existing wet basins/fire ponds, so that they can be regularly inspected for signs of erosion or blockage. Even though the rear wet basin is no longer considered part of the project's drainage system, it is still important that it is inspected regularly.

10. ***Standard 10** requires an Illicit Discharge Compliance Statement be provided.*

a) To comply with Standard 10 the Applicant states that an Illicit Discharge Compliance Statement will be provided to the Town prior to the discharge of stormwater to the post-construction stormwater BMPs and prior to the issuance of a Certificate of Compliance. The Town may choose to require receipt of this statement as a condition of approval.

General Technical Review

11. *Water Supply Comments:*

   a) The proposed development will be serviced by a combination of new and existing private wells on the subject property. Due to the intensity of use, this is considered a Public Water System (PWS), and the Applicant states that all permitting will be done through MassDEP in accordance with 310 CMR 22 and MassDEP's Guidelines for Public Water Systems. A waiver has been requested from local permitting through the Bolton Board of Health. HW has no opposition to this waiver request, but defers to the appropriate Town of Bolton staff, Boards and Commissions.

   b) The Public Water System wells generate a Zone I radius of protection and an Interim Wellhead Protection Area (IWPA), which are both dependent on the approved yield/volume of each well. The Zone I radii for the existing and proposed well(s) are depicted on the Site Development Plans. The Applicant states that the proposed well is only shown conceptually and that final layout is subject to MassDEP approvals. The Applicant further states that the drilling and installation of all private wells will be coordinated with the Bolton Conservation Commission and Board of Health.

   c) The design of the Public Water System is being performed by Onsite Engineering, Inc. and a design summary memo can be found in Appendix C of the Project Narrative which provides details about the existing and proposed wells along with a description of water treatment, distribution and fire protection.

12. *Wastewater Disposal Comments:*

   a) The project will include a new on-site wastewater treatment and disposal system to serve both the proposed residential development and the modified office building. The Applicant states that the system will be designed by Onsite Engineering, Inc. in accordance with MassDEP *Guidelines for the Design, Construction, Operation and Maintenance of Small Treatment Facilities with Land Disposal*, revised July 2018, and that it is subject to a MassDEP Groundwater Discharge Permit subsequent to a hydrogeological evaluation approval process.

   b) The design flow for the proposed residential development is 43,440 gallons per day (GPD) based on 394 total bedrooms (at 110 GPD/bedroom) along with a 100 GPD allowance for the leasing office space. Since the clubhouse and amenity space are restricted to only residents and their guests, there are no additional flows associated with those elements, as per MassDEP advisory opinions. HW agrees with this preliminary design flow calculation.

   c) The design flow for the modified office building is 4,688 GPD, which is based on a total floor area of 62,500 SF. Since the office building modifications will be carried out by others under a separate application, HW notes that the actual design flows may vary based on the final architectural plans.

d) HW recommends that the existing leaching facility location be called out on the Existing Conditions Plans, and that the existing office building sewer service is depicted on the Utility Plans with connection to the proposed sewer.

e) HW recommends that the proposed sewer manhole annotation is changed on the Utility Plans from PDMH to PSMH and that the Utility Legend is depicted on all Utility Plans.

f) An existing drainpipe near the driveway entrance flows under the proposed leach field toward the wet basin/fire pond. HW notes that this pipe and other elements of the drainage system may need to be modified to comply with Title 5 requirements.

13. *Additional Comments:*

a) There is a small dog park proposed to service the apartment buildings, which is shown to the west of Building 3. HW recommends that the Applicant confirm that the dog park size and shape shown are appropriate for the project, and that additional information is added, such as the surface materials, fence specifications, park amenities, drainage and means of disposal for both dog waste and regular trash/recycling. HW notes that the dog park is located outside of the Zone I boundary and outside of any jurisdictional areas under the Wetlands Protection Act, but it is within the Interim Wellhead Protection Area associated with the existing wells on the subject property.

b) HW recommends that the flow direction of Great Brook is added to the Site Development Plans.

c) A proposed maintenance gate for the existing well area is shown on the Site Development Plans, but the access drive linework appears to be missing. HW also advises the Applicant to consider whether any dedicated access is required for the new well location.

d) There is a large ledge outcrop located within and to the north of proposed Building 1 which will need to be entirely removed to accommodate the project, including subsurface elements such as the foundation and utilities. HW recommends that the Applicant provides a preliminary description of the proposed ledge removal method(s) being considered for the project, for review by applicable Town staff, Boards and Commissions.

14. *Waiver Requests:*

a) Applications for a Comprehensive Permit through the Zoning Board of Appeals requires an Applicant to comply with all local codes, ordinances, Bylaws or regulations unless an exemption or variance is formally requested in the application or modification to the application. As described in detail in *Section 5.1* of the Project Narrative & Drainage Report, the Applicant is requesting waivers from the following local Bylaws, rules and regulations:

  - Town of Bolton Bylaws (Zoning & Wetlands)

  - Planning Board Rules & Regulations
  - Conservation Commission Rules & Regulations
  - Rules & Regulations of the Board of Health

b) HW defers to the Bolton ZBA on the granting of these waivers, but notes that the proposed development project is still required to comply with all applicable regulations, permits and policies of the Commonwealth of Massachusetts. These include, but are not limited to, the Massachusetts Stormwater Handbook, the Wetlands Protection Act/Regulations, Title 5 of the State Environmental Code, MassDEP *Guidelines for the Design, Construction, Operation and Maintenance of Small Treatment Facilities with Land Disposal*, MassDEP Groundwater Discharge Permit, and MassDEP’s Guidelines for Public Water Systems. As noted above HW recommends that the Applicant respect the local 25-foot no disturb zone to the adjacent BVWs surrounding the project site.

Conclusions

HW recommends that the Bolton Zoning Board of Appeals require that the Applicant provide a written response to address these comments as part of the permitting process. The Applicant is advised that provision of these comments does not relieve him/her of the responsibility to comply with all Commonwealth of Massachusetts laws, and federal regulations as applicable to this project. Please contact Janet Carter Bernardo at jbernardo@horsleywitten.com or at 508-833-6600 if you have any questions regarding these comments.

Sincerely,

Horsley Witten Group, Inc.

Janet Carter Bernardo

A Ball

Janet Carter Bernardo, P.E.
Associate Principal

Amy M. Ball, PWS, CWS
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ASSOCIATES, INC.

April 12, 2022

Bolton Zoning Board of Appeals
c/o Ms. Valerie Oorthuys, Town Planner
Bolton Town Hall
663 Main Street
Bolton, MA 01740

RE: A&M Project # 1670-15

Proposed Comprehensive Permit
648 & 652 Canton Ave.
Response to Peer Review Comments

Dear Ms. Oorthys and Member of the Zoning Board of Appeals:

On behalf of our Client, WP East Acquisitions, LLC, Allen & Major Associates Inc. (A&M) would like to provide responses, summarized below as related to peer review memos prepared by Janet Carter Bernardo PE, Associate Principal and Amy M. Ball, Senior Ecologist of Horsley Witten Group Inc. dated February 4, 2022 and Jeffrey S. Dirk, PE of Vanasse & Associates, Inc. dated February 9, 2022.

The responses to the comments are shown below in **bold** preceded by the original comment shown in *italics*.

Revisions to the site plans reflecting these comments are identified as part of Revision 1 dated April 12, 2022.

Horsley Witten Group, Inc.

Wetland Resources:

Comment 1: HW recommends that the Applicant clarify the jurisdictional status of the two interior wetland areas.

Response 1: The applicant has filed an Abbreviated Notice of Resource Area Delineation (ANRAD) with the Bolton Conservation Commission. The ANRAD requests the Commission render a finding as to the classification of the interior pocketed areas depicted as Series 'B' and 'C' on the application drawings. Through historical evidence in conjunction with the property owner and Goddard Consulting LLC., it is the team's opinion that these areas do not fall under the protection of the local wetlands bylaw or the Wetlands Protection Act. Each area was created to receive developed runoff during initial construction of the Bolton Office Park. The process with the Commission is ongoing. The findings of the ANRAD will be reflected in the required Notice of Intent for the project. The applicant would request that any approval of the Comprehensive Permit by accompanied by a condition requiring Conservation Commission approval. Should the site development drawings change as part of the Commission's process, the applicant would return to the Zoning Board of Appeals for an insubstantial change determination and permit modification request as required by the Permit program.

Resource Area Alterations:

Comment 2: *HW recommends that the Applicant clarify the amount of wetland resource area fill and the jurisdictional status of the wetland resource areas.*

Alterations are also proposed within the locally regulated 25-foot buffer zone in three locations:

a) Grading associated with the installation of Subsurface Infiltration System #1 located south of Building 4;

b) Grading associated with the installation of Subsurface Infiltration System #2 located east of Garage C; and

c) Grading associated with the provision of 2,500 CY of compensatory flood storage.

Response 2: **As noted in Response 1 above, the jurisdictional status of the "resource areas" is being evaluated by the Bolton Conservation Commission and will be reported when completed. It is the intent of the application to fill in non-jurisdictional areas 'B' and 'C' as designated on the site plans.**

As part of the Zoning Board review process, A&M attended a site walk with Ms. Amy Ball of Horsley Witten, and Valerie Oorthuys, Town Planner, as part of the peer review process. During the walk, the potential resource area south of Building 4 was shown to be associated with the existing fire pond that receives direct stormwater runoff from the rear parking lot through sheet flow. As a condition of an Order of Conditions issued to the current landowner, rip-rap spillways have recently been installed that are intended to mitigate erosion that is occurring at the edge of the pavement. These spillways are intended to reinforce the pond's use as stormwater management and would eliminate the 25-foot buffer zone noted in Comment 2a.

As part of the Revision 1 site plan drawings, A&M has eliminated a portion of the slope grading that would have occurred within the 25 foot buffer zone. This has been replaced with a retaining wall located outside of the 25-foot buffer. Where subsurface drainage system 2 is located within 10 feet of the retaining wall, an impermeable liner will be provided to eliminate the possibility of breakout from the drain field. The final wall block construction will be determined as part of the construction drawings for the project.

The Revision 1 site plan drawings continue to reflect an area that will be grading to provide compensatory flood storage volume for the area of construction proposed around Garage C and subsurface infiltration system 2. The foot per foot calculation to meet the performance standards shall be provided within the application for Notice of Intent with the Bolton Conservation Commission. It is A&M's opinion that replication directly adjacent to the wetland resource area will be beneficial to the overall site environs. If the Commission requests the flood storage area to be relocated, it will be assessed at that time. A final set of plans, presuming an Order of Conditions from the Commission, shall be provided to the Zoning Board of Appeals for review and record.

Additional Permitting Considerations:

Comment 3: *HW recommends that the Applicant provide clarifications of the additional wetland permits and/or reviews required at a minimum, when filing the NOI with the Conservation Commission, so that the full extent of resource area alterations is understood by the Town, and we recommend that the Applicant provide copies of all wetland permits to the Town.*

Response 3: A&M has filed the ANRAD application with the Conservation Commission and anticipates filing of a WPA Form 3 Notice of Intent (NOI) in due course. The NOI will outline the construction of elements within the jurisdictional areas, including a Riverfront Alternatives Analysis, as is required for this project. Bordering Vegetated Wetlands, Riverfront, and Bordering Land Subject to Flooding are anticipated.

Should "wetland" areas 'B' and 'C' be determined jurisdictional, the applicant will file a WW 10/11 Major/Minor Fill application through MassDEP. This is a state action permit that will be sought wholly through MassDEP with copies to the Bolton Conservation Commission.

A filing with the Army Corps. of Engineers shall also be made dependent on the outcome of the ANRAD process.

Waiver Requests:

Comment 4: *However, at this time, given the extent of alterations within the 25-foot buffer and within just 2-3 feet of the BVW, and in the southernmost area, an outfall is proposed at the wetland boundary, HW recommends that the ZBA consider holding the local bylaw provisions for protection of local wetland areas (to be filled) as well as the 25-foot buffer.*

Response 4: HW's opinion is noted. The revisions made to the buffer encroachment adjacent to Garage C and Subsurface Infiltration System 2 have been eliminated. The waiver request has not been rescinded pending outcome of the ANRAD process with the Conservation Commission.

Stormwater Review:

Comment 1: ***Standard 1*** *states that no new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands of the Commonwealth.*

a) The project includes two new outfalls for each subsurface infiltration system, which will discharge treated stormwater at stabilized outlets protected by riprap energy dissipators as detailed on Sheet C-503. The outlets for Subsurface Infiltration System 1 discharge treated stormwater to the south, into the BVW at the rear of the site. The outlets for Subsurface Infiltration System 2 discharge treated stormwater to the east toward Great Brook and the adjacent BVW. HW notes that the riprap energy dissipators do not appear to be drawn to scale on the Grading & Drainage Plans and recommends that the Applicant revise them for consistency with the detail on Sheet C-503.

b) It does appear that both systems are discharging within feet of the edge of the adjacent, *BVWs. HW recommends that if feasible the Applicant pull back the outfalls to respect the local 25-foot buffer zone. It is not clear why the Applicant has chosen to create a parking lot on the east side of the site within an existing grassed area so close to the wetland and in turn remove an existing parking lot that is further from the wetland.*

c) HW further recommends that the Applicant limit the area of disturbance on the south side of the project area to the edge of the existing parking lot.

d) The existing outfall location at the northern BVW at the front of the site will be maintained, which will receive runoff from the portion of the site being considered "redevelopment" as it relates to the MSH. The first 150 feet ± of the existing access drive will be preserved, including the drainage infrastructure which captures and conveys runoff to the northern BVW. Further discussion of the redevelopment aspects can be found under Standard 7.

Response 1: **a) A&M has revised the rip-rap dissipater pads to be at the correct scaled length on the Revision 1 drawings.**

b) The selection of the parking lot is driven by the proximity to the proposed drinking water well in the southeast corner of the site. The well, by MassDEP standards, will require a Zone 1 radius of 312 feet. Per the standards to minimize pollutant introduction, no vehicular parking is allowed within the Zone 1 radius. Under this standard, the existing parking lot is being reclaimed and the new easterly lot constructed. The area of the easterly lot is currently cleared and has been previously disturbed. It is A&M's opinion that the construction can be accomplished without any degradation to the adjacent resource areas.

c) The work adjacent to the southern fire pond remains as originally shown save for modifications to the rip-rap dissipater pads. The entirety of the parking field currently sheet flows toward the rear fire pond. It is A&M's opinion that the development shown on the project plans can be constructed without any degradation of the areas that currently exist, noting that the Conservation Commission has approved work outside of the pavement for the installation of the rip-rap dissipater pads noted above.

d) No response required.

Comment 2: ***Standard 2** requires that the stormwater management systems be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*

a) The Applicant provided a hydrologic analysis for the 2-year, 10-year, 25-year, and 100- year storm events, under both Existing and Proposed Conditions. The precipitation rates utilized were obtained from the NOAA Atlas 14 database for the Bolton area, which is currently the local industry standard. HW reviewed all components of the hydrologic analysis, which include Existing & Proposed Watershed Plans, Existing & Proposed HydroCAD models, and a Narrative summary of the hydrologic analysis.

The proposed subsurface infiltration systems were sized appropriately, such that the peak *discharge rates under Proposed Conditions do not exceed those under Existing Conditions for all storm events analyzed. Additionally, the Applicant has documented that total runoff volumes are decreased in the Proposed Condition for all storm events.*

b) There is a minor discrepancy between the total watershed areas reported in the Existing and Proposed models. HW recommends that the Applicant revise the models as necessary to ensure the total areas match.

c) The Applicant has chosen to include two separate areas within Subcatchment E-3, both technically are tributary to Great Brook, however one side flows into a large wetland before reaching Great Brook. HW recommends that the Applicant separate these two areas of Subcatchment E-3 and revise the HydroCAD model accordingly.

d) The peak discharge rates and volumes are controlled by the use of two outlet control structures for each subsurface infiltration system, which are located within the pavement areas. These outlet control structures discharge treated stormwater to the stabilized outlets described under Standard 1. HW notes that the inside diameter of the outlet control structures is listed as 4 feet on the detail on Sheet C-506, but the plan view appears to depict a larger diameter to accommodate the inlet and outlet pipe connections. HW recommends that the Applicant verify the required diameter of the outlet structures (and any other oversized manholes) and update the plans and/or details accordingly. As noted previously HW recommends that the outfalls be pulled further away from the edge of the adjacent wetlands.

e) Due to the large size of the subsurface infiltration systems, the Applicant included pipe manifolds on either end to facilitate even distribution of stormwater during large storm events. The manifold elevation is set approximately 12 inches above the primary inlet to the isolator row, which means that stormwater is forced to first enter the isolator row for treatment and will only enter the manifold pipe when the depth exceeds 12 inches. HW finds this to be an acceptable design but recommends that the Applicant adds text to the inlet manhole call-outs to clarify which pipe is meant to be higher.

f) The Applicant provided pipe sizing calculations for both the 25-year and 100-year storm events using the Rational Method, which document that all pipes within the closed drainage system are sized properly. No further action required.

Response 2: **a) No further response required. However, as a result of some minor changes and HydroCAD routing, the runoff rates and volumes are slightly different than the original submission. This is largely due to the separation of existing watershed E-3 into two (2) sub basins as requested. The updated figures are shown in the table below:**

Design Point #1 – Front Wet Basin/Fire Pond

Design Point 1 Existing vs Proposed peak rate of runoff to Front Wet Basin/Fire Pond

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	11.54	10.44	-1.1 (9.2%)
10-year	23.34	21.10	-2.24 (9.6%)
25-year	31.02	28.04	-2.98 (9.6%)
100-year	42.99	38.87	-4.12 (9.6%)

Design Point 1 Existing vs Proposed runoff volume to Front Wet Basin/Fire Pond

Design Storm	Existing (cf)	Proposed (cf)	Difference (cf)
2-year	41,807	37,793	-4,014 (9.6%)
10-year	83,594	75,567	-8,027 (9.6%)
25-year	111,477	100,773	-10,704 (9.6%)
100-year	155,956	140,981	-14,975 (9.6%)

Design Point #2 – Rear Wet Basin/Fire Pond

Design Point 2 Existing vs Proposed peak rate of runoff to Rear Wet Basin/Fire Pond

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	12.44	3.72	-8.72 (70.1%)
10-year	21.50	9.73	-11.77 (54.7%)
25-year	27.13	17.65	-9.48 (34.9%)
100-year	35.73	35.54	-0.19 (0.5%)

Design Point 2 Existing vs Proposed runoff volume to Rear Wet Basin/Fire Pond

Design Storm	Existing (cf)	Proposed (cf)	Difference (cf)
2-year	40,386	12,533	-27,853 (69.0%)
10-year	71,369	39,266	-32,103 (45.0%)
25-year	91,157	57,855	-33,302 (36.5%)
100-year	122,015	88,202	-33,813 (27.7%)

Design Point #3 – Great Brook

Design Point 3 Existing vs Proposed peak rate of runoff at Great Brook

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	3.50	3.08	-0.42 (12.0%)
10-year	14.28	13.55	-0.73 (5.1%)
25-year	22.88	22.52	-0.36 (1.6%)
100-year	37.38	36.46	-0.92 (2.5%)

Design Point 3 Existing vs Proposed runoff volume at Great Brook

Design Storm	Existing (cf)	Proposed (cf)	Difference (cf)
2-year	19,385	14,115	-5,270 (27.2%)
10-year	59,111	51,535	-7,576 (12.8%)
25-year	91,460	80,342	-11,118 (12.2%)
100-year	147,170	130,327	-16,843 (11.4%)

b) A&M has reviewed the watershed areas and reconciled the pre- and post-development total areas to 25.74 acres coordinated within the HydroCAD and watershed maps as attached.

c) As recommended, A&M has divided watershed area E-3 into two (2) separate sub-basin watersheds (E-3 and E-5) with curve numbers and times of concentrations as appropriate. Both watersheds combine at Design Point 3 for the total runoff from the site. Watershed boundaries were limited to the wetland resource area boundaries with no flow time or volume storage within the wetland areas.

d) The inside diameters for the referenced control structures have been corrected to five-foot diameter on the detail sheets. Additionally, any diameter over 4 foot (standard) has been annotated on the Revision 1 site plans. The outfall pipes have been relocated further away from the resource areas as described above.

Comment 3: ***Standard 3*** *requires that the annual recharge from the post-development site approximate the annual recharge from pre-development conditions based on soil type.*

a) The Applicant provides calculations for the required recharge volume using both the Hydrologic Soil Group (HSG B=0.35") and the MA MS4 General Permit requirement of 1" rainfall over the total post-development impervious area. Based on the 1" rainfall depth over 377,668 square feet (SF) of impervious area, the required recharge volume is 31,472 cubic feet (CF). The Applicant utilized the Simple Dynamic Method for sizing the two subsurface infiltration systems to retain/infiltrate the required recharge volume. HW notes that there are minor discrepancies in the impervious area number used, between the Narrative, the Post-Development HydroCAD model and the Simple Dynamic Method HydroCAD model. These discrepancies should be rectified by the Applicant based on the final impervious area calculations.

HW further notes that the total recharge volume presented in the Simple Dynamic Method calculation is 30,755 CF, which is less than the required 31,472 CF. It is also noted that the Simple Dynamic Method HydroCAD model shows a minor amount of additional storage above the peak elevation and below the low outlets, which effectively adds storage volume to the numbers reported. HW recommends that the Applicant revisit this calculation or provide further explanation of its design methodology.

b) The Applicant included soil testing results in the application package, but the test locations are not depicted on the plans. HW notes that small symbols appear on the grading and drainage plans which appear to indicate the locations of TP-11, 12 & 14, but the corresponding test pit logs were not found in the application package. In accordance with Volume 2, Chapter 2, page 97 of the MSH the Applicant is required to conduct a minimum of two test pits within each infiltration system. HW recommends that the Applicant revisit the soil testing information to ensure that all available test results are adequately documented on the plans and report(s).

c) In accordance with the previous comment, HW is unable to confirm the soil testing information used in the design of the subsurface infiltration systems. However, both systems *are located within a "fill" area, which will likely provide adequate separation to the seasonal high groundwater table. Based on the narrative description, the infiltration rates used seem appropriate, but will need to be confirmed based on HW's review of the additional soil testing information to be submitted by the Applicant.*

d) HW recommends that the Applicant modify the construction detail for the subsurface infiltration systems to clearly state which existing soil layers must be removed prior to installation.

Response 3: **a) A&M has re-calculated the total impervious area reflective of the Revision 1 site plans. The total area for the entirety of the site is 377,030 s.f. with 109,161 routed through subsurface infiltration system 1 and 146,643 routed through subsurface infiltration system 2 (proposed sub-watersheds P5A and P5B). The remainder is based on the impervious areas contained within existing watersheds E-1 and E-3.**

A&M has provided a recharge volume equivalent to 1" of runoff over the impervious area which equates to 31,419 c.f. This is a correction over the previous recharge volume as part of the recalculation of watershed areas. The provided recharge volume within sub-surface system 1 is 14,182 c.f. Sub-surface system 2 is 17,313 c.f.. This equates to a total recharge volume available of 31,495 c.f. meeting the required standard. This information is contained within the HydroCAD information.

The revised basin drawdown time is defined as:

$\text{Time}_{\text{drawdown}}$ = R_v / (K)(bottom area)
where R_v = Required Recharge Volume, ft3
K = Saturated Hydraulic Conductivity (Rawls Table)
Bottom area = Bottom area of recharge structure

Drawdown Calculation

System	R_v	K	Bottom Area	$\text{Time}_{\text{drawdown}}$
Sub-surface Sys 1	10,868 cf	2.41 in/hr	9,620 sf	5.6 hrs (0.23 day)
Sub-surface Sys 2	7,295 cf	8.27 in/hr	12,059 sf	0.9 hrs (0.04 day)

Note: Volume for drawdown is based on the volume from HydroCAD below the lowest outlet.

b) A&M has highlighted the soil testing locations on the Revision 1 site plan drawings as well as providing the soil logs on Sheet C-107.

c) See Comment b above. Additionally, attached hereto, A&M has provided the Hantush calculations required for the groundwater mounding analysis as required when a system has less than four feet of separation to the estimated seasonal high groundwater elevation.

The parameters used for the groundwater mounding were:

Subsurface system 1

Recharge Rate:	**1.13 ft/day (10,868 c.f./9,620 s.f.)**
Specific Yield:	**0.2**
Hydraulic Conductivity:	**2.41 in/hr (4.82 ft/day)**
½ length of field:	**100.5 ft**
½ width of field:	**23.9 ft**
Duration of infiltration:	**0.23 days (based on full drawdown of recharge volume)**
Initial saturated thickness:	**10 ft (soil boring data for drilled water reports initial refusal depths at 20 ft. 10 ft was used as a minimum recommended value by MassDEP.**

Calculated mound height is 1.291 feet

Subsurface system 2

Recharge Rate:	**0.60 ft/day (7,295 c.f./12,059 s.f.)**
Specific Yield:	**0.2**
Hydraulic Conductivity:	**8.27 in/hr (16.54 ft/day)**
½ length of field:	**65.0 ft**
½ width of field:	**46.4 ft**
Duration of infiltration:	**0.04 days (based on full drawdown of recharge volume)**
Initial saturated thickness:	**10 ft (soil boring data for drilled water reports initial refusal depths at 20 ft. 10 ft was used as a minimum recommended value by MassDEP.**

Calculated mound height is 0.12 feet.

d) A&M has revised the construction detail to denote remove of organic layers, asphalt, brick and other materials that would be unacceptable for use below the drain fields. The note requires consultation with the engineer prior to installation of the chambers.

Comment 4: ***Standard 4*** *requires that the stormwater system be designed to remove 80% Total Suspended Solids (TSS) and to treat 1-inch of volume from the impervious area for water quality. The drainage system must also provide at least 44% TSS removal for pre-treatment of runoff from paved surfaces prior to entering any infiltration practices.*

a) The Applicant has provided the required water quality calculations to verify compliance with Standard 4 on pages 4-4 through 4-6 of the Project Narrative & Drainage Report. The stormwater treatment train included deep-sump hooded catch basins, proprietary water quality structures (Contech CDS, Cascade, and Stormceptors), and subsurface infiltration systems (Stormtech SC-740 chambers) equipped with isolator rows. HW finds the selected best management practices (BMPs) and associated calculations reasonable and appropriate for the project. No further action required.

b) HW notes that the Applicant has proposed a Contech CDS unit within the parking lot of the adjacent office building property, which treats runoff from the adjacent proposed pavement areas. HW finds this to be a reasonable design approach, but notes that an easement would likely need to be secured for future maintenance of the structure.

The Applicant appears to comply with Standard 4.

Response 4: a) No response required.

b) The applicant is currently working with the existing property owner on the development of easements that will be required to construct and manage the project as shown. The easements shall be recorded as part of the transaction for the project.

*Comment 5: **Standard 5** relates to projects with a Land Use of Higher Potential Pollutant Loads (LUHPPL).*

a) The Applicant explains that the proposed project is considered a LUHPPL because the parking area is "high intensity" (greater than 1,000 trips per day). As required, the Applicant documents that the stormwater management system was designed using the 1" Water Quality Volume and that proprietary water quality structures will provide greater than 44% pretreatment prior to conveyance to the subsurface infiltration systems. No further action required.

The Applicant appears to comply with standard 5.

Response 5: a) No response required.

*Comment 6: **Standard 6** relates to projects with stormwater discharging into a critical area, a Zone II or an Interim Wellhead Protection Area of a public water supply. These discharges require the use of the specific source control and pollution prevention measures and the specific structure stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the MSH.*

a) Standard 6 applies because the project development is located adjacent to several Zone I's and within the Interim Wellhead Protection Area. The stormwater treatment train and infiltration practices described previously in this letter are suitable for use in these areas. No further action required.

b) The Applicant states that the existing southerly wet basin/fire pond will be located within a Zone I to the proposed drinking water supply well. As a result, this pond is no longer considered as part of the stormwater management system but will continue to perform its function as a fire pond and receiving water body for the outlets from proposed subsurface infiltration system 1. Based upon the proposed stormwater design, HW finds this to be a reasonable assessment. No further action required.

Response 6: a) No response required.

b) No response required.

*Comment 7: **Standard 7** relates to projects considered redevelopment. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice* *requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.*

a) The proposed development is considered a mix of redevelopment and new development. The main access road and existing driveway to the office building parking lot will generally be preserved, with proposed pavement resurfacing, sidewalks, and landscaping improvements. The redevelopment portion of the project also includes runoff from the proposed clubhouse roof and associated parking lot and amenity space. These flows will be treated by a proposed CDS unit prior to draining toward the front wet basin/fire pond. The overall impervious area draining to the front wet basin/fire pond will be reduced, which satisfies the requirement for the redevelopment classification.

b) HW notes that there are two existing catch basins at the existing driveway entrance off Main Street, with the westerly catch basin flowing through the easterly catch basin prior to discharging toward the existing BVW. The existing discharge pipe is a 12-inch reinforced concrete pipe which runs underneath proposed Leaching Field B. HW recommends that the Applicant review the drainpipe network in this area to confirm that it complies with Title 5, and also whether any drainage improvements could be made to provide additional treatment for this runoff from the high-intensity driveway entrance, prior to discharging into the existing BVW.

Response 7: a) No response required.

b) The catch basins have been relocated away from the proposed leaching fields to avoid this conflict.

Comment 8: ***Standard 8*** *requires a plan to control construction related impacts including erosion, sedimentation or other pollutant sources.*

a) The Applicant prepared an Erosion Control Plan (Sheet C-100) and has also included Erosion Control Notes on Sheet C-002 and corresponding details on Sheet C-501. The design calls for "silt fence & tubular barrier" around the limit of work where warranted and shows the location of a stabilized construction entrance and proper protection for the existing catch basins on site. These erosion control measures, and associated documentation are consistent with standard engineering practice. The Applicant also notes that the project will require the preparation of a Stormwater Pollution Prevention Plan (SWPPP) prior to construction, which is a requirement of the EPA National Pollutant Discharge Elimination System (NPDES) Construction General Permit for construction sites which disturb more than one acre of land. HW recommends that the Town require receipt of the SWPPP a minimum of 14 days prior to land disturbance.

b) HW recommends that the Applicant confirm that the proposed grading and erosion control barrier along the Great Brook corridor can be constructed without disturbing the existing native trees or shrubs. There is a minor adjustment to the treeline in the proposed conditions, but it is unclear what type of vegetation will be affected. HW further recommends that trees *greater than 10-inch diameter within the work area be located on the existing conditions plan, if not already shown, and recommends that the Applicant note any trees that will be removed because of the proposed development. It appears that the Applicant has chosen to protect the trees that are located within the islands of the existing southern parking lot. The parking lot is proposed to be removed and a meadow created with a number of the trees within the parking lot to remain.*

c) HW recommends adding construction fence surrounding the infiltration areas during construction to protect from compaction due to heavy equipment.

d) A note on the Sheet C-002 describes basic instructions for dewatering. If the Applicant anticipates dewatering to be required, HW recommends that a detail for dewatering be provided along with proposed locations.

Response 8: a) HW's recommendation is noted. A SWPPP shall be prepared in advance of construction and provided to the appropriate Town department at least 14 days in advance of land disturbance.

b) The applicant is unaware of a specific bylaw provision that requires the tagging of trees over a certain diameter in size but would otherwise request a waiver from this level of detail being provided.

c) A&M has included HW's recommendation on the Revision 1 site plan drawings and included notations to install protective fencing around the infiltration systems during construction until they can be protected from compaction of soils.

d) A&M has revised the note regarding dewatering to specifically require the preparation of a plan of action by the contractor inclusive of pertinent details. This plan can be provided to the Town's designated representative for record prior to dewatering activities. While a geotechnical investigation report has been prepared that indicated groundwater conditions, the applicant would like to defer completion of this report until it can be coordinated with the input of the contractor's that shall be required to implement it.

Comment 9: ***Standard 9*** *requires a Long-Term Operation and Maintenance (O&M) Plan be provided.*

The Applicant has provided an Operation & Maintenance Plan for this project, prepared by Allen & Major Associates, Inc. and dated September 10, 2021. HW has the following comments:

a) Under the "Structural Pretreatment BMPs" section, the reference to the various Contech water quality structures does not match the design plans. HW recommends that the Applicant revisit this section to clearly state the different types of structures and ensure that the corresponding manufacturer O&M Plans are included for each structure. References to cast iron hoods and deep sump catch basins should also be removed from this section as appropriate.

b) The "Subsurface Structures" section should be modified to include provisions for inspecting *the systems at certain intervals following large rain events to ensure they are properly draining. HW notes that a detail is included for inspection ports, but their locations are not identified on the plan view. HW recommends that the Applicant identify the proposed inspection port locations on the plans, which are preferably located in drive aisles rather than parking spaces to facilitate access. A note should also be added for the inspection of outlet control structures on an annual basis.*

c) The Applicant included plan sheet O&M 1 entitled "Operation & Maintenance Plan" which depicts the key elements of the stormwater management system for reference during long term maintenance activities. HW recommends that all water quality structure labels are updated to call out the specific Contech products being used, since each has individual O&M requirements. It may also be appropriate to coordinate further with Contech to see if future maintenance could be simplified by reducing the number of different Contech products being used in the design.

d) Sheet O&M 1 should be updated to call out the inlet and outlet locations for both of the existing wet basins/fire ponds, so that they can be regularly inspected for signs of erosion or blockage. Even though the rear wet basin is no longer considered part of the project's drainage system, it is still important that it is inspected regularly.

Response 9: a) The Contech devices have been revised in the O&M report narrative as recommended. A&M has elected to leave the deep sump catch basins in the report as they are included as pre-treatment devices in Volume 2 Chapter 2 of the MassDEP stormwater regulations.

b) Details regarding system inspections have been added to the O&M report as recommended. Inspection ports have been located within each subsurface infiltration field. A note regarding inspection of the outlet control structures annually has also been added.

c) The specific Contech information labels have been added to the Revision 1 site plans as recommended. A&M has not endeavored to coordinate specific models with the manufacturer at this time, but can solicit this information prior to construction to simplify inspection and maintenance.

d) The inlet, outlet, and weirs for the existing fire ponds have been added to the site plans as recommended.

*Comment 10: **Standard 10** requires an Illicit Discharge Compliance Statement be provided.*

a) To comply with Standard 10 the Applicant states that an Illicit Discharge Compliance Statement will be provided to the Town prior to the discharge of stormwater to the post-construction stormwater BMPs and prior to the issuance of a Certificate of Compliance. The Town may choose to require receipt of this statement as a condition of approval.

Response 10: Noted. The applicant is amenable to the proposed condition.

General Technical Review:

Comment 11: Water Comments:

a) The proposed development will be serviced by a combination of new and existing private wells on the subject property. Due to the intensity of use, this is considered a Public Water System (PWS), and the Applicant states that all permitting will be done through MassDEP in accordance with 310 CMR 22 and MassDEP's Guidelines for Public Water Systems. A waiver has been requested from local permitting through the Bolton Board of Health. HW has no opposition to this waiver request, but defers to the appropriate Town of Bolton staff, Boards and Commissions.

b) b) The Public Water System wells generate a Zone I radius of protection and an Interim Wellhead Protection Area (IWPA), which are both dependent on the approved yield/volume of each well. The Zone I radii for the existing and proposed well(s) are depicted on the Site Development Plans. The Applicant states that the proposed well is only shown conceptually and that final layout is subject to MassDEP approvals. The Applicant further states that the drilling and installation of all private wells will be coordinated with the Bolton Conservation Commission and Board of Health.

c) The design of the Public Water System is being performed by Onsite Engineering, Inc. and a design summary memo can be found in Appendix C of the Project Narrative which provides details about the existing and proposed wells along with a description of water treatment, distribution and fire protection.

Response 11: a) Noted. No additional response required.

b) Noted. The drilling of the wells has been coordinated with the Bolton Conservation Commission. Further work (extension of piping, storage, etc.) will be subject to inclusion under the Notice of Intent application. The final details of the Public Water Supply are subject to MassDEP review.

c) As noted by the Board of Health Assistant to the ZBA, both the proposed public water supply and private onsite wastewater treatment facility are permitted at the State level only. The Town of Bolton has local regulations that govern 1) private water supply wells, 2) groundwater protection, which specifically exclude subsurface sewage disposal system discharges, and 3) supplemental regulations to 310 CMR 15.000 (Title 5) for subsurface sewage disposals systems that have a calculated design flow less than 10,000 gallons per day (gpd).

As the development of public groundwater sources in Massachusetts is governed by the Massachusetts Drinking Water Regulations (310 CMR 22.21) and the approval of onsite sewage disposal for sites that generate greater than 10,000 gpd are governed by the Massachusetts Groundwater Discharge Permit Program (314 CMR 5.00), neither of these State regulations are supplemented by local bylaws and/or regulations.

Based on the email issued from the Board of Health Assistant, this position was affirmed by the Board of Health at their October 26, 2021 meeting where this project was discussed relative to the planned public water supply and Groundwater Discharge Permit. Specifically, the Board indicated that only State level jurisdiction was applicable to this project since it was a public water supply and that Title 5 was not applicable (specifically because the site is larger than 10,000 gpd and therefore 310 CMR 15.000 does not apply). The email issued is attached to this memorandum for reference.

Further, it is important to note that the level of active treatment and processing of sewage generated at the site necessary to meet a State issued standard Groundwater Discharge Permit far exceeds the standards noted in both Title 5 and the Town's local bylaw for septic system disposal. The components of active treatment (and regular operator oversight) ensures that the actual discharge meets or exceeds Groundwater Quality Standards at the point of discharge.

Based on this information, in response to the peer review comments to the ZBA, since there are no local regulations that are applicable to the planned public water supply and private wastewater treatment facility, waivers to local bylaws/regulations and/or permitting at the local level for these aspects of the project are not required and therefore, are not subject to waiver request approvals by the ZBA as part of the Comprehensive Permit Process. Given this, it is customary that comprehensive permits of this nature are written such that the local ZBA approval is only contingent ant securing all necessary State approvals for public water supply and a Groundwater Discharge Permit.

Comment 12: *Wastewater Disposal Comments:*

a) *The project will include a new on-site wastewater treatment and disposal system to serve both the proposed residential development and the modified office building. The Applicant states that the system will be designed by Onsite Engineering, Inc. in accordance with MassDEP Guidelines for the Design, Construction, Operation and Maintenance of Small Treatment Facilities with Land Disposal, revised July 2018, and that it is subject to a MassDEP Groundwater Discharge Permit subsequent to a hydrogeological evaluation approval process.*

b) *The design flow for the proposed residential development is 43,440 gallons per day (GPD) based on 394 total bedrooms (at 110 GPD/bedroom) along with a 100 GPD allowance for the leasing office space. Since the clubhouse and amenity space are restricted to only residents and their guests, there are no additional flows associated with those elements, as per MassDEP advisory opinions. HW agrees with this preliminary design flow calculation.*

c) *The design flow for the modified office building is 4,688 GPD, which is based on a total floor area of 62,500 SF. Since the office building modifications will be carried out by others under a separate application, HW notes that the actual design flows may vary based on the final architectural plans.*

d) *HW recommends that the existing leaching facility location be called out on the Existing Conditions Plans, and that the existing office building sewer service is depicted on the Utility Plans with connection to the proposed sewer.*

e) *HW recommends that the proposed sewer manhole annotation is changed on the Utility Plans from PDMH to PSMH and that the Utility Legend is depicted on all Utility Plans.*

f) *An existing drainpipe near the driveway entrance flows under the proposed leach field toward the wet basin/fire pond. HW notes that this pipe and other elements of the drainage system may need to be modified to comply with Title 5 requirements.*

Response 12: a) Noted. See Response 11c above.

b) No response required.

c) Noted. The final square footage and wastewater flow will be determined prior to discharge based on the Bolton Office Park's building configuration.

d) The existing conditions plan has been revised to include the approximate location of the Bolton Office Park leaching field on the westerly sideline of the driveway entrance.

e) The sewer manhole labels have been revised on the Revision 1 site plan drawings.

f) The existing drain pipe is proposed to be relocated as shown on the Revision 1 site plan drawings.

Comment 13: Additional Comments:

a) *There is a small dog park proposed to service the apartment buildings, which is shown to the west of Building 3. HW recommends that the Applicant confirm that the dog park size and shape shown are appropriate for the project, and that additional information is added, such as the surface materials, fence specifications, park amenities, drainage and means of disposal for both dog waste and regular trash/recycling. HW notes that the dog park is located outside of the Zone I boundary and outside of any jurisdictional areas under the Wetlands Protection Act, but it is within the Interim Wellhead Protection Area associated with the existing wells on the subject property.*

b) *HW recommends that the flow direction of Great Brook is added to the Site Development Plans.*

c) *A proposed maintenance gate for the existing well area is shown on the Site Development Plans, but the access drive linework appears to be missing. HW also advises the Applicant to consider whether any dedicated access is required for the new well location.*

d) *There is a large ledge outcrop located within and to the north of proposed Building 1 which will need to be entirely removed to accommodate the project, including subsurface elements such as the foundation and utilities. HW recommends that the Applicant provides a preliminary description of the proposed ledge removal method(s) being considered for the* *project, for review by applicable Town staff, Boards and Commissions.*

Response 13: a) It is the applicant's opinion that the dog park is sufficiently sized for a project of this nature given their experience in prior developments. During final design, the dog park fencing, waste receptacles, waste bags, water stations, etc. shall be determined. These can be provided for record to the Commission. At present, it is anticipated that the surface treatment of the dog park shall be six inches of mulch.

b) Flow arrows of Great Brook have been added to the Revision 1 site design plans as requested.

c) The access path was inadvertently omitted from the prior plans. It is shown on the Revision 1 site plan drawings.

d) Based on observations from the test pit program and our observations of the rock outcrops, site bedrock is considered very hard and may be difficult, if not impossible, to remove efficiently using mechanical means and conventional excavation equipment. Thus, it is anticipated that rock removal will require either localized hoe-ramming, breaking by fracturing and splitting with non-explosive means, or controlled blasting. Where the depth of bedrock removal is limited to a few feet, the use of a hoe ram may be appropriate. However, where the depth of bedrock removal is more significant, a combination of hoe ramming and controlled blasting methods may be needed. If blasting is required, it shall adhere to all applicable local and State regulations.

Comment 14: Waiver Requests:

a) Applications for a Comprehensive Permit through the Zoning Board of Appeals requires an Applicant to comply with all local codes, ordinances, Bylaws or regulations unless an exemption or variance is formally requested in the application or modification to the application. As described in detail in Section 5.1 of the Project Narrative & Drainage Report, the Applicant is requesting waivers from the following local Bylaws, rules and regulations:

- *Town of Bolton Bylaws (Zoning & Wetlands)*
- *Planning Board Rules & Regulations*
- *Conservation Commission Rules & Regulations*
- *Rules & Regulations of the Board of Health*

b) b) HW defers to the Bolton ZBA on the granting of these waivers, but notes that the proposed development project is still required to comply with all applicable regulations, permits and policies of the Commonwealth of Massachusetts. These include, but are not limited to, the Massachusetts Stormwater Handbook, the Wetlands Protection Act/Regulations, Title 5 of the State Environmental Code, MassDEP Guidelines for the Design, Construction, Operation and Maintenance of Small Treatment Facilities with Land Disposal, MassDEP Groundwater Discharge Permit, and MassDEP's Guidelines for Public Water Systems. As noted above HW recommends that the Applicant respect the local 25-foot no disturb zone to the adjacent BVWs surrounding the project site.

Response 14: **a) No response required.**

b) HW's recommendation is noted. The Revision 1 site plan drawings have removed the encroachment into the 25' buffer adjacent to Great Brook as suggested. The work within adjacency to the rear fire pond remains under the anticipation that these areas shall be determined to be stormwater management and not subject to the Bolton wetlands bylaw.

Vanasse & Associates, Inc.

Site Plans:

Comment S1: A vehicle turning analysis should be provided using the AutoTurn© software for service and delivery vehicles (SU-30 or SU-40 design vehicle). The turning analysis should depict all maneuvers required to enter and exit the Project site, loading areas and the locations for trash/recycling, and should demonstrate that the subject vehicles can access the Project site and circulate in an unimpeded manner.

Response S1: The service vehicle autoturn plan has been added as sheet C-602 to the Revision 1 site plan drawings.

Comment S2: A narrative should be provided that describes how tenant moves and trash/recycling pick-up will be accommodated/managed. The narrative should be consistent with and inform the vehicle turning analysis.

Response S2: The applicant provides on-site property managers that are involved in the scheduling of move-ins and large deliveries. Designated areas have been added to the site that will be cordoned off during scheduled periods.

Comment S3: "Keep Right" signs should be installed in the leading edge (nose) of the median of the Bolton Office Park driveway facing Route 117 and for motorists exiting the Project site.

Response S3: A "Keep Right" sign has been added as recommended.

Comment S4: "Only" pavement markings should be installed to accompany the turn arrows in the lane approaching Route 117 and a lane use regulatory sign should be installed prior to the entrance to the turn lanes.

Response S4: Pavement markings have been added as recommended.

Comment S5: STOP-signs and STOP-lines should be added for the drive aisles that intersect the main drive from Route 117.

Response S5: Stop signs and lines have been added at the recommended locations.

Comment S6: "One-Way" and "Do Not Enter" signs should be installed to regulate the flow of traffic where one-way traffic is to be conveyed (mail center and between Building 1 and Building 4).

Response S6: "One-Way" and "Do Not Enter" signs are located at the entry and exit of the one way movement between Buildings 1 and 4.

Comment S7: Pedestrian crossing warning signs should be installed at the crossings at the mail center and between Building 1 and Building 3.

Response S7: Pedestrian crossing signs have been added as recommended at the crosswalk locations noted.

Comment S8: The sight triangle areas for the Bolton Office Park driveway intersection with Route 117 should be shown along with a note to indicate: "Signs, landscaping and other features located within sight triangle areas shall be designed, installed and maintained so as not to exceed 2.5-feet in height. Snow accumulation (windrows) located within sight triangle areas that exceed 3.5-feet in height or that would otherwise inhibit sight lines shall be promptly removed."

Response S8: The sight triangle designation and note has been added to the site plan. The triangles were evaluated by TEC and are contained within the Traffic Impact and Assessment Study.

Comment S9: Consideration should be given to installing electric vehicle (EV) charging stations.

Response S9: The applicant has designated 2 charging stations (4 vehicles) at each building. Additionally, infrastructure will be installed for a future installation of 2 additional stations (4 additional vehicles) at each building. These locations are designated on the site layout plan.

Comment S10: Bicycle racks should be provided at the clubhouse and at appropriate locations proximate to each residential building. Interior, weather protected bicycle parking should also be provided within each building.

Response S10: Bicycle storage has been provided within the onsite garages for resident use.

A&M believes these responses will provide sufficient information for the final review of this application.

If you require any additional information, please feel free to contact me.

Very truly yours,

ALLEN & MAJOR ASSOCIATES, INC.

Philip Cordeiro, P.E.
Branch Manager
pcordeiro@allenmajor.com

cc: WP East Acquisitions, LLC
J. Bernardo, P.E., Horsely Witten Group
File

Enclosure: Revision 1 Site Development Drawings dated April 12, 2022

HANTUSH GROUNDWATER MOUNDING SPREADSHEETS

SUBSURFACE INFILTRATION SYSTEM 1

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin.
Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values

1.1300	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
4.82	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
100.500	**x**	**1/2 length of basin (x direction, in feet)**
23.900	**y**	**1/2 width of basin (y direction, in feet)**
0.230	**t**	**duration of infiltration period (days)**
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

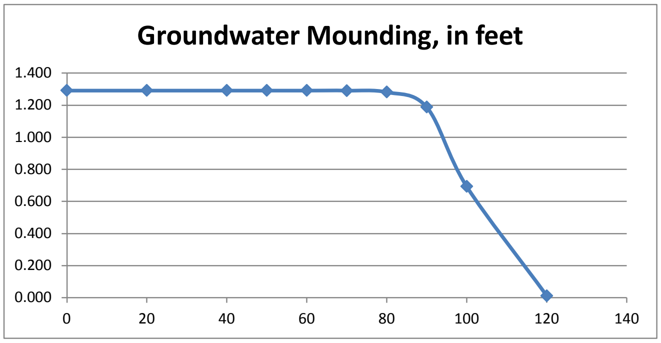
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

11.291	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
1.291	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
1.291	**0**
1.291	**20**
1.291	**40**
1.291	**50**
1.291	**60**
1.291	**70**
1.281	**80**
1.188	**90**
0.693	**100**
0.012	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

SUBSURFACE INFILTRATION SYSTEM 2

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin.
Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values

0.6000	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
16.54	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
65.000	**x**	**1/2 length of basin (x direction, in feet)**
46.400	**y**	**1/2 width of basin (y direction, in feet)**
0.040	**t**	**duration of infiltration period (days)**
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

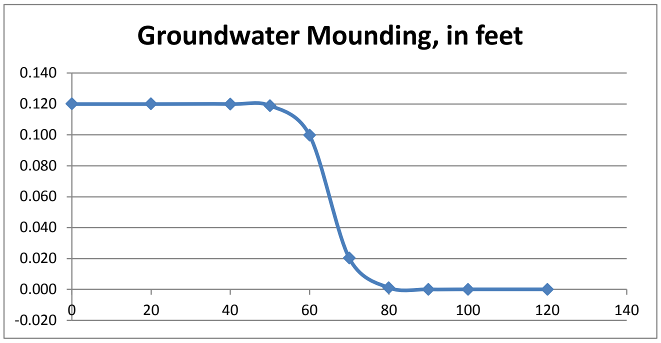
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.120	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.120	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.120	**0**
0.120	**20**
0.120	**40**
0.119	**50**
0.100	**60**
0.020	**70**
0.001	**80**
0.000	**90**
0.000	**100**
0.000	**120**

Re-Calculate Now

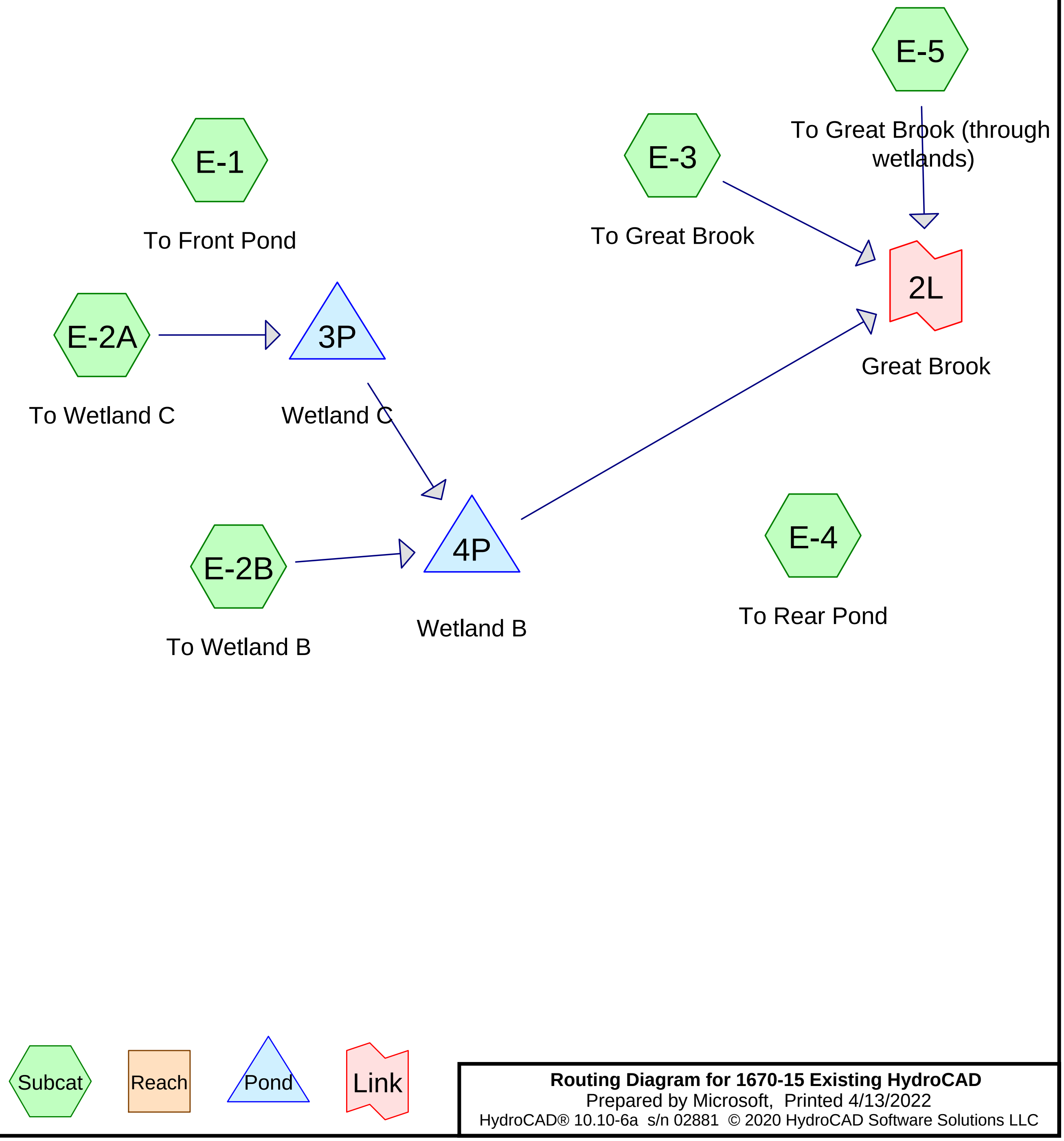


Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

APPENDIX G
HydroCAD

PRE-DEVELOPMENT



Routing Diagram for 1670-15 Existing HydroCAD
Prepared by Microsoft, Printed 4/13/2022
HydroCAD® 10.10-6a s/n 02881 © 2020 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=345,377 sf 53.30% Impervious Runoff Depth>1.45"
Flow Length=405' Tc=10.4 min CN=80 Runoff=11.54 cfs 41,807 cf

Subcatchment E-2A: To Wetland C Runoff Area=63,246 sf 6.89% Impervious Runoff Depth>0.51"
Flow Length=314' Tc=7.8 min UI Adjusted CN=62 Runoff=0.56 cfs 2,687 cf

Subcatchment E-2B: To Wetland B Runoff Area=62,941 sf 6.46% Impervious Runoff Depth>0.51"
Flow Length=203' Tc=5.7 min UI Adjusted CN=62 Runoff=0.61 cfs 2,676 cf

Subcatchment E-3: To Great Brook Runoff Area=202,379 sf 3.81% Impervious Runoff Depth>0.51"
Flow Length=353' Tc=8.6 min UI Adjusted CN=62 Runoff=1.74 cfs 8,596 cf

Subcatchment E-4: To Rear Pond Runoff Area=226,166 sf 78.70% Impervious Runoff Depth>2.14"
Flow Length=219' Tc=7.2 min CN=89 Runoff=12.44 cfs 40,386 cf

Subcatchment E-5: To Great Brook Runoff Area=221,230 sf 0.00% Impervious Runoff Depth>0.47"
Flow Length=353' Tc=5.0 min CN=61 Runoff=1.91 cfs 8,703 cf

Pond 3P: Wetland C Peak Elev=344.67' Storage=2,687 cf Inflow=0.56 cfs 2,687 cf
Outflow=0.00 cfs 0 cf

Pond 4P: Wetland B Peak Elev=344.75' Storage=823 cf Inflow=0.61 cfs 2,676 cf
18.0" Round Culvert n=0.013 L=107.0' S=0.0169 '/' Outflow=0.11 cfs 2,086 cf

Link 2L: Great Brook Inflow=3.50 cfs 19,385 cf
Primary=3.50 cfs 19,385 cf

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=345,377 sf 53.30% Impervious Runoff Depth>2.90"
Flow Length=405' Tc=10.4 min CN=80 Runoff=23.34 cfs 83,594 cf

Subcatchment E-2A: To Wetland C Runoff Area=63,246 sf 6.89% Impervious Runoff Depth>1.45"
Flow Length=314' Tc=7.8 min UI Adjusted CN=62 Runoff=2.14 cfs 7,630 cf

Subcatchment E-2B: To Wetland B Runoff Area=62,941 sf 6.46% Impervious Runoff Depth>1.45"
Flow Length=203' Tc=5.7 min UI Adjusted CN=62 Runoff=2.29 cfs 7,598 cf

Subcatchment E-3: To Great Brook Runoff Area=202,379 sf 3.81% Impervious Runoff Depth>1.45"
Flow Length=353' Tc=8.6 min UI Adjusted CN=62 Runoff=6.64 cfs 24,409 cf

Subcatchment E-4: To Rear Pond Runoff Area=226,166 sf 78.70% Impervious Runoff Depth>3.79"
Flow Length=219' Tc=7.2 min CN=89 Runoff=21.50 cfs 71,369 cf

Subcatchment E-5: To Great Brook Runoff Area=221,230 sf 0.00% Impervious Runoff Depth>1.38"
Flow Length=353' Tc=5.0 min CN=61 Runoff=7.77 cfs 25,428 cf

Pond 3P: Wetland C Peak Elev=345.32' Storage=5,239 cf Inflow=2.14 cfs 7,630 cf
Outflow=0.15 cfs 2,440 cf

Pond 4P: Wetland B Peak Elev=345.05' Storage=1,891 cf Inflow=2.29 cfs 10,037 cf
18.0" Round Culvert n=0.013 L=107.0' S=0.0169 '/' Outflow=0.95 cfs 9,274 cf

Link 2L: Great Brook Inflow=14.28 cfs 59,111 cf
Primary=14.28 cfs 59,111 cf

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=345,377 sf 53.30% Impervious Runoff Depth>3.87"
Flow Length=405' Tc=10.4 min CN=80 Runoff=31.02 cfs 111,477 cf

Subcatchment E-2A: To Wetland C Runoff Area=63,246 sf 6.89% Impervious Runoff Depth>2.16"
Flow Length=314' Tc=7.8 min UI Adjusted CN=62 Runoff=3.33 cfs 11,394 cf

Subcatchment E-2B: To Wetland B Runoff Area=62,941 sf 6.46% Impervious Runoff Depth>2.16"
Flow Length=203' Tc=5.7 min UI Adjusted CN=62 Runoff=3.57 cfs 11,345 cf

Subcatchment E-3: To Great Brook Runoff Area=202,379 sf 3.81% Impervious Runoff Depth>2.16"
Flow Length=353' Tc=8.6 min UI Adjusted CN=62 Runoff=10.36 cfs 36,452 cf

Subcatchment E-4: To Rear Pond Runoff Area=226,166 sf 78.70% Impervious Runoff Depth>4.84"
Flow Length=219' Tc=7.2 min CN=89 Runoff=27.13 cfs 91,157 cf

Subcatchment E-5: To Great Brook Runoff Area=221,230 sf 0.00% Impervious Runoff Depth>2.08"
Flow Length=353' Tc=5.0 min CN=61 Runoff=12.29 cfs 38,290 cf

Pond 3P: Wetland C Peak Elev=345.35' Storage=5,375 cf Inflow=3.33 cfs 11,394 cf
Outflow=0.53 cfs 6,194 cf

Pond 4P: Wetland B Peak Elev=345.21' Storage=2,709 cf Inflow=3.57 cfs 17,539 cf
18.0" Round Culvert n=0.013 L=107.0' S=0.0169 '/' Outflow=1.63 cfs 16,718 cf

Link 2L: Great Brook Inflow=22.88 cfs 91,460 cf
Primary=22.88 cfs 91,460 cf

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=345,377 sf 53.30% Impervious Runoff Depth>5.42"
Flow Length=405' Tc=10.4 min CN=80 Runoff=42.99 cfs 155,956 cf

Subcatchment E-2A: To Wetland C Runoff Area=63,246 sf 6.89% Impervious Runoff Depth>3.39"
Flow Length=314' Tc=7.8 min UI Adjusted CN=62 Runoff=5.36 cfs 17,860 cf

Subcatchment E-2B: To Wetland B Runoff Area=62,941 sf 6.46% Impervious Runoff Depth>3.39"
Flow Length=203' Tc=5.7 min UI Adjusted CN=62 Runoff=5.75 cfs 17,783 cf

Subcatchment E-3: To Great Brook Runoff Area=202,379 sf 3.81% Impervious Runoff Depth>3.39"
Flow Length=353' Tc=8.6 min UI Adjusted CN=62 Runoff=16.70 cfs 57,139 cf

Subcatchment E-4: To Rear Pond Runoff Area=226,166 sf 78.70% Impervious Runoff Depth>6.47"
Flow Length=219' Tc=7.2 min CN=89 Runoff=35.73 cfs 122,015 cf

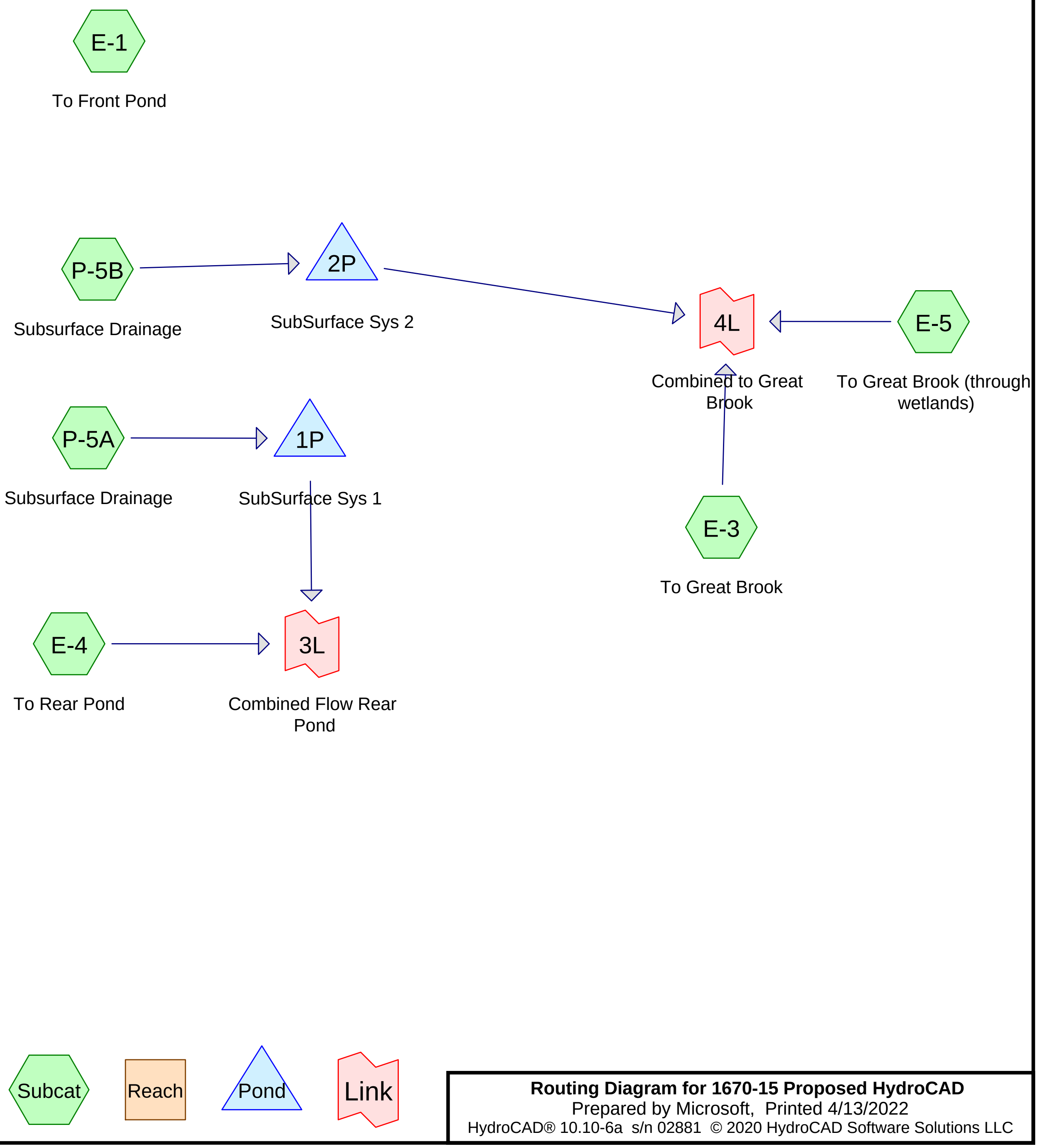
Subcatchment E-5: To Great Brook Runoff Area=221,230 sf 0.00% Impervious Runoff Depth>3.28"
Flow Length=353' Tc=5.0 min CN=61 Runoff=20.00 cfs 60,502 cf

Pond 3P: Wetland C Peak Elev=345.45' Storage=5,885 cf Inflow=5.36 cfs 17,860 cf
Outflow=2.99 cfs 12,651 cf

Pond 4P: Wetland B Peak Elev=345.59' Storage=5,705 cf Inflow=5.78 cfs 30,433 cf
18.0" Round Culvert n=0.013 L=107.0' S=0.0169 '/' Outflow=3.77 cfs 29,529 cf

Link 2L: Great Brook Inflow=37.38 cfs 147,170 cf
Primary=37.38 cfs 147,170 cf

POST-DEVELOPMENT



Routing Diagram for 1670-15 Proposed HydroCAD
Prepared by Microsoft, Printed 4/13/2022
HydroCAD® 10.10-6a s/n 02881 © 2020 HydroCAD Software Solutions LLC

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                 Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
                  Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
       Reach routing by Stor-Ind+Trans method  -  Pond routing by Stor-Ind method

SubcatchmentE-1: To Front Pond        Runoff Area=312,214 sf   53.40% Impervious   Runoff Depth>1.45"
                                    Flow Length=405'   Tc=10.4 min   CN=80   Runoff=10.44 cfs  37,793 cf

SubcatchmentE-3: To Great Brook        Runoff Area=151,818 sf   4.17% Impervious   Runoff Depth>0.51"
                                      Flow Length=420'   Tc=6.0 min   CN=62   Runoff=1.45 cfs  6,455 cf

SubcatchmentE-4: To Rear Pond         Runoff Area=120,015 sf   42.40% Impervious   Runoff Depth>1.20"
                                     Flow Length=197'   Tc=6.3 min   CN=76   Runoff=3.72 cfs  11,993 cf

SubcatchmentE-5: To Great Brook        Runoff Area=190,039 sf   0.42% Impervious   Runoff Depth>0.47"
                                      Flow Length=353'   Tc=5.0 min   CN=61   Runoff=1.64 cfs  7,476 cf

SubcatchmentP-5A: Subsurface DrainageRunoff Area=139,454 sf   78.28% Impervious   Runoff Depth>2.23"
                                                    Tc=6.0 min   CN=90   Runoff=8.29 cfs  25,930 cf

SubcatchmentP-5B: Subsurface DrainageRunoff Area=207,812 sf   70.57% Impervious   Runoff Depth>1.97"
                                                   Tc=6.0 min   CN=87   Runoff=11.04 cfs  34,198 cf

Pond 1P: SubSurface Sys 1              Peak Elev=348.07'  Storage=11,368 cf   Inflow=8.29 cfs  25,930 cf
                       Discarded=0.50 cfs  25,364 cf   Primary=0.12 cfs  539 cf   Outflow=0.62 cfs  25,903 cf

Pond 2P: SubSurface Sys 2              Peak Elev=339.48'  Storage=8,304 cf   Inflow=11.04 cfs  34,198 cf
                       Discarded=2.31 cfs  34,005 cf   Primary=0.19 cfs  184 cf   Outflow=2.50 cfs  34,189 cf

Link 3L: Combined Flow Rear Pond                                              Inflow=3.72 cfs  12,533 cf
                                                                             Primary=3.72 cfs  12,533 cf

Link 4L: Combined to Great Brook                                              Inflow=3.08 cfs  14,115 cf
                                                                             Primary=3.08 cfs  14,115 cf
```

```
                    Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
                      Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
       Reach routing by Stor-Ind+Trans method  -  Pond routing by Stor-Ind method

SubcatchmentE-1: To Front Pond       Runoff Area=312,214 sf   53.40% Impervious   Runoff Depth>2.90"
                                  Flow Length=405'   Tc=10.4 min   CN=80   Runoff=21.10 cfs  75,567 cf

SubcatchmentE-3: To Great Brook       Runoff Area=151,818 sf   4.17% Impervious   Runoff Depth>1.45"
                                   Flow Length=420'   Tc=6.0 min   CN=62   Runoff=5.47 cfs  18,324 cf

SubcatchmentE-4: To Rear Pond        Runoff Area=120,015 sf   42.40% Impervious   Runoff Depth>2.55"
                                   Flow Length=197'   Tc=6.3 min   CN=76   Runoff=8.15 cfs  25,490 cf

SubcatchmentE-5: To Great Brook       Runoff Area=190,039 sf   0.42% Impervious   Runoff Depth>1.38"
                                   Flow Length=353'   Tc=5.0 min   CN=61   Runoff=6.68 cfs  21,843 cf

SubcatchmentP-5A: Subsurface DrainageRunoff Area=139,454 sf   78.28% Impervious   Runoff Depth>3.89"
                                               Tc=6.0 min   CN=90   Runoff=14.10 cfs  45,229 cf

SubcatchmentP-5B: Subsurface DrainageRunoff Area=207,812 sf   70.57% Impervious   Runoff Depth>3.58"
                                               Tc=6.0 min   CN=87   Runoff=19.69 cfs  62,042 cf

Pond 1P: SubSurface Sys 1            Peak Elev=348.61'  Storage=14,712 cf   Inflow=14.10 cfs  45,229 cf
                    Discarded=0.50 cfs  28,310 cf   Primary=5.34 cfs  13,776 cf   Outflow=5.84 cfs  42,086 cf

Pond 2P: SubSurface Sys 2            Peak Elev=340.20'  Storage=15,171 cf   Inflow=19.69 cfs  62,042 cf
                    Discarded=2.31 cfs  50,660 cf   Primary=4.30 cfs  11,368 cf   Outflow=6.61 cfs  62,028 cf

Link 3L: Combined Flow Rear Pond                                                Inflow=9.73 cfs  39,266 cf
                                                                               Primary=9.73 cfs  39,266 cf

Link 4L: Combined to Great Brook                                               Inflow=13.55 cfs  51,535 cf
                                                                              Primary=13.55 cfs  51,535 cf
```

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=312,214 sf 53.40% Impervious Runoff Depth>3.87"
Flow Length=405' Tc=10.4 min CN=80 Runoff=28.04 cfs 100,773 cf

Subcatchment E-3: To Great Brook Runoff Area=151,818 sf 4.17% Impervious Runoff Depth>2.16"
Flow Length=420' Tc=6.0 min CN=62 Runoff=8.53 cfs 27,364 cf

Subcatchment E-4: To Rear Pond Runoff Area=120,015 sf 42.40% Impervious Runoff Depth>3.47"
Flow Length=197' Tc=6.3 min CN=76 Runoff=11.12 cfs 34,715 cf

Subcatchment E-5: To Great Brook Runoff Area=190,039 sf 0.42% Impervious Runoff Depth>2.08"
Flow Length=353' Tc=5.0 min CN=61 Runoff=10.55 cfs 32,891 cf

Subcatchment P-5A: Subsurface Drainage Runoff Area=139,454 sf 78.28% Impervious Runoff Depth>4.95"
Tc=6.0 min CN=90 Runoff=17.70 cfs 57,508 cf

Subcatchment P-5B: Subsurface Drainage Runoff Area=207,812 sf 70.57% Impervious Runoff Depth>4.62"
Tc=6.0 min CN=87 Runoff=25.09 cfs 79,975 cf

Pond 1P: SubSurface Sys 1 Peak Elev=349.06' Storage=16,990 cf Inflow=17.70 cfs 57,508 cf
Discarded=0.50 cfs 29,672 cf Primary=9.59 cfs 23,140 cf Outflow=10.09 cfs 52,812 cf

Pond 2P: SubSurface Sys 2 Peak Elev=340.78' Storage=20,000 cf Inflow=25.09 cfs 79,975 cf
Discarded=2.31 cfs 59,871 cf Primary=6.08 cfs 20,087 cf Outflow=8.39 cfs 79,958 cf

Link 3L: Combined Flow Rear Pond Inflow=17.64 cfs 57,855 cf
Primary=17.64 cfs 57,855 cf

Link 4L: Combined to Great Brook Inflow=22.52 cfs 80,342 cf
Primary=22.52 cfs 80,342 cf

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: To Front Pond Runoff Area=312,214 sf 53.40% Impervious Runoff Depth>5.42"
Flow Length=405' Tc=10.4 min CN=80 Runoff=38.87 cfs 140,981 cf

Subcatchment E-3: To Great Brook Runoff Area=151,818 sf 4.17% Impervious Runoff Depth>3.39"
Flow Length=420' Tc=6.0 min CN=62 Runoff=13.73 cfs 42,890 cf

Subcatchment E-4: To Rear Pond Runoff Area=120,015 sf 42.40% Impervious Runoff Depth>4.96"
Flow Length=197' Tc=6.3 min CN=76 Runoff=15.81 cfs 49,622 cf

Subcatchment E-5: To Great Brook Runoff Area=190,039 sf 0.42% Impervious Runoff Depth>3.28"
Flow Length=353' Tc=5.0 min CN=61 Runoff=17.18 cfs 51,972 cf

Subcatchment P-5A: Subsurface Drainage Runoff Area=139,454 sf 78.28% Impervious Runoff Depth>6.59"
Tc=6.0 min CN=90 Runoff=23.20 cfs 76,620 cf

Subcatchment P-5B: Subsurface Drainage Runoff Area=207,812 sf 70.57% Impervious Runoff Depth>6.24"
Tc=6.0 min CN=87 Runoff=33.37 cfs 108,057 cf

Pond 1P: SubSurface Sys 1 Peak Elev=349.43' Storage=18,368 cf Inflow=23.20 cfs 76,620 cf
Discarded=0.50 cfs 31,401 cf Primary=20.46 cfs 38,580 cf Outflow=20.96 cfs 69,981 cf

Pond 2P: SubSurface Sys 2 Peak Elev=341.67' Storage=25,238 cf Inflow=33.37 cfs 108,057 cf
Discarded=2.31 cfs 72,569 cf Primary=14.67 cfs 35,465 cf Outflow=16.99 cfs 108,034 cf

Link 3L: Combined Flow Rear Pond Inflow=35.54 cfs 88,202 cf
Primary=35.54 cfs 88,202 cf

Link 4L: Combined to Great Brook Inflow=36.46 cfs 130,327 cf
Primary=36.46 cfs 130,327 cf

SIMPLE DYNAMIC METHOD HYDROCAD MODEL

The Required Recharge Volume was done in accordance with the Massachusetts Stormwater Handbook, Volume 3 Chapter 1 – Documenting Compliance with the Massachusetts Stormwater Management Standards for the Simple Dynamic Method.

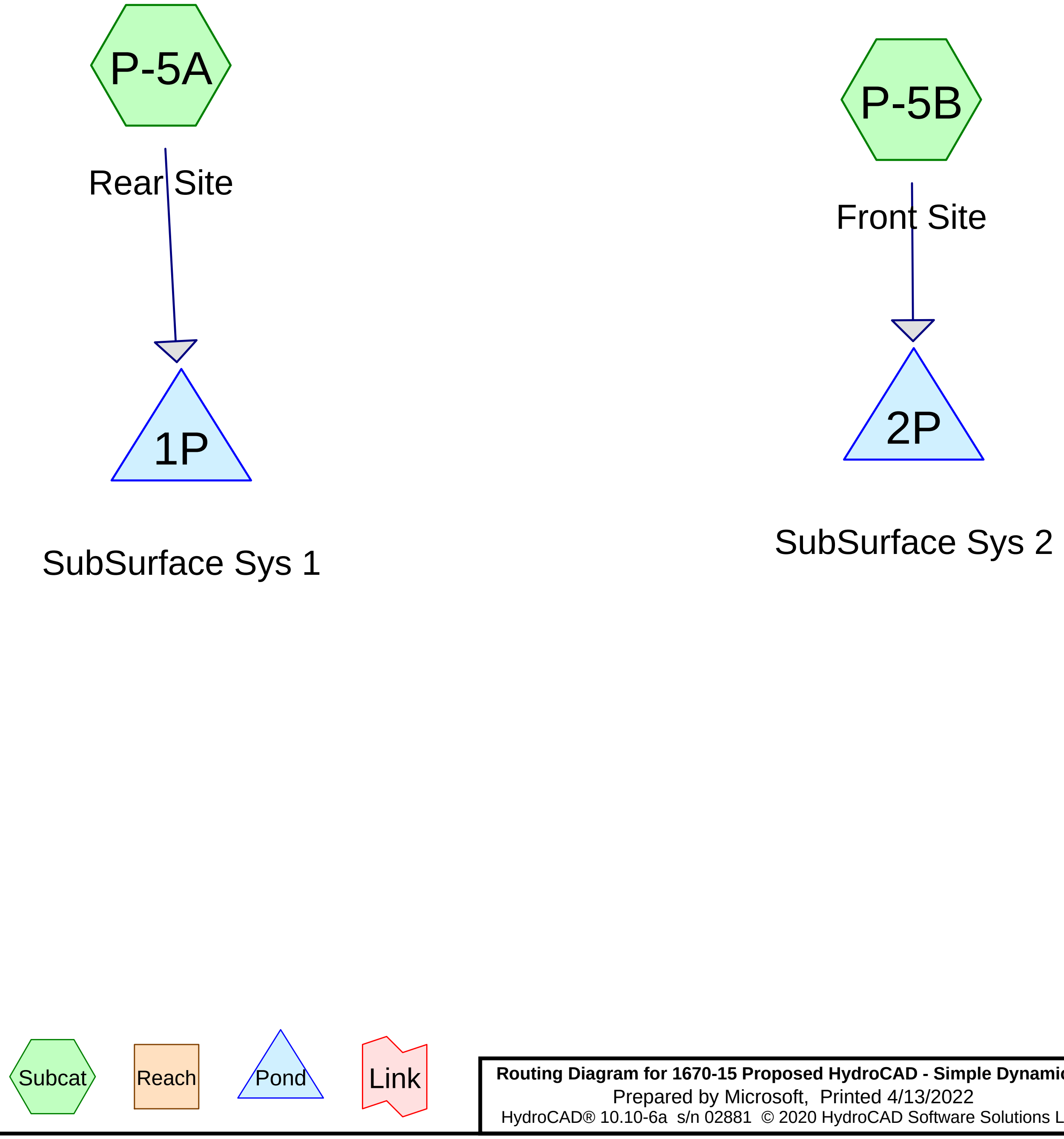
To size an infiltration BMP using the "Simple Dynamic" Method, applicants may also use a computer model based on TR-20 as described below. As more fully set forth below, this computer model assumes that the Required Water Quality Volume is entering the infiltration BMP during the peak two hours of the storm and that runoff is being discharged from the BMP during the same two hour period at the Rawls Rate. This contemporaneous exfiltration allows a proponent to reduce the size of the infiltration BMP.

a. *Use Equation 1 (Rv=F x impervious area) to determine the Required Recharge Volume*
b. *Select a 24-hour rainfall event that generates the Required Recharge Volume during the peak 2 hours. Use only the Site's impervious drainage area and the default NRCS Initial Abstraction of 0.2S and Type III storm. Set the storm duration for 24 hours, but use a start time of 11 hours and an end time of 13 hours. This creates a truncated hydrograph where most of the rainfall typical of a 24-hour Type III Storm occurs in just 2 hours. Selecting the correct precipitation depth is an iterative process. Various precipitation depths must be tested to determine which depth generates the Required Recharge Volume, using the Win TR-20 method (or other software based on TR-20). Each precipitation depth evaluated generates a runoff hydrograph. The area under the hydrograph is a volume. The correct result is achieved when the volume under the inflow hydrograph equals the Required Recharge Volume.*
c. *Using the resulting inflow hydrograph, choose an appropriate exfiltration structure with an appropriate bottom area and storage volume.*[1]
d. *Use recharge system bottom as maximum infiltrative surface area. Do not use sidewalls.*[2]
e. *Assume stormwater exfiltrates from the device over the peak 2-hour period of the rainfall event determined in step b above*
f. *Set exfiltration rates no higher than the Rawls Rates for the corresponding soil at the specific location where infiltration is proposed (see Table 2.3.3).*
g. *Assume exfiltration rate is constant.*
h. *Using the computer model, confirm adequate Storage Volume.*
i. *Go to STEP 5 to confirm that the bottom of the proposed infiltration BMP is large enough to ensure that the practice will drain completely in 72 hours or less. For purposes of the STEP 5 evaluation, assume the exfiltration rates are no higher than the Rawls Rates*

---

[1] An applicant may have to select several different size infiltration structures before s/he identifies a structure that is adequately sized.

[2] If the recharge system includes stone or other media, remember that the effective storage volume only includes the voids between the stone or other media.



Routing Diagram for 1670-15 Proposed HydroCAD - Simple Dynamic Tes
Prepared by Microsoft, Printed 4/13/2022
HydroCAD® 10.10-6a s/n 02881 © 2020 HydroCAD Software Solutions LLC

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                         Time span=11.00-13.00 hrs, dt=0.01 hrs, 201 points
                         Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
                Reach routing by Stor-Ind+Trans method  -  Pond routing by Stor-Ind method

SubcatchmentP-5A: Rear Site          Runoff Area=169,775 sf   100.00% Impervious   Runoff Depth>1.00"
                                                     Tc=6.0 min   CN=98   Runoff=7.74 cfs  14,182 cf

SubcatchmentP-5B: Front Site         Runoff Area=207,257 sf   100.00% Impervious   Runoff Depth>1.00"
                                                     Tc=6.0 min   CN=98   Runoff=9.45 cfs  17,313 cf

Pond 1P: SubSurface Sys 1              Peak Elev=347.97'  Storage=10,652 cf   Inflow=7.74 cfs  14,182 cf
                          Discarded=0.50 cfs  3,527 cf   Primary=0.00 cfs  0 cf   Outflow=0.50 cfs  3,527 cf

Pond 2P: SubSurface Sys 2               Peak Elev=339.29'  Storage=6,402 cf   Inflow=9.45 cfs  17,313 cf
                        Discarded=2.31 cfs  13,131 cf   Primary=0.00 cfs  0 cf  Outflow=2.31 cfs  13,131 cf
```

APPENDIX I

OPERATION & MAINTENANCE PLAN

OPERATION & MAINTENANCE PLAN

Multi-Family Development
580 Main Street Bolton, MA

Prepared: September 10, 2021
Revised: April 12, 2022

Site Locus

CLIENT:
Limited Dividend Affiliate of
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

allenmajor.com

OPERATION & MAINTENANCE PLAN

Multi-Family Development
580 Main Street Bolton, MA

PROPONENT:
Limited Dividend Affiliate of
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

ISSUED:
September 10, 2021

REVISED:
April 12, 2022

A&M PROJECT NO.:
1670-15

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ALLEN & MAJOR ASSOCIATES, INC. | SECTION 1.0

SECTION 1.0

OPERATIONS & MAINTENANCE PLAN

1.1 INTRODUCTION

In accordance with the standards set forth by the Stormwater Management Policy issued by the Massachusetts Department of Environmental Protection (MassDEP), Allen & Major Associates, Inc. has prepared the following Operations & Maintenance (O&M) Plan for the proposed stormwater management system for the Multi-Family Development located at 580 Main Street in Bolton, MA.

This plan focuses on post construction maintenance of the on-site drainage system. Operation and Maintenance (O&M) practices discussed below are recommendations made by the Design Engineer based on available reference material on Best Management Practices (BMP's) and experience. The property owner is responsible for implementation of the plan, and is encouraged to revise / supplement this plan accordingly based on actual site conditions.

The plan is broken down into two major sections. The first section describes the long-term pollution prevention measures (Long Term Pollution Prevention Plan). The second section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long Term Maintenance Plan).

1.2 NOTIFICATION PROCEDURES FOR CHANGE OF RESPONSIBILITY FOR O&M

The Stormwater Management System (SMS) for this project is owned by a Limited Dividend Affiliate of WP East Acquisitions, LLC (owner). The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance Plan.

The owner shall submit an annual summary report and the completed Operation & Maintenance Schedule & Checklist to the Conservation Commission (via email or print copy), highlighting inspection and maintenance activities including performances of BMPs. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the Commission that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the Commission of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the Commission.

1.3 CONTACT INFORMATION

Stormwater Management System Owner:	Limited Dividend Affiliate of WP East Acquisitions, LLC 91 Hartwell Avenue Lexington, MA 02421 Phone: TBD

Emergency Contact Information:

Limited Dividend Affiliate of WP East Acquisitions, LLC (Owner/Operator)	Phone: TBD
Bolton Department of Public Works	Phone: 978-779-6402
Bolton Fire Department (non-emergency line)	Phone: 978-779-2203
MassDEP Emergency Response	Phone: (888) 304-1133
Clean Harbors Inc (24-Hour Line)	Phone: (800) 645-8265

1.4 CONSTRUCTION PERIOD

1. Call Digsafe: 1-888-344-7233
2. Schedule a meeting with the various Town Departments, Design Engineer and Owner at least three (3) days prior to start of construction.
3. Install Erosion Control measures (construction entrance, wattles, straw bales, silt fence, silt sac, etc.) as shown on the Plans prepared by A&M. If required, by any special conditions, the Town shall review the installation of erosion control measures prior to the start of any site demolition work. Install Construction fencing if determined to be necessary at the commencement of construction.
4. All erosion and sedimentation controls shall be in accordance with MassDEP's Erosion and Sedimentation Control guidelines revised through May 2003 and the USDA SCS Erosion and Sedimentation Control in site development dated September 1983.
5. Site access shall be achieved only from the designated construction entrances.
6. Cut and clear trees in construction areas only (within the limit of work; see plans).
7. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.

8. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.
9. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on-site for review.
10. All erosion control measures shall be maintained, repaired, or replaced as required or at the direction of the owner's engineer or the Town's representative.
11. Sediment accumulation up-gradient of the straw bales, silt fence, and stone check dams greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.
12. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.
13. Install stone check dam on-site during construction as needed. Refer to the erosion control details. Temporary sediment basins combined with stone check damns shall be installed on-site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.
14. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
15. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
16. Dust pollution shall be controlled using on-site water trucks and/or an approved soil stabilization product.
17. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly. The report shall document any deficiencies and corrective actions taken by the applicant.
18. No overuse, over-compaction, or storage of materials shall occur within any areas defined as stormwater infiltration to prevent the incidental compaction of soils. The areas are to be constructed as soon as possible and protected from construction traffic. NO CONSTRUCTION WATERS are to be emptied into an infiltration system. An allowance may be accommodated for a temporary excavation of soils within the infiltration basin for collection and handling of construction water, but the entirety of the debris is to be removed in order to achieve the grades as shown on the construction drawings.

19. The entire drainage system, including but not limited to catch basin, manholes, piping, water quality structures and infiltration system should be cleaned prior to turnover to the Owner.

1.5 LONG-TERM POLLUTION PREVENTION PLAN

Standard #4 from the MassDEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance Plan of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures of the LTPPP.

- **Housekeeping**
  The existing development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland areas. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

- **Storing of Materials & Water Products**
  The trash and waste program for the site includes exterior dumpsters. There is a trash contractor used to pick up the waste material in the dumpsters. The stormwater drainage system has water quality inlets designed to capture trash and debris.

- **Vehicle Washing**
  Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The existing development does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

- **Spill Prevention & Response**
  Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the buildings and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

1. Spill hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
4. All spills shall be cleaned up immediately after discovery.
5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at (888) 304-1333.
6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

- **Maintenance of Lawns, Gardens, and Other Landscaped Areas**
  It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff/landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trees shall be planted over the drain lines or recharge area, and that only shallow rooted plants and shrubs will be allowed.
  - **Fertilizer**

    Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ration of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

Type:	LESCO® 28-0-12 (Lawn Fertilizer)
	MERIT® 0.2 Plus Turf Fertilizer
	MOMENTUM™ Force Weed & Feed

- **Suggested Aeration Program**

  In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

  Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

  The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

- **Landscape Maintenance Program Practices**:

  - **Lawn**

    1. Mow a minimum of once a week in spring, to a height of 2” to 2 1/2” high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cute, the less

the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.

2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
4. Do not remove grass clippings after mowing.
5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.

- **Shrubs**
  1. Mulch not more than 3″ depth with shredded pine or fir bark.
  2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals are to occur within 6″ of the ground to open up shrub and maintain two-year wood (the blooming wood).
  3. Hand-prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
- **Trees**
  1. Provide aftercare of new tree plantings for the first three years.
  2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
  3. Water once a week for the first year; twice a month for the second; once a month for the third year.
  4. Prune trees on a four-year cycle.
- **Invasive Species**
  1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

- **Storage and Use of Herbicides and Pesticides**
  Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and

water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) should be retained who is licensed with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Department of Agricultural Resources.

The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor household or structural pests, refer to 333 CMR 13.08.

Before beginning each application, the applicator must post a Department approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator's best judgment. It is intended to give sufficient notice so that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

1. Name and phone number of pest control company;
2. Date and time of the application;
3. Name and license number of the applicator;
4. Target pests; and
5. Name and EPA Registration Number of pesticide products applied.

- **Pet Waste Management**
  The owner's landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the development. The pet waste shall be disposed of in accordance with local and state regulations.

- **Operations and Management of Septic Systems**
  The private on-site wastewater treatment systems shall be inspected in accordance with the special conditions from the groundwater discharge permit issues by MassDEP.

- **Management of Deicing Chemicals and Snow**
  Snow will be stockpiled on site until the accumulated snow becomes a hazard to the daily operations of the site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to MassDEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations

  The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. If used, the de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. If used, de-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand.

1.6 LONG-TERM MAINTENANCE PLAN – FACILITIES DESCRIPTION

A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

The following is a description of the Stormwater Management System for the project site.

- **Stormwater Collection System – On-Site**: The stormwater collection system is comprised of deep sump hooded catch basins, Contech CDS 2015-4 water quality structures, Stormtech Isolator Row, a sub-surface infiltration system consisting of Stormtech SC-740 Chambers, wet basin, a closed gravity pipe network and several outlet control structures.
  The stormwater runoff from the building rooftops are collected using roof drains. The stormwater is conveyed to the discharge locations using internal building plumbing and external roof leaders. The building rooftop runoff discharges to one of several sub-surface infiltration systems.

1.7 INSPECTION AND MAINTENANCE FREQUENCY AND CORRECTIVE MEASURES

In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the following areas, facilities, and measures will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the footprint of the SMS.

Attached is an Operation and Maintenance Plan (OM-1) illustrating the location of the following SMS components that will require continuing inspection as outlined in the document:

- *Street Sweeping*
- *Deep Sump Hooded Catch Basin*
- *Contech CDS 2015-4 Water Quality Structures*
- *Stormtech Isolator Row*
- *Sub-Surface Infiltration Systems (Stormtech SC-740 Chambers)*
- *Pipe Ends*
- *Wet Basin*
- *Snow Storage (as outlined on plan)*

1.8 STRUCTURAL PRETREATMENT BMPS

Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

Deep Sump Catch Basins:

Deep sump catch basins, also known as oil and grease or hooded catch basins, are underground retention systems designed to remove trash, debris, and coarse sediment from stormwater runoff, and serve as temporary spill containment devices for floatables such as oils and greases.

Regular maintenance is essential. Deep sump catch basins remain effective by removing pollutants only if they are cleaned out frequently. One study found that once 50% of the sump volume is filled, the catch basin is not able to retain additional sediments.

Inspect or clean deep sump catch basins at least four times per year and at the end of the foliage and snow-removal seasons. Sediments must also be removed four times per year or whenever the depths of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

Clamshell buckets are typically used to remove sediment in Massachusetts. However, vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Always consider the safety of the staff cleaning deep sump catch basins. Cleaning a deep sump catch basin within a road with active traffic or even within a parking lot is dangerous, and a police detail may be necessary to safeguard workers.

Although catch basin debris often contains concentrations of oil and hazardous materials, such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Unless there is evidence that they have been contaminated by a spill or other means, MassDEP does not routinely require catch basin cleanings to be tested before disposal. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste, without any prior approval by MassDEP. However, some landfills require catch basin cleanings to be tested before they are accepted.

With prior MassDEP approval, catch basin cleanings may be used as grading and shaping materials at landfills undergoing closure (see Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites) or as daily cover at active landfills. MassDEP also encourages the beneficial reuse of catch basin cleanings whenever possible. A Beneficial Reuse Determination is required for such use.

MassDEP regulations prohibit landfills from accepting materials that contain free-draining liquids. One way to remove liquids is to use a hydraulic lift truck during cleaning operations so that the material can be decanted at the site. After loading material from several catch basins into a truck, elevate the truck so that any free-draining liquid can flow back into the structure. If there is no free water in the truck, the material may be deemed to be sufficiently dry. Otherwise catch basin cleanings must undergo a Paint Filter Liquids Test. Go to www.Mass.gov/dep/recycle/laws/cafacts.doc for information on all of the MassDEP requirements pertaining to the disposal of catch basin cleanings

Contech Cascade Separator Water Quality Structure

Cascade Separator systems should be inspected at regular intervals with maintenance performed as necessary to maintain performance. Sediment accumulation rates will vary based on treatment location and site utilization.

Inspections should be performed twice per year in the spring and fall. If upon routine inspection, increased loading is observed, more frequent inspections may be warranted. The inspections should quantify the accumulation of hydrocarbons, trash, and sediment using a calibrated dipstick, tape measure or other instrument. Cleaning is required before the observed level of sediment reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. Cleaning procedures can follow those described under the 450i water quality structure below.

Contech CDS 2015-4 Water Quality Structure

CDS 2015 Water Quality Structure systems should be inspected at regular intervals with maintenance performed as necessary to maintain performance. Sediment accumulation rates will vary based on treatment location and site utilization.

Inspections should be performed twice per year in the spring and fall. If upon routine inspection, increased loading is observed, more frequent inspections may be warranted. The inspections should confirm no blockages or obstructions are present on the inlet and separator screens. Inspection should also quantify the accumulation of hydrocarbons, trash, and sediment using a calibrated dipstick, tape measure or other instrument. Cleaning is required when the level of sediment has reached 75% of the capacity in the isolated sump and/or when an appreciable level of hydrocarbons and trash has accumulated. Cleaning procedures can follow those described under the 450i water quality structure below.

Contech 450i Water Quality Structure:

Regular maintenance is essential. Inspect or clean water quality structure at least twice per year (e.g. spring & fall) and snow-removal seasons. Sediments must also be removed whenever the depths of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Please refer to the Stormceptor STC Operation and Maintenance Guide attached hereafter.

Vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Always consider the safety of the staff cleaning the structure. Cleaning structures within a road with active traffic or even within a parking lot is dangerous, and a police detail may be necessary to safeguard workers.

Although debris often contains concentrations of oil and hazardous materials, such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Unless there is evidence that they have been contaminated by a spill or other means, MassDEP does not routinely require catch basin cleanings to be tested before disposal. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste, without any prior approval by MassDEP. However, some landfills require catch basin cleanings to be tested before they are accepted.

With prior MassDEP approval, catch basin cleanings may be used as grading and shaping materials at landfills undergoing closure (see Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites) or as daily cover at active landfills. MassDEP also encourages the beneficial reuse of catch basin cleanings whenever possible. A Beneficial Reuse Determination is required for such use.

MassDEP regulations prohibit landfills from accepting materials that contain free-draining liquids. One way to remove liquids is to use a hydraulic lift truck during cleaning operations so that the material can be decanted at the site. After loading material from several catch basins into a truck, elevate the truck so that any free-draining liquid can flow back into the structure. If there is no free water in the truck, the material may be deemed to be sufficiently dry. Otherwise catch basin cleanings must undergo a Paint Filter Liquids Test. Go to www.Mass.gov/dep/recycle/laws/cafacts.doc for information on all of the MassDEP requirements pertaining to the disposal of catch basin cleanings.

1.9 TREATMENT BMPS

Stormtech Isolator Row:

Stormtech's Isolator Row is an isolated row of chambers wrapped in geotextile fabric which filters the stormwater, trapping pollutants in the row before entering the adjacent chambers. The Isolator Row inspection/maintenance should be done in accordance with the manufacturer's guidelines and documentation. A copy is attached hereafter.

Wet Basins:

Wet basins use a permanent pool of water as the primary mechanism to treat stormwater. The pool allows sediments to settle (including fine sediments) and removes soluble pollutants. Wet basins must have additional dry storage capacity to control peak discharge rates. Wet basins have a moderate to high capacity to remove most urban pollutants, depending on how large the volume of the permanent pool is in relation to the runoff from the surrounding watershed.

Inspect wet basins at least once per year to ensure they are operating as designed. Inspect the outlet structure for evidence of clogging or excessive outflow releases. Potential problems to check include: subsidence, erosion, cracking or tree growth on the embankment, damage to the emergency spillway, sediment accumulation around the outlet, inadequacy of the inlet/outlet channel erosion control measures, change in the condition of the pilot channel, erosion within the basin and banks, and the emergence of invasive species. During inspections, note any changes to the wet basin or the contributing watershed area because these may affect basin performance. At least twice a year, mow the upper-stage, side slopes, embankment and emergency spillway. At this time, also check the sediment in the forebay for accumulated material, sediment, trash, and debris and remove it. Remove sediment from the basin as necessary, and at least once every 10 years.

1.10 CONVEYANCE BMPS

Grass Swale:

Grass Drainage Channels should be inspected within the first three months after construction to ensure proper vegetation is established; thereafter, Inspect 2 times per year (preferably in Spring and Fall) to ensure they are working in their intended fashion and that they are free of sediment and debris. Remove any obstructions to flow, including accumulated sediments and debris and vegetated growth. Repair any erosion of the ditch lining. Vegetated ditches will be mowed at least annually or otherwise maintained to control the growth of woody vegetation and maintain flow capacity. Any woody vegetation growing through riprap linings must also be removed. Repair any slumping side slopes as soon as practicable and correct any erosion of the channel's bottom or side slopes.

1.11 INFILTRATION BMPS

Subsurface Structures:

Subsurface structures are underground systems that capture runoff, and gradually infiltrate it into the groundwater through rock and gravel.

Because subsurface structures are installed underground, they are extremely difficult to maintain. Inspect inlets at least twice a year. Remove any debris that might clog the system. Include mosquito controls in the Operation and Maintenance Plan.

Inspect outlet from subsurface structures to adjacent resource area for signs of scour and sediment accumulation at least twice annually. Remove sediment accumulation and add rip rap as necessary to prevent scour.

Outlet control structures should be evaluated at least once per year.

1.12 OTHER BMPS AND ACCESSORIES:

Outlet Control Structures:

Outlets of BMPs are devices that control the flow of stormwater out of the BMP to the conveyance system.

Inspect outlet structures twice per year. Remove any accumulated sediment and debris that could prevent flow at the outlet structure.

Culverts:
Inspect culverts 2 times per year (preferably in Spring and Fall) to ensure that the culverts are working in their intended fashion and that they are free of debris. Remove any obstructions to flow; remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit and repair any erosion damage at the culvert's inlet and outlet.

Rip Rap and Level Spreaders:

Inspect twice per year for erosion, debris accumulation, and unwanted vegetation. Erosion areas shall be stabilized and sediment, debris, and woody vegetation will be removed.

Vegetated Areas:

Inspect slopes and embankments early in the growing season to identify active or potential erosion problems. Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

Roadway and Parking Surfaces:

Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Mosquito Control Plan:

MA Stormwater Handbook; Volume 2, Chapter 5 (Attached)

Both above ground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance, and treatment with larvicides can minimize this potential.

1.13 SUPPLEMENTAL INFORMATION

PROPOSED OPERATIONS AND MAINTENANCE LOG FORM

Based on site specific stormwater management system asset list. At a minimum, fields should be provided for:

- Date of inspection
- Name of inspector
- Condition of each BMP, including components such as:
  - Pretreatment devices
  - Vegetation

  - Other safety devices
  - Control structures
  - Embankments, slopes, and safety benches
  - Inlet and outlet channels and structures
  - Underground drainage
  - Sediment and debris accumulation in storage and forebay areas (including catch basins)
  - Any nonstructural practices
  - Any other item that could affect the proper function of the stormwater management system
- Description of the need for maintenance
- Description of maintenance performed

APPENDIX A

SUPPLEMENT INFORMATION

SNOW DISPOSAL GUIDANCE

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

Massachusetts Department of Environmental Protection
Bureau of Water Resources
Snow Disposal Guidance

Effective Date: December 23, 2019

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: Bureau of Resource Protection (BRP) Snow Disposal Guideline No. BRPG97-1 issued December 12, 1997 and BRPG01-01 issued March 8, 2001; Bureau of Water Resources (BWR) snow disposal guidance issued December 21, 2015 and December 12, 2018.

Approved by: Kathleen Baskin, Assistant Commissioner, Bureau of Water Resources

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are protective of wetlands, drinking water, and water bodies, and are acceptable to the Massachusetts Department of Environmental Protection (MassDEP), Bureau of Water Resources.

APPLICABILITY: These Guidelines are issued by MassDEP's Bureau of Water Resources on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to all federal agencies, state agencies, state authorities, municipal agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While MassDEP is aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything that occurs on the land has the potential to impact the Commonwealth's water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help federal agencies, state agencies, state authorities, municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter. Following these guidelines and obtaining the necessary approvals may also help municipalities in cases when seeking reimbursement for snow disposal costs from the Federal Emergency Management Agency is possible.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas or upland locations on impervious surfaces away from water resources and drinking water wells. At these locations, the snow meltwater can filter into the soil, leaving behind sand and debris which can be removed in the spring. The following conditions should be followed:

- Within water supply Zone A and Zone II, avoid storage or disposal of snow and ice containing deicing chemicals that has been collected from streets located outside these zones. Municipalities may have a water supply protection land use control that prohibits the disposal of snow and ice containing deicing chemicals from outside the Zone A and Zone II, subject to the Massachusetts Drinking Water Regulations at 310 CMR 22.20C and 310 CMR 22.21(2).
- Avoid storage or disposal of snow or ice in Interim Wellhead Protection Areas (IWPA) of public water supply wells, and within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater.
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage systems including detention basins, swales or ditches. Snow combined with sand and debris may block a stormwater drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Recommended Site Selection Procedures

It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

- Estimate how much snow disposal capacity may be needed for the season so that an adequate number of disposal sites can be selected and prepared.
- Identify sites that could potentially be used for snow disposal, such as municipal open space (e.g., parking lots or parks).
- Select sites located in upland locations that are not likely to impact sensitive environmental resources first.
- If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

Snow Disposal Mapping Assistance

MassDEP has an online mapping tool to assist in identifying possible locations to potentially dispose of snow. MassDEP encourages municipalities to use this tool to identify possible snow disposal options. The tool identifies wetland resource areas, public drinking water supplies and other sensitive locations where snow should not be disposed. The tool may be accessed through the Internet at the following web address: **https://maps.env.state.ma.us/dep/arcgis/js/templates/PSF/**.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- Wherever possible maintain a 50-foot vegetated buffer between the disposal site and adjacent waterbodies to filter pollutants from the meltwater.
- Clear debris from the site prior to using the site for snow disposal.
- Clear debris from the site and properly dispose of it at the end of the snow season, and no later than May 15.

3. SNOW DISPOSAL APPROVALS

Proper snow disposal may be undertaken through one of the following approval procedures:

- Routine snow disposal – Minimal, if any, administrative review is required in these cases when upland and pervious snow disposal locations or upland locations on impervious surfaces that have functioning and maintained stormwater management systems have been identified, mapped, and used for snow disposal following ordinary snowfalls. Use of upland and pervious snow disposal sites avoids wetland resource areas and allows snow meltwater to recharge groundwater and will help filter pollutants, sand, and other debris. This process will address the majority of snow removal efforts until an entity exhausts all available upland snow disposal sites. The location and mapping of snow disposal sites will help facilitate each entity's routine snow management efforts.
- Emergency Certifications – If an entity demonstrates that there is no remaining capacity at upland snow disposal locations, local conservation commissions may issue an Emergency Certification under the Massachusetts Wetlands Protection regulations to authorize snow disposal in buffer zones to wetlands, certain open water areas, and certain wetland resource areas (i.e. within flood plains). Emergency Certifications can only be issued at the request of a public agency or by order of a public agency for the protection of the health or safety of citizens, and are limited to those activities necessary to abate the emergency. See 310 CMR 10.06(1)-(4). Use the following guidelines in these emergency situations:
    - Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
    - Do not dispose of snow in salt marshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
    - Do not dispose of snow where trucks may cause shoreline damage or erosion.
    - Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.

- Severe Weather Emergency Declarations – In the event of a large-scale severe weather event, MassDEP may issue a broader Emergency Declaration under the Wetlands Protection Act which allows federal agencies, state agencies, state authorities, municipalities, and businesses greater flexibility in snow disposal practices. Emergency Declarations typically authorize greater snow disposal options while protecting especially sensitive resources such as public drinking water supplies, vernal pools, land containing shellfish, FEMA designated floodways, coastal dunes, and salt marsh. In the event of severe winter storm emergencies, the snow disposal site maps created by municipalities will enable MassDEP and the Massachusetts Emergency Management Agency (MEMA) in helping communities identify appropriate snow disposal locations.

  If upland disposal sites have been exhausted, the Emergency Declaration issued by MassDEP allows for snow disposal near water bodies. In these situations, a buffer of at least 50 feet, preferably vegetated, should still be maintained between the site and the waterbody. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, the Emergency Declaration issued by MassDEP may allow disposal of snow in certain waterbodies under certain conditions. ***A federal agency, state agency, state authority, municipality or business seeking to dispose of snow in a waterbody should take the following steps***:

- Call the emergency contact phone number [(888) 304-1133)] and notify the MEMA of the municipality's intent.
- MEMA will ask for some information about where the requested disposal will take place.
- MEMA will confirm that the disposal is consistent with MassDEP's Severe Weather Emergency Declaration and these guidelines and is therefore approved.

During declared statewide snow emergency events, MassDEP's website will also highlight the emergency contact phone number [(888) 304-1133)] for authorizations and inquiries. For further non-emergency information about this Guidance you may contact your MassDEP Regional Office Service Center:

Northeast Regional Office, Wilmington, 978-694-3246
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7650
Western Regional Office, Springfield, 413-755-2114

MOSQUITO CONTROL

Chapter 5
Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within 3 days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

Some stormwater practices are designed to include permanent wet pools. These practices – if maintained properly – can limit mosquito breeding by providing habitat for mosquito predators. Additional measures that can be taken to reduce mosquito populations include increasing water circulation, attracting mosquito predators by adding suitable habitat, and applying larvicides.

The Massachusetts State Reclamation and Mosquito Control Board (SRMCB), through the Massachusetts Mosquito Control Districts, can undertake further mosquito control actions specifically for the purpose of mosquito control pursuant to Massachusetts General Law Chapter 252. The Mosquito Control Board, http://www.mass.gov/agr/mosquito/, describes mosquito control methods and is in the process of developing guidance documents that describe Best Management Practices for mosquito control projects.

The SRMCB and Mosquito Control Districts are not responsible for operating and maintaining stormwater BMPs to reduce mosquito populations. The owners of property that construct the stormwater BMPs or municipalities that “accept” them through local subdivision approval are responsible for their maintenance.[1] The SRMCB is composed of officials from MassDEP, Department of Agricultural Resources, and Department of Conservation and Recreation. The nine (9) Mosquito Control Districts overseen by the SRMCB are located throughout Massachusetts, covering 176 municipalities.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the following actions:

- ***Minimize Land Disturbance:*** Minimizing land disturbance reduces the likelihood of mosquito breeding by reducing silt in runoff that will cause construction period controls to clog and retain standing pools of water for more than 72 hours.
- ***Catch Basin inlets:*** Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads

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[1] MassDEP and MassHighway understand that the numerous stormwater BMPs along state highways pose a unique challenge. To address this challenge, the 2004 MassHighway Stormwater Handbook will provide additional information on appropriate operation and maintenance practices for mosquito control when the Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards..

caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (*Bs*) using a licensed pesticide applicator.
- ***Check Dams:*** If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- ***Design construction period sediment traps*** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide *Bs* after it rains from June through October, until the first frost occurs.
- ***Construction period open conveyances:*** When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- ***Revegetating Disturbed Surfaces:*** Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- ***Sediment fences/hay bale barriers:*** When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

Post-Construction Stormwater Treatment Practices

- Mosquito control begins with the environmentally sensitive site design. Environmentally sensitive site design that minimizes impervious surfaces reduces the amount of stormwater runoff. Disconnecting runoff using the LID Site Design credits outlined in the Massachusetts Stormwater Handbook reduces the amount of stormwater that must be conveyed to a treatment practice. Utilizing green roofs minimizes runoff from smaller storms. Storage media must be designed to dewater within 72 hours after precipitation.
- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
  - ***Bioretention Areas/Rain Gardens/Sand Filter:*** These practices tend not to result in mosquito breeding. If any level spreaders, weirs or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
  - ***Infiltration Trenches:*** This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
  - ***Constructed Stormwater Wetlands:*** Habitat features can be incorporated in constructed stormwater wetlands to attract dragonflies, amphibians, turtles, birds, bats, and other natural predators of mosquitoes.
  - ***Wet Basins:*** Wet basins can be designed to incorporate fish habitat features, such as deep pools. Introduce fish in consultation with Massachusetts Division of Fisheries and Wildlife. Vegetation within wet basins designed as fish habitat must be properly managed to ensure that vegetation does not overtake the habitat. Proper design to ensure that no low circulation or "dead" zones are created may reduce the potential for mosquito breeding. Introducing bubblers may increase water circulation in the wet basin.

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- ***Basins:*** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open.
- ***BMPs without a permanent pool of water:*** All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Wallace indicates that extended dry extended detention basins may breed more mosquitoes than wet basins. It is, therefore, imperative to design outlets from extended dry detention basins to completely dewater within the 72-hour period.
- ***Energy Dissipators and Flow Spreaders:*** Currier and Moeller, 2000 indicate that shallow recesses in energy dissipators and flow spreaders trap water where mosquitoes breed. Set the riprap in grout to reduce the shallow recesses and minimize mosquito breeding.
- ***Outlet control structures:*** Debris trapped in small orifices or on trash racks of outlet control structures such as multiple stage outlet risers may clog the orifices or the trash rack, causing a standing pool of water. Optimize the orifice size or trash rack mesh size to provide required peak rate attenuation/water quality detention/retention time while minimizing clogging.
- ***Rain Barrels and Cisterns:*** Seal lids to reduce the likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over inlets. The cistern system should be designed to ensure that all collected water is drained into it within 72 hours.
- ***Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins:*** Seal all manhole covers to reduce likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over the outlet (CALTRANS 2004).

The Operation and Maintenance Plan should provide for mosquito prevention and control.

- ***Check dams:*** Inspect permanent check dams on the schedule set forth in the O&M Plan. Inspect check dams 72 hours after storms for standing water ponding behind the dam. Take corrective action if standing water is found.
- ***Cisterns:*** Apply *Bs* larvicide in the cistern if any evidence of mosquitoes is found. The Operation and Maintenance Plan shall specify how often larvicides should be applied to waters in the cistern.
- ***Water quality swales:*** Remove and properly dispose of any accumulated sediment as scheduled in the Operation and Maintenance Plan.
- ***Larvicide Treatment:*** The Operation and Maintenance Plan must include measures to minimize mosquito breeding, including larviciding.
- The party identified in the Operation and Maintenance Plan as responsible for maintenance shall see that larvicides are applied as necessary to the following stormwater treatment practices: catch basins, oil/grit separators, wet basins, wet water quality swales, dry extended detention basins, infiltration basins, and constructed stormwater wetlands. The Operation and Maintenance Plan must ensure that all larvicides are applied by a licensed pesticide applicator and in compliance with all pesticide label requirements.
- The Operation and Maintenance Plan should identify the appropriate larvicide and the time and method of application. For example, *Bacillus sphaericus (Bs*), the preferred

larvicide for stormwater BMPs, should be hand-broadcast.[2] Alternatively, Altosid, a Methopren product, may be used. Because some practices are designed to dewater between storms, such as dry extended detention and infiltration basins, the Operation and Maintenance Plan should provide that larviciding must be conducted during or immediately after wet weather, when the detention or infiltration basin has a standing pool of water, unless a product is used that can withstand extended dry periods.

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[2] *Bacillus thuringienis israelensis* or *Bti* is usually applied by helicopter to wetlands and floodplains

Roads and Stormwater BMPs

In general, the stormwater BMPs used for land development projects can also be used for new roadways and roadway improvement projects. However, for improvement of existing roads, there are often constraints that limit the choice of BMP. These constraints derive from the linear configuration of the road, the limited area within the existing right-of-way, the structural and safety requirements attendant to good roadway design, and the long-term maintainability of the roadway drainage systems. The MassHighway Handbook provides strategies for dealing with the constraints associated with providing stormwater BMPs for roadway redevelopment projects.

Roadway design can minimize impacts caused by stormwater. Reducing roadway width reduces the total and peak volume of runoff. Designing a road with country drainage (no road shoulders or curbs) disconnects roadway runoff. Disconnection of roadway runoff is eligible for the Low Impact Site Design Credit provided the drainage is disconnected in accordance with specifications outlined in Volume 3.

Like other parties, municipalities that work within wetlands jurisdictional areas and adjacent buffer zones must design and implement structural stormwater best management practices in accordance with the Stormwater Management Standards and the Stormwater Management Handbook. In addition, in municipalities and areas where state agencies operate stormwater systems, the DPWs (or other town or state agencies) must meet the “good housekeeping“ requirement of the municipality’s or agency's MS4 permit.

MassHighway has taken stormwater management one step further by working with MassDEP to develop the MassHighway Storm Water Handbook for Highways and Bridges. The purpose of the MassHighway Handbook is to provide guidance for persons involved in the design, permitting, review and implementation of state highway projects, especially those involving existing roadways where physical constraints often limit the stormwater management options available. These constraints, like those common to redevelopment sites, may make it difficult to comply precisely with the requirements of the Stormwater Management Standards and the Massachusetts Stormwater Handbook.[3] In response to these constraints, MassDEP and MHD developed specific design, permitting, review and implementation practices that meet the unique challenges of providing environmental protection for existing state roads. The information in the MassHighway Handbook may also aid in the planning and design of projects to build new highways and to add lanes to existing highways, since they may face similar difficulties in meeting the requirements of the Stormwater Management Standards.

Although it is very useful, the MassHighway Handbook does not allow MassHighway projects to proceed without individual review and approval by the issuing authority when subject to the Wetlands Protection Act Regulations, 310 CMR 10.00, or the 401 Water Quality Certification Regulations, 314 CMR 9.00. For example, MassHighway must provide a Conservation Commission with a project-specific Operation and Maintenance Plan in accordance with Standard 9 that documents how the project’s post-construction BMPs will be operated and maintained.[4]

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[3] The 2004 MassHighway Handbook outlines standardized methods for dealing with these constraints as they apply to highway redevelopment projects. MassDEP and MassHighway intend to work together to provide guidance for add a lane projects when the 2004 Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards.

[4] The general permit for municipal separate storm sewer systems (the MS4 Permit) requires MassHighway to develop and implement procedures for the proper operation and maintenance of stormwater BMPs. To

Some municipalities have asked if the MassHighway Handbook governs municipal road projects. The answer is no.[5] The MassHighway Handbook was developed in response to the unique problems and challenges arising out of the management of the state highway system. Like other project proponents, cities and towns planning road or other projects in areas subject to jurisdiction under the Wetlands Protection Act must design and implement LID, non-structural and structural best management practices in accordance with the Stormwater Management Standards and the Massachusetts Stormwater Handbook.

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avoid duplication of effort, MassHighway may be able rely on the same procedures to fulfill the operation and maintenance requirements of Standard 9 and the MS 4 Permit.

[5] Although the MassHighway Handbook does not govern municipal road projects, cities and towns may find some of the information presented in the Handbook useful.

OPERATION & MAINTENANCE SUMMARY TABLE

OPERATION AND MAINTENANCE PLAN SCHEDULE

Date:

ALLEN & MAJOR
ASSOCIATES, INC.

Project: Multi-Family Development
Project Address: 580 Main Street Bolton, MA

Responsible for O&M Plan: WP East Acquisitions, LLC
Address: 91 Hartwell Avenue Lexington, MA 02421
Phone:

All information within table is derived from Massachussetts Stormwater Handbook: Volume 2, Chapter 2

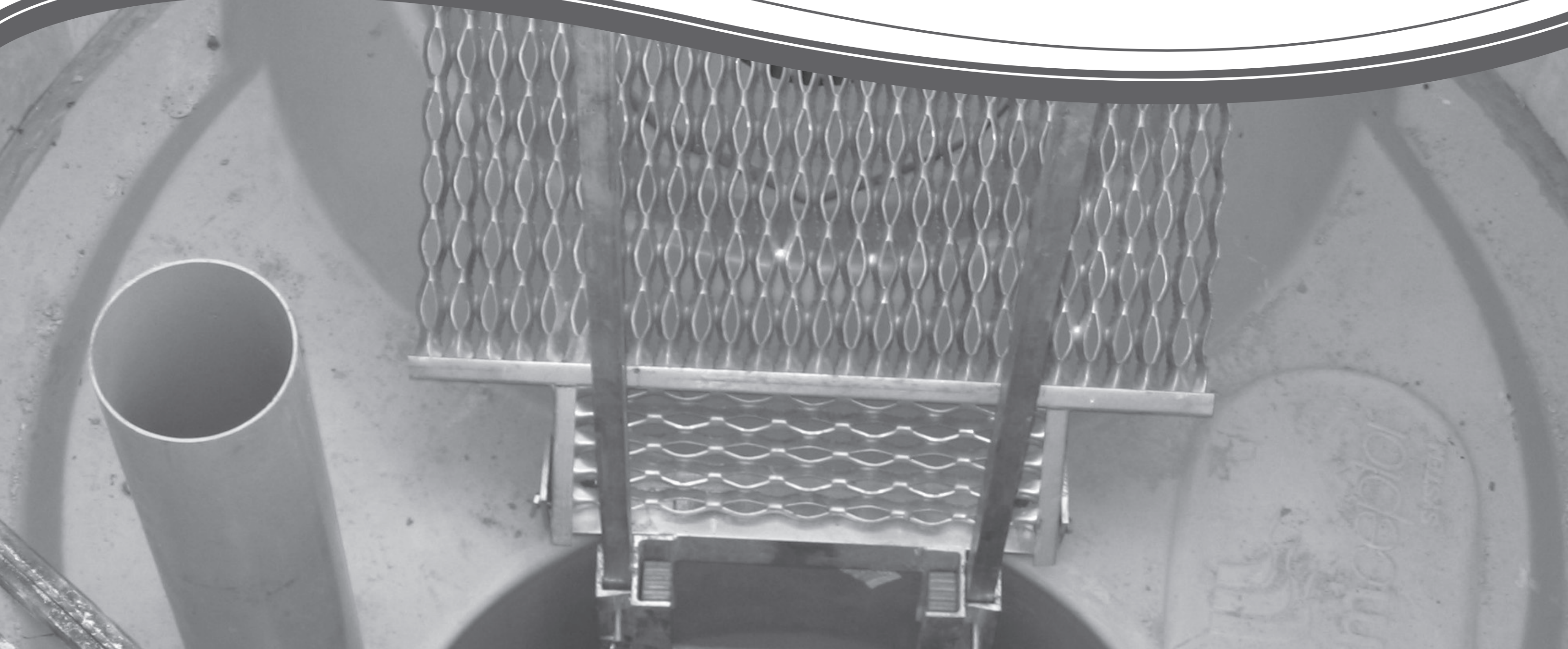
BMP CATEGORY	BMP OR MAINTENANCE ACTIVITY	SCHEDULE/ FREQUENCY	NOTES	ESTIMATED ANNUAL MAINTENANCE COST	INSPECTION PERFORMED	
					DATE:	BY:
STRUCTURAL PRETREATMENT BMPs	**DEEP SUMP HOODED CATCH BASIN**	Twice per year.	Inspect and clean catch basin units whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.	$1,000		
	PROPRIETARY SEPARATORS	In accordance with manufacturers requirements, but no less than twice a year following installation and once a year thereafter.	Remove sediment and other trapped pollutants at frequency or level specified by manufacturer.	$1,000		
TREATMENT BMP'S	**PROPRIETARY STORMTECH ISOLATOR ROW**	Twice per year minimum; follow manufacturer's schedule	Inspect for standing water, sediment, trash and debris and clogging. Inspect to determine if system drains in 72 hours once a year during wet season after a large storm.	$1,000		
	WET BASIN	Twice per year.	Inspect wet basins to ensure they are operating as designed. Mow the upper stage, side slopes, embankments and emergency spillway. Check the sediment forebay for accumulated sediment, trash, debris and remove it. Remove sediment from the basin as necessary and at least once evry 10 yrs.	$1,000		
CONVEYANCE BMPs	**GRASS SWALE**	Remove sediment annually. Mow once a month during growing season. Repair erosion no less than once per year.	Remove sediment from forebay and grass channel, mow, repair areas of erosion and revegetate.	$500		
INFILTRATION BMPs	**SUBSURFACE STRUCTURES**	Inspect structure inlets at least twice a year. Remove debris that may clog the system as needed.	Because subsurface structures are installed underground, they are extremely difficult to maintain. Remove any debris that might clog the system.	$1,000		

OTHER BMP's	**POROUS PAVEMENT**	Assess exfiltration capability at least once a year. Inspect for deterioration annually. Monitor if paving surface is draining properly as needed.	Monitor to ensure that the paving surface drains properly after storms. For porous asphalts and concretes, clean the surface using power washer to dislodge trapped particles and then vacuum sweep the area. Inspect the surface annually for deterioration.	$2,000		
BMP ACCESSORIES	**LEVEL SPREADERS**	Inspect regularly, especially after large rainfall events.	Inspect level spreaders regularly, especially after large rainfall events. Note and repair any erosion or low spots in the spreader.	$1,000		
	OUTLET STRUCTURES	Periodic cleaning of Outlet Control Structures as needed.	Clear trash and debris as necessary.	$500		
OTHER MAINTENANCE ACTIVITY	**MISQUITO CONTROL**	Inspect BMPs as needed to ensure the system's drainage time is less than the maximum 72 hour period.	Massachusetts stormwater handbook requires all stormwater practices that are designed to drain do so within 72 hours to reduce the number of mosquitos that mature to adults since the aquatic stage of a mosquito is 7-10 days.	$300		
	SNOW STORAGE	Clear and remove snow to approved storage locations as necessary to ensure systems are working properly and are protected from meltwater pollutants.	Carefully select snow disposal sites before winter. Avoid dumping removed snow over catch basins, or in detention ponds, sediment forebays, rivers, wetlands, and flood plains. It is also prohibited to dump snow in the bioretention basins or gravel swales.	$500		
	STREET SWEEPING	Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring.	Sweep, power broom or vacuum paved areas. Submit information that confirms that all street sweepings have been completed in accordance with state and local requirements	$2,000		

STORMCEPTOR OPERATION & MAINTENANCE

CONTECH®
ENGINEERED SOLUTIONS

Stormceptor® STC
Operation and Maintenance Guide



Stormceptor® STC

Stormceptor Design Notes

- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.

Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences			
Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in. (75 mm)	1 in. (25 mm)	3 in. (75 mm)
Multiple inlet pipes	3 in. (75 mm)	3 in. (75 mm)	Only one inlet pipe.

Maximum inlet and outlet pipe diameters:

Inlet/Outlet Configuration	Inlet Unit STC 450i	In-Line Unit STC 900 to STC 7200	Series* STC 11000 to STC 16000
Straight Through	24 inch (600 mm)	42 inch (1050 mm)	60 inch (1500 mm)
Bend (90 degrees)	18 inch (450 mm)	33 inch (825 mm)	33 inch (825 mm)

- The inlet and in-line Stormceptor units can accommodate turns to a maximum of 90 degrees.
- Minimum distance from top of grade to crown is 2 feet (0.6 m)
- Submerged conditions. A unit is submerged when the standing water elevation at the proposed location of the Stormceptor unit is greater than the outlet invert elevation during zero flow conditions. In these cases, please contact your local Stormceptor representative and provide the following information:
- Top of grade elevation
- Stormceptor inlet and outlet pipe diameters and invert elevations
- Standing water elevation
- Stormceptor head loss, K = 1.3 (for submerged condition, K = 4)

Stormceptor® STC

OPERATION AND MAINTENANCE GUIDE

Table of Content

1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 •2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

2. Stormceptor Design Overview

2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18” (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.

3. Key Operation Features

3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{SC} = \frac{H}{6_H} = \frac{Q}{A_S}$$

Where:

v_{SC} = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$Ø_H$ = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft3/s (m3/s)

A_S = surface area, ft^2 (m^2)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

4. Stormceptor Product Line

4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

Table 1. Stormceptor Models

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft^3 (L)
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

4.2. Inline Stormceptor

The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.

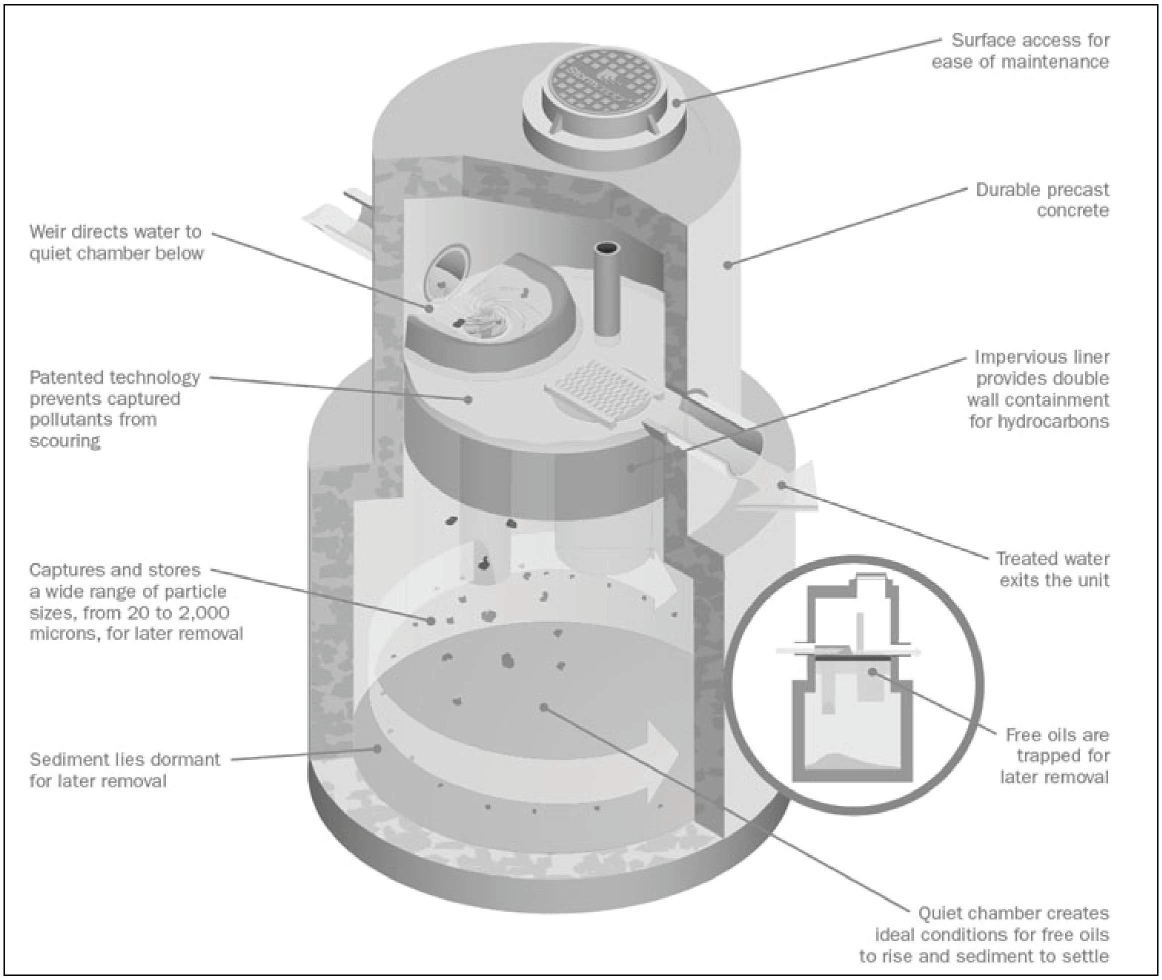


Figure 1. Inline Stormceptor

Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.

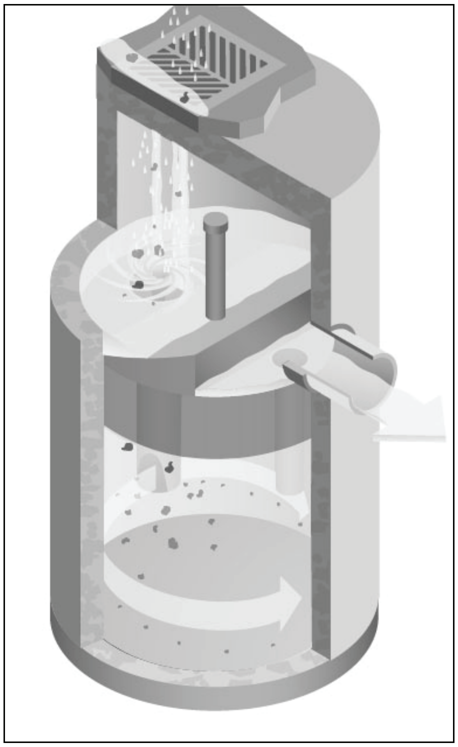


Figure 2. Inlet Stormceptor

4.3. Inlet Stormceptor

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

4.4. Series Stormceptor

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.

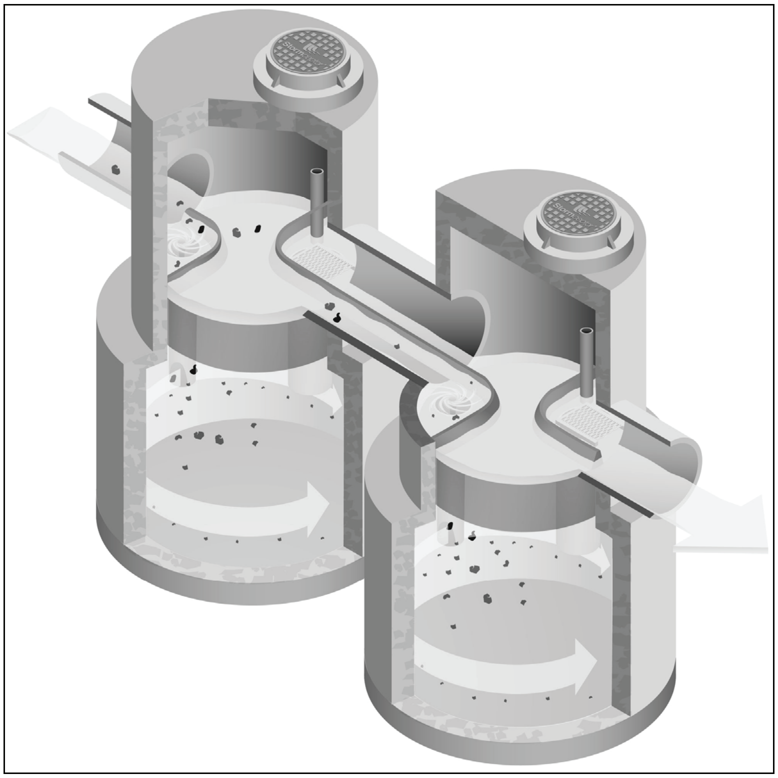


Figure 3. Series System

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

Table 2. Fine Distribution

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
    - » The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
    - » The distribution of TSS with the hydrology is properly and accurately considered in the sizing
    - » Particle size distribution is properly considered in the sizing
    - » The sizing can be optimized for TSS removal
    - » The cost benefit of alternate TSS removal criteria can be easily assessed
    - » The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit www.imbriumsystems.com to download a free copy of the program.

5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site's typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit's performance. As an integral part of the product's design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered "stable" surfaces which have non – erodible surfaces.

Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as "unstable". These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

'Oil Removal' describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

‘Spill Capture’ describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit’s available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

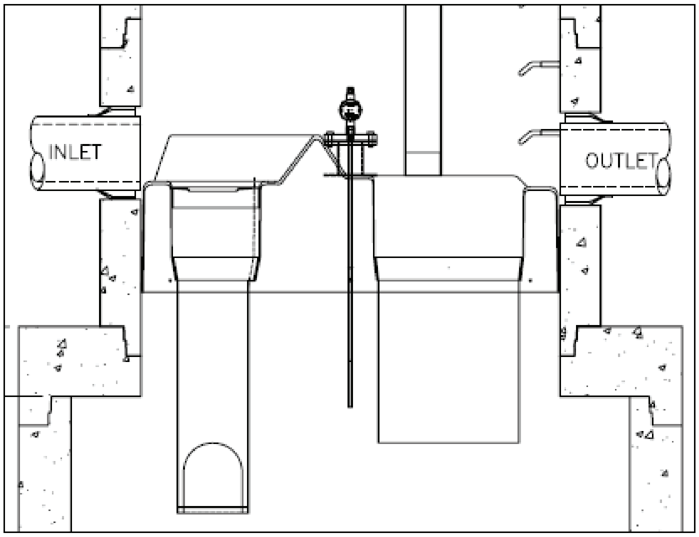


Figure 4. Oil level alarm

6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.

7. Stormceptor Options

The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

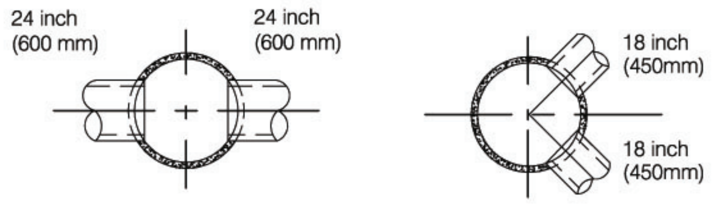
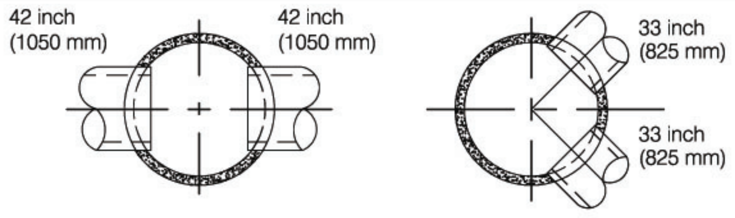
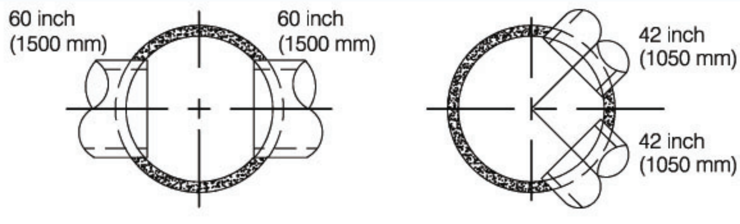
Upper Chamber Diameter	Maximum Pipe Diameters for Straight Through and 90° Bends (Based on Concrete Pipe)
Inlet Stormceptor	 24 inch (600 mm) 24 inch (600 mm) 18 inch (450mm) 18 inch (450mm)
Inline Stormceptor	 42 inch (1050 mm) 42 inch (1050 mm) 33 inch (825 mm) 33 inch (825 mm)
Inline Stormceptor or Series Stormceptor	 60 inch (1500 mm) 60 inch (1500 mm) 42 inch (1050 mm) 42 inch (1050 mm)

Figure 5. Maximum pipe diameters for straight through and bend applications

*The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.

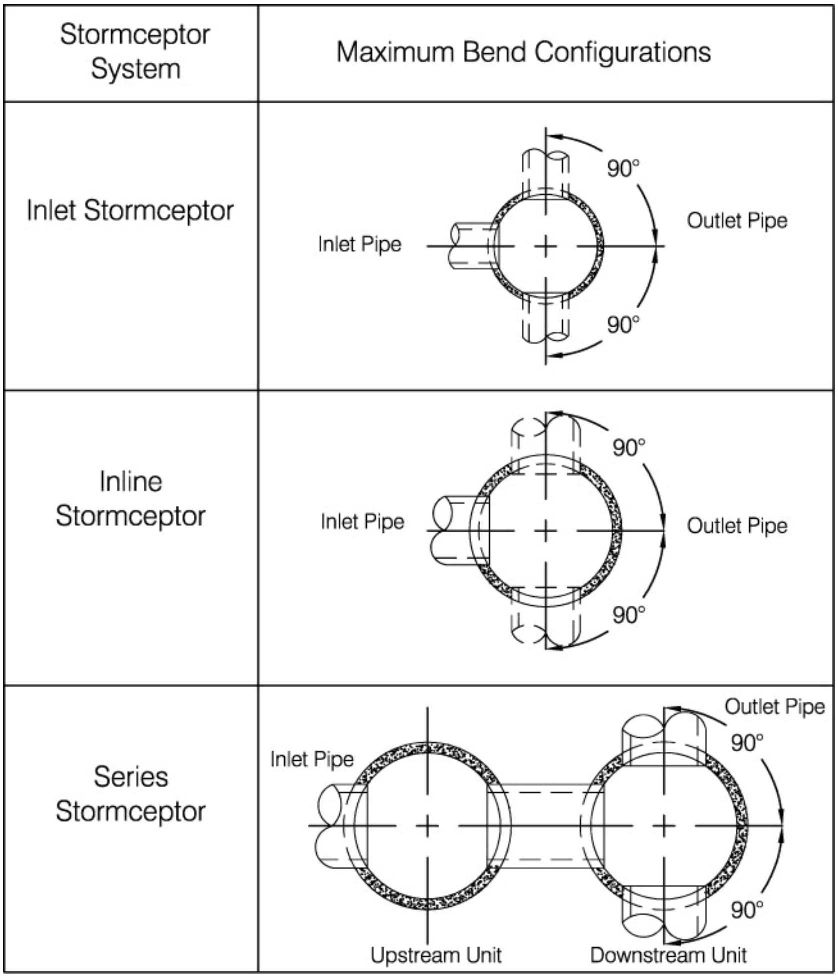


Figure 6. Maximum bend angles

7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life- cycle maintenance cost.

7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss = k*1.3v2/2g).

However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation

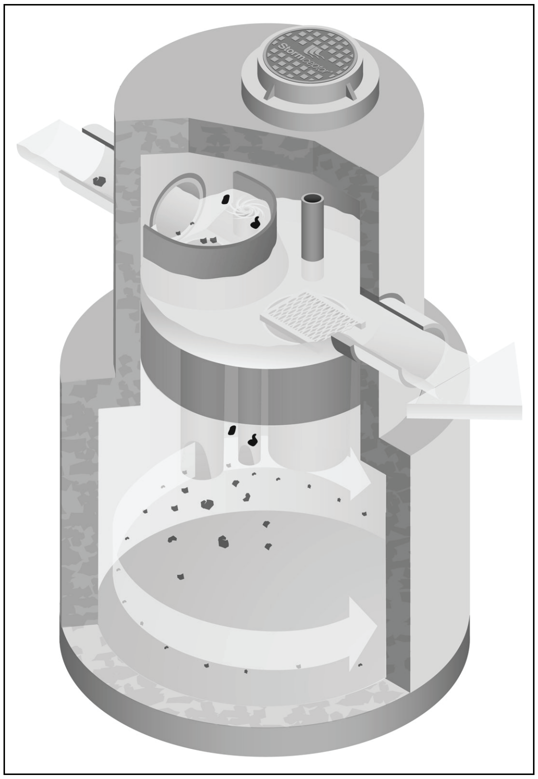


Figure 7. Submerged Stormceptor

8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between “approved alternatives”. The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system’s performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product’s performance claims.

8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system’s design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

12. Maintenance

12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well- established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

Table 4. Sediment Depths Indicating Required Servicing*

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit’s total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10 mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.

SUPPORT

Drawings and specifications are available at www.ContechES.com.

Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, and earth stabilization products. For information, visit www.ContechES.com or call 800.338.1122

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STORMTECH ISOLATOR ROW OPERATION & MAINTENANCE

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An ADS® company

Isolator® Row O&M Manual

THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160LP, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

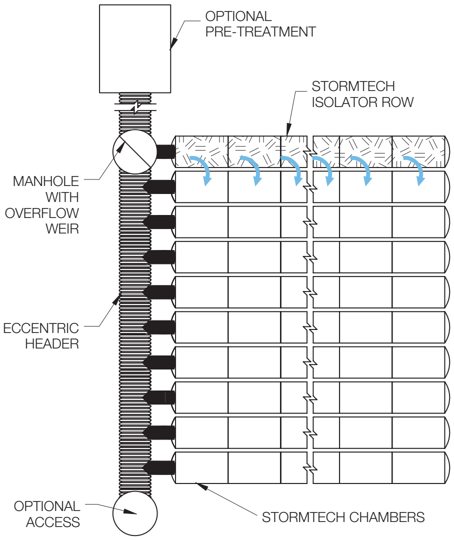
The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

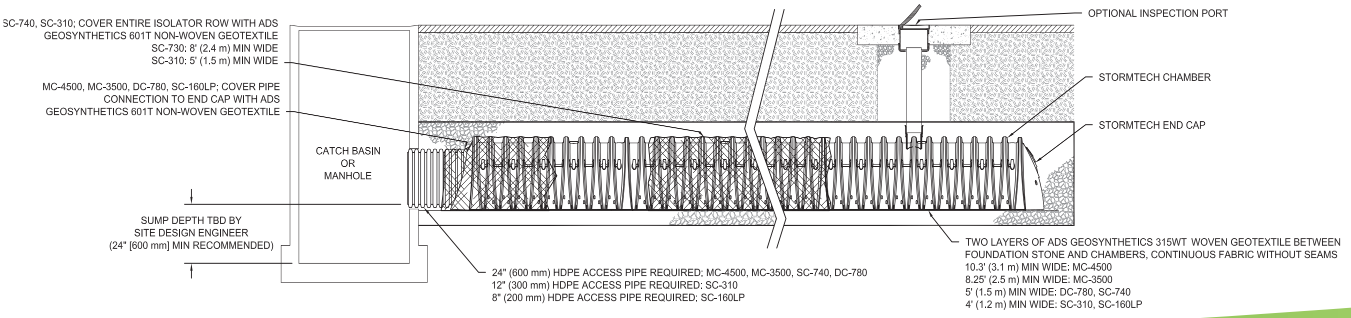
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1

Inspect Isolator Row for sediment.

- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    - 1. Mirrors on poles or cameras may be used to avoid a confined space entry
    - 2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2

Clean out Isolator Row using the JetVac process.

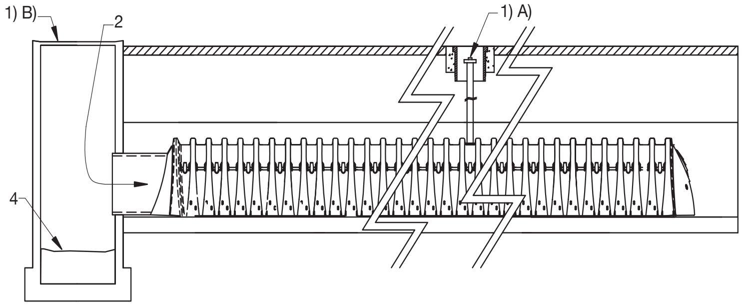
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

STEP 3

Replace all caps, lids and covers, record observations and actions.

STEP 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

StormTech Maintenance Log

Project Name:
Location:

StormTech
www.stormtech.com

	Stadia Rod Readings				
Date	**Fixed point to chamber bottom (1)**	**Fixed point to top of sediment (2)**	**Sediment Depth (1) - (2)**	**Observations / Actions**	**Inspector**

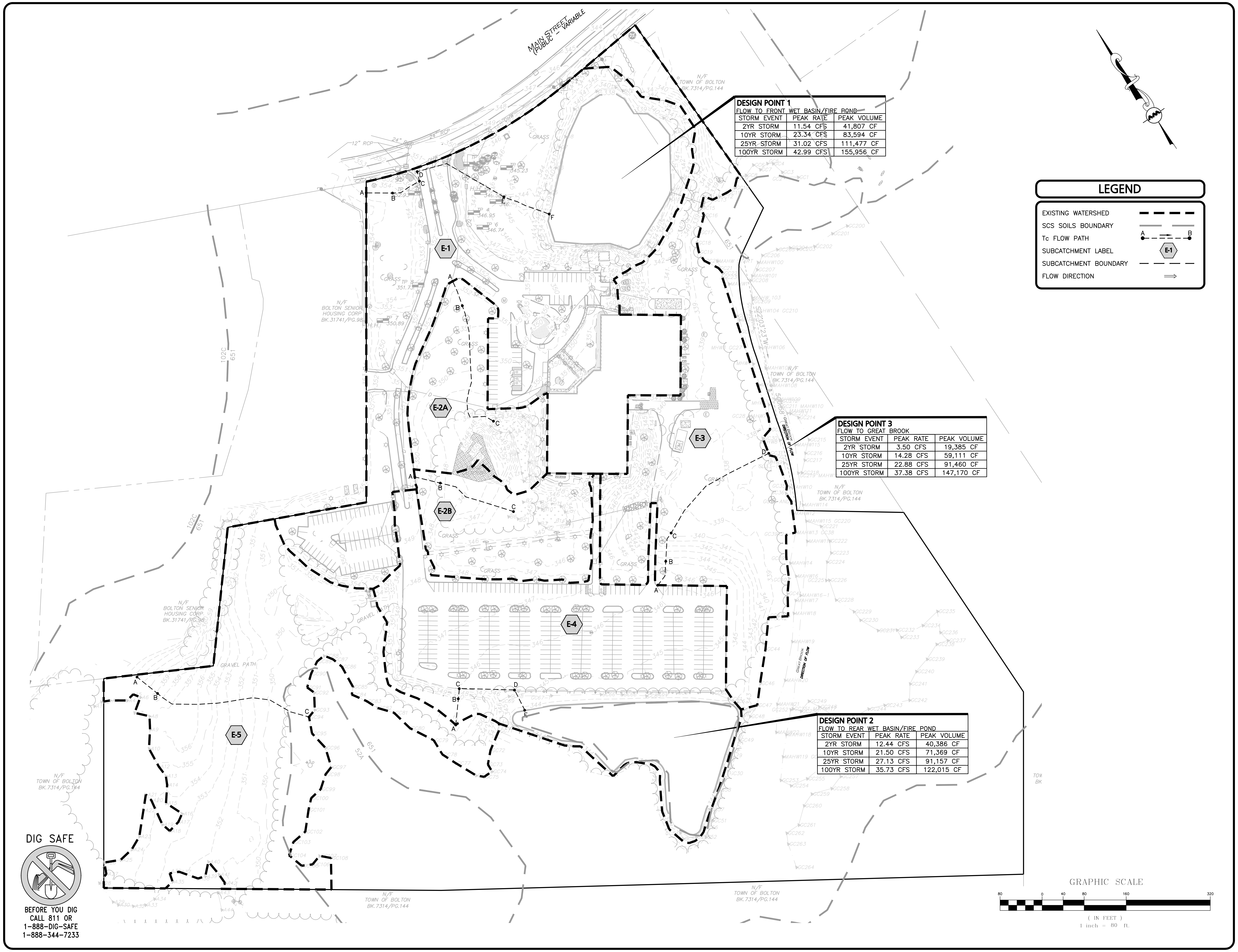
APPENDIX B SITE PLANS

SITE PLAN

APPENDIX J

WATERSHED PLANS

EXISTING WATERSHED PLAN EWS-1



DESIGN POINT 1
FLOW TO FRONT WET BASIN/FIRE POND

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	11.54 CFS	41,807 CF
10YR STORM	23.34 CFS	83,594 CF
25YR STORM	31.02 CFS	111,477 CF
100YR STORM	42.99 CFS	155,956 CF

DESIGN POINT 3
FLOW TO GREAT BROOK

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	3.50 CFS	19,385 CF
10YR STORM	14.28 CFS	59,111 CF
25YR STORM	22.88 CFS	91,460 CF
100YR STORM	37.38 CFS	147,170 CF

DESIGN POINT 2
FLOW TO REAR WET BASIN/FIRE POND

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	12.44 CFS	40,386 CF
10YR STORM	21.50 CFS	71,369 CF
25YR STORM	27.13 CFS	91,157 CF
100YR STORM	35.73 CFS	122,015 CF

LEGEND

EXISTING WATERSHED	▬ ▬ ▬
SCS SOILS BOUNDARY	— — —
Tc FLOW PATH	A •—• B
SUBCATCHMENT LABEL	E-1
SUBCATCHMENT BOUNDARY	– – –
FLOW DIRECTION	⇒

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1-888-344-7233

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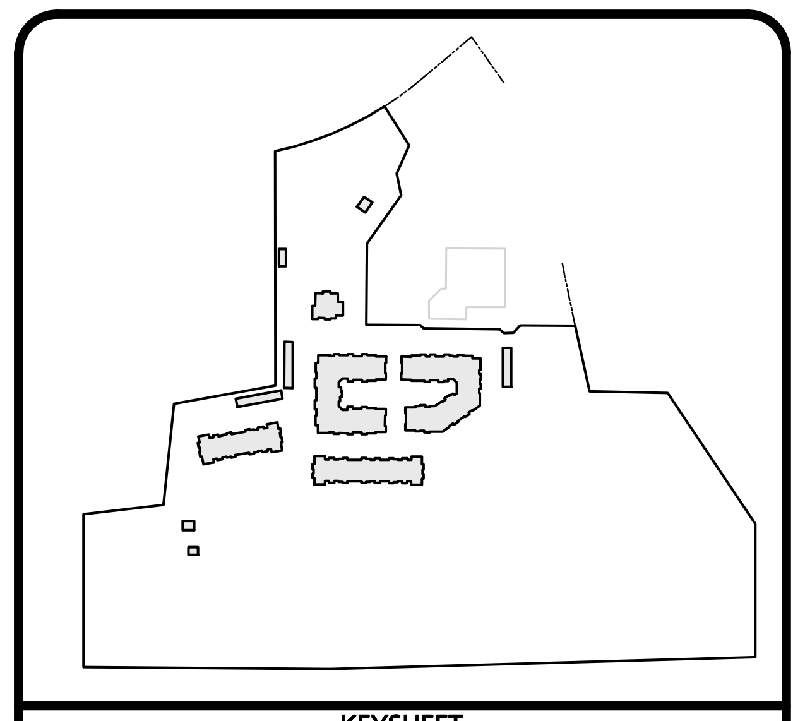

KEYSHEET

ISSUED FOR COMPREHENSIVE PERMIT APPLICATION
REV. 1- 04-12-2022

PHILIP L. CORDEIRO
CIVIL
NO. 47083

Philip L Cordeiro
c=US, o=Allen and Major Associates Inc.,
ou=A01410C00000175798BB4FD00002012, cn=Philip L Cordeiro
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PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

1	04-12-2022	PER REVIEW COMMENTS
REV	DATE	DESCRIPTION

APPLICANT\OWNER:
LIMITED DIVIDEND AFFILIATE OF
WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE, 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:
APPLICATION FOR
COMPREHENSIVE PERMIT ALTA
NASHOBA VALLEY
580 MAIN STREET BOLTON, MA

PROJECT NO.	1670-15	DATE:	09-10-2021
SCALE:	1" = 80'	DWG. NAME:	C1670-15
DESIGNED BY:	PGM	CHECKED BY:	PLC

PREPARED BY:

ALLEN & MAJOR
ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com

10 MAIN STREET
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WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

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DRAWING TITLE:	SHEET No.
EXISTING WATERSHED PLAN	EWS-1

PROPOSED WATERSHED PLAN – PWS-1

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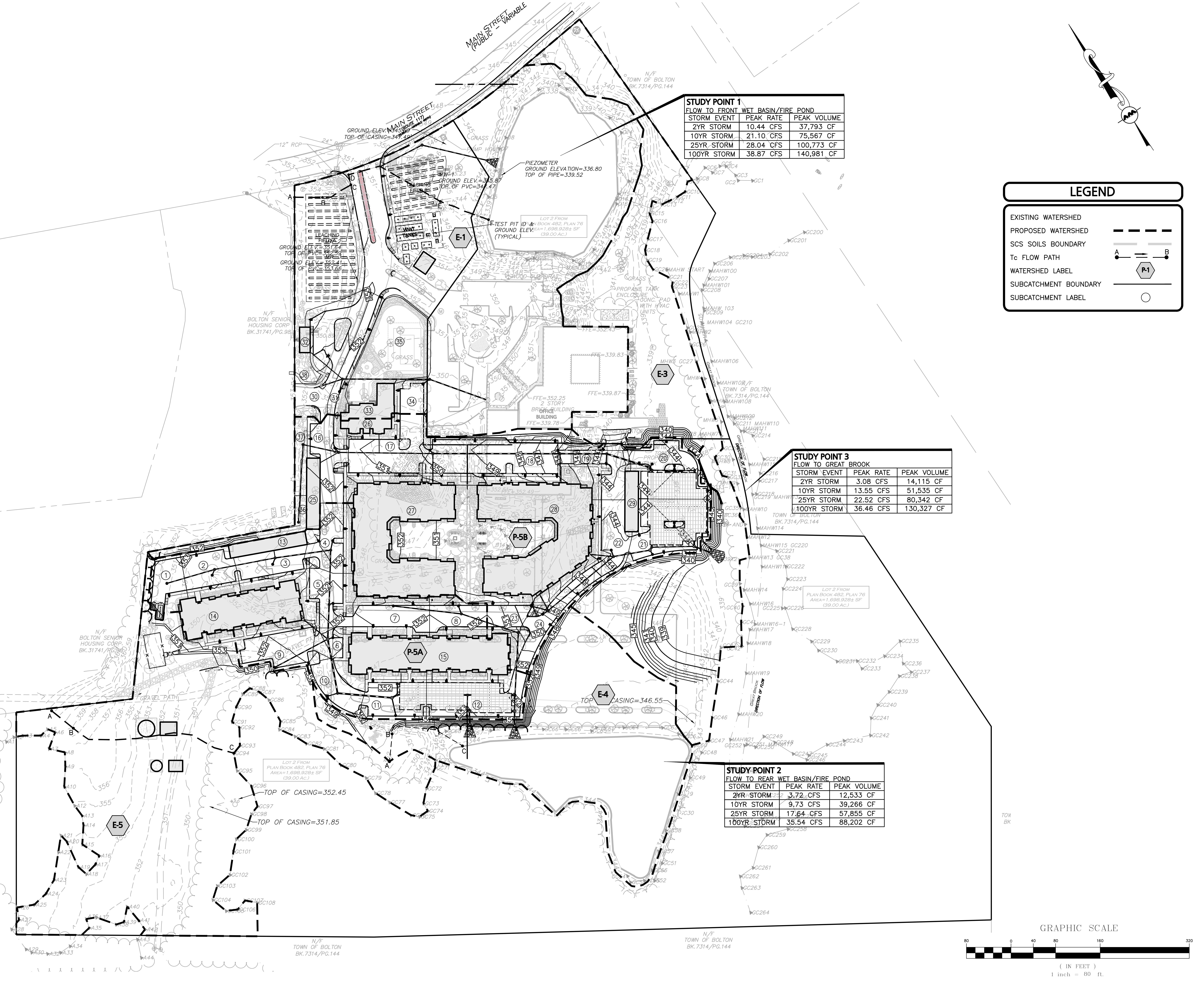

STUDY POINT 1
FLOW TO FRONT WET BASIN/FIRE POND

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	10.44 CFS	37,793 CF
10YR STORM	21.10 CFS	75,567 CF
25YR STORM	28.04 CFS	100,773 CF
100YR STORM	38.87 CFS	140,981 CF

STUDY POINT 3
FLOW TO GREAT BROOK

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	3.08 CFS	14,115 CF
10YR STORM	13.55 CFS	51,535 CF
25YR STORM	22.52 CFS	80,342 CF
100YR STORM	36.46 CFS	130,327 CF

STUDY POINT 2
FLOW TO REAR WET BASIN/FIRE POND

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	3.72 CFS	12,533 CF
10YR STORM	9.73 CFS	39,266 CF
25YR STORM	17.64 CFS	57,855 CF
100YR STORM	35.54 CFS	88,202 CF

LEGEND

EXISTING WATERSHED	
PROPOSED WATERSHED	▬ ▬ ▬ ▬
SCS SOILS BOUNDARY	▬ ▬
Tc FLOW PATH	A ●— → —● B
WATERSHED LABEL	P-1
SUBCATCHMENT BOUNDARY	———
SUBCATCHMENT LABEL	○

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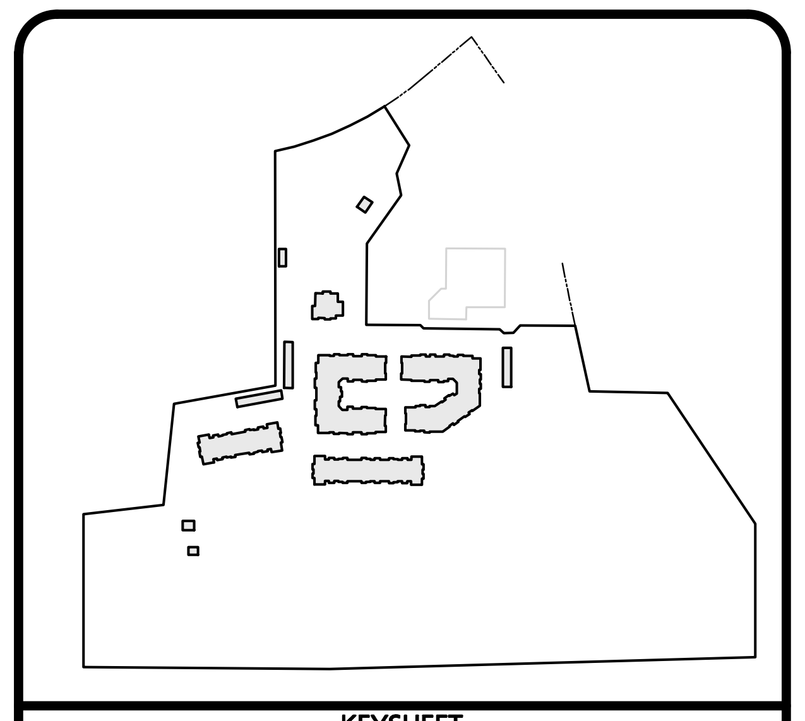
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ou=A01410C00000175798BB4F D00002012, cn=Philip L Cordeiro
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PREPARED BY:
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FAX: (508) 923-6309
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:
PROPOSED WATERSHED PLAN

SHEET No.
PWS-1

Horsley Witten Group
Sustainable Environmental Solutions
112 Water Street • 6th Floor • Boston, MA 02109
857-263-8193 • horsleywitten.com

April 20, 2022

Ms. Valerie Oorthuys, Town Planner
Bolton Town Hall
663 Main Street
Bolton, MA 01740

Re: Second Stormwater Technical Peer Review
Comprehensive Permit Application – ALTA Nashoba Valley
580 Main Street, Bolton MA

Dear Ms. Oorthuys:

The Horsley Witten Group (HW) is pleased to provide the Bolton Zoning Board of Appeals (ZBA) with this letter report summarizing our second technical peer review of the multi-family residential development proposed at 580 Main Street in Bolton, MA (Assessor's Map 4C Lot 24). Allen & Major Associates, Inc. has prepared the Comprehensive Permit plan set and Project Narrative & Drainage Report on behalf of Limited Dividend Affiliate of WP East Acquisition, LLC (Applicant). The proposed development, submitted in accordance with Massachusetts General Law Chapter 40B, Section 20-23, includes four (4) three-story residential buildings (229 units), a clubhouse, a mail center, and access road, 382 parking spaces and supporting infrastructure. The project includes private on-site wells for water supply, and a private on-site wastewater treatment system.

The subject property contains approximately 39 acres of land and is the current location of the Bolton Office Park, which will be modified under a separate application to allow for the proposed development. The subject property is proposed to be divided into two parcels: Lot 1 will be created for the modified Bolton Office Park, and Lot 2 (comprised of 32.4 acres) will be created for the proposed residential development. The existing access driveway into the site will be preserved and will provide access for the proposed development, the existing senior housing facility, and the existing office building. Located within the Limited Business (LB) Zoning District and adjacent to the Residential Zoning District, the 39-acre parcel contains several resource areas including Bordering Vegetated Wetlands (BVW), Isolated Vegetated Wetlands (IVW), Riverfront Area, and Bordering Land Subject to Flooding (BLSF). HW understands that the Applicant will be required to file a Notice of Intent (NOI) with the Bolton Conservation Commission for work proposed within these resource areas as well as the wetland buffer zones.

Documents Reviewed

HW has received the following documents in response to our initial review dated February 4, 2022:

- Response to Peer Review Comments letter, prepared by Allen & Major Associates, Inc., dated April 12, 2022, (142 pages) including attachments:
    - Hantush Groundwater Mounding Spreadsheets
    - Appendix G – HydroCAD
    - Appendix I – Operation & Maintenance Plan
        - Appendix A – Supplement Information
        - Appendix B – Site Plan (dated 4/12/22)
    - Appendix J – Watershed Plans

- Plan Set entitled “Application for Comprehensive Permit, Alta Nashoba Valley, 580 Main Street, Bolton, MA”, prepared by Allen & Major Associates, Inc., and Market Square Architects, dated September 10, 2021, revised through April 12, 2022, which includes:

Title Sheet	
Existing Conditions	V-101 – V-104
Notes & Abbreviations	C-001 – C-002
Conceptual Property Line Modification	C-003
Erosion Control Plan	C-100
Overall Layout and Materials Plan	C-101
Layout and Materials Plan	C-102 – C-104
Overall Grading and Drainage Plan	C-105
Grading & Drainage Plan	C-106 – C-108
Overall Utilities Plan	C-109
Utilities Plan	C-110 – C-112
Details	C-501 – C-507
Vehicle Movement Plan	C-601
Service/Delivery Vehicle Movement Plan	C-602
Landscape Plan (by Grady Consulting, LLC)	1
Arch Plans – Building 1	B1.A1.01 – B1.A2.00
Arch Plans – Building 2	B2.A1.01 – B2.A2.00
Arch Plans – Building 3	B3.A1.01 – B3.A2.00
Arch Plans – Building 4	B4.A1.01 – B4.A2.00
Arch Plans – Clubhouse	CH.A1.01 – CH.A2.00
Arch Plans – Garages	GA.A1.01 – GC.A2.01
Arch Plans – Mail and Parcel	MP.A1.01 – MP.A2.01

In addition to the materials above, HW reviewed relevant source data from MassGIS to better understand site constraints and context.

This second peer review dated April 20, 2022 does not include the Wetlands Resources portion. The wetlands review will be submitted at a later date.

Stormwater Review

The proposed stormwater management design includes a closed drainage system consisting of deep sump hooded catch basins, drain manholes, and proprietary treatment units, and two (2) subsurface infiltration chamber systems. There are two existing stormwater wet basins on the property which also serve as fire ponds, and these will be preserved. The proposed disturbance is greater than one acre and a portion of the work is within the 100-foot buffer zone of a BVW, Riverfront Area associated with Great Brook, and Bordering Land Subject to Flooding. HW based our review on the Massachusetts Stormwater Handbook (MSH) dated February 2008 which includes ten stormwater performance standards that apply to the proposed project, the Massachusetts Wetlands Protection Act (310 CMR 10.00), and standard engineering practice.

According to the MSH, the project is considered to be a mix of redevelopment and new development due to the existing office building, parking lots and maintained landscape area currently occupying most of the project area. The Applicant has explained that the front portion of the project area is being considered redevelopment while the remainder of the project was designed as new development. HW agrees with the Applicant’s designations, which are consistent with the intent of the MSH. The new development portion(s) must fully comply with the Stormwater Standards, while the redevelopment portion is only required to comply with certain standards to the maximum extent practicable. Further information on the redevelopment requirements can be found in the discussion of Standard 7 below.

After reviewing the documents listed above, HW offers the following comments, which are presented in accordance with the ten Massachusetts Stormwater Standards:

1. ***Standard 1*** *states that no new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands of the Commonwealth.*

    a) The project includes two new outfalls for each subsurface infiltration system, which will discharge treated stormwater at stabilized outlets protected by riprap energy dissipators as detailed on Sheet C-503. The outlets for Subsurface Infiltration System 1 discharge treated stormwater to the south, into the BVW at the rear of the site. The outlets for Subsurface Infiltration System 2 discharge treated stormwater to the east toward Great Brook and the adjacent BVW. HW notes that the riprap energy dissipators do not appear to be drawn to scale on the Grading & Drainage Plans and recommends that the Applicant revise them for consistency with the detail on Sheet C-503.

    April 20, 2022: The Applicant has revised the scale of the riprap aprons as suggested. HW has no further comment.

    b) It does appear that both systems are discharging within feet of the edge of the adjacent BVWs. HW recommends that if feasible the Applicant pull back the outfalls to respect the local 25-foot buffer zone. It is not clear why the Applicant has chosen to create a parking lot on the east side of the site within an existing grassed area so close to the wetland and in turn remove an existing parking lot that is further from the wetland.

    April 20, 2022: The Applicant has clarified that the parking area has been relocated because of the proposed well and the state regulations. Furthermore, the Applicant has pulled the discharge point for Infiltration System 2 to outside of the 25-foot buffer zone. The riprap aprons for Infiltration System 1 are located within the adjacent wetland and considered fill. The approximately 400 sf of fill will require an Order of Conditions from the Bolton Conservation Commission. HW recommends that the ZBA consider as a Condition of Approval receipt of an Order

of Conditions from the Bolton Conservation Commission allowing the riprap fill material in the resource area.

c) HW further recommends that the Applicant limit the area of disturbance on the south side of the project area to the edge of the existing parking lot.

April 20, 2022: The Applicant stated that it believes that the work on the south side of the project can be completed without degradation of the surrounding area. As noted above, HW recommends that the ZBA require receipt of an Order of Conditions allowing the work within 25 feet of the resource area. HW notes that the resource area to the south of Infiltration System 1 was previously used as a fire pond, the Applicant intends to allow the pond to function as a wetland and it will no longer be used as a fire pond. HW has no further comment.

d) The existing outfall location at the northern BVW at the front of the site will be maintained, which will receive runoff from the portion of the site being considered “redevelopment” as it relates to the MSH. The first 150 feet ± of the existing access drive will be preserved, including the drainage infrastructure which captures and conveys runoff to the northern BVW. Further discussion of the redevelopment aspects can be found under Standard 7.

April 20, 2022: HW has no further comment.

2. ***Standard 2*** *requires that the stormwater management systems be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*

a) The Applicant provided a hydrologic analysis for the 2-year, 10-year, 25-year, and 100-year storm events, under both Existing and Proposed Conditions. The precipitation rates utilized were obtained from the NOAA Atlas 14 database for the Bolton area, which is currently the local industry standard. HW reviewed all components of the hydrologic analysis, which include Existing & Proposed Watershed Plans, Existing & Proposed HydroCAD models, and a Narrative summary of the hydrologic analysis.

The proposed subsurface infiltration systems were sized appropriately, such that the peak discharge rates under Proposed Conditions do not exceed those under Existing Conditions for all storm events analyzed. Additionally, the Applicant has documented that total runoff volumes are decreased in the Proposed Condition for all storm events.

April 20, 2022: The Applicant has revised the HydroCAD model and has provided the updated information and Table illustrating that the pre-development peak flows and volumes will be reduced under post-development conditions. HW has no further comment.

b) There is a minor discrepancy between the total watershed areas reported in the Existing and Proposed models. HW recommends that the Applicant revise the models as necessary to ensure the total areas match.

April 20, 2022: The Applicant has revised the HydroCAD model and confirmed that the pre-development and post-development watershed areas are equivalent. HW has no further comment.

c) The Applicant has chosen to include two separate areas within Subcatchment E-3, both technically are tributary to Great Brook, however one side flows into a large wetland before reaching Great Brook. HW recommends that the Applicant separate these two areas of Subcatchment E-3 and revise the HydroCAD model accordingly.

April 20, 2022: The Applicant has revised the HydroCAD model as suggested. HW has no further comment.

d) The peak discharge rates and volumes are controlled by the use of two outlet control structures for each subsurface infiltration system, which are located within the pavement areas. These outlet control structures discharge treated stormwater to the stabilized outlets described under Standard 1. HW notes that the inside diameter of the outlet control structures is listed as 4 feet on the detail on Sheet C-506, but the plan view appears to depict a larger diameter to accommodate the inlet and outlet pipe connections. HW recommends that the Applicant verify the required diameter of the outlet structures (and any other oversized manholes) and update the plans and/or details accordingly. As noted previously HW recommends that the outfalls be pulled further away from the edge of the adjacent wetlands.

April 20, 2022: The Applicant has adjusted several proposed manhole structures to be 5-foot diameter. HW notes that the information associated with the outlet control structures for Subsurface Infiltration System 2 is difficult to read. HW has no further comment.

e) Due to the large size of the subsurface infiltration systems, the Applicant included pipe manifolds on either end to facilitate even distribution of stormwater during large storm events. The manifold elevation is set approximately 12 inches above the primary inlet to the isolator row, which means that stormwater is forced to first enter the isolator row for treatment and will only enter the manifold pipe when the depth exceeds 12 inches. HW finds this to be an acceptable design but recommends that the Applicant adds text to the inlet manhole call-outs to clarify which pipe is meant to be higher.

April 20, 2022: The Applicant has added the clarification to the Grading and Drainage Plans as suggested. HW has no further comment.

f) The Applicant provided pipe sizing calculations for both the 25-year and 100-year storm events using the Rational Method, which document that all pipes within the closed drainage system are sized properly. No further action required.

April 20, 2022: HW has no further comment.

*3. **Standard 3** requires that the annual recharge from the post-development site approximate the annual recharge from pre-development conditions based on soil type.*

a) The Applicant provides calculations for the required recharge volume using both the Hydrologic Soil Group (HSG B=0.35”) and the MA MS4 General Permit requirement of 1” rainfall over the total post-development impervious area. Based on the 1” rainfall depth over 377,668 square feet (SF) of impervious area, the required recharge volume is 31,472 cubic feet (CF). The Applicant utilized the Simple Dynamic Method for sizing the two subsurface infiltration systems to retain/infiltrate the required recharge volume. HW notes that there are minor discrepancies in the impervious area number used, between the Narrative, the Post-Development HydroCAD model and the Simple Dynamic Method HydroCAD model. These discrepancies should be rectified by the Applicant based on the final impervious area calculations.

HW further notes that the total recharge volume presented in the Simple Dynamic Method calculation is 30,755 CF, which is less than the required 31,472 CF. It is also noted that the Simple Dynamic Method HydroCAD model shows a minor amount of additional storage above the peak elevation and below the low outlets, which effectively adds storage volume to the numbers reported. HW recommends that the Applicant revisit this calculation or provide further explanation of its design methodology.

April 20, 2022: The Applicant has adjusted the total impervious area and revised the recharge calculations. It appears that the Applicant is providing the required recharge volume. HW has no further comment.

b) The Applicant included soil testing results in the application package, but the test locations are not depicted on the plans. HW notes that small symbols appear on the grading and drainage plans which appear to indicate the locations of TP-11,12 & 14, but the corresponding test pit logs were not found in the application package. In accordance with Volume 2, Chapter 2, page 97 of the MSH the Applicant is required to conduct a minimum of two test pits within each infiltration system. HW recommends that the Applicant revisit the soil testing information to ensure that all available test results are adequately documented on the plans and report(s).

April 20, 2022: The Applicant has clarified the location of the four test pits and provided the test pit logs on Sheet C-107. HW has no further comment.

c) In accordance with the previous comment, HW is unable to confirm the soil testing information used in the design of the subsurface infiltration systems. However, both systems are located within a “fill” area, which will likely provide adequate separation to the seasonal high groundwater table. Based on the narrative description, the infiltration rates used seem appropriate, but will need to be confirmed based on HW’s review of the additional soil testing information to be submitted by the Applicant.

April 20, 2022: The Applicant has provided the test pits logs as noted above. The exfiltration rates utilized appear reasonable for the soil texture identified below the systems. The bottoms of the subsurface infiltration systems are located two feet above the ESHGW table. The Applicant has provided the groundwater mounding analysis and has clearly detailed the various variables utilized for the Hantush calculation. As designed the groundwater mound should not rise into the subsurface chambers. HW has no further comment.

d) HW recommends that the Applicant modify the construction detail for the subsurface infiltration systems to clearly state which existing soil layers must be removed prior to installation.

April 20, 2022: The Applicant has added a note regarding the removal of fill material beneath the Stormtech Chamber System on sheet C-505. HW has no further comment.

4. ***Standard 4*** *requires that the stormwater system be designed to remove 80% Total Suspended Solids (TSS) and to treat 1-inch of volume from the impervious area for water quality. The drainage system must also provide at least 44% TSS removal for pre-treatment of runoff from paved surfaces prior to entering any infiltration practices.*

   a) The Applicant has provided the required water quality calculations to verify compliance with Standard 4 on pages 4-4 through 4-6 of the Project Narrative & Drainage Report. The stormwater treatment train included deep-sump hooded catch basins, proprietary water quality structures (Contech CDS, Cascade, and Stormceptors), and subsurface infiltration systems (Stormtech SC-740 chambers) equipped with isolator rows. HW finds the selected best management practices (BMPs) and associated calculations reasonable and appropriate for the project. No further action required.

      April 20, 2022: HW has no further comment.

   b) HW notes that the Applicant has proposed a Contech CDS unit within the parking lot of the adjacent office building property, which treats runoff from the adjacent proposed pavement areas. HW finds this to be a reasonable design approach, but notes that an easement would likely need to be secured for future maintenance of the structure.

      April 20, 2022: The Applicant is in the process of developing the applicable easement.

      The Applicant appears to comply with Standard 4.

      April 20, 2022: HW has no further comment.

5. ***Standard 5*** *relates to projects with a Land Use of Higher Potential Pollutant Loads (LUHPPL).*

   a) The Applicant explains that the proposed project is considered a LUHPPL because the parking area is “high intensity” (greater than 1,000 trips per day). As required, the Applicant documents that the stormwater management system was designed using the 1” Water Quality Volume and that proprietary water quality structures will provide greater than 44% pretreatment prior to conveyance to the subsurface infiltration systems. No further action required.

      The Applicant appears to comply with standard 5.

      April 20, 2022: HW has no further comment.

6. ***Standard 6*** *relates to projects with stormwater discharging into a critical area, a Zone II or an Interim Wellhead Protection Area of a public water supply. These discharges require the use of the specific source control and pollution prevention measures and the specific structure stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the MSH.*

   a) Standard 6 applies because the project development is located adjacent to several Zone I’s and within the Interim Wellhead Protection Area. The stormwater treatment train and infiltration practices described previously in this letter are suitable for use in these areas. No further action required.

      April 20, 2022: HW has no further comment.

b) The Applicant states that the existing southerly wet basin/fire pond will be located within a Zone I to the proposed drinking water supply well. As a result, this pond is no longer considered as part of the stormwater management system but will continue to perform its function as a fire pond and receiving water body for the outlets from proposed subsurface infiltration system 1. Based upon the proposed stormwater design, HW finds this to be a reasonable assessment. No further action required.

April 20, 2022: HW has no further comment.

7. ***Standard 7*** *relates to projects considered redevelopment. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.*

a) The proposed development is considered a mix of redevelopment and new development. The main access road and existing driveway to the office building parking lot will generally be preserved, with proposed pavement resurfacing, sidewalks, and landscaping improvements. The redevelopment portion of the project also includes runoff from the proposed clubhouse roof and associated parking lot and amenity space. These flows will be treated by a proposed CDS unit prior to draining toward the front wet basin/fire pond. The overall impervious area draining to the front wet basin/fire pond will be reduced, which satisfies the requirement for the redevelopment classification.

April 20, 2022: HW has no further comment.

b) HW notes that there are two existing catch basins at the existing driveway entrance off Main Street, with the westerly catch basin flowing through the easterly catch basin prior to discharging toward the existing BVW. The existing discharge pipe is a 12-inch reinforced concrete pipe which runs underneath proposed Leaching Field B. HW recommends that the Applicant review the drainpipe network in this area to confirm that it complies with Title 5, and also whether any drainage improvements could be made to provide additional treatment for this runoff from the high-intensity driveway entrance, prior to discharging into the existing BVW.

April 20, 2022: The Applicant has relocated the drainage pipe to avoid the leaching field. HW has no further comment.

8. ***Standard 8*** *requires a plan to control construction related impacts including erosion, sedimentation or other pollutant sources.*

a) The Applicant prepared an Erosion Control Plan (Sheet C-100) and has also included Erosion Control Notes on Sheet C-002 and corresponding details on Sheet C-501. The design calls for “silt fence & tubular barrier” around the limit of work where warranted and shows the location of a stabilized construction entrance and proper protection for the existing catch basins on site. These erosion control measures, and associated documentation are consistent with standard engineering practice. The Applicant also notes that the project will require the preparation of a Stormwater Pollution Prevention Plan (SWPPP) prior to construction, which is a requirement of the EPA National Pollutant Discharge Elimination System (NPDES) Construction General Permit for construction sites which disturb more than one acre of land. HW recommends that the Town require receipt of the SWPPP a minimum of 14 days prior to land disturbance.

April 20, 2022: HW recommends that the Town require receipt of the SWPPP a minimum of 14 days prior to land disturbance. HW has no further comment.

b) HW recommends that the Applicant confirm that the proposed grading and erosion control barrier along the Great Brook corridor can be constructed without disturbing the existing native trees or shrubs. There is a minor adjustment to the treeline in the proposed conditions, but it is unclear what type of vegetation will be affected. HW further recommends that trees greater than 10-inch diameter within the work area be located on the existing conditions plan, if not already shown, and recommends that the Applicant note any trees that will be removed because of the proposed development. It appears that the Applicant has chosen to protect the trees that are located within the islands of the existing southern parking lot. The parking lot is proposed to be removed and a meadow created with a number of the trees within the parking lot to remain.

April 20, 2022: HW defers to the ZBA the needed to understand the quantity and size of trees proposed to be removed for this development.

c) HW recommends adding construction fence surrounding the infiltration areas during construction to protect from compaction due to heavy equipment.

April 20, 2022: The Applicant has added a note to Sheet C-100 as suggested. HW has no further comment.

d) A note on the Sheet C-002 describes basic instructions for dewatering. If the Applicant anticipates dewatering to be required, HW recommends that a detail for dewatering be provided along with proposed locations.

April 20, 2022: The Applicant has added a note requiring the contractor to provide a dewatering plan to the Town for review if determined to be needed. HW has no objection to this suggestion.

9. ***Standard 9*** *requires a Long-Term Operation and Maintenance (O&M) Plan be provided.*

The Applicant has provided an Operation & Maintenance Plan for this project, prepared by Allen & Major Associates, Inc. and dated September 10, 2021. HW has the following comments:

a) Under the “Structural Pretreatment BMPs” section, the reference to the various Contech water quality structures does not match the design plans. HW recommends that the Applicant revisit this section to clearly state the different types of structures and ensure that the corresponding manufacturer O&M Plans are included for each structure. References to cast iron hoods and deep sump catch basins should also be removed from this section as appropriate.

April 20, 2022: The Applicant has revised the O&M Plan as suggested. HW has no further comment.

b) The “Subsurface Structures” section should be modified to include provisions for inspecting the systems at certain intervals following large rain events to ensure they are properly draining. HW notes that a detail is included for inspection ports, but their locations are not identified on the plan view. HW recommends that the Applicant identify the proposed inspection port locations on the plans, which are preferably located in drive aisles rather than parking spaces to facilitate access. A note should also be added for the inspection of outlet control structures on an annual basis.

April 20, 2022: The Applicant has revised the O&M Plan as suggested. HW has no further comment.

c) The Applicant included plan sheet O&M 1 entitled “Operation & Maintenance Plan” which depicts the key elements of the stormwater management system for reference during long term maintenance activities. HW recommends that all water quality structure labels are updated to call out the specific Contech products being used, since each has individual O&M requirements. It may also be appropriate to coordinate further with Contech to see if future maintenance could be simplified by reducing the number of different Contech products being used in the design.

April 20, 2022: The Applicant has revised the O&M Plan as suggested. HW has no further comment.

d) Sheet O&M 1 should be updated to call out the inlet and outlet locations for both of the existing wet basins/fire ponds, so that they can be regularly inspected for signs of erosion or blockage. Even though the rear wet basin is no longer considered part of the project’s drainage system, it is still important that it is inspected regularly.

April 20, 2022: The Applicant has revised the O&M Plan as suggested. HW has no further comment.

10. ***Standard 10** requires an Illicit Discharge Compliance Statement be provided.*

a) To comply with Standard 10 the Applicant states that an Illicit Discharge Compliance Statement will be provided to the Town prior to the discharge of stormwater to the post-construction stormwater BMPs and prior to the issuance of a Certificate of Compliance. The Town may choose to require receipt of this statement as a condition of approval.

April 20, 2022: The Town may choose to require receipt of this statement as a condition of approval.

General Technical Review

11. *Water Supply Comments:*

a) The proposed development will be serviced by a combination of new and existing private wells on the subject property. Due to the intensity of use, this is considered a Public Water System (PWS), and the Applicant states that all permitting will be done through MassDEP in accordance with 310 CMR 22 and MassDEP’s Guidelines for Public Water Systems. A waiver has been requested from local permitting through the Bolton Board of Health. HW has no opposition to this waiver request, but defers to the appropriate Town of Bolton staff, Boards and Commissions.

April 20, 2022: HW has no further comment.

b) The Public Water System wells generate a Zone I radius of protection and an Interim Wellhead Protection Area (IWPA), which are both dependent on the approved yield/volume of each well. The Zone I radii for the existing and proposed well(s) are depicted on the Site Development Plans. The Applicant states that the proposed well is only shown conceptually and that final layout is subject to MassDEP approvals. The Applicant further states that the drilling and installation of all private wells will be coordinated with the Bolton Conservation Commission and Board of Health.

April 20, 2022: The Applicant is coordinating with the Board of Health and MassDEP. HW has no further comment.

c) The design of the Public Water System is being performed by Onsite Engineering, Inc. and a design summary memo can be found in Appendix C of the Project Narrative which provides details about the existing and proposed wells along with a description of water treatment, distribution and fire protection.

April 20, 2022: The Applicant has provided a narrative in it April 12, 2022 response letter explaining that the wastewater and water supply systems proposed are permitted on the state level and therefore no waivers from local regulations are needed. HW concurs with the Applicant's statement.

12. *Wastewater Disposal Comments:*

a) The project will include a new on-site wastewater treatment and disposal system to serve both the proposed residential development and the modified office building. The Applicant states that the system will be designed by Onsite Engineering, Inc. in accordance with MassDEP *Guidelines for the Design, Construction, Operation and Maintenance of Small Treatment Facilities with Land Disposal*, revised July 2018, and that it is subject to a MassDEP Groundwater Discharge Permit subsequent to a hydrogeological evaluation approval process.

April 20, 2022: The Applicant has provided a narrative in it April 12, 2022 response letter explaining that the wastewater and water supply systems proposed are permitted on the state level and therefore no waivers from local regulations are needed. HW concurs with the Applicant's statement.

b) The design flow for the proposed residential development is 43,440 gallons per day (GPD) based on 394 total bedrooms (at 110 GPD/bedroom) along with a 100 GPD allowance for the leasing office space. Since the clubhouse and amenity space are restricted to only residents and their guests, there are no additional flows associated with those elements, as per MassDEP advisory opinions. HW agrees with this preliminary design flow calculation.

April 20, 2022: HW has no further comment.

c) The design flow for the modified office building is 4,688 GPD, which is based on a total floor area of 62,500 SF. Since the office building modifications will be carried out by others under a separate application, HW notes that the actual design flows may vary based on the final architectural plans.

April 20, 2022: HW has no further comment.

d) HW recommends that the existing leaching facility location be called out on the Existing Conditions Plans, and that the existing office building sewer service is depicted on the Utility Plans with connection to the proposed sewer.

April 20, 2022: The Applicant has added the existing leaching field to the existing Conditions Plan as well as the sewer service on the Utility Plan. HW has no further comment.

e) HW recommends that the proposed sewer manhole annotation is changed on the Utility Plans from PDMH to PSMH and that the Utility Legend is depicted on all Utility Plans.

April 20, 2022: The Applicant has revised the sewer manhole notations. HW has no further comment.

f) An existing drainpipe near the driveway entrance flows under the proposed leach field toward the wet basin/fire pond. HW notes that this pipe and other elements of the drainage system may need to be modified to comply with Title 5 requirements.

April 20, 2022: The Applicant has relocated the drainage pipe to avoid the leaching field. HW has no further comment.

13. *Additional Comments:*

a) There is a small dog park proposed to service the apartment buildings, which is shown to the west of Building 3. HW recommends that the Applicant confirm that the dog park size and shape shown are appropriate for the project, and that additional information is added, such as the surface materials, fence specifications, park amenities, drainage and means of disposal for both dog waste and regular trash/recycling. HW notes that the dog park is located outside of the Zone I boundary and outside of any jurisdictional areas under the Wetlands Protection Act, but it is within the Interim Wellhead Protection Area associated with the existing wells on the subject property.

April 20, 2022: The Applicant has noted that it will provide final design details to the Town for documentation purposes. The ZBA may choose to include receipt of these details prior to occupancy as a Condition of Approval.

b) HW recommends that the flow direction of Great Brook is added to the Site Development Plans.

April 20, 2022: The Applicant has added the flow direction of Great brook as requested. HW has no further comment.

c) A proposed maintenance gate for the existing well area is shown on the Site Development Plans, but the access drive linework appears to be missing. HW also advises the Applicant to consider whether any dedicated access is required for the new well location.

April 20, 2022: The Applicant has provided the access drive on Sheet C-104. HW has no further comment.

d) There is a large ledge outcrop located within and to the north of proposed Building 1 which will need to be entirely removed to accommodate the project, including subsurface elements such as the foundation and utilities. HW recommends that the Applicant provides a preliminary description of the proposed ledge removal method(s) being considered for the project, for review by applicable Town staff, Boards and Commissions.

April 20, 2022: The Applicant has stated in its response letter that the ledge may be removed by hoe ramming and/or controlled blasting. HW has no further comment.

14. *Waiver Requests:*

a) Applications for a Comprehensive Permit through the Zoning Board of Appeals requires an Applicant to comply with all local codes, ordinances, Bylaws, or regulations unless an exemption or variance is formally requested in the application or modification to the application. As described in detail in *Section 5.1* of the Project Narrative & Drainage Report, the Applicant is requesting waivers from the following local Bylaws, rules and regulations:

- Town of Bolton Bylaws (Zoning & Wetlands)
- Planning Board Rules & Regulations
- Conservation Commission Rules & Regulations
- Rules & Regulations of the Board of Health

April 20, 2022: HW has no further comment.

b) HW defers to the Bolton ZBA on the granting of these waivers, but notes that the proposed development project is still required to comply with all applicable regulations, permits and policies of the Commonwealth of Massachusetts. These include, but are not limited to, the Massachusetts Stormwater Handbook, the Wetlands Protection Act/Regulations, Title 5 of the State Environmental Code, MassDEP *Guidelines for the Design, Construction, Operation and Maintenance of Small Treatment Facilities with Land Disposal*, MassDEP Groundwater Discharge Permit, and MassDEP's Guidelines for Public Water Systems. As noted above HW recommends that the Applicant respect the local 25-foot no disturb zone to the adjacent BVWs surrounding the project site.

April 20, 2022: HW has no further comment.

Conclusions

HW is satisfied that the Applicant has adequately addressed our stormwater comments as well as our general technical review. We reserve further comment regarding the wetlands review. The Applicant is advised that provision of these comments does not relieve him/her of the responsibility to comply with all Commonwealth of Massachusetts laws, and federal regulations as applicable to this project. Please contact Janet Carter Bernardo at jbernardo@horsleywitten.com or at 508-833-6600 if you have any questions regarding these comments.

Sincerely,

Horsley Witten Group, Inc.

Janet Carter Bernardo

Janet Carter Bernardo, P.E.
Associate Principal

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