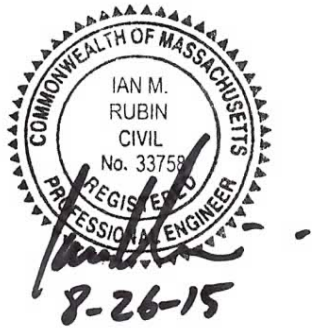
DRAINAGE REPORT

FOR

258 & 262 MAIN STREET
READING, MA



August 26, 2015

Prepared for:
READING CRE VENTURES, LLC
2 FARRWOOD DRIVE
ANDOVER, MASSACHUSETTS 01810

Prepared by:
MARKEY & RUBIN, INC.
360 MASSACHUSETTS AVENUE
ACTON, MASSACHUSETTS 01720

MARKEY & RUBIN, INC.
360 MASS. AVENUE, ACTON, MA 01720
PHONE: (978)264-4600

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MARKEY & RUBIN, INC.
360 MASS. AVENUE, ACTON, MA 01720
PHONE: (978)264-4600

1. DRAINAGE REPORT

1.1 Introduction

The purpose of these calculations is to show that with development there is no increase in peak runoff when comparing pre- vs. post-conditions.

1.2 Site Description

This project consists of two abutting parcels of land: 258 and 262 Main Street, Reading.

On 258 Main Street, the existing two-story building is unoccupied at this time but was used as a commercial building (retail) until fairly recently. The site has a paved entrance and a large parking lot extending behind the building. The building is situated quite high above the street in front. The center of the land is high and slopes down in all directions mostly towards the front and back. The building is supported by a retaining wall in the front and right hand side, when facing the building from the street.

On 262 Main Street, the existing ranch style building was also used for commercial purposes and is now unoccupied. Parking is in front with a driveway extending down the side of the building.

These two lots are to be combined with development, the new building to be a three story retail and office building with parking on the sides and to the rear of the building. The new parking will not extend as far in the rear as is currently.

From soil tests and borings, the site consists of glacial outwash, mostly sand and gravel below about 3-5 feet of fill. Groundwater is reported at depths of about 12-14 feet and refusal is at about 17-18 feet deep.

For design purposes, water table is designed at the elevation of 91. That is assuming 12 feet to groundwater from an elevation of 103.

The soils as referenced in National Resource Conservation Commission (NRCS) are Urban land - which have no specific rating. However, as mentioned above, the soils are glacial outwash or Group A soils for design purposes.

For infiltration rate, the Rawls Rates are used, i.e. for this is a A-soils, the rate is 8.27 in/hr .

1.3 Comparison of Pre- and Post-Development Areas

On the site as a whole, comparing pre-development to post-development, here are the areas in percentages:

Current Conditions	
Impervious Surface	53.9%
Lawn, Shrubs, Trees	46.1%

Proposed Conditions	
Impervious Surface	74.0%
Lawn, Shrubs, Trees	26.0%

1.4 Methods of Calculations

Calculations are based upon standard methodologies set forth in U.S. Soil Conservation Service TR-55 and TR-20 and performed by *HydroCAD Software*. More specifically, the rainfall is based upon a design storm in 24 hours, and a Type III Rainfall. The size of storm is as follows:

Storm Event	24-hr Precipitation
100-yr	6.6”
25-yr	5.4”
10-yr	4.5”
2-yr	3.2”

As in standard practice, the Antecedent Moisture Content (AMC) is assumed normal in the calculations, that being AMC 2.

Formulae Used:

Time of Concentration, $\mathbf{T_c}$, is calculated by summing different travel times, T_t, for each consecutive different type of flow from runoff. The types of flow in the design considered are as follows:

TR-55 Sheet Flow,

$$T_t = 0.007(nL)^{0.8} / (P_2^{0.5}.s^{0.4})$$

where:

T_t =Travel time [hours]
n = Manning's coefficient for sheet flow (See table)
L = Flow length [feet]
P_2 = 2-year, 24-hour rainfall [inches]
S = Land slope (along flow path) [ft/ft]

TR-55 Shallow Concentrated Flow,

$$T_t = L/V \text{ and } V = K_v.S^{1/2}$$

where:

V = Average velocity
K_v = Velocity factor
S = Land slope (along flow path) [rise/run]

and Channel Flow which is calculated using Manning's Equation.

The minimum Time of Concentration for a subcatchment is taken as 0.1 hrs as defined in TR-55.

The **amount of runoff** for a given storm event is determined by the SCS Runoff Equation is:

$$Q = (P-0.2S)^2/(P+0.8S) \text{ and } S = 1000/CN - 10,$$

where:

Q = Precipitation excess (runoff) [inches or mm]
P = Cumulative precipitation [inches or mm]
S = Potential maximum retention [inches]
CN = Curve number (TR-55)

1.5 Drainage Subcatchment Areas

For pre-development conditions, there are two subcatchment areas - one to the rear and right of the lot, and the other towards Main Street.

For Post-development conditions, there are four subcatchments - two the same as in pre-development conditions and two new catchment areas, those being catch basins feeding infiltration beds.

Here are the areas tabulated:

Pre-development Conditions

Existing Conditions				
	Sub 1	Sub 2	Totals	
Impervious	9264	7526	16790	53.9%
Brush	5300	9070	14370	46.1%
Totals	14564	16596	31160	100.0%

Post-development Conditions

Proposed Conditions						
	Sub 1	Sub 2	Sub 3	Sub 4	Totals	
Impervious	5378	14251	3437	0	23066	74.0%
Brush	1001	4774	27	2291	8093	26.0%
Total	6379	19025	3464	2291	31159	100.0%

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PHONE: (978)264-4600

1.6 Runoff Tabulated Results

To compare pre-development results to post development, we have subcatchments 1 and subcatchments 2 in both pre-and post-conditions. Subcatchments 3 and 4 in post-development conditions, infiltrate all runoff into the ground for storms up to 100-year design conditions.

		Pre	Post	Pre	Post
		2 yr		10 yr	
	Flow (cfs)	0.53	0.36	0.95	0.55
Sub 1	Vol. (af)	0.036	0.025	0.064	0.040
	Flow (cfs)	0.41	0.00	0.88	0.00
Sub 2	Vol. (af)	0.025	0.000	0.051	0.000

		Pre	Post	Pre	Post
		25 yr		100 yr	
	Flow (cfs)	1.24	0.69	1.65	0.87
Sub 1	Vol. (af)	0.085	0.051	0.113	0.065
	Flow (cfs)	1.23	0.00	1.74	0.02
Sub 2	Vol. (af)	0.071	0.001	0.100	0.003

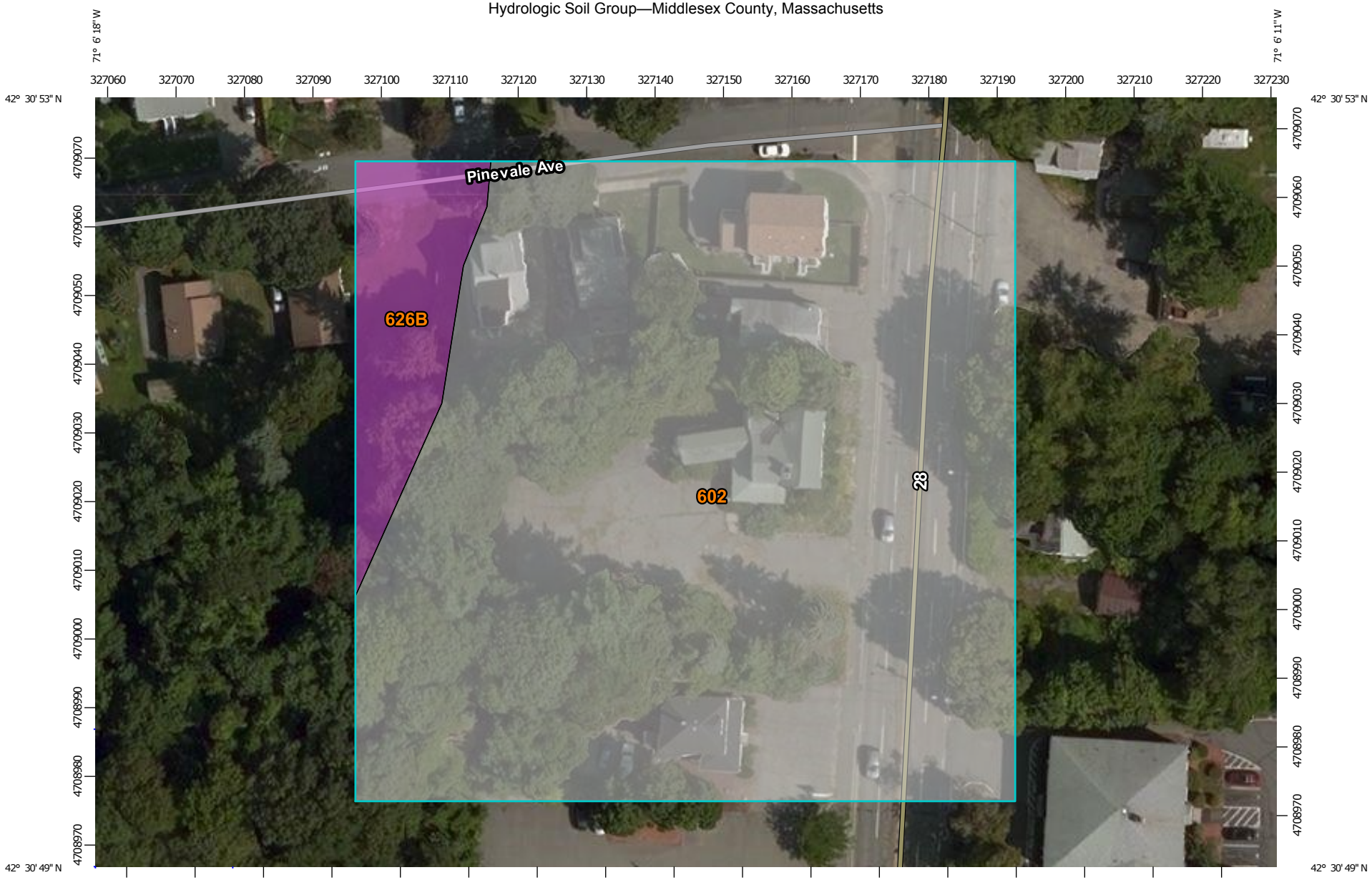
1.7 Conclusion

The calculations show that runoff is reduced with development in all storms used in the design.

MARKEY & RUBIN, INC.
360 MASS. AVENUE, ACTON, MA 01720
PHONE: (978)264-4600

APPENDIX 2.2
TEST BORING DATA

Hydrologic Soil Group—Middlesex County, Massachusetts



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:25,000.

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: http://websoilsurvey.nrcs.usda.gov
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: Middlesex County, Massachusetts
Survey Area Data: Version 14, Sep 19, 2014

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

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts (MA017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
602	Urban land		2.0	91.8%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	0.2	8.2%
Totals for Area of Interest			**2.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

MARKEY & RUBIN, INC.
360 MASS. AVENUE, ACTON, MA 01720
PHONE: (978)264-4600

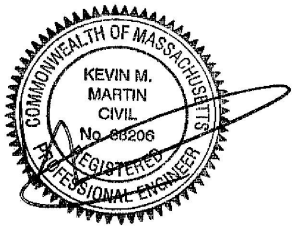
APPENDIX 2.3
DRAINAGE CALCULATIONS

258 & 262 Main Street, Reading
Project Report
August 26, 2015

UTS of Massachusetts, Inc.
5 Richardson Lane
Stoneham, MA 02180
781-438-7755 (p) / 781-438-6216 (f)
utsofmass.com

MEMORANDUM

TO: Saverio P. Fulciniti
Highland Wealth
PO Box 163
Reading, MA 01867



FROM: Kevin Martin, P.E.
Geotechnical Engineer

DATE: August 2, 2013

RE: **GEOTECHNICAL SUMMARY REPORT**
PROPOSED OFFICE BUILDING
258 MAIN STREET
READING, MASSACHUSETTS

This memorandum report serves as a geotechnical summary report for the referenced project. The contents of this memorandum are subject to the attached ***Limitations***.

SITE & PROJECT DESCRIPTION

The project site is located at 258 Main Street in Reading, MA Present development includes a 2-story, wood-framed building suspected to be supported on a basement level foundation. This building is vacant and will be removed for the project. Based on review of the *Site Plan* (Sullivan Engineering Group - Nov 2011), site grades vary from elevation ≈98-104 ft possessing a downward slope to the front (east). A stone retaining wall accommodates the elevated grades along Main Street.

It is proposed to remove the existing building and other site construction to accommodate a new office building. The new building is to consist of a two-story building with ground level parking below (basement level garage). It is intended to support the building on a spread footing foundation. The First Floor Elevation (FFE) & Garage Floor Elevation (GFE) are shown to be 107.5 ft & 97.0 ft respectively. As such, cuts of about ≈5-8 ft will be necessary to achieve the garage level.

The purpose of this study is to provide a geotechnical evaluation of the subgrade conditions as they pertain to foundation design and construction as required by the *Massachusetts State Building Code*. This report does not include an environmental assessment relative to oil, gasoline, solid waste and/or other hazardous materials. The environmental conditions of the property should be addressed by others as necessary. This study also does not include review of infiltration systems, detention ponds, dry wells, underground utilities or other site design unless specifically addressed herein.

SUBSURFACE EXPLORATIONS

Test Borings

The exploration program for the project included four (4) test borings throughout the site. The test borings (B1 to B4) were advanced to refusal depths of ≈17-18 ft utilizing 4¼ inch continuous flight hollow stem augers. Soil samples were typically retrieved at no greater than 5 ft intervals with a 2 inch diameter split-spoon sampler. Standard Penetration Tests (SPTs) were performed at the sampling intervals in general accordance with ASTM-D1586 (*Standard Method for Penetration Test and Split-Barrel Sampling of Soils*). Field descriptions and penetration resistance of the soils encountered, observed depth to groundwater, depth to apparent bedrock refusal and other pertinent data are contained on the attached *Test Boring Logs*. The attached *Sketch* shows the test bore locations.

SUBSURFACE CONDITIONS

The subsurface conditions generally include (1) shallow Fill underlain by (2) dense Glacial soils then (3) apparent Bedrock refusal.

Fill was encountered to shallow depths generally less than ≈3-5 ft below grade. The Fill varies in composition but generally consists of a brown, fine to medium Sand, some gravel, little silt. Some Organic laden soils were also encountered but generally limited based on this study. Other Fill should be expected around the site being associated with intersecting utilities, foundation backfill and prior site construction.

The parent overburden soils generally include a dense Glacial Outwash. These soils are generally granular, dense and well-draining. The Outwash typically includes a Sand & Gravel, trace to little silt. Occasional cobbles and boulders are embedded in the Till which is typical of the area geology. The Outwash is stable, dense and compact.

Test boring refusal, apparently bedrock, was encountered in ALL the test bores at depths of ≈17-18 ft below grade. The consistent depth to refusal further suggests Bedrock. Bedrock, as such, is not expected to impact the project.

Groundwater was encountered at depths of about ≈12-14 ft in the test holes for this study. It should be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, utilities and other factors differing from the time of the measurements.

FOUNDATION SUBGRADE RECOMMENDATIONS

The subgrade conditions are favorable for supporting the proposed building on a conventional spread footing foundation with a concrete floor slab. The existing fill and organic laden soils, however, are **not** suitable for structural support. As such, these soils as well as abandoned foundations, intersecting utilities and other questionable matter should be fully removed from the foundation area including the *Footing Zone of Influence* to expose the parent subgrade (Glacial Outwash). The *Footing Zone of Influence* is defined as that area extending laterally outward and downward at a 1H:1V splay from the edge of foundation. Given the basement level garage, most of the fill and other questionable matter is expected to be removed (or penetrated) to achieve foundation grade. Structural Fill necessary to achieve grade should conform to the *Specifications* (Table 1).

The parent subgrade soils should be exposed in the foundation areas prior to casting the footings or placing structural fill. It is recommended that the parent subgrade soils be proof-rolled with vibratory densification and exhibit stable and compact conditions. The purpose of the proof-rolling is to densify the site soils and identify potential loose or unstable areas which should be removed as necessary. Recommended proof-rolling should involve at least 4-5 passes with a vibratory compactor (minimum 850 pound static weight) operating at peak energy. During the proof rolling process, the subgrade should be observed by an Engineer to identify areas exhibiting weaving or instability. It will be necessary to remove weakened or unstable soils and replace with a Structural Fill. Wet subgrade should not be proof-rolled but should require dewatering and protection with a base of ¾-inch minus crushed stone

The subgrade should ultimately be stable, dewatered, compact and protected from frost throughout construction. Bearing subgrades that become weakened or disturbed due to wet conditions or other cause will be rendered unsuitable for structural support. An Engineer from UTS should be scheduled to review the foundation subgrade conditions and preparation during construction.

FOUNDATION DESIGN RECOMMENDATIONS

The footings are expected to gain bearing support directly atop the parent glacial soils (Outwash) and/or compacted Structural Fill (Table 1). Footings may be designed using an allowable bearing capacity of 5 ksf (FS=3). The allowable bearing capacity may be increased a third (⅓) when considering transient loads such as wind or seismic. The bearing capacity is contingent upon the perimeter strip footings and isolated column footings being no less than 2 ft and 3 ft in width respectively. For footings less than 3 ft in lateral dimension, the net allowable bearing capacity should be reduced to one-third and multiplied by the least lateral footing dimension in feet.

Foundation settlement should be less than ¾ inch with differential settlement less than ½ inch. Exterior footings shall be provided with at least 4 ft of frost protection. Proper frost protection should be necessary during winter construction.

Recommendations for the lateral earth pressure against the unbalanced walls and drainage control are outlined on Table 2. Proper drainage behind the unbalanced foundation walls will also be necessary as summarized on Table 2.

The subsurface conditions were reviewed with respect to seismic criteria set forth in the ***Massachusetts State Building Code (Eighth Edit)***. Based on the relative density of the soils and the depth to groundwater, the site is not susceptible to liquefaction in the event of an earthquake (*Section 1804.6*). Based on interpretation of the *Building Code*, the *Site Classification* (Section 9.4.1.2.1) is "C" (Very Dense Soil).

It is recommended that a minimum 8-inch base of *Clean Granular Fill* (Table 1) be placed below the concrete floor slab for moisture and frost control. The gravel base shall be increased to no less than 12 inches for exterior concrete slabs exposed to frost as well as below the garage floor slab. A subgrade modulus of 175 pci may be used for design of the floor slab. A vapor retarder should be used below the floor slab dependent upon the floor treatment. A vapor barrier should be specified by others per ACI Standards. Structural fill necessary within and below the foundation should also conform to the attached *Specifications* (Table 1). The Outwash soils are expected to be suitable for Structural Fill provided they are segregated from the organic soils, are screened of large stones and are compacted to specified density.

FOUNDATION DRAINAGE

Since the project will incorporate a below grade garage level, it is recommended that perimeter foundation drains be used to control groundwater where unbalanced foundation walls exist. The purpose of the drainage system is for both structural purposes (hydrostatic stresses and uplift) and to mitigate groundwater intrusion into the basement garage. A drainage collection system is also required for embedded foundations per the *MSBC*.

The drains should consist of minimum 4-inch diameter perforated PVC SDR-35 pipe encased in 12 inches of ¾-inch stone and wrapped with a geotextile filter fabric such as Mirafi 140N or equal. The drains should be placed about 4 inches upwards from the bottom of the footing with an invert elevation of at least 10 inches below the underside of the adjacent floor slab. The drains should not encroach within the *Footing Zone of Influence* defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1H:1V splay. To provide drainage along the basement wall, a 18 inch wide vertical lift of *Structural Fill* (Table 1) should be placed directly behind the foundation wall to within 18 inches of finish grade. The drains should discharge into the storm drain system by gravity (not subject to surcharge). The Site Engineer should consider the outlet of the foundation drains. It is recommended that a backflow preventer be installed at the outlet

of the under-drain to reduce the impact of surcharges in the event of high water and to impede rodent activity that may clog the drain. The drains should be provided with permanent clean-outs at convenient locations to access all sections of the system. Clean-outs should be located at bends and no greater than 175 ft on-center.

The ground surface immediately adjacent to the foundation should be sloped away from the buildings to allow for positive drainage. It is also recommended that the surficial materials adjacent to the buildings be relatively impermeable to reduce the volume of precipitation infiltrating into the subsurface. Such impermeable materials include Portland cement concrete, bituminous concrete, or a vegetated silty topsoil. Roof gutters should discharge away from the basements or to controlled site structures. Storm water infiltration systems (infiltrators, dry wells, etc) shall be kept away or below the basement foundations. This should be reviewed by the Site Engineer.

The basement foundation should be waterproofed or, at a minimum, damproofed to protect against moisture damage. The basement floor should be damproofed with minimum ten-mil polyethylene or StegoWrap™ with joints lapped 8 inches below the floor slab or with application of bituminous or other approved material to the surface. Damproofing of below grade foundation walls should include the application of a bituminous or other approved material from the top of footing to above ground level. Below slab foundations (such as elevator pits) should be fitted with continuous waterstops in all construction joints and should be waterproofed as well as structurally designed (buoyant load) to protect against groundwater intrusion. Groundwater relief or drainage is typically not feasible for the depressed elevator pit. An equivalent fluid weight of 90 pcf should be used for the design of the elevator pit as the groundwater will not be controlled in this depressed area.

CONSTRUCTION CONCERNS

The contractor should be required to maintain stable-dewatered subgrades for foundations, pavements and other concerned areas during construction. Subgrade disturbance may be influenced by excavation methods, moisture, precipitation, groundwater control and construction activities. The site soils are considered moderately moisture sensitive and may become weakened or softened if exposed to chronic wet conditions and construction activities. The contractor should understand these concerns and take precautions to reduce subgrade disturbance. Such precautions may include diverting storm run-off away from construction areas, reducing traffic in sensitive areas, limiting the extent of exposed subgrade if inclement weather is forecast, backfilling footings as soon as practicable and maintaining an effective dewatering program. It may be prudent for the contractor to place a lift of ¾-inch minus crushed stone atop the prepared subgrade to protect it from weakening and softening as construction progresses. The protective base be should extend ≈6 inches below and laterally beyond the footing limits for protection during construction. The protective stone base should be considered elective and dependent upon the site conditions during construction. In general, the protective stone base is not expected to be necessary given the granular subgrade and depressed groundwater. The moisture concerns are typically more problematic if construction occurs during the winter or spring seasons. The protective stone base shall be required in wet areas that

encroach the groundwater table. The purpose of the stone base in wet conditions is to protect the bearing subgrade, facilitate construction dewatering and provide a dry/stable base upon which to progress the foundation construction. The protective stone base shall be tamped with a plate compactor and exhibit stable conditions. Soils exhibiting weaving or instability should be over-excavated to more competent bearing soil and replaced with a free draining structural fill. The foundation subgrades should ultimately be stable, dewatered, protected from frost and compact throughout construction. An Engineer from UTS should be scheduled to review the subgrade conditions and preparation.

The groundwater table, if encountered, will need to be temporarily controlled during construction to complete work in dry conditions and protect the competency of the subgrade. The groundwater table, where encountered, should be continuously maintained at least one foot below construction grade until backfilling is complete. The groundwater is expected to be controlled with conventional sumps and pumps. The temporary sumps should be filtered with stone and fabric and extend at least 18 inches below construction grade. A ≈6 inch lift of ¾-inch minus crushed stone should be placed atop the wet subgrade to protect its competency and facilitate dewatering. The stone base should have positive slope to the sump. Adequate dewatering and storm water management are necessary for maintaining the competency of the site soils.

CONSTRUCTION MONITORING

It is recommended that a qualified engineer or representative be retained to review earthwork activities such as the preparation of the foundation bearing subgrade and the placement/compaction of Structural Fill. It is recommended that UTS be retained to provide construction monitoring services. This is to observe compliance with the design concepts presented herein.

We trust the contents of this memorandum report are responsive to your needs at this time. Should you have any questions or require additional assistance, please do not hesitate to contact our office.

kmm50/uts13/ReadingMainSt.wpd

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.

3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

Review

4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.

5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by UTS of Massachusetts, Inc.

Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

7. This report has been prepared for the exclusive use of Highland Wealth in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

8. This report has been prepared for this project by UTS of Massachusetts, Inc. This report was completed for geotechnical design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to preliminary geotechnical design considerations.

TABLE 1

Proposed Office Building
258 Main Street
Reading, MA

Recommended Soil Gradation & Compaction Specifications

Clean Granular Fill
(Select Gravel Fill)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
3 inch	100
3/4 inch	60-90
No. 4	20-70
No. 200	2-8

NOTE: For minimum 8-inch base below Concrete Floor Slabs (in heated areas)
For minimum 12-inch base for concrete slabs exposed to frost
For minimum 12-inch base below garage level slab
A ¾-inch crushed stone may be used in lieu of gravel

Structural Fill
(Gravelly SAND, little Silt)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
5 inch	100
3/4 inch	60-100
No. 4	20-85
No. 200	0-10

NOTE: For use as structural load support below the foundations
For use as backfill behind unbalanced foundation/retaining walls
A ¾-inch crushed stone may be used in wet conditions

Structural Fill placed beneath the foundation should include the *Footing Zone of Influence* which is defined as that area extending laterally one foot from the edge of the footing then outward and downward at a 1H:1V splay. Structural Fill should be placed in loose lifts not exceeding 12 inches for heavy vibratory rollers and 8 inches for vibratory plate compactors. All Structural Fill should be compacted to at least 95 percent of maximum dry density as determined by the Modified Proctor Test (ASTM-D1557). The Structural Fill should be compacted within ±3% of optimum moisture content. The adequacy of the compaction efforts should be verified by field density testing which is also a requirement of the *Massachusetts State Building Code*.

TABLE 2

Proposed Office Building
258 Main Street
Reading, MA

Recommended Lateral Earth Pressures & Drainage for Unbalanced Walls

Lateral earth pressures for the structural design and stability analysis of unbalanced foundation walls (basement walls, retaining walls, elevator pit, etc) are provided herein. The following table outlines the recommended lateral earth pressure coefficients and equivalent fluid weights:

WALL CONDITION	LATERAL TRANSLATION (Δ/H)	EARTH PRESSURE COEFFICIENT (K)	EQUIVALENT FLUID WEIGHT (γ_{EFW})
restrained	0	K_o	60 pcf
no restraint	0.002	K_a	35 pcf
no restraint	0.02	K_p (FS=3)	125 pcf
seismic	n/a	K_{eq}	see note

where: Δ = movement at top of wall by tilting or lateral translation
H = height of wall

The above lateral earth pressures are based upon:

1. Rankine earth pressure theory;
2. Retaining wall backfilled with Structural Fill (Table 1)
3. Unit weight of backfill less than 125 pcf
4. No hydrostatic pressures
5. No surcharge loading;
6. A level backfill in front and behind of wall;
7. Seismic loads distributed as an inverse triangle over the height of wall (*MSBC*);
8. Dynamic/compaction stresses accounted for with seismic pressures;
9. Soil backfill densified with plate compactors within 3 ft lateral distance of wall;
10. Top 2 ft should not be considered for passive resistance.

The lateral load due to seismic pressure shall be in accordance with *Section 9.5.2.9* of the *MSBC* (8th Edition). *Equation 9.5.2.9* shall be used to estimate the seismic force (F_w). The unit weight of the backfill used in this equation is 125 pcf (Structural Fill). There are no soils subject to liquefaction below and/or behind the wall.

The lateral resistance of retaining walls should also accommodate surcharge loads. Uniformly distributed loads should be superimposed along the face of the wall at a magnitude equal to the surcharge pressure multiplied by the appropriate earth pressure coefficient. Surcharge loads should be considered where they are located within a horizontal distance equivalent to 1.0 times the height of the wall. Anticipated point or line loads situated behind the wall should be evaluated in accordance with linear elastic theory.

For frost and drainage concerns, it is recommended that *Structural Fill* (Table 1) be placed directly behind the unbalanced walls. The ground surface immediately adjacent to the unbalanced foundation should be sloped away from the building to allow for positive drainage. It is also recommended that the surficial materials adjacent to the building be relatively impermeable to reduce the volume of precipitation infiltrating into the subgrade. Such impermeable materials include Portland cement concrete, bituminous concrete, or a vegetated silty topsoil. Roof gutters should discharge away from the basements or to controlled site structures. Storm water infiltration systems (infiltrators, dry wells, etc) shall be kept away or below the basement foundations. This should be reviewed by the Site Engineer.

Unbalanced foundation walls should be provided with adequate footing drains per the *MSBC*. The drains should be located along the periphery of the foundation. The perimeter foundation drain should be located at least 4 inches above the bottom of footing elevation and six inches outward from the edge of footing. The drains should not encroach within the *Footing Zone of Influence* defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1H:1V splay. Furthermore, the invert elevation of the drain should be at least 10 inches below the underside of the adjacent floor slab. The drains should consist of minimum 4 inch diameter, perforated PVC-SDR 35 drain pipe encased within 12 inches of ¾-inch stone and wrapped with a filter fabric such as Mirafi 140N or equal. The drains should discharge via gravity to a storm drain line not subject to surcharge. The Site Engineer should review the discharge of the drains in this regard. The drains should be provided with permanent clean-outs at convenient locations to facilitate access to all sections of the system.

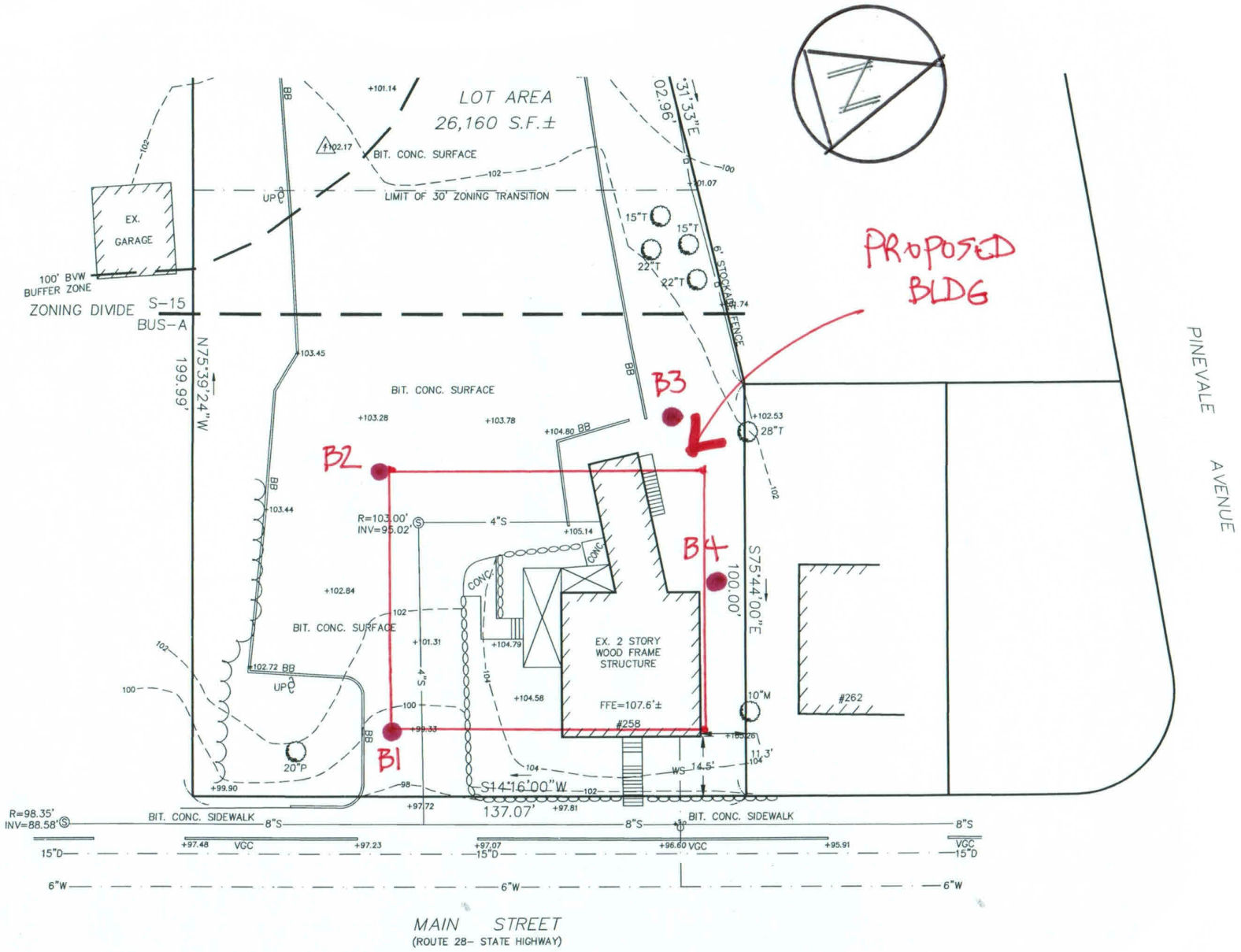
If the unbalanced foundation walls can not be drained to alleviate hydrostatic forces, then the lateral earth pressure equivalent fluid weight should be increased to 90 pcf. Such earth pressures should be used for elevator pits, if necessary.

The recommended friction factors to be used for retaining wall design are as follows:

<u>Recommended Friction Factor (f)</u>
$f = \tan(\delta)$, where δ is the interface friction angle

- Concrete against the following soils

Structural Fill (Table 1)	0.50
Glacial Soils	0.50


LOT AREA
26,160 S.F.±
BIT. CONC. SURFACE
LIMIT OF 30' ZONING TRANSITION
EX. GARAGE
100' BVW BUFFER ZONE
ZONING DIVIDE S-15 BUS-A
PROPOSED BLDG
B1
B2
B3
B4
N75°39'24"W 199.99'
S31°33"E 102.96'
S75°44'00"E 100.00'
S14°16'00"W 137.07'
6' STOCKADE FENCE
EX. 2 STORY WOOD FRAME STRUCTURE
FFE=107.6'±
#258
#262
R=103.00' INV=95.02'
R=98.35' INV=88.58'
BIT. CONC. SIDEWALK
VGC
PINEVALE AVENUE
MAIN STREET
(ROUTE 28- STATE HIGHWAY)

TEST BORING LOG

SHEET 1

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Site: 258 Main Street
Reading, MA

BORING B-1

PROJECT NO. 13-0733

DATE: July 29, 2013

Ground Elevation:	100 ft+/-
Date Started:	July 26, 2013
Date Finished:	July 26, 2013
Driller:	TF
Soil Engineer/Geologist:	KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
7/25/13	12 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
						4"	Pavement
1		1	10"	1'0"-3'0"	4-7-6-6		Brown, fine to coarse Sand, some silt, little gravel (FILL)
		2	12"	3'0"-5'0"	11-14-20-26	3'	
5		3	8"	5'0"-7'0"	16-21-28-29		Brown, fine to coarse Sand & Gravel, little silt (GLACIAL)
10		4	10"	10'0"-12'0"	19-16-23-20		Brown, fine to coarse Sand & Gravel, trace silt, cobbles,
15		5	8"	15'0"-17'0"	26-40-39-58		Same, wet
						18'	Auger Refusal at 18 ft
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 2

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Site: 258 Main Street
Reading, MA

BORING B-2

PROJECT NO. 13-0733

DATE: July 29, 2013

Ground Elevation:	103 ft+/-
Date Started:	July 26, 2013
Date Finished:	July 26, 2013
Driller:	TF
Soil Engineer/Geologist:	KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
7/26/13	14 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
							Pavement
1		1	8"	1'0"-3'0"	7-10-12-9	3'	Brown, fine to medium Sand, some gravel, little silt, dry (FILL)
		2	4"	3'0"-5'0"	12-16-17-21		Brown, fine to medium Sand & Gravel, trace silt, cobbles, dry
5		3	12"	5'0"-7'0"	28-29-31-34		Same, dry (GLACIAL) w/ cobbles
10		4	12"	10'0"-12'0"	23-20-29-35		Brown, fine to medium Sand, some gravel, little silt, cobbles, boulders
15		5	10"	15'0"-16'6"	42-68-87	16'6"	Brown, fine to medium Sand & Gravel, little silt, cobbles, wet
							Refusal at 16'6"
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 3

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Site: 258 Main Street
Reading, MA

BORING B-3/B-3A

PROJECT NO. 13-0733

DATE: July 29, 2013

Ground Elevation:	103 ft+/-
Date Started:	July 26, 2013
Date Finished:	July 26, 2013
Driller:	TF
Soil Engineer/Geologist:	KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
7/26/13	14 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
1		1	6"	0"-2'0"	3-3-4-5		Topsoil
		2	4"	2'0"-4'0"	9-31-12-13	2'	Rust Brown, fine to medium Sand, some silt, trace loam (SUBSOIL/FILL)
5		3	8"	5'0"-7'0"	26-32-29-31	5'	Brown, fine to medium Sand & Gravel, trace silt, cobbles, boulders, dry
10		4	10"	10'0"-12'0"	24-31-28-29		Brown, fine to coarse Sand & Gravel, little silt, cobbles (GLACIAL)
15		5	10"	15'0"-17'0"	34-51-72-68		Same, wet
20						18'	B-3 refusal at 5 ft B-3A refusal at 18 ft
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 4

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Site: 258 Main Street
Reading, MA

BORING B-4

PROJECT NO. 13-0733

DATE: July 29, 2013

Ground Elevation:	103 ft+/-
Date Started:	July 26, 2013
Date Finished:	July 26, 2013
Driller:	TF
Soil Engineer/Geologist:	KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
7/26/13	14 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
1		1	4"	0"-2'0"	2-3-3-5		Black, Organic Silt, roots (TOPSOIL)
		2	6"	2'0"-4'0"	5-8-9-12	2'	Brown, fine to medium Sand & Gravel, little silt, dry (FILL)
5		3	6"	5'0"-6'6"	18-29-85	5'	Brown, fine to medium Sand & Gravel, little silt, cobbles, boulders, dry
10		4	6"	10'0"-12'0"	12-18-15-24		Same (GLACIAL)
15		5	10"	15'0"-15'10"	63-100/4"		Same, wet
						17'	Refusal at 17 ft
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

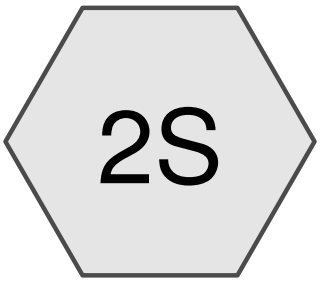
Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

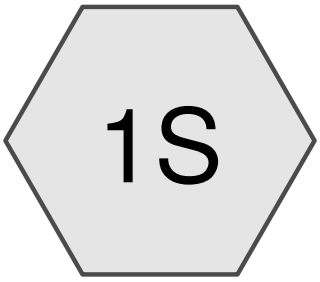
MARKEY & RUBIN, INC.
360 MASS. AVENUE, ACTON, MA 01720
PHONE: (978)264-4600

APPENDIX 2.3
DRAINAGE CALCULATIONS

258 & 262 Main Street, Reading
Project Report
July 24, 2015



Sub 2



Sub 1

Subcat Reach Pond Link

Routing Diagram for existing conditions
Prepared by Toshiba, Printed 7/24/2015

Summary for Subcatchment 1S: Sub 1

Runoff = 0.53 cfs @ 12.10 hrs, Volume= 0.036 af, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

	Area (sf)	CN	Description
*	9,264	98	Impervious Surfaces
	5,300	49	50-75% Grass cover, Fair, HSG A
	14,564	80	Weighted Average
	5,300		36.39% Pervious Area
	9,264		63.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min**

Summary for Subcatchment 2S: Sub 2

Runoff = 0.41 cfs @ 12.01 hrs, Volume= 0.025 af, Depth> 0.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

	Area (sf)	CN	Description
*	7,526	98	Impervious Surfaces
	9,070	49	50-75% Grass cover, Fair, HSG A
	16,596	71	Weighted Average
	9,070		54.65% Pervious Area
	7,526		45.35% Impervious Area

Summary for Subcatchment 1S: Sub 1

Runoff = 0.95 cfs @ 12.09 hrs, Volume= 0.064 af, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	9,264	98	Impervious Surfaces
	5,300	49	50-75% Grass cover, Fair, HSG A
	14,564	80	Weighted Average
	5,300		36.39% Pervious Area
	9,264		63.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min**

Summary for Subcatchment 2S: Sub 2

Runoff = 0.88 cfs @ 12.01 hrs, Volume= 0.051 af, Depth> 1.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	7,526	98	Impervious Surfaces
	9,070	49	50-75% Grass cover, Fair, HSG A
	16,596	71	Weighted Average
	9,070		54.65% Pervious Area
	7,526		45.35% Impervious Area

Summary for Subcatchment 1S: Sub 1

Runoff = 1.24 cfs @ 12.09 hrs, Volume= 0.085 af, Depth> 3.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.40"

	Area (sf)	CN	Description
*	9,264	98	Impervious Surfaces
	5,300	49	50-75% Grass cover, Fair, HSG A
	14,564	80	Weighted Average
	5,300		36.39% Pervious Area
	9,264		63.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min**

Summary for Subcatchment 2S: Sub 2

Runoff = 1.23 cfs @ 12.01 hrs, Volume= 0.071 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.40"

	Area (sf)	CN	Description
*	7,526	98	Impervious Surfaces
	9,070	49	50-75% Grass cover, Fair, HSG A
	16,596	71	Weighted Average
	9,070		54.65% Pervious Area
	7,526		45.35% Impervious Area

Summary for Subcatchment 1S: Sub 1

Runoff = 1.65 cfs @ 12.09 hrs, Volume= 0.113 af, Depth> 4.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.60"

	Area (sf)	CN	Description
*	9,264	98	Impervious Surfaces
	5,300	49	50-75% Grass cover, Fair, HSG A
	14,564	80	Weighted Average
	5,300		36.39% Pervious Area
	9,264		63.61% Impervious Area

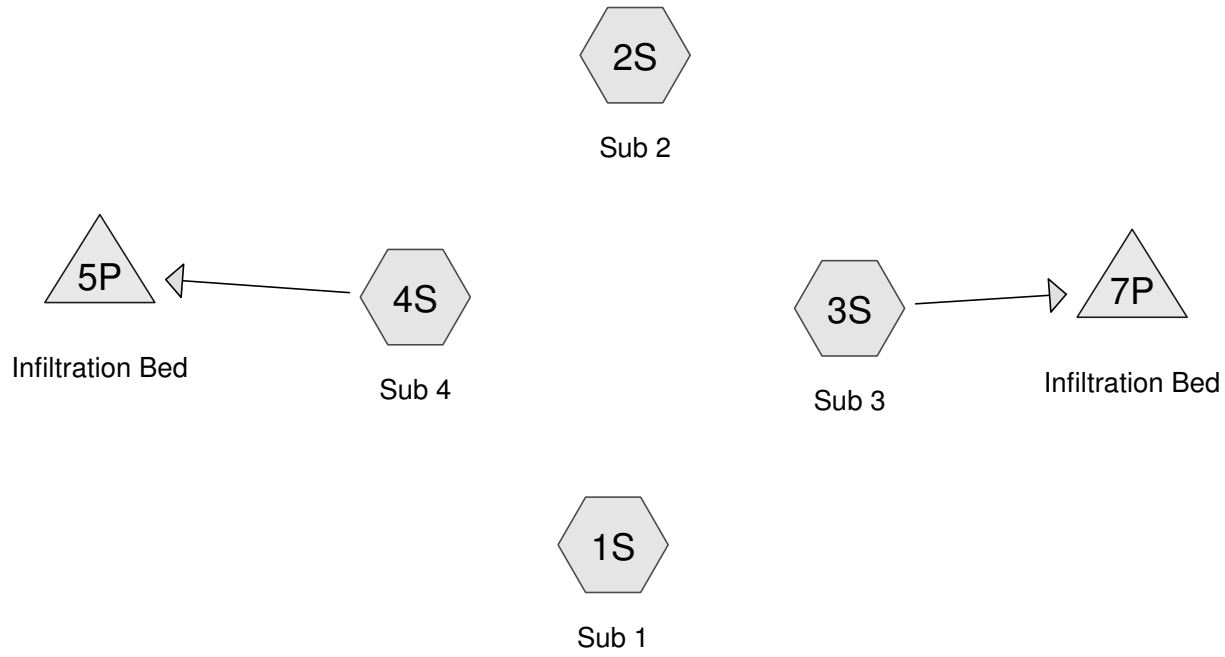
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min**

Summary for Subcatchment 2S: Sub 2

Runoff = 1.74 cfs @ 12.00 hrs, Volume= 0.100 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.60"

	Area (sf)	CN	Description
*	7,526	98	Impervious Surfaces
	9,070	49	50-75% Grass cover, Fair, HSG A
	16,596	71	Weighted Average
	9,070		54.65% Pervious Area
	7,526		45.35% Impervious Area



Subcat Reach Pond Link

Routing Diagram for Proposed Conditions R1
Prepared by Toshiba, Printed 7/24/2015

Summary for Subcatchment 1S: Sub 1

Runoff = 0.36 cfs @ 12.09 hrs, Volume= 0.025 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

	Area (sf)	CN	Description
*	5,378	98	Impervious Surfaces
	1,001	39	>75% Grass cover, Good, HSG A
	6,379	89	Weighted Average
	1,001		15.69% Pervious Area
	5,378		84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr min**

Summary for Subcatchment 2S: Sub 2

Runoff = 0.00 cfs @ 24.01 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
2,291	39	>75% Grass cover, Good, HSG A
2,291		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Subcatchment 3S: Sub 3

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

	Area (sf)	CN	Description
*	3,437	98	Impervious Surfaces
	27	39	>75% Grass cover, Good, HSG A
	3,464	98	Weighted Average
	27		0.78% Pervious Area
	3,437		99.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Subcatchment 4S: Sub 4

Runoff = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af, Depth= 1.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

	Area (sf)	CN	Description
*	14,251	98	Impervious Surfaces
	4,774	39	>75% Grass cover, Good, HSG A
	19,025	83	Weighted Average
	4,774		25.09% Pervious Area
	14,251		74.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Pond 5P: Infiltration Bed

Inflow Area = 0.437 ac, 74.91% Impervious, Inflow Depth = 1.61" for 2-yr event
Inflow = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af
Outflow = 0.24 cfs @ 11.91 hrs, Volume= 0.059 af, Atten= 71%, Lag= 0.0 min
Discarded = 0.24 cfs @ 11.91 hrs, Volume= 0.059 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 93.45' @ 12.45 hrs Surf.Area= 0.028 ac Storage= 0.011 af

Plug-Flow detention time= 11.3 min calculated for 0.059 af (100% of inflow)
Center-of-Mass det. time= 11.3 min (844.3 - 832.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	93.00'	0.000 af	**152.00'W x 8.00'L x 3.17'H Field A** 0.088 af Overall - 0.088 af Embedded = 0.000 af x 40.0% Voids
#2A	93.00'	0.061 af	**retain_it 2.5'** x 19 Inside #1 Inside= 84.0"W x 30.0"H => 17.56 sf x 8.00'L = 140.4 cf Outside= 96.0"W x 38.0"H => 25.33 sf x 8.00'L = 202.7 cf
		0.061 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	93.00'	**0.24 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.24 cfs @ 11.91 hrs HW=93.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Summary for Pond 7P: Infiltration Bed

Inflow Area = 0.080 ac, 99.22% Impervious, Inflow Depth = 2.97" for 2-yr event
Inflow = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af
Outflow = 0.06 cfs @ 11.78 hrs, Volume= 0.020 af, Atten= 76%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.78 hrs, Volume= 0.020 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 93.62' @ 12.46 hrs Surf.Area= 0.007 ac Storage= 0.004 af

Plug-Flow detention time= 14.6 min calculated for 0.020 af (100% of inflow)
Center-of-Mass det. time= 14.6 min (771.0 - 756.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	93.00'	0.000 af	**8.00'W x 40.00'L x 3.17'H Field A** 0.023 af Overall - 0.023 af Embedded = 0.000 af x 40.0% Voids
#2A	93.00'	0.016 af	**retain_it 2.5'** x 5 Inside #1 Inside= 84.0"W x 30.0"H => 17.56 sf x 8.00'L = 140.4 cf Outside= 96.0"W x 38.0"H => 25.33 sf x 8.00'L = 202.7 cf
		0.016 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	93.00'	**0.06 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.06 cfs @ 11.78 hrs HW=93.03' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.06 cfs)

Summary for Subcatchment 1S: Sub 1

Runoff = 0.55 cfs @ 12.09 hrs, Volume= 0.040 af, Depth= 3.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	5,378	98	Impervious Surfaces
	1,001	39	>75% Grass cover, Good, HSG A
	6,379	89	Weighted Average
	1,001		15.69% Pervious Area
	5,378		84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr min**

Summary for Subcatchment 2S: Sub 2

Runoff = 0.00 cfs @ 14.70 hrs, Volume= 0.000 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
2,291	39	>75% Grass cover, Good, HSG A
2,291		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Subcatchment 3S: Sub 3

Runoff = 0.35 cfs @ 12.08 hrs, Volume= 0.028 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	3,437	98	Impervious Surfaces
	27	39	>75% Grass cover, Good, HSG A
	3,464	98	Weighted Average
	27		0.78% Pervious Area
	3,437		99.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Subcatchment 4S: Sub 4

Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.099 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	14,251	98	Impervious Surfaces
	4,774	39	>75% Grass cover, Good, HSG A
	19,025	83	Weighted Average
	4,774		25.09% Pervious Area
	14,251		74.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Pond 5P: Infiltration Bed

Inflow Area = 0.437 ac, 74.91% Impervious, Inflow Depth = 2.73" for 10-yr event
Inflow = 1.39 cfs @ 12.09 hrs, Volume= 0.099 af
Outflow = 0.24 cfs @ 11.75 hrs, Volume= 0.099 af, Atten= 83%, Lag= 0.0 min
Discarded = 0.24 cfs @ 11.75 hrs, Volume= 0.099 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 94.14' @ 12.56 hrs Surf.Area= 0.028 ac Storage= 0.028 af

Plug-Flow detention time= 32.5 min calculated for 0.099 af (100% of inflow)
Center-of-Mass det. time= 32.5 min (850.3 - 817.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	93.00'	0.000 af	**152.00'W x 8.00'L x 3.17'H Field A** 0.088 af Overall - 0.088 af Embedded = 0.000 af x 40.0% Voids
#2A	93.00'	0.061 af	**retain_it 2.5'** x 19 Inside #1 Inside= 84.0"W x 30.0"H => 17.56 sf x 8.00'L = 140.4 cf Outside= 96.0"W x 38.0"H => 25.33 sf x 8.00'L = 202.7 cf
		0.061 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	93.00'	**0.24 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.24 cfs @ 11.75 hrs HW=93.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Summary for Pond 7P: Infiltration Bed

Inflow Area = 0.080 ac, 99.22% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.35 cfs @ 12.08 hrs, Volume= 0.028 af
Outflow = 0.06 cfs @ 11.69 hrs, Volume= 0.028 af, Atten= 83%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.69 hrs, Volume= 0.028 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 94.12' @ 12.54 hrs Surf.Area= 0.007 ac Storage= 0.007 af

Plug-Flow detention time= 28.5 min calculated for 0.028 af (100% of inflow)
Center-of-Mass det. time= 28.5 min (778.3 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	93.00'	0.000 af	**8.00'W x 40.00'L x 3.17'H Field A** 0.023 af Overall - 0.023 af Embedded = 0.000 af x 40.0% Voids
#2A	93.00'	0.016 af	**retain_it 2.5'** x 5 Inside #1 Inside= 84.0"W x 30.0"H => 17.56 sf x 8.00'L = 140.4 cf Outside= 96.0"W x 38.0"H => 25.33 sf x 8.00'L = 202.7 cf
		0.016 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	93.00'	**0.06 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.06 cfs @ 11.69 hrs HW=93.03' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.06 cfs)

Summary for Subcatchment 1S: Sub 1

Runoff = 0.69 cfs @ 12.09 hrs, Volume= 0.051 af, Depth= 4.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.40"

	Area (sf)	CN	Description
*	5,378	98	Impervious Surfaces
	1,001	39	>75% Grass cover, Good, HSG A
	6,379	89	Weighted Average
	1,001		15.69% Pervious Area
	5,378		84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr min**

Summary for Subcatchment 2S: Sub 2

Runoff = 0.00 cfs @ 12.41 hrs, Volume= 0.001 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.40"

Area (sf)	CN	Description
2,291	39	>75% Grass cover, Good, HSG A
2,291		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Subcatchment 3S: Sub 3

Runoff = 0.42 cfs @ 12.08 hrs, Volume= 0.034 af, Depth= 5.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.40"

	Area (sf)	CN	Description
*	3,437	98	Impervious Surfaces
	27	39	>75% Grass cover, Good, HSG A
	3,464	98	Weighted Average
	27		0.78% Pervious Area
	3,437		99.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Subcatchment 4S: Sub 4

Runoff = 1.80 cfs @ 12.09 hrs, Volume= 0.129 af, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.40"

	Area (sf)	CN	Description
*	14,251	98	Impervious Surfaces
	4,774	39	>75% Grass cover, Good, HSG A
	19,025	83	Weighted Average
	4,774		25.09% Pervious Area
	14,251		74.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Pond 5P: Infiltration Bed

Inflow Area = 0.437 ac, 74.91% Impervious, Inflow Depth = 3.54" for 25-yr event
Inflow = 1.80 cfs @ 12.09 hrs, Volume= 0.129 af
Outflow = 0.24 cfs @ 11.68 hrs, Volume= 0.129 af, Atten= 87%, Lag= 0.0 min
Discarded = 0.24 cfs @ 11.68 hrs, Volume= 0.129 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 94.69' @ 12.65 hrs Surf.Area= 0.028 ac Storage= 0.041 af

Plug-Flow detention time= 52.7 min calculated for 0.129 af (100% of inflow)
Center-of-Mass det. time= 52.7 min (863.0 - 810.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	93.00'	0.000 af	**152.00'W x 8.00'L x 3.17'H Field A** 0.088 af Overall - 0.088 af Embedded = 0.000 af x 40.0% Voids
#2A	93.00'	0.061 af	**retain_it 2.5'** x 19 Inside #1 Inside= 84.0"W x 30.0"H => 17.56 sf x 8.00'L = 140.4 cf Outside= 96.0"W x 38.0"H => 25.33 sf x 8.00'L = 202.7 cf
		0.061 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	93.00'	**0.24 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.24 cfs @ 11.68 hrs HW=93.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Summary for Pond 7P: Infiltration Bed

Inflow Area = 0.080 ac, 99.22% Impervious, Inflow Depth = 5.16" for 25-yr event
Inflow = 0.42 cfs @ 12.08 hrs, Volume= 0.034 af
Outflow = 0.06 cfs @ 11.64 hrs, Volume= 0.034 af, Atten= 86%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.64 hrs, Volume= 0.034 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 94.48' @ 12.58 hrs Surf.Area= 0.007 ac Storage= 0.010 af

Plug-Flow detention time= 40.1 min calculated for 0.034 af (100% of inflow)
Center-of-Mass det. time= 40.1 min (786.9 - 746.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	93.00'	0.000 af	**8.00'W x 40.00'L x 3.17'H Field A** 0.023 af Overall - 0.023 af Embedded = 0.000 af x 40.0% Voids
#2A	93.00'	0.016 af	**retain_it 2.5'** x 5 Inside #1 Inside= 84.0"W x 30.0"H => 17.56 sf x 8.00'L = 140.4 cf Outside= 96.0"W x 38.0"H => 25.33 sf x 8.00'L = 202.7 cf
		0.016 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	93.00'	**0.06 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.06 cfs @ 11.64 hrs HW=93.03' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.06 cfs)

Summary for Subcatchment 1S: Sub 1

Runoff = 0.87 cfs @ 12.08 hrs, Volume= 0.065 af, Depth= 5.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

	Area (sf)	CN	Description
*	5,378	98	Impervious Surfaces
	1,001	39	>75% Grass cover, Good, HSG A
	6,379	89	Weighted Average
	1,001		15.69% Pervious Area
	5,378		84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr min**

Summary for Subcatchment 2S: Sub 2

Runoff = 0.02 cfs @ 12.29 hrs, Volume= 0.003 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

Area (sf)	CN	Description
2,291	39	>75% Grass cover, Good, HSG A
2,291		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Subcatchment 3S: Sub 3

Runoff = 0.51 cfs @ 12.08 hrs, Volume= 0.042 af, Depth= 6.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

	Area (sf)	CN	Description
*	3,437	98	Impervious Surfaces
	27	39	>75% Grass cover, Good, HSG A
	3,464	98	Weighted Average
	27		0.78% Pervious Area
	3,437		99.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Subcatchment 4S: Sub 4

Runoff = 2.34 cfs @ 12.09 hrs, Volume= 0.169 af, Depth= 4.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

	Area (sf)	CN	Description
*	14,251	98	Impervious Surfaces
	4,774	39	>75% Grass cover, Good, HSG A
	19,025	83	Weighted Average
	4,774		25.09% Pervious Area
	14,251		74.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 0.1 hr. min.**

Summary for Pond 5P: Infiltration Bed

Inflow Area = 0.437 ac, 74.91% Impervious, Inflow Depth = 4.65" for 100-yr event
Inflow = 2.34 cfs @ 12.09 hrs, Volume= 0.169 af
Outflow = 0.24 cfs @ 11.60 hrs, Volume= 0.169 af, Atten= 90%, Lag= 0.0 min
Discarded = 0.24 cfs @ 11.60 hrs, Volume= 0.169 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 95.48' @ 12.89 hrs Surf.Area= 0.028 ac Storage= 0.061 af

Plug-Flow detention time= 83.9 min calculated for 0.169 af (100% of inflow)
Center-of-Mass det. time= 83.8 min (886.5 - 802.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	93.00'	0.000 af	**152.00'W x 8.00'L x 3.17'H Field A** 0.088 af Overall - 0.088 af Embedded = 0.000 af x 40.0% Voids
#2A	93.00'	0.061 af	**retain_it 2.5'** x 19 Inside #1 Inside= 84.0"W x 30.0"H => 17.56 sf x 8.00'L = 140.4 cf Outside= 96.0"W x 38.0"H => 25.33 sf x 8.00'L = 202.7 cf
		0.061 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	93.00'	**0.24 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.24 cfs @ 11.60 hrs HW=93.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Summary for Pond 7P: Infiltration Bed

Inflow Area = 0.080 ac, 99.22% Impervious, Inflow Depth = 6.36" for 100-yr event
Inflow = 0.51 cfs @ 12.08 hrs, Volume= 0.042 af
Outflow = 0.06 cfs @ 11.58 hrs, Volume= 0.042 af, Atten= 88%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.58 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 94.99' @ 12.67 hrs Surf.Area= 0.007 ac Storage= 0.013 af

Plug-Flow detention time= 57.7 min calculated for 0.042 af (100% of inflow)
Center-of-Mass det. time= 57.7 min (801.4 - 743.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	93.00'	0.000 af	**8.00'W x 40.00'L x 3.17'H Field A** 0.023 af Overall - 0.023 af Embedded = 0.000 af x 40.0% Voids
#2A	93.00'	0.016 af	**retain_it 2.5'** x 5 Inside #1 Inside= 84.0"W x 30.0"H => 17.56 sf x 8.00'L = 140.4 cf Outside= 96.0"W x 38.0"H => 25.33 sf x 8.00'L = 202.7 cf
		0.016 af	Total Available Storage

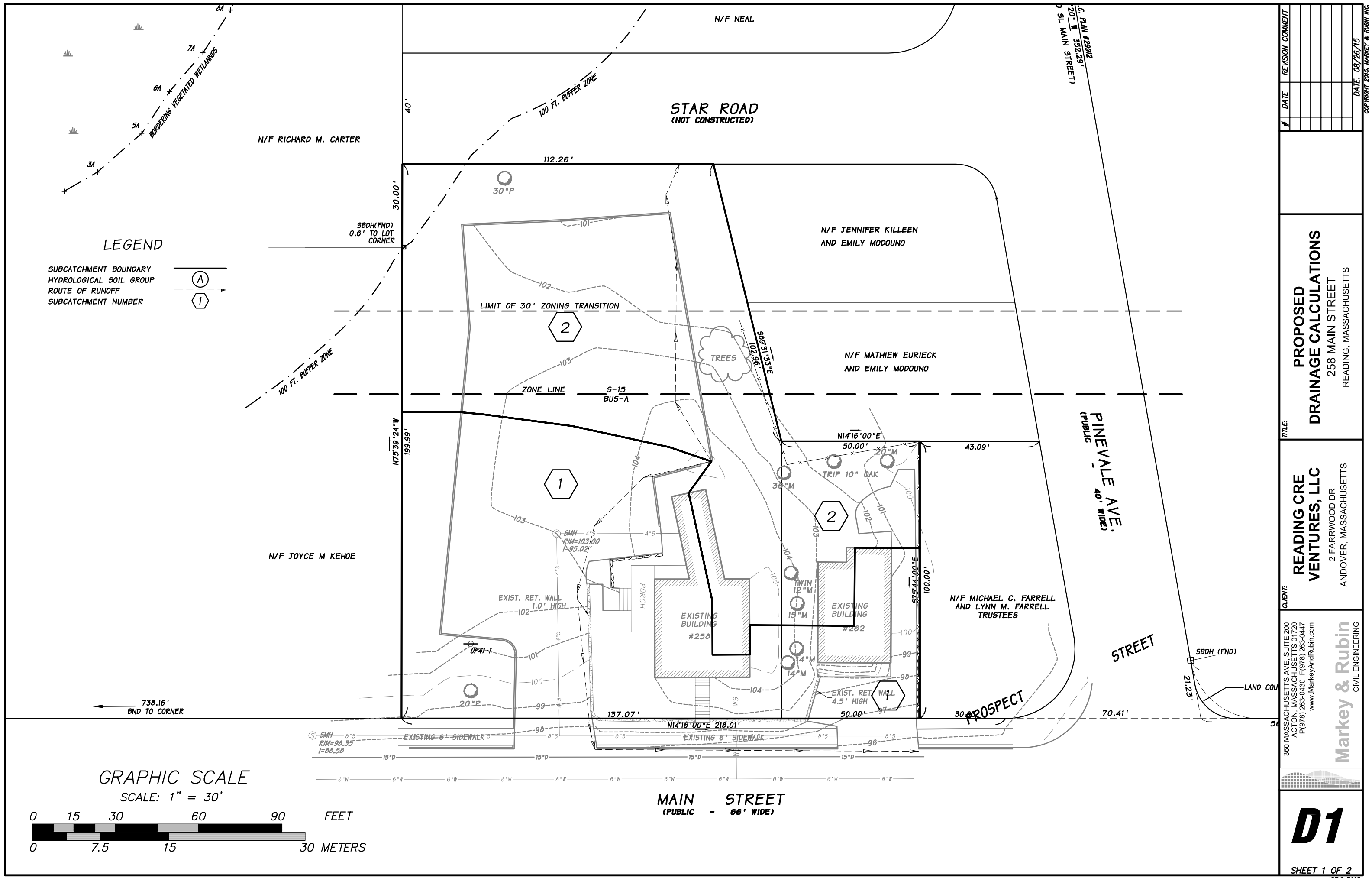
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	93.00'	**0.06 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.06 cfs @ 11.58 hrs HW=93.03' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.06 cfs)

MARKEY & RUBIN, INC.
360 MASS. AVENUE, ACTON, MA 01720
PHONE: (978)264-4600

APPENDIX 2.4
DRAINAGE SKETCHES



#	DATE	REVISION COMMENT

DATE: 08/26/15

TITLE:
PROPOSED DRAINAGE CALCULATIONS
258 MAIN STREET
READING, MASSACHUSETTS

CLIENT:
READING CRE VENTURES, LLC
2 FARRWOOD DR
ANDOVER, MASSACHUSETTS

Markey & Rubin
CIVIL ENGINEERING
360 MASSACHUSETTS AVE, SUITE 200
ACTON, MASSACHUSETTS 01720
P(978) 263-0430 F(978) 263-0447
www.MarkeyAndRubin.com

D1

SHEET 1 OF 2

JOB# 5118

STAR ROAD
(NOT CONSTRUCTED)

N/F RICHARD M. CARTER

BORDERING VEGETATED WETLANDS

100 FT. BUFFER ZONE

S14°16'00"W 112.26'

30.00'

SBDH(FND)
0.6' TO LOT
CORNER

N/F JENNIFER KILLEEN
AND EMILY MODOUNO

OUTDOOR TABLES AND
BENCHES AMONGST LAWN
AND SHADE TREES.

TRSF. DUMPSTER ON
12'X12' CONC. PAD
ENCLOSED BY FENCE
(SEE DETAILS) &
SCREENED WITH
SHRUBS.

SNOW STORAGE AREA
(3 DESIGNATED PARKING SPACES
FOR SNOW REMOVAL
DURING SNOW STORMS)

LIMIT OF 30' ZONING TRANSITION

PARKING SPACES = 11

S69°31'33"E 102.96'

N/F MATHIEW EURIECK
AND EMILY MODOUNO

2x10 RETAIN-IT
INFILTRATION BED
(SEE DETAILS)

CB
RIM=97.2

ZONE LINE

ZONE LINE

S-15
BUS-A

50.00'
N14°16'00"E

PINEVALE AVE.
(PUBLIC - 40' WIDE)

199.99'
N75°39'24"W

PARKING SPACES = 13

PARKING SPACES = 8

BIKE RACK

CB
RIM=97.7

43.09'

2X3 RETAIN-IT
INFILTRATION
BED (SEE DETAILS)

RET.WALL MIN.
6" ABOVE
FINAL GRADE
W/ 6' HIGH
PVC
SCREENED
FENCE

WALKWAY

RAMP

WALKWAY

2"W
4" DI (FIRE)

PROPOSED
COMMERCIAL
BUILDING

GFA = 14,851± SF
PARKING SPACES TOTAL = 52
FFE = 99.0

66.7'

72.0'

PROPOSED 4' CONC. WALKWAY

PARKING SPACES = 9

PARKING SPACES = 10

100.00'
S75°44'00"E

N/F JOYCE M KEHOE

N/F MICHAEL C. FARRELL
AND LYNN M. FARRELL
TRUSTEES

4' WALKWAY

1 SPACE

4' WALKWAY

PROPOSED
STOP SIGN
AND STOP BAR

PROP. COMPANY SIGN

PROPOSED
STOP SIGN
AND STOP BAR

738.16'
BND TO CORNER

137.07'
N14°16'00"E 218.01'

50.00'

30.93'

PROP. 6" SCH. 40 PVC SEWER

SMH
RIM=98.35
I=88.50

EXISTING 6'
SIDEWALK

PROP.
SIDEWALK

EXISTING 6'
SIDEWALK

EXISTING 6'
SIDEWALK

20.0'

20.0'

15"D 15"D 15"D 15"D

6"W 6"W 6"W 6"W 6"W 6"W 6"W 6"W 6"W 6"W 6"W

EX. WS TO BE
KILLED AT MAIN

PROP. TAPPING
SLEEVE W/GATE

MAIN STREET
(PUBLIC - 66' WIDE)

LEGEND

SUBCATCHMENT BOUNDARY
HYDROLOGICAL SOIL GROUP (A)
ROUTE OF RUNOFF
SUBCATCHMENT NUMBER (1)

GRAPHIC SCALE

SCALE: 1" = 30'

0 15 30 60 90 FEET

0 7.5 15 30 METERS

#	DATE	REVISION COMMENT

DATE: 08/26/15

TITLE:
PROPOSED DRAINAGE CALCULATIONS
258 MAIN STREET
READING, MASSACHUSETTS

CLIENT:
READING CRE VENTURES, LLC
2 FARRWOOD DR
ANDOVER, MASSACHUSETTS

Markey & Rubin
CIVIL ENGINEERING
360 MASSACHUSETTS AVE, SUITE 200
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www.MarkeyAndRubin.com

D2