Appendix B
GZA Soil Report

ASB
design group LLC
Civil Engineering
Traffic Engineering
Architecture
Landscape Design & Construction
363 Boston Street, Route 1
Topsfield MA. 01983
978-500-8419
www.asbdesigngroup.com

Proactive by Design

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

372 Merrimac Street
Newburyport, MA 01950
781.278.4800
www.gza.com

June 16, 2015
File No. 18.0172343.00

Ms. Christine Barensfeld
IFARM, LLC
55 Towne Road
Boxford, Massachusetts 01921

Re: Geotechnical Engineering Report
Proposed Bridge Abutments
IFARM (Site)
55 Towne Road
Boxford, Massachusetts

Dear Ms. Barensfeld:

In accordance with our proposal dated May 15, 2015, GZA GeoEnvironmental, Inc. (GZA) is pleased to submit this report to IFarm, LLC ("Client") summarizing the results of our geotechnical engineering evaluation for the proposed bridge construction at the Site located at 55 Towne Road in Boxford Massachusetts. The primary objectives of our services were to evaluate subsurface conditions and develop geotechnical recommendations for the design and construction of the abutments for the proposed bridge.

Elevations cited in this report are referenced to the elevations shown on the "Existing Conditions, Property Line Plan," Drawing C2, by ASB Design Group, LLC (ASB) of Topsfield, Massachusetts dated June 8, 2015.

This report is subject to the Limitations included as **Appendix A**.

BACKGROUND

Our understanding of the project is based on discussions with Thad Berry of ASB, a review of the Site Plans (dated May 18, 2015), and our Site visit. The project includes the construction of a bridge in a private, residential asphalt-paved driveway to replace an existing plastic drain pipe. The current asphalt-paved access road to the property crosses a 15-inch-diameter plastic pipe that provides a drainage path for the outlet of a small pond. It was reported that flow is typically low, except during extreme weather events. It is proposed to restore the stream outlet from the pond by removing the 15-inch pipe under the road and replacing it with a 12-foot-wide bridge. Additionally, the pond will be improved with the installation of a dry fire hydrant.

GZA was requested to provide a geotechnical investigation to address subsurface conditions impacting the bridge abutments and the location of the dry hydrant. The location of the Site is depicted on **Figure 1**, Site Location Plan.

SCOPE OF SERVICES

To achieve the stated objectives, GZA performed the following scope of work:

1. Met with the project team at the site to discuss the proposed bridge abutments and the pond improvements.
2. Reviewed proposed design and construction plans for the bridge abutments and dry hydrant.
3. Developed and executed a subsurface exploration program consisting of three test borings to evaluate soil conditions.
4. Performed gradation analyses on two soil samples obtained from the explorations to confirm field visual classifications and to help evaluate potential reuse of the soils.
5. Performed engineering analyses, developed geotechnical design and construction recommendations, and prepared this report summarizing our findings.

SUBSURFACE EXPLORATIONS

GZA developed and executed the exploration program as described in the following paragraphs. A GZA representative observed the borings, classified the soil samples, and prepared test boring logs, as attached as **Appendix B**. Boring locations are shown on **Figure 2**: Site Plan with Exploration Locations.

On May 29, 2015, Geologic Earth Exploration, Inc., of Norfolk, Massachusetts drilled three borings (GZ-1 through GZ-3). Two borings (GZ-1 and GZ-3) were located at the approximate abutment locations, and one boring (GZ-2) was located at the approximate dry hydrant location. The borings were advanced using cased drive-and-wash drilling techniques to depths of about 8 to 21 feet below existing ground surface (corresponding to approximate boring termination elevations of between 106 feet and 92 feet). Standard Penetration Tests (SPTs) were performed and split spoon samples were generally obtained continuously near the ground surface and at approximately five feet intervals thereafter. Boreholes were backfilled with drill cuttings upon completion of drilling.

GEOTECHNICAL LABORATORY ANALYSIS

GZA submitted two soil samples to Thielsch Engineering Laboratory in Cranston, Rhode Island for geotechnical identification testing. Gradation analyses were performed on samples obtained at the following exploration locations/sample depths: GZ-2 S-4 (6-feet to 8-feet) and GZ-3 S-3 (9-feet to 11-feet). Geotechnical Laboratory Results are attached as **Appendix D**.

SUBSURFACE CONDITIONS

The generalized soil profile described herein is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are likely more variable. For specific soil profile information, refer to the exploration logs in **Appendix B**.

SOIL CONDITIONS

Based on the subsurface explorations performed at the Site, the general soil profile consists of topsoil or asphalt overlying fill, with organics, over glacial till. These strata are described below in order of increasing depth. Bedrock was not encountered in the explorations.

- ***Topsoil/Asphalt*** – Up to approximately six inches of topsoil was encountered at the ground surface at boring GZ-2. The topsoil generally consisted of medium dense fine to coarse sand containing up to approximately 20 percent silt and up to 10 percent gravel and roots. At borings GZ-1 and GZ-3, about 2 to 3 inches of asphalt was encountered at the ground surface.
- ***Fill*** – Five to seven feet of fill was encountered below the topsoil/asphalt, which likely represents the fill used to construct the road. The fill generally consisted of either medium dense, fine to coarse sand containing up to approximately 20 percent gravel and up to approximately 20 percent silt, or medium dense silt or soft organics silt, with trace roots.
- ***Glacial Till*** – Glacial till was encountered below the fill at depths between of about five to seven feet below the existing ground surface (corresponding to approximate elevations 106 to 110 feet). The glacial till layer generally consisted of fine to coarse sand containing up to 50 percent silt and up to 35 percent gravel. SPT N-values within the glacial till, obtained during the investigation, ranged from 52 to more than 100 blows per foot (bpf), indicating that the till was very dense.

GROUNDWATER

The groundwater level was measured in borings GZ-2 and GZ-3 following drilling activities. Groundwater was observed in boring GZ-2 at an approximate depth of 2.6-feet (el. 110.4) approximately 20 minutes after drilling activities were completed. Note that boring GZ-2 was advanced without the use of casing or drill water, whereas boring GZ-3 was advanced utilizing drill water and casing. Groundwater was observed in boring GZ-3 at an approximate depth of 4-feet below ground surface (el. 109) approximately 20 minutes after the completion of boring activities.

Water level readings were made in the explorations at the times and under conditions stated on the logs and in the text of this report. 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 occurring since the time measurements were made.

IMPLICATIONS OF SUBSURFACE CONDITIONS

Measurements made during the current field activities indicate that the observed groundwater elevation (el.109) at the approximate bridge abutment boring location GZ-3 is near the existing plastic culvert elevation of 108.8 feet at the upstream end of the culvert. According to proposed construction drawings, the proposed restored stream bed elevation will be approximately 107 feet. Based on these measurements, de-watering of abutment foundation areas will likely be required during construction. Stream flow will also need to be diverted away from foundation excavations during construction.

RECOMMENDATIONS

The following recommendations are based on our understanding of the project and subject to the Limitations contained in **Appendix A** of this report.

DESIGN RECOMMENDATIONS

Foundation Type

For the proposed bridge abutments, we recommend a shallow foundation system consisting of spread footings bearing on undisturbed, natural glacial till.

The recommended maximum net allowable design bearing pressure for footings supported on undisturbed glacial till or on compacted Sand-Gravel Fill placed over undisturbed glacial till is three tons per square foot (3 tsf). Based on the stream bed restoration elevation of 107 feet, an anticipated abutment footing grade of el. 103 feet, and the soil stratigraphy encountered at the borings, the footing excavation should extend into the undisturbed natural glacial till.

The footings should be designed in accordance with the International Building Code (IBC) with Massachusetts State Building Code 8th Edition (MSBC) amendments. Accordingly, for foundations less than three feet in the least lateral dimension, the allowable bearing pressure should be reduced to one-third of the above value multiplied by the least lateral footing dimension in feet. For footings supported on soil, continuous wall footings should be at least 1.5 feet wide. To provide protection from frost, exterior footings should bear at least 4 feet below finish grade.

Settlement

Total and differential post-construction settlements are anticipated to be less than ½-inch, provided that the abutment footings designed and constructed as recommended herein.

Seismic Design

Soils at the site are not considered liquefiable based on criteria outlined in Section 1615 of the MSBC. Based on the soil conditions encountered, we recommend that Site Class C be used for seismic design in accordance with Section 9.4.1.2 of the MSBC. Also, the mapped seismic design factors for Topsfield, Ss and S_1, are 0.33 and 0.074, respectively, in accordance with Table 1604.10 of the Massachusetts State Building Code (MSBC).

Design Groundwater Elevation

Based on field observations, groundwater levels for this site approximately range from elevation 109 to 110 near the bridge abutments. According to conversations with the project civil engineer and current property owner, extreme precipitation events have resulted in elevated water levels washing out the road. Based on these data, groundwater is expected to be near elevation 109 during construction;

however, bridge abutment design should consider extreme precipitation events resulting in groundwater elevations to the existing road surface (el. 113). However, this level may be due to ponding resulting from restricted flow through the pipe.

As the proposed stream bed elevation is about two feet below the observed groundwater elevation, the abutment should be drained. Provide a footing drain at the base of the abutments to relieve hydrostatic pressures. These drains should be designed to drain by gravity and should daylight downstream of the abutments at an elevation lower than the streambed elevation at the abutments. The drains should consist of perforated four inch diameter PVC surrounded by six inches of ¾-inch Crushed Stone wrapped in non-woven filter fabric. The project civil engineer should identify the discharge for the drains.

Lateral Earth Pressures

Abutment structures subjected to unbalanced earth-loading conditions should be designed to resist lateral earth pressures.

For the purpose of evaluating lateral earth pressures for use in designing the abutments, we recommend using an equivalent fluid unit weight of 55 pounds/cubic foot. This pressure assumes horizontal backfill conditions and that the walls are backfilled with free draining Sand-Gravel Fill within at least three feet of the back of the walls (that is, no hydrostatic pressure).

The abutment walls should be backfilled with free draining Sand-Gravel Fill within at least three feet of the back of the walls. However, to account for high water events, the abutment walls should be designed for hydrostatic pressure using an equivalent fluid weight of 90 above the water level.

Where the calculated earth pressure behind the wall is less than 250 pounds per square foot (psf), it should be increased to 250 psf to account for stresses created by compaction within five feet of the wall. Walls should also be designed for appropriate surcharge, sloping backfill, and seismic loads per the IBC. Since the abutment walls are subject to vehicle loading, they should be designed for a minimum of the American Association of State Highway Transportation Officials HS-20 loading or other appropriate loading designated by the municipality or local fire department.

The recommended coefficient of friction to resist sliding between mass concrete/formed concrete and the natural granular soils or Granular Fill is 0.35.

The factors of safety for overturning and sliding under static loads should be at least 1.5. Passive pressure should not be included as a resisting force when analyzing for overturning and sliding.

Pavement Design

In areas of new pavement, GZA recommends the following asphalt pavement sections:

	Light Duty Pavement	Heavy Duty Pavement
Asphalt Surface (in.)	1.5	1.5
Asphalt Binder (in.)	1.5	2.5
Sand-Gravel Base Course (in.)	9	14

Dry Fire Hydrant

The proposed hydrant location is upstream of the existing dam structure. According to conversations with the project civil engineer, the hydrant piping will be installed to a depth of approximately four feet. The Town requires installation of a concrete apron around the dry hydrant. The hydrant should be located as far to the north (upstream) from the dam as possible. Additionally, the size of the excavation for the installation of the dry hydrant should be minimized to reduce the potential to introduce a water migration pathway past the existing dam structure. The pipe should be founded on the undisturbed glacial till or on compacted Sand-Gravel Fill placed over undisturbed glacial till.

Provided that the concrete apron is not subjected to vehicle loading, the excavation can be backfilled with excavated material to approximately 6-inches below the slab bottom, compacted in lifts. In slab areas, provide a minimum six-inch-thick layer of compacted Sand-Gravel Fill or ¾-inch Crushed Stone as base course. Subgrade preparation recommendations are provided in subsequent sections of this report. If the apron will be subjected to vehicle loading, base course thickness should be 18 inches.

CONSTRUCTION RECOMMENDATIONS

Abutment Subgrade Preparation

Topsoil, existing fill, loose sand, clay and silt, and organic silt should be removed down to the glacial till bearing stratum within the bearing zone of the abutment footings. The bearing zone is described as within a line drawn down at a one-horizontal to one-vertical (1H:1V) from one foot outside the footing edge. Based on the plans for the proposed bridge reviewed by GZA, we anticipate that glacial till will be present at or near the proposed subgrade level of the abutment footings. Excavation to final subgrade elevation should be performed using a smooth-edged bucket (to the extent practical) to minimize possible disturbance to the subgrade. Where practical, the subgrade should be proof-compacted prior to concrete placement with at least six passes of a large plate compactor; if the subgrade is wet, proof-compaction may disturb the subgrade. Any weak or soft spots identified during proof-compaction should be overexcavated and replaced with compacted Granular or Sand-Gravel Fill (refer to **Table 1** for Recommended Gradations for Fill Materials). We recommend that final excavation to subgrade elevation not be made until the areas are ready for fill or concrete placement. For glacial till subgrades, we recommend placing up to six inches of

Sand-Gravel or ¾-inches of Crushed Stone, or a three inch mud mat of lean concrete to help protect the subgrade and aid in dewatering if needed. Crushed Stone should be wrapped in non-woven filter fabric where greater than 4 inches in thickness.

Dry Hydrant and Pavement Subgrade Preparation

Topsoil, unsuitable fill materials, and large roots should be removed from the dry hydrant and pavement subgrades prior to fill placement (if needed). The exposed glacial till or sand subgrade should be proof-compacted with a heavy vibratory walk behind plate compactor. Any weak or soft spots identified during proof-compaction should be over-excavated and replaced with compacted Granular or Sand-Gravel Fill.

Fill Material and Compaction

All fill placed below and within the bearing zone of influence of the abutment foundations, or as pavement/dry hydrant base course should be compacted to at least 95 percent of the maximum dry density as determined by Modified Proctor Tests (ASTM D-1557, Method C). Fill within two feet of the bottom of pavement should be compacted to at least 95 percent maximum dry density and to at least 92 percent of the maximum dry density at depths greater than two feet. Fill placed within proposed landscaped areas should be compacted to at least 90 percent of the maximum dry density.

Extra care should be used when compacting adjacent to abutment walls. Hand-operated rollers or plate compactors weighing not more than 250 pounds should be used within a lateral distance of five feet of walls. Backfill and compaction should proceed on both sides of the abutment wall so that the difference in top of fill on either side does not exceed two feet. Protect subgrades from frost at all times during construction. Fill should not be placed over frozen soil.

Construction Dewatering

Excavation for abutment footing construction will likely be performed to a depth below 105 feet. This elevation is below the observed groundwater elevation of 109 feet, and construction dewatering will be required to control groundwater to elevations approximately two feet below the proposed bottom of excavation. Based on a review of existing soil conditions, it is anticipated that this can be achieved through diverting surface water and the use of localized sumps for collection and removal of water. It is likely that water may be pumped to downstream temporary discharge pits excavated on Site, the existing onsite pond (after implementation of appropriate sediment control), or other appropriate sedimentation basins prior to discharge. No discharge of pumped water off site should be performed unless approved by the appropriate regulatory agencies, and if allowed, should be done in accordance will all federal, state, and/or local regulations. Dewatering may require a discharge permit and possible filtration of the water prior to discharge.

In addition, water that collects from precipitation events may also impact construction. We recommend that temporary control measures be implemented to reduce the amount of surface water (from rainfall runoff) from potentially entering and ponding in the excavations. Temporary measures should include, but not be limited to, construction of drainage ditches to divert and/or reduce the amount of surface water flowing over exposed subgrades during construction.

Reuse of Existing Material

Due to the presence of organics, the existing topsoil/fill is unsuitable for reuse in abutment footing and pavement areas, but may be reused on Site as cover in landscaped areas.

Based on laboratory analysis and visual classification, glacial till may be used as fill for site grading outside of footing areas provided that the material does not contain organics, roots, or other debris and can be placed and compacted as required herein. Note, however, that the soils will be difficult to re-use, especially in wet weather due to their relatively high silt and fine sand content. Also, existing site materials should not be reused within three feet laterally of walls as the existing materials do not meet the criteria for free-draining Sand-Gravel fill, which is required behind abutment walls.

Management and Disposal of Excavated Soil

Excess soils generated from excavations is anticipated to consist of topsoil, existing fill, and glacial till. Soils that cannot be reused on Site, whether due to excess quantity or the unsuitable nature of the material, may require off-Site disposal. Off site disposal should be conducted according to local, State and Federal regulations.

Temporary Excavation Support

Abutment installation may require excavation to depths up to 10 feet. Based on the distance to the property boundaries, excavation support is not anticipated to be needed. However, in the event that excavation support is needed or used, a temporary excavation support system, such as drilled or driven soldier piles and lagging or steel sheet piles, should be designed and stamped by a registered Professional Engineer in the state of Massachusetts engaged by the Contractor and submitted to GZA for review prior to construction.

The Owner and the Contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations.

The Contractor should be aware that slope height, slope inclination, or excavations depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations, e.g.; OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance from the crest of the slope equal to no less than the slope height. Exposed slope faces should also be protected against the elements.

CLOSURE

We recommend that GZA be retained to prepare technical specifications for earthwork for inclusion in the project documents. In addition, we recommend that GZA be retained during construction to observe footing subgrades to confirm the absence of unsuitable material, and backfilling and compaction procedures in accordance with the requirements of the MSBC.

We have enjoyed working with you on this project. Please do not hesitate to call us if you have any questions.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Matthew L. Steele, LEED G.A.
Assistant Project Manager

Bruce W. Fairless, P.E.
Consultant Reviewer

Frank S. Vetere, P.E.
Associate Principal

Attachments:

FIGURE

FIGURE 1	EXPLORATION PLAN
FIGURE 2	SITE PLAN

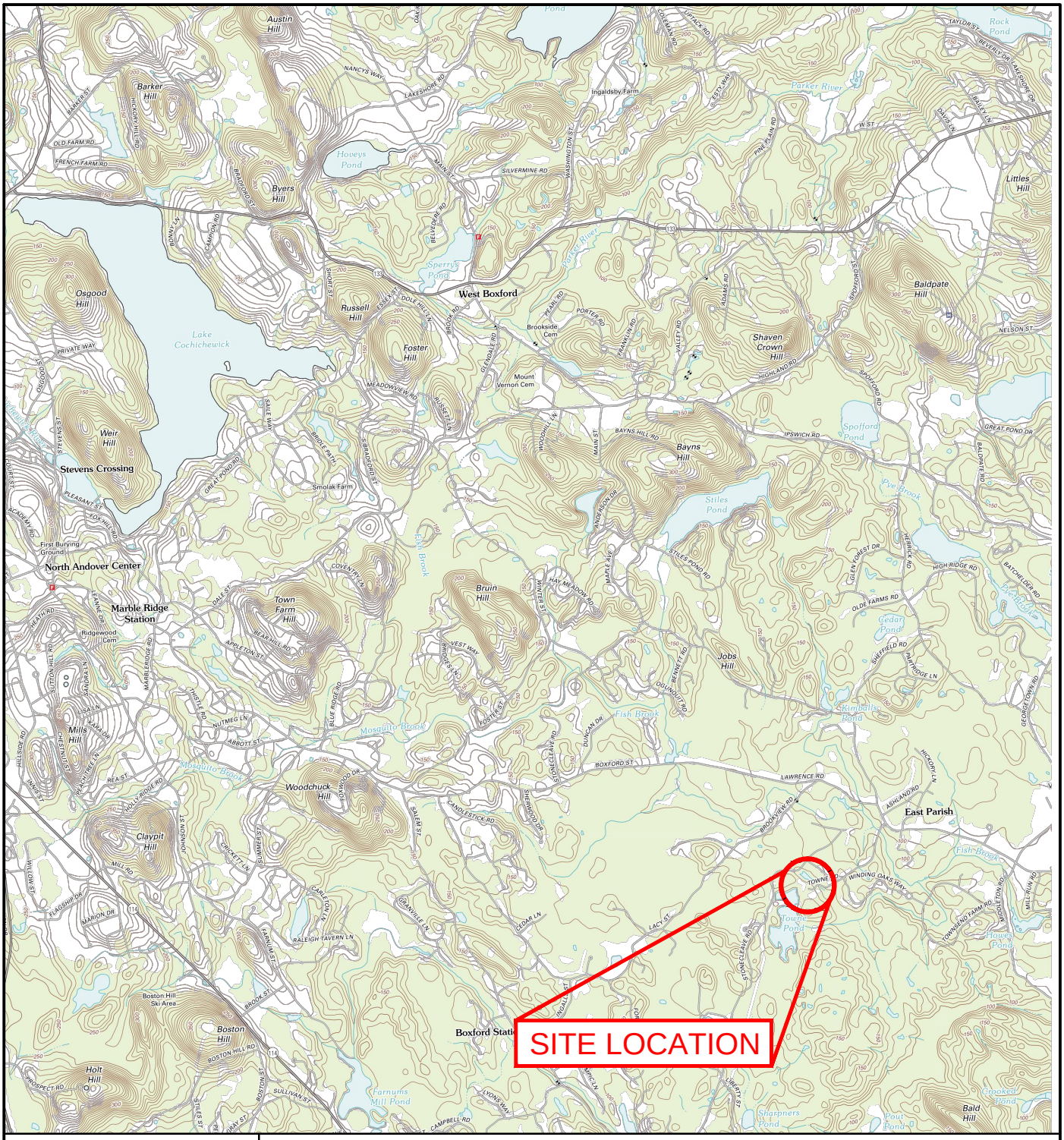
TABLE

TABLE 1	RECOMMENDED GRADATIONS FOR FILL MATERIALS

APPENDICES

APPENDIX A	LIMITATIONS
APPENDIX B	BORING LOGS
APPENDIX C	GEOTECHNICAL LABORATORY RESULTS

FIGURES



MASSACHUSETTS

QUADRANGLE LOCATION

SOURCE:
USGS TOPOGRAPHIC MAP PROVIDED BY
THE U.S. DEPARTMENT OF THE INTERIOR

N
W E
S

0 2500 5000 10,000
SCALE IN FEET

GEOTECHNICAL ENGINEERING SERVICES
55 TOWNE ROAD
BOXFORD, MASSACHUSETTS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
IFARM, LLC
55 TOWNE ROAD
BOXFORD, MA 01921

SITE LOCATION PLAN

PROJ MGR: MLS	REVIEWED BY: MLS	CHECKED BY: FSV	FIG 1
DESIGNED BY: AJK	DRAWN BY: AJK	SCALE: AS SHOWN	
DATE: 5/26/2015	PROJECT NO. 18.0172343.00	REVISION NO.	SHEET NO. OF

EXISTING POND

SOIL BORING GZ-2

SOIL BORING GZ-3

SOIL BORING GZ-1

FIRE ROAD

TOWNE ROAD

25' NO DISTURB ZONE

75' NO CONSTRUCTION ZONE

EDWARD A. & JANICE A. CHIULCHIOLO

CONC. DAM

SPILLWAY ELEV.=114.6

TOP OF DAM ELEV.=112.3

16" PINE

20" PINE

10" HICKORY

16" HICKORY

22" HICKORY

28" HICKORY

10" MAPLE

6" MAPLE

6" TREE

4" TREE

15" PLASTIC INV.=108.8

15" PLASTIC INV.=108.1

PROPOSED BRIDGE
12' SPAN
BRIDGE SURFACE ELEVATION = 112.6
STREAM RESTORATION ELEVATION = 107

PROPOSED BRIDGE ABUTMENTS (TYP.)

CROSS-SECTION A-A
SEE SHEET C3

EDGE OF PAVEMENT

51+00 PC +98.45

50+32 PT +77.08

50+54

1+00 PC +09.11

1+00 PT +91.48

2+00 PC +24.77

2+00

49+80

END OF TOWNE ROAD RIGHT-OF-WAY

REFERENCE:

1. BASE PLAN DEVELOPED FROM AN ELECTRONIC COPY OF A DRAWING BY ASB DESIGN GROUP, LLC ENTITLED, "CULVERT RECONSTRUCTION & HYDRANT INSTALLATION - CULVERT DETAIL," DATED 5/18/2015 AND PROVIDED TO GZA BY THE CLIENT.

NOTE:

1. THE LOCATION OF THE EXPLORATIONS WERE APPROXIMATELY DETERMINED BY LINE OF SIGHT AND/OR TAPE MEASUREMENTS FROM EXISTING TOPOGRAPHIC FEATURES. THESE LOCATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

LEGEND:

GZ- APPROXIMATE LOCATION OF BORINGS DRILLED BY GEOLOGIC EARTH EXPLORATION AND OBSERVED BY GZA ON MAY 25, 2015.

0 10 20 40 60

SCALE IN FEET

N W E S

NO.	ISSUE/DESCRIPTION	BY	DATE

GEOTECHNICAL ENGINEERING SERVICES
55 TOWNE ROAD
BOXFORD, MASSACHUSETTS

SITE PLAN
WITH EXPLORATION LOCATIONS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
IFARM, LLC
55 TOWNE ROAD
BOXFORD, MA 01921

PROJ MGR: MLS	REVIEWED BY: MLS	CHECKED BY: FSV	FIG 2
DESIGNED BY: AJK	DRAWN BY: AJK	SCALE: AS SHOWN	
DATE: 5/26/2015	PROJECT NO. 18.0172343.00	REVISION NO.	SHEET NO. OF

TABLE

TABLE 1

RECOMMENDED USE AND GRADATION CRITERIA FOR FILL MATERIALS

Proposed Bridge Abutments-iFarm
55 Towne Road
Boxford, Massachusetts

USE OF FILL MATERIAL

Granular Fill:	Below footings and slab base course.
Sand-Gravel:	Slab base course, below footings, and as backfill within three feet laterally of walls.
Crushed Stone:	For use in bottom of excavations to aid in construction dewatering and maintaining subgrade stability, backfill behind walls in confined areas, and around perforated drain lines.

GRADATION REQUIREMENTS

Sieve Size	Percent Finer by Weight
Granular Fill shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. Structural Fill shall conform to the following gradation requirements:	
2/3 of the loose lift thickness	100
No. 10	30 - 95
No. 40	10 - 70
No. 200	*0 - 15 * 0 -8 for backfill behind walls
Sand-Gravel shall consist of durable sand and gravel and shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. Sand-Gravel shall conform to the following gradation requirements:	
3 inch	100
1/2 inch	50 - 85
No. 4	40 - 75
No. 40	10 - 35
No. 200	0 - 8
Crushed Stone shall consist of durable crushed rock or durable crushed gravel stone and shall be free from ice and snow, clay, loam and other deleterious material. Crushed Stone shall conform to the following gradation requirements:	
1 inch	100
3/4 inch	90 - 100
1/2 inch	10 - 50
3/8 inch	0 - 20
No. 4	0 - 5

APPENDICES

APPENDIX A

LIMITATIONS

GEOTECHNICAL LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our IFARM, LLC (Client) for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the contract documents, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report,as appropriate, to reflect the unanticipated changed conditions .

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

4. In conducting our work, GZA relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

Subsurface Conditions

5. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs. The nature and extent of variations between these explorations may not become evident until further exploration or construction. If variations or other latent conditions then become evident, it will be necessary to reevaluate the conclusions and recommendations of this report.

6. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

7. Water level readings have been made in test holes (as described in this Report) and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however

occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.

8. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.

9. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

Compliance with Codes and Regulations

10. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

Cost Estimates

11. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

Additional Services

12. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

APPENDIX B

BORING LOGS

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

IFARM, LLC
55 Towne Road
Boxford, MA

BORING NO.: GZ-1
SHEET: 1 of 1
PROJECT NO: 18.0172343.00
REVIEWED BY: Frank Vetere

Drilling Co.: Geologic Earth Exploration, Inc.
Foreman: John Boyd
Logged By: Matt Steele

Type of Rig: Track Mounted
Rig Model: Soil Scout
Drilling Method: Wash & Drive

Boring Location: See Plan
Ground Surface Elev. (ft.): 113
Final Boring Depth (ft.): 9
Date Start - Finish: 5/29/2015 -

H. Datum:
V. Datum:

Auger/Casing Type: HW
I.D/O.D.(in): 4/4.5
Hammer Weight (lb.): 300
Hammer Fall (in.): 30
Other:

Sampler Type: Split Spoon
I.D./O.D. (in.): 2.0
Sampler Hmr Wt (lb): 140
Sampler Hmr Fall (in): 30
Other:

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
Not Measured				

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
		S-1	0.5-2.5	24	10	9 12 13 10	25	S-1A: 3" Moist, medium dense, black, fine to coarse SAND, little gravel, little Silt (fill) S-1B: 7" Moist, medium dense, brown, fine to coarse SAND, little gravel, trace Silt (fill)	1 2 3 4			FILL	
											3'		110.0'
5		S-2	4-6	24	16	10 4 7 43	11	S-2A: 4" Moist, medium dense, brown, clayey SILT, trace Sand S-2B: 12" Moist, medium dense, light brown, SILT, trace Sand, trace Roots				FILL/ORGANIC SILT	
											5.5'		107.5'
		S-3	7-9	24	6	45 60 79 54	R	S-3: Wet, very dense, light brown, fine to coarse GRAVEL, some Sand, trace Silt (fill)	5 6 7 8			TILL	
											9'		104.0'
10								Bottom of boring at 9 feet.					
15													
20													

REMARKS

1. Splitspoon driven with donut hammer hoisted by rope & cathead.
2. Advanced roller bit thru +/- 2" asphalt pavement.
3. Casing spun in from 0.5' - 4' bgs.
4. Obstruction encoutered +/- 3.0' -4'.
5. At above 6' due to obstruction.
6. Unable to set casing. Offset +/-1.0' west.
7. Casing obstruction +/-7.0'.
8. Boring terminated at +/-9' bgs, backfilled with cuttings, sand, and Bentonite, as needed and patched at surface to match surroundings.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: GZ-1

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

IFARM, LLC
55 Towne Road
Boxford, MA

BORING NO.: GZ-2
SHEET: 1 of 1
PROJECT NO: 18.0172343.00
REVIEWED BY: Frank Vetere

Drilling Co.: Geologic Earth Exploration, Inc.
Foreman: John Boyd
Logged By: Matt Steele

Type of Rig: Track Mounted
Rig Model: Soil Scout
Drilling Method: Wash & Drive

Boring Location: See Plan
Ground Surface Elev. (ft.): 114
Final Boring Depth (ft.): 8
Date Start - Finish: 5/29/2015 -

H. Datum:
V. Datum:

Auger/Casing Type: Not Used
I.D/O.D.(in):
Hammer Weight (lb.):
Hammer Fall (in.):
Other:

Sampler Type: Split Spoon
I.D./O.D. (in.): 2.0
Sampler Hmr Wt (lb): 140
Sampler Hmr Fall (in): 30
Other:

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
05/29/2015	1250	2.57	None	+/-20 Min.

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
		S-1	0-2	24	4	3 6 5 5	11	S-1: Dry, medium dense, brown, fine to coarse SAND, little Silt, trace Gravel, trace Roots (topsoil)	1 2		0.5'	TOPSOIL	113.5'
		S-2	2-4	24	4	2 2 3 7	5	S-2A: 2" Moist, loose, brown, fine to medium SAND, little Silt, trace Clay (Fill) S-2B: 2" Wet, soft, brown, CLAY and SILT, trace Sand (Fill)	3			FILL	
5		S-3	4-6	24	10	14 14 25 32	39	S-3A: 5" Wet, dense, dark brown, GRAVEL, little Sand, trace Silt, trace Organics (Fill) S-3B: 5" Wet, dense, brown, SILT, trace Sand, trace Gravel	4 5		5'		109.0'
		S-4	6-8	24	10	24 30 22 17	52	S-4: Wet, very dense, brown to red, SAND and SILT, little Gravel	6		8'	TILL	106.0'
								Bottom of boring at 8 feet.					
10													
15													
20													

REMARKS

1. Split spoon driven with donut hammer hoisted by rope & cathead.
2. S-2 driven in hole from S-1
3. 3" split spoon driven to open boring from 0'-4' bgs.
4. Saturated soils in S-3.
5. S-4 driven in hole from S-3.
6. Boring terminated at 8.0' bgs. Boring backfilled to surface with cuttings, sand and Bentonite, as needed.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: GZ-2

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

IFARM, LLC
55 Towne Road
Boxford, MA

BORING NO.: GZ-3
SHEET: 1 of 1
PROJECT NO: 18.0172343.00
REVIEWED BY: Frank Vetere

Drilling Co.: Geologic Earth Exploration, Inc.	**Type of Rig:** Track Mounted	**Boring Location:** See Plan	**H. Datum:**
Foreman: John Boyd	**Rig Model:** Soil Scout	**Ground Surface Elev. (ft.):** 113	
Logged By: Matt Steele	**Drilling Method:** Wash & Drive	**Final Boring Depth (ft.):** 20.8	**V. Datum:**
		Date Start - Finish: 5/29/2015 -	

Auger/Casing Type: HW	**Sampler Type:** Split Spoon	
I.D/O.D.(in): 4/4.5	**I.D./O.D. (in.):** 2.0	
Hammer Weight (lb.): 300	**Sampler Hmr Wt (lb):** 140	
Hammer Fall (in.): 30	**Sampler Hmr Fall (in):** 30	
Other:	**Other:**	

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
05/29/2015	1500	3.7	None	20 Min.

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
									1		0.3'	ASPHALT	112.7'
												FILL/SAND	
5		S-1	4-6	24	11	15 18 17 3	35	S-1A: 6" Moist, medium dense, black, fine to coarse SAND, little Silt, trace Gravel S-1B: 5" Moist, loose, black, SILT, trace Silt, trace Sand, trace Roots	2		5.5'		107.5'
		S-2	6-8	24	16	4 9 44 45	53	S-2A: 12" Very dense, grey, SILT, trace Sand S-2B: 4" Very dense, tan, fine to medium SAND, some Silt, trace Gravel			7'	FILL/ORGANIC SILT	106.0'
10		S-3	9-11	24	8	29 28 39 36	67	S-3: Very dense, brown, fine to coarse SAND, some Silt, some Gravel					
									3			TILL	
15		S-4	14-15.3	15	8	26 38 100 3	R	S-4: Very, dense, brown, fine to medium SAND, some Silt, trace Gravel	4				
20		S-5	19-20.8	21	12	43 37 65 50/3	R	S-5: Very, dense, brown, fine to medium SAND, some Silt, trace Gravel					
								Bottom of boring at 20.8 feet.	5		20.8'		92.2'

REMARKS

1. Splitspoon driven with donut hammer hoisted by rope & cathead.
2. Advanced rollerbit through +/- 3" of asphalt pavement; no sampling 0' - 4'.
3. Obstruction in roller bit +/- 13.0'.
4. Spoon obstruction 15.3'.
5. Boring terminated at +/-20.8' backfilled with sand, Bentonite, and cuttings as needed. Patched at the surface to match the surroundings.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: GZ-3

APPENDIX C

GEOTECHNICAL LABORATORY RESULTS

LABORATORY TESTING DATA SHEET

Project Name iFARM | Project Location Boxford, Ma | Reviewed By Matthew Steele

Project No. 18.0172343.00 | Assigned By Matthew Steele

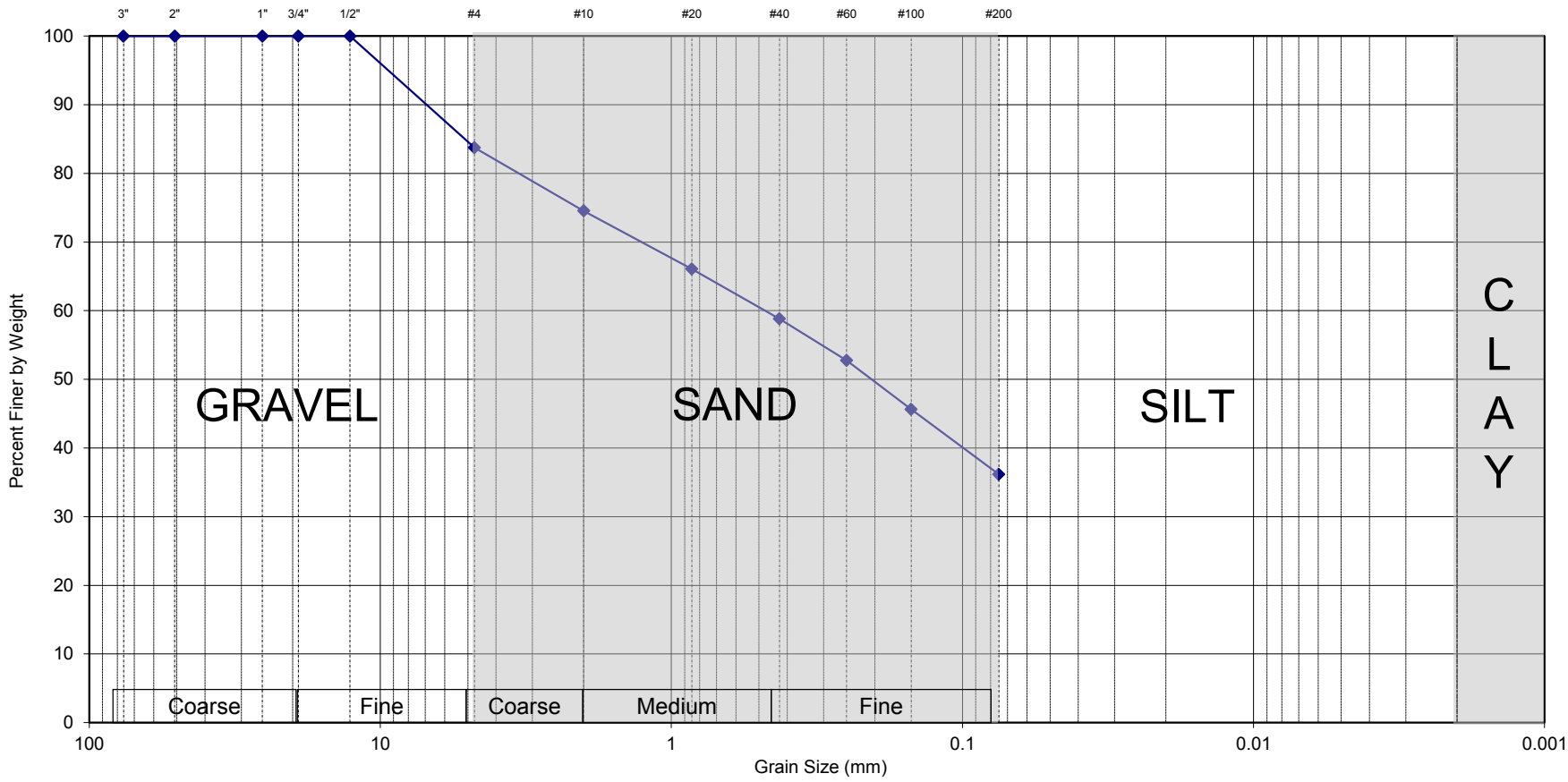
Project Manager Matthew Steele | Date 6/15/15 | Date Reviewed *6/15/2015*

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests: Natural Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	Org. %	Density: γ_d MAX (pcf) W_{opt} (%)	Strength Tests: CBR Setup as % of Proctor	CBR Dry unit wt. pcf	CBR Water Content %	CBR @ 0.1" @ 0.2"	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Laboratory Log and Soil Description
GZ-2	S-4	6-8	1	14.7			36.2										Brown f-c SAND and SILT, little fine Gravel
GZ-3	S-3	9-11	2	10.6			27.1										Brown f-c SAND, some Silt, some f-c Gravel

THIELSCH ENGINEERING
195 Frances Avenue
Cranston, RI 02910
401-467-6454

ASTM D422

U.S. STANDARD SIEVE AND HYDROMETER



Gravel	Sand	Fines
16.3%	47.6%	36.1%

Lab #	Exploration	Sample	Depth	Description	WC	LL	PL	PI
1	GZ-2	S-4	6-8'	Brown f-c SAND and SILT, little fine Gravel	14.7			

Sieve Size	% Passing
¾"	100.0
½"	100.0
#4	83.7
#10	74.5
#20	66.1
#40	58.8
#60	52.8
#100	45.6
#200	36.1

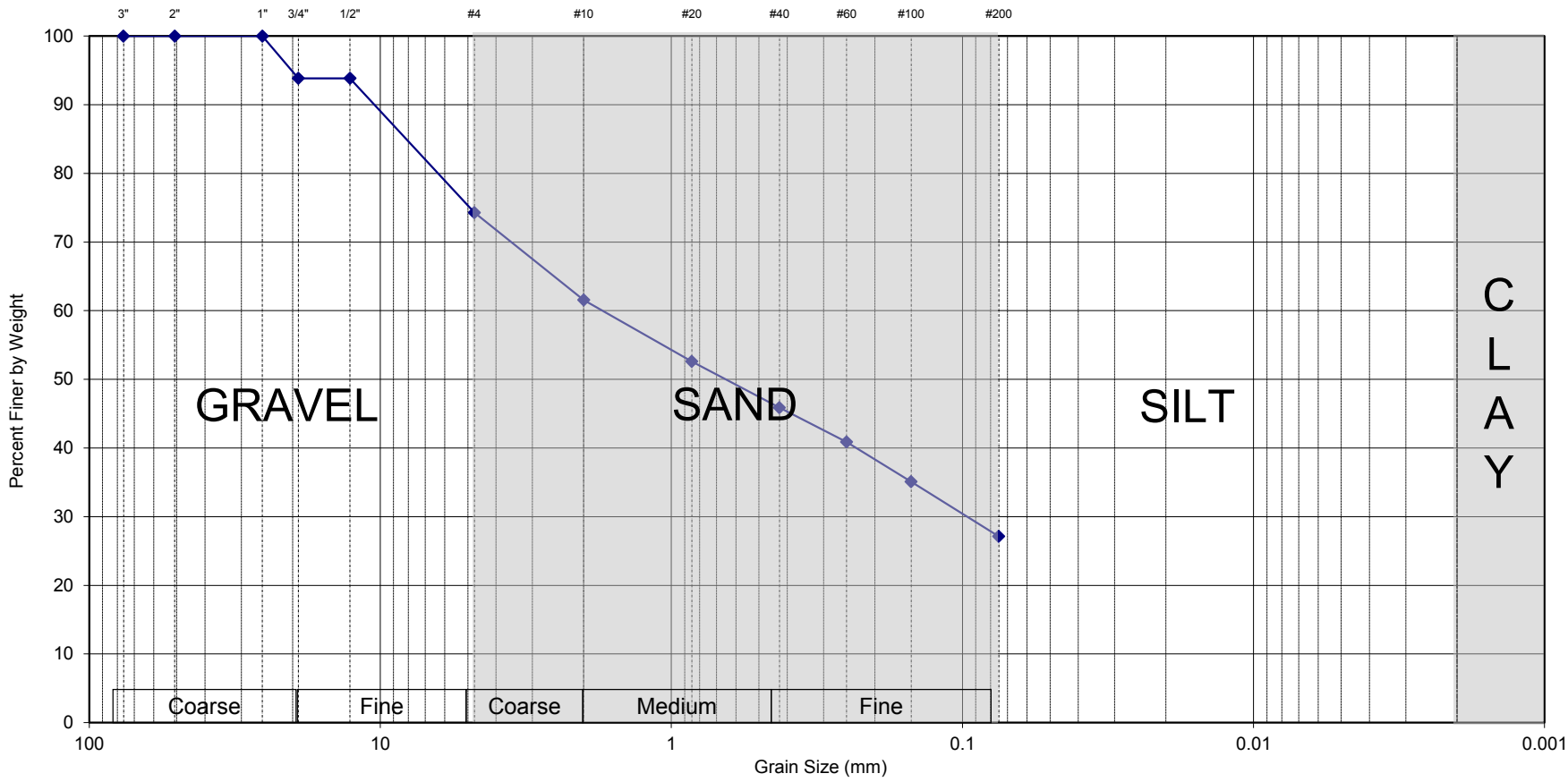
THIELSCH ENGINEERING
195 Frances Ave., Cranston, RI 02910
401-467-6454

CTS-74-15-0003
iFARM
Boxford, MA
GZA Project # 18.0172343.00

Tested by: AS/MS Date: 6/13/15
Reviewed by: MBP Date: 6/15/15

ASTM D422

U.S. STANDARD SIEVE AND HYDROMETER



Gravel	Sand	Fines
25.7%	47.2%	27.1%

Lab #	Exploration	Sample	Depth	Description	WC	LL	PL	PI
2	GZ-3	S-3	9-11'	Brown f-c SAND, some Silt, some f-c Gravel	10.6			

Sieve Size	% Passing
¾"	93.8
½"	93.8
#4	74.3
#10	61.6
#20	52.6
#40	45.9
#60	40.9
#100	35.1
#200	27.1

THIELSCH ENGINEERING
195 Frances Ave., Cranston, RI 02910
401-467-6454

CTS-74-15-0003
iFARM
Boxford, MA
GZA Project # 18.0172343.00

Tested by: AS/MS Date: 6/13/15
Reviewed by: MBP Date: 6/15/15

Appendix C
Stormwater Checklist

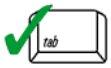
ASB
design group LLC
Civil Engineering
Traffic Engineering
Architecture
Landscape Design & Construction
363 Boston Street, Route 1
Topsfield MA. 01983
978-500-8419
www.asbdesigngroup.com

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.



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.

[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.

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

Checklist for Stormwater Report

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.

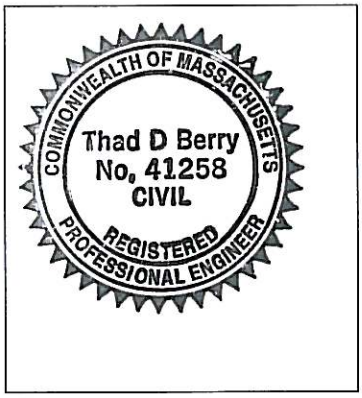
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



Thad D Berry 7/2/2015
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 for Stormwater Report

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 for Stormwater Report

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.

[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 for Stormwater Report

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 for 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 for 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.