REPORT ON
FINAL GEOTECHNICAL DESIGN EVALUATION
WATERBURY BUS MAINTENANCE FACILITY REPLACEMENT
WATERTOWN, CONNECTICUT

by

Haley & Aldrich, Inc.
Bedford, New Hampshire

for

Wendel Duchscherer Architects and Engineers
Buffalo, New York

File No. 39192-000
Revised 7 August 2014
24 July 2013

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Attention: Kirk Burzynski
Project Manager

Subject: Final Geotechnical Design Evaluation
Waterbury Bus Maintenance Facility Replacement
Wendel Project No. 3308-01C
Watertown, Connecticut

Dear Mr. Burzynski:

This report presents the results of subsurface investigations and provides geotechnical design and construction recommendations for the proposed Waterbury Bus Maintenance Facility Replacement in Watertown, Connecticut. This work was completed in accordance with our proposal revised 15 November 2012 and your subsequent authorization. The report has been revised to incorporate: comments from Connecticut Department of Transportation received by Haley & Aldrich on 24 September 2013; "Addendum – Slope Stability Assessment and Recommendations" dated 30 August 2013; "Addendum 2 – Pump Stations" dated 25 September 2013; "Addendum No. 3 – Foundation Assessments and Environmental Consultation" dated 4 May 2014; and "Review of Greenway Trail" dated 12 May 2014.

We greatly appreciate the opportunity to serve your project team. Please do not hesitate to contact us if you wish to discuss the contents of this report or any aspect of the project.

Sincerely yours,
HALEY & ALDRICH, INC.

Meghan Hatton

Meghan M. Hatton
Geotechnical Engineer

John G. DiGenova
Vice President

Enclosures

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1. INTRODUCTION

1.1 Proposed Development

The proposed construction consists of three (3) distinct buildings: Bus Storage, Bus Maintenance, and Administrative & Operations. Each building will be separated by an architectural building joint where applicable. We understand that the building as a whole is approximately 580 ft in the North-South direction and 380 ft in the East-West direction. The building will have primarily two levels (ground lower level and first floor), with the exception of two small areas where the building will have only one level (first floor) and a small area with a second level for administration. The three building levels are described below:

- A 95,185 sq. ft lower level parking area and pump room with a slab-on-grade at approximate El. 303.5 to 304 to accommodate 165 total parking spaces. The resulting maximum column loads due to the bus storage level and extended column spacing will be on the order of 800 kips.

- A 105,555 sq. ft bus storage area, a 8,660 sq. ft operations area, a 41,150 sq. ft maintenance area, and a 16,485 sq. ft service area on the first floor. The northeastern and part of the western portion of the building will not include a lower level below the first floor and will be slab-on-grade (approximate El. 316) with maximum column loads expected to be 600 kips or less.

- A 8,910 sq. ft administration area on the second floor (approximate El. 332) at the southeastern portion of the building.

- Two wet well pump stations proposed at the southern portion of the site and southwest of the site.

The above building information was provided to us in the architectural plan set titled, "330801-WBTM-ARCH-Progress SET-10-15-13" and the structural plan set titled, "WBMF Progress set" dated 12 July 2013.

Services were completed in accordance with the Connecticut Department of Transportation (CTDOT) Geotechnical Engineering Manual Section 7-2.1

1.2 Purpose and Scope

The purpose of this investigation was to characterize site subsurface soil, rock, and groundwater conditions and provide geotechnical design and construction recommendations for the proposed structure. The scope of work included the following:

- Plan, execute, and monitor a subsurface exploration program in the area of the proposed building and proposed pump stations.

- Perform geotechnical laboratory tests on soil samples recovered from subsurface explorations for determination of engineering properties required in foundation design and site development studies and aid in the classification of soils.

- Interpret the subsurface data and perform engineering evaluations of geotechnical aspects of foundation design and construction, and site development.

- Prepare this report documenting the results of the investigations and providing geotechnical design and construction recommendations.

1.3 Elevation Datum

Elevations presented in this report refer to the National Geodetic Vertical Datum of 1929 (NGVD 29).

1.4 Existing Site Conditions

The general location of the project site is shown on Figure 1, Project Locus. The site is currently undeveloped and was formerly a drive-in theater. Some portions of the parking lot and driveways are still present. The site contains numerous piles of fill and debris. Mining of sand and gravel deposits appears to be occurring north of the site. The project site is bounded by the Naugatuck River on the east and north, a railroad and Route 8 on the west, and Frost Bridge Road on the south. The existing site grades vary between approximately El. 302 and El. 310.

2. SUBSURFACE EXPLORATIONS

2.1 Recent Explorations

Nineteen (19) test borings, designated HA-1 through HA-22 (excluding HA-6, HA-9, HA-10) were drilled in the vicinity of the proposed development in support of the design during the period 18 to 25 March 2013 by Seaboard Drilling, Inc. of Chicopee, Massachusetts. As-drilled exploration locations and ground surface elevations were provided by the CTDOT. The as-drilled test boring locations are shown on Figure 2. The test borings were monitored in the field by Haley & Aldrich.

Two additional test borings, designated PS-1 and PS-2, were drilled in the vicinity of the proposed wet well pump stations on and off the site by Seaboard Drilling, Inc. of Chicopee, Massachusetts on 19 December 2013. As-drilled locations and ground surface elevations were surveyed by the CTDOT and have not yet been provided as of 14 January 2014. The test boring locations are shown on Figures 2 and 3. The test borings were monitored in the field by Haley & Aldrich.

The test boring reports are included in Appendix A. A summary of the subsurface information from these explorations is presented in Table 1.

2.2 Previous Explorations

A subsurface exploration program including twenty-eight (28) test borings was previously performed by Earth Design Associates, Inc. in March 2002 for a building of a different configuration. The previous test boring locations are shown on Figure 2.

The previous test boring reports can be found in Appendix B. A summary of the subsurface information from the previous explorations is presented in Table 2.

2.3 Geotechnical Laboratory Testing

Laboratory grain-size analyses and moisture contents were performed on sixteen (16) of the soil samples from the recent test borings to aid visual classification of in-situ soils and the evaluation of the soils for re-use as engineered fill during construction. Soil samples were submitted to GeoTesting Express of Acton, Massachusetts for testing. The results of the geotechnical laboratory testing are included in Appendix C.

3. SUBSURFACE CONDITIONS

3.1 Subsurface Soils

The subsurface explorations encountered the following generalized soil strata at the site, in order of increasing depth below ground surface. Some strata may be missing, or in a different order, at particular locations. Location-specific descriptions are provided on the attached logs.

Topsoil or Asphalt – Some of the borings encountered a thin layer of topsoil or asphalt at the ground surface, up to 1 ft thick in some areas.

Fill – Fill was encountered in forty-one of the forty-six total borings at depths ranging from 0 to 1 ft below existing ground surface (approximate El. 306 to 300.9). The fill ranged in thickness from 0.5 to 14 ft and consisted of very loose to very dense brown coarse to fine SAND with varying amounts of gravel, silt, and organic fibers/roots. The fill appears to be associated with the former site development.

Alluvium – Beneath the fill some of the recent explorations encountered alluvium, with thicknesses between 1.5 and 10 ft. Eighteen of the nineteen recent borings encountered the alluvium at depths between 0 and 2.5 ft below existing ground surface (approximate El. 304 to 300). Note that previous borings by others did not identify the alluvium and that if present it was likely described as fill. Boring HA-21 did not fully penetrate the alluvium and was terminated 10 ft into the layer (El. 294). The alluvium typically consisted of very loose to very dense brown medium to fine SAND with varying amounts of silt and gravel. **The upper portions of the alluvium contained dark brown fine SAND and SILT with organic material**. Boring locations HA-18 and HA-21 encountered GRAVEL with varying amounts of silt and sand in the alluvium.

Glaciofluvial Deposits – Forty-five of the forty-six borings encountered glaciofluvial deposits at depths ranging from 2 to 14 ft below existing ground surface (approximate El. 301 to 290). The borings extended 4.5 to 66 ft into the glaciofluvial deposits (El. 294 to 231), but none of the borings, apart from HA-11, penetrated through the entire glaciofluvial layer. The glaciolfluvial deposits typically consisted of loose to very dense brown coarse to fine SAND with varying amounts of gravel and silt, and GRAVEL with varying amounts of sand and silt. Some samples included brown SILT with varying amounts of sand and gravel.

Glacial Till Deposits – One boring, HA-11, encountered suspected glacial till deposits at a depth of approximately 72.5 ft below existing ground surface (El. 231). The boring was terminated after extending 26 ft into the glacial till (El. 205). The glacial till consisted of very dense brown medium to fine SAND with varying amounts of silt and gravel with cobbles and boulders.

3.2 Groundwater

Groundwater levels were observed in forty-four of the forty-six borings during or shortly after drilling. Measured groundwater levels typically varied between 4 and 13.5 ft below ground surface (El. 301 to 288.5).

Groundwater depths in test borings may not be representative because they are influenced by drilling methods. Water levels can be expected to vary with seasonal changes, precipitation, fluctuation in

nearby river level, snow melt, construction activities, and other factors. As a result, water levels encountered during and following construction may differ from those encountered in the explorations.

3.3 Field Hydraulic Conductivity Testing

Field hydraulic conductivity testing was performed at two boring locations (HA-16 and HA-17) in the areas of the proposed storm water detention basins. The testing was conducted using the falling head method in cased boreholes. Test results are summarized in Table 3.

4. GEOTECHNICAL ENGINEERING RECOMMENDATIONS

4.1 Foundation and Slab Design

4.1.1 Design Methodology

Recommendations in this report are in general accordance with the requirements of the State of Connecticut Building Code (including the 2009 Amendment) and the CTDOT Geotechnical Design Manual. Engineering calculations have been performed in accordance with Allowable Strength Design methods (ASD) which is the standard for building projects. Bearing capacity, settlement, and global stability calculations for the building and site retaining wall are presented in Appendices D, E, and F.

4.1.2 Foundation Type Assessment

Haley & Aldrich made an assessment of potential foundation options, presented in our "Waterbury Bus Maintenance Facility – Foundation Assessments Memorandum," dated 9 May 2014. In summary, several foundation options were reviewed and assessed, i.e., Rammed Aggregate Piers, Rapid Impact Compaction, Deep Dynamic Compaction, Concrete Filled Steel Pipe Piles, and Precast Concrete Piles. Based upon several meetings with the team design and CTDOT, Rapid Impact Compaction (RIC) in conjunction with spread footing foundations was selected.

4.1.3 Foundation Design Criteria

The existing undocumented fill soils and organic alluvium (upper portion) in their current condition are not suitable for foundation support. The RIC will densify these materials in-place and provide for suitable bearing. Reinforced concrete spread footings supporting building walls, columns and other structural elements should bear on a minimum of 1 ft of Compacted Granular Fill CTDOT M.02.01 above RIC stabilized soils.

Recommendations for RIC stabilized foundation system are presented below:

- Description – RIC consists of the densifications of shallow soils using a hydraulic hammer that repeatedly strikes the ground. Soils can be effectively compacted to depth of about 10 to 15 ft beneath existing grades.
- Allowable bearing capacity = 4 ksf
- Cut/Fill Impact: Requires 1 ft of removal of soils for the placement of a 1 ft thick working pad of imported Compacted Granular Fill CTDOT M.02.01.
- Prior to placing the 1 ft thick working pad of imported Compacted Granular Fill the subgrade should be observed by the geotechnical engineer and any unsuitable materials removed and replaced with Compacted Granular Fill.
- Areal Extent of Improvement – Main Building Area: Zone A (entire zone footprint plus an additional 6 ft horizontally), Zone B (entire zone footprint plus an additional 4 ft horizontally), Zone C (entire zone footprint plus an additional 15 ft horizontally). The vertical extent of removal and replacement should be as follows:

  - Zone A – to El. 298

- Zone B – to El. 298
- Zone C – to El. 302

- In addition to the main building area, other areas to receive soil improvement by RIC are identified as follows: Two garage entranceway retaining walls (Zone A extents to be applied); retaining wall connected to the building to the west (Zone A extents to be applied); and areaway retaining wall to the north (Zone B extents to be applied).
- The RIC contractor shall design their soil improvement system for an allowable bearing capacity of at least 4 ksf and to limit total static settlement to be 1 in. or less, with differential settlements between individual footings, or within a 30-ft distance along a continuous strip footing, not exceeding about 0.5 in.
- Vibration monitoring should be completed at the start of RIC to verify that vibrations are within acceptable limits. The RIC should limit vibrations to less than 0.75 inches per second at all points along the property line. The Contractor shall continuously monitor vibrations during RIC using three-dimensional seismographs. At least three seismographs shall be employed at all times during the RIC Work.
- Densification of the subsoils should be verified through a post-ground improvement soil boring program consisting of geotechnical test borings using comparable drilling equipment and drilling techniques used in this exploration program (see test boring reports). The post-ground improvement test borings should yield Standard Penetration Test (SPT) N-values that represent an improved bearing condition in soils above the water table. The level of soil improvement required will be assessed based upon the selected RIC contractor's submittal and the level of improvement they deem necessary to meet the settlement and bearing capacity criteria specified.
- This system of ground improvement is proprietary and usually performed on a design-build basis. The requirements of the design should be identified in a performance specification for the project. Thus, the design-build earthwork Contractor should submit their proposed design for review, comment, and potential modification. The above RIC detailing will be transmitted in the Contract Documents in a special provision prepared by Haley & Aldrich.

We understand that Haley & Aldrich will provide full-time monitoring during the RIC and other earthwork activities related to preparation of bearing surfaces.

General foundation recommendations are presented below:

- Footings bearing in soil with a least lateral dimension (width) of at least 3 ft may be designed using a maximum net allowable bearing pressure of 4 ksf. For footings in soil with a least lateral dimension less than 3 ft, the maximum allowable bearing pressure should be reduced to a value equal to one third of the bearing pressure multiplied by the least lateral dimension of the footing in feet. For example, a 2-ft wide footing on soil should be designed using a reduced allowable bearing pressure equal to 1/3 x 2 ft x 4 ksf = 2.66 ksf.

- Footings should have a least lateral dimension of 18 in. or greater.

- Bottom of footings bearing in soil should be positioned at least 3.5 ft below adjacent ground or slab surface exposed to freezing. Footings in heated interior locations should bear at least 18 in. below the adjacent slab surface. Please see Section 4.1.4 for

additional depth requirements for those footings that could be impacted by scour during flood events.

- Footings should be positioned to bear below a reference line drawn upward and outward on a 1.5 horizontal to 1 vertical (1.5H:1V) slope from the bottom of any adjacent utilities or other underground structures.

- For loading combinations which include transient loads such as seismic and wind loads, the maximum allowable bearing pressure may be increased by 33 percent (maximum pressure caused by static portion of the loads limited to 4.0 ksf).

4.1.4 Flood Scour from Adjacent River

We note that a formal scour study has not been completed for the project.

The adjacent Naugatuck River may impact the footing performance if water levels reach the 500-year flood plan elevation (about El. 310.5). For those footings that may be impacted by flow/scour during flooding events, the bottom of footing elevation should be increased by 1 ft below frost depth (total depth of 4.5 ft).

4.1.5 Settlement

For footings designed and constructed as recommended herein, we estimate total static settlement will be 1 in. or less, with differential settlements between individual footings, or within a 30-ft distance along a continuous strip footing, not exceeding about 0.5 in. Settlements are expected to occur relatively concurrent with load application.

4.1.6 Floor Slab

The ground floor slab will be subject to frost which may heave the floor slab. If these conditions are not acceptable then a full depth slab section (3.5 ft thick) will be required. The full depth slab section would consist of 6 in. thick concrete slab over 8 in. thick Compacted Granular Fill (Bank or Crushed Gravel) CTDOT M.02.01 over 28 in. thick free draining material CTDOT M.02.07

Assuming that the risk of misalignment is acceptable, design the lowest floor to be a soil-supported slab-on-grade bearing on a minimum 8-in. thickness of Compacted Granular Fill. Design for a modulus of subgrade reaction of 150 lbs. per cu. in.

Any topsoil, bituminous concrete, and other deleterious materials should be removed below floor slabs. Existing underground structures, foundations, and utilities should be removed within 4 ft below the bottom of lowest floor slabs. Backfill excavations made to remove utilities and existing structures with Compacted Granular Fill. Portions of underground utilities that will remain below or within 10 ft of proposed structure footprints should be abandoned in-place by capping and filling with cement grout.

Prior to placing Compacted Granular Fill, exposed subgrades should be vigorously compacted with a minimum of eight passes of vibratory compaction equipment imparting a minimum dynamic force of 20 tons and until the subgrade is observed to be firm and stable. If soft or

unsuitable material is encountered at the subgrade, we recommend that the unsuitable material be over-excavated and replaced with Compacted Granular Fill and the entire subgrade re-compacted until a firm and stable surface is achieved.

A minimum 4-in. thickness of Compacted Granular Fill should be provided between tops of footings and the bottom of slabs.

4.2 Seismic Design

The soils at the site are generally considered to be not liquefaction susceptible during the design earthquake. A site class definition of D is recommended, in accordance with the State Building Code. Site coefficients Fa = 1.6 and Fv = 2.4 may be used in design.

4.3 Building Permanent Foundation Drainage and Dampproofing

Water was observed between El. 301 and 288.5 during and shortly after drilling at the boring locations. We anticipate that groundwater will most likely be encountered during excavations for the lower level parking areas. We recommend a design groundwater level of El. 303.5 (finished floor at ground level).

- In general, where finished floor slab elevations are less than 2 ft below the adjacent exterior ground surface, the risk of hydrostatic pressures and infiltration through walls is small. In such cases, permanent foundation drains are not considered necessary; however, measures should be taken to seal construction joints or other potential water leakage points for the below-grade portion of the exterior walls.

- When the final adjacent exterior grade is greater than 2 ft above the lowest slab elevation, perimeter foundation drains should be provided at the base of the exterior foundation or basement wall. The foundation drains should consist of a continuous, perforated drain pipe installed at the base of the backfilled side of the wall (or wall footing), freely draining backfill against the below-grade walls, and damp-proofing of the exterior of walls.

  - The drain pipes should consist of 6 in. diameter continuous, perforated SCH 40 PVC, or equivalent drain pipe, laid with a pitch of at least 0.1 percent downward toward the discharge points, completely surrounded by a 6 in. zone of Crushed Aggregate CT DOT M.01.01 No. 6. The drain pipe should be positioned besides the footing, with invert elevation between the bottom of footing and 4 in. below the underside of the adjacent interior slab.

  - Backfill within 2 ft laterally of the exterior walls and for 12-in. over the footing to the drain pipe should consist of Crushed Aggregate CTDOT M.01.01 No. 6.

  - The drain pipe and Crushed Aggregate area should be separated from the surrounding soil by a 6 oz. per sq. yd. non-woven geotextile.

- The perimeter piping should be designed to provide redundant flow paths from each system to the sump or other discharge point(s). Cleanouts extending from the drain pipes to ground surface or the slab, as applicable, should be provided at layout corners or terminations to facilitate maintenance. The design should prevent backflow of site stormwater or roof runoff into the subsurface drain systems.

Ideally, water collected by the foundation drainage systems should be directed in pipes by gravity away from the building to the site storm water system.

- The final layout of the perimeter drains and tie-ins should be coordinated with the foundation design and the other site utilities. Sizing of the sump pit, pump design and other mechanical elements of the system, as required, should be completed by the project's MEP consultant.

- Caulking, waterstops or similar permanent seal should be provided at all foundation wall construction joints.

We assume that others will obtain any necessary permit(s) to enable permanent discharge to the site storm water system.

Foundation and basement walls should be dampproofed and insulated in accordance with the Building Code.

Elevator pits, mechanical pits and other small depressions beneath the basement should be waterproofed and designed to resist hydrostatic pressures corresponding to a groundwater level equal to the adjacent floor elevation and possibly the flood elevation (if required). Cementitious or ironitic waterproofing installed on the interior sump pit surfaces is recommended.

As an additional measure, surface runoff should be directed away from the building. In general, the ground surface immediately around the building should be sloped downward away from the structure to divert surface runoff. To limit surface water infiltration into the drainage system, it is recommended that the upper 8 in. of backfill within 10 ft of the building, in unpaved areas, consist of topsoil or other soil having low permeability.

4.4 Lateral Earth Pressures

Building foundation walls serving as retaining walls should be designed in accordance with the applicable below-listed lateral pressures. These recommendations assume that the walls are drained full height, including a perimeter drain at the base of the wall, as recommended herein. The height of the wall (H) herein is defined as the distance in feet between exterior site grade and the top of the footing.

Backfill behind basement building walls and site retaining walls should consist of a minimum 2 ft thick layer of free draining fill consisting of Crushed Aggregate CT DOT M.01.01 No. 6. as described in Section 4.3 above.

For seismic loading conditions, walls should be designed to resist static earth plus seismic pressures. Surcharge pressures do not need to be considered for seismic design unless the surcharge will be applied over an extended time.

The recommended minimum factors of safety against sliding and overturning under static loading conditions are 1.5 and 2.0, respectively. The recommended minimum factors of safety against sliding and overturning under seismic loading conditions are 1.3 and 1.5, respectively.

We recommend that the structural drawings in the construction contract document package include a note indicating the sequence of wall construction (and more importantly restrictions on its backfilling).

For restrained walls, we recommend a note be provided on the drawings that indicate the section(s) of floor slab(s) and framing required to be in-place prior to placement of backfill above a certain elevation behind the wall. Additionally, a note should be provided that cautions against future penetrations in floor slabs or framing that may compromise the lateral stability of the wall without appropriate engineering. For unrestrained walls, we recommend a note be provided that indicates the elevation to which backfill should be placed behind the wall prior to erecting steel on top of the wall.

4.4.1 Restrained Walls (At Rest)

Design walls that are braced at the top and bottom for the following lateral pressures:

- Static Earth: Equivalent fluid unit weight equal to 55 pounds per square foot (psf) per foot depth applied to the bottom of the footing.
- Seismic: Inverted triangular pressure applied over the height of the wall (H) with a magnitude of 7H (psf) at the top of the wall.
- Surcharge: Uniform pressure applied from the elevation of the surcharge to the top of footing with a magnitude of 0.5q (psf), where q is the vertical surcharge pressure (psf).

4.4.2 Unrestrained Walls (Active)

Design walls that are free to deflect at the top of the wall (i.e., are not braced) for the following lateral pressures:

- Static Earth: Equivalent fluid unit weight equal to 35 psf per foot depth applied to the bottom of the footing
- Seismic: Same as for restrained walls.
- Surcharge: Same as for restrained walls except with a magnitude of 0.3q.

4.5 Resistance to Lateral Loads

Lateral loads may be resisted using friction between footing bases and underlying bearing materials. The resistance to lateral loads provided by friction between footing concrete and underlying Glaciofluvial or Compacted Granular Fill should be calculated using a coefficient of friction (ultimate) equal to 0.55.

4.6 Utilities

Utilities may be soil-supported, bearing in the existing fill soils, in naturally deposited soils or in newly-placed compacted fill, following the removal of unsuitable bearing materials if encountered during construction. Underslab utilities should be located above foundation bearing levels or outside the Zone of Influence below adjacent footings.

4.7 Detention Basins

The storm water detention basins will be at the southern portion of the site with bottom elevations at approximately El. 293 and El. 290. Field hydraulic conductivity values ranged from 1.6 x 10^{-04} to 5.6 x 10^{-04} cm/sec.

4.8 Pavements

Materials exposed at anticipated pavement subgrade elevations will consist of miscellaneous fill soils. These soils generally consist of sand and gravel in varying proportions with traces and/or pockets of miscellaneous debris from the existing foundation slabs. The majority of these materials would be considered to have low to moderate frost-susceptibility, typically containing about 10% fines or less. Pockets and zones of siltier materials may be encountered and could be moderately frost susceptible. Consequently, there is some risk that paved areas could experience some frost heaving and vertical misalignment where they are directly underlain by these soils within the depth of frost protection. To avoid risk of any frost-induced heaving, a full-depth (3.5 ft frost depth potential) non-frost susceptible pavement section would be required, which is not commonly provided in this area. If a non-frost susceptible subgrade is desirable to the owner, the total pavement sections presented below should incorporate a clean sand layer (less than 5% fines) beneath the proposed sections to increase the total section to a thickness of 3.5 ft.

The recommendations provided herein assume some risk of settlement due to the presence of fill soils beneath the pavements and the relatively high traffic loads from bus traffic for a relatively high design life (20 years). We anticipate that these effects will be tolerable, but will likely require repair and maintenance of pavements before reaching the end of the pavement's expected useful life.

The following minimum pavement sections are recommended:

<u>Standard-duty Flexible Pavement (auto traffic only):</u>

Pavement: 4 in. thickness (1.5 in. wear course HMA S0.375, 2.5 in. binder course HMA S0.5)
Base: 14.0 in. Processed Aggregate Base CTDOT Section M.05.01

<u>Heavy Duty Flexible Pavement (mixed auto and bus traffic):</u>

Pavement: 7.5 in. thickness (1.5 in. wear course HMA S0.375, 6 in. binder course HMA S0.5)
Base: 12 in. Processed Aggregate Base CTDOT Section M.05.01

<u>Heavy Duty Rigid Pavement (mixed auto and bus traffic):</u>

Pavement: 6 in. Portland Cement Concrete
Base: 12 in. Processed Aggregate Base CTDOT Section M.05.01

The above sections are based on our experience for typical facilities of this type. If actual bus and auto traffic counts are provided a more detailed assessment could be made. Should the Contractor encounter soft subgrade conditions or poorly-compacted existing fill during construction, use of geogrid for subgrade improvement, such as Tensar BX-1100 or other approved subgrade-improvement technique may be necessary to achieve stable pavement subgrades.

The pavement recommendations also assume that a stable, firm subgrade is achieved beneath the base and subbase courses, and that the subgrades are prepared as recommended in this report.

4.9 Site Retaining Walls

A cast-in-place cantilever site retaining wall is planned at the west side of the site. We understand that this wall type was selected due to the proposed utilities corridors at the site and geometric site constraints. The following wall configurations are proposed:

- West Side Site Retaining Wall is about 1,000 lf long with a height varying from about 11 to 18 ft.

The overall global stability factor of safety and the bearing capacity factor of safety were both above the respective required values of 1.5 (global) and 2.5 (bearing capacity). The retaining walls should be founded at 3.5 ft below adjacent grades for frost. Global stability calculations for the proposed retaining wall are presented in Appendix F.

The existing undocumented fill soils and organic alluvium (upper portion) are not suitable for foundation support for retaining walls. Footings should bear on naturally-deposited inorganic alluvium (lower portion) or naturally-deposited glaciofluvial soils. We recommend the wall be constructed on a prepared 1 ft thick pad of Compacted Granular Fill (Bank or Crushed Gravel) CTDOT M.02.01.
The backfill beneath the foundations should consist of Compacted Granular Fill placed in controlled lifts up to the bottom of the footing. Prior to placing Compacted Granular Fill, exposed subgrades should be compacted with a minimum of eight passes of vibratory compaction equipment imparting a minimum dynamic force of 20 tons and until the subgrade is observed by the Project Engineer to be firm and stable. If soft or unsuitable material is encountered at the subgrade, we recommend that the unsuitable material be over-excavated and replaced with Compacted Granular Fill and the entire subgrade re-compacted until a firm and stable surface is achieved.

- Footings bearing in soil with a least lateral dimension (width) of at least 3 ft may be designed using a maximum net allowable bearing pressure of 4 ksf. For footings in soil with a least lateral dimension less than 3 ft, the maximum allowable bearing pressure should be reduced to a value equal to one third of the bearing pressure multiplied by the least lateral dimension of the footing in feet. For example, a 2-ft wide footing on soil should be designed using a reduced allowable bearing pressure equal to 1/3 x 2 ft x 4 ksf = 2.66 ksf.

- Footings should have a least lateral dimension of 18 in. or greater.

- Footings should be positioned to bear below a reference line drawn upward and outward on a 1.5 horizontal to 1 vertical (1.5H:1V) slope from the bottom of any adjacent utilities or other underground structures.

- For loading combinations which include transient loads such as seismic and wind loads, the maximum allowable bearing pressure may be increased by 33 percent (maximum pressure caused by static portion of the loads limited to 4.0 ksf).

- Wall backfill materials, lateral loading on the retaining wall and resistance to lateral loads are presented in Sections 4.4 and 4.5.

4.10 Northern and Eastern Slopes and Retaining Walls

Man-made slopes up to 3H:1V are proposed to extend along the majority of the northern and eastern portions of the site. An approximate 325 ft long modular block Mechanically Stabilized Earth (MSE) wall is proposed at a portion along the toe of the eastern slope. An approximate 10 ft wide bike trail is proposed just east of the proposed MSE wall. The proposed bike trail will situated south-north at the eastern portion of the site along the river.

We recommend that the northern and eastern slopes be armored for scour protection. The bottom 4 ft of the slope should be armored with a minimum two ft thick layer of M12.02 Modified Rip-rap underlain by a non-woven medium-duty geotextile fabric. At the toe of the slope, M12.02 Standard Rip-Rap should be keyed in by providing a 3.5 ft deep by 3.5 ft wide key underlain by a non-woven medium-duty geotextile. The limits of the slope armor should extend along the north and east sides of the site. The exposed slope surface should be appropriately vegetated.

Global stability for the proposed northern and eastern slopes and retaining walls was analyzed for the following cases:

- Normal water level base conditions (Static and Seismic)
- Water levels at the 100 year flood (Static)
- Water levels at the 500 year flood (Static)
- Water levels after the flood levels have receded for the 100 year flood (Static) – rapid drawdown condition
- Water levels after the flood levels have receded for the 500 year flood (Static) – rapid drawdown condition

Two sections of the northern and eastern slope and wall systems were analyzed at the locations shown on the sketch provided in Appendix G.

Section 1 was estimated to be the steepest section of the slope with only a short wall near the bottom of the slope. The following global stability factors of safety were calculated (Bishop and Spencer Methods) for Section 1.

Case	Design Water Elevation Crest	Design Water Elevation Toe	Factor of Safety
Base Case – Static	298	295	2.3
Base Case – Seismic	298	295	1.5
100 Year Flood – Static	302	300	2.3
100 Year Flood Rapid Drawdown - Static	302	295	2.3
500 Year Flood – Static	312.5	310.5	1.8
500 Year Flood Rapid Drawdown - Static	312.5	295	1.2

Global stability outputs for the slope/wall system at Section 1 are included in Appendix G. A factor of safety of 1.5 or greater is considered acceptable for the static cases. A factor of safety of 1.1 or greater is considered acceptable for the seismic and rapid drawdown cases since they are unlikely events.

Section 2 included the highest portion of the proposed MSE wall. Internal stability should be assessed by the proprietary MSE wall designer. Our analyses included bearing resistance, overturning, sliding, and global stability for this wall system.

The following global stability factors of safety were calculated (Bishop and Spencer Methods) for Section 2.

Case	Design Water Elevation Crest	Design Water Elevation Toe	Factor of Safety
Base Case – Static	298	295	2.5
Base Case – Seismic	298	295	1.5
100 Year Flood – Static	302	300	1.9
100 Year Flood Rapid Drawdown - Static	302	295	1.9
500 Year Flood – Static	312.5	310.5	2.1
500 Year Flood Rapid Drawdown - Static	312.5	295	1.3

Global stability outputs and the external stability analyses for the slope/wall system at Section 2 are included in Appendix G.

4.11 Pump Stations

Two pump stations are proposed at the southern portion of the site and southwest of the site east of Frost Bridge Road. At this time the proposed bottom elevations of the wet well pump stations are unknown. Subsurface conditions encountered at the pump stations consisted of:
Pump Station Location PS-1

- Fill – approximately 1 ft thick consisting of medium dense SAND with varying amounts of silt and gravel.
- Alluvium – approximately 6 ft thick consisting of loose to medium dense sandy SILT with organics.
- Glaciofluvial Deposits – approximately 30 ft thick consisting of loose to very dense sandy GRAVEL and medium to fine SAND with varying amounts of silt.

Pump Station Location PS-2

- Topsoil – approximately 0.5 ft thick.
- Fill – approximately 9.5 ft thick consisting of medium dense to dense SAND with varying amounts of gravel and silt. Cobbles and boulders were noted from 1 to 10 ft.
- Glaciofluvial Deposits – approximately 17 ft thick consisting of medium dense to very dense medium to fine SAND with varying amounts of silt.

We recommend the following applicable design parameters for the pump station structures:

Angle of Internal Friction of Soil, ϕ	32 degrees
At-Rest Earth Pressure, K_o	0.47
Active Earth Pressure, K_a	0.30
Design Groundwater Level	At Ground Surface
Friction Factor Between Concrete and Soil, $\tan\delta$	0.45

The wet well structures should bear on naturally-deposited inorganic alluvium (lower portion) or naturally-deposited glaciofluvial soils.

Uplift of the pump station structures could be resisted by the buoyant weight of the structures, by increasing the footprint of the base slab and utilizing the buoyant weight of the soils above the base slab, and/or utilizing the side friction of the concrete. An uplift factor of safety of at least 1.3 should be applied.

4.12 Other Development Considerations

No peat or other compressible soils were encountered in the explorations that could cause time-related ground settlement or other similar site development concerns.

5. CONSTRUCTION CONSIDERATIONS

5.1 General

This section of the report discusses geotechnical construction-related issues to provide guidance to those responsible for preparing construction contract documents. Prospective contractors should evaluate construction issues on the basis of their own experience and taking into account their own construction methods.

5.2 Excavation and Dewatering

Soil excavations will be required to reach design subgrades for the ground floor level. It is anticipated that excavation of soil materials can be accomplished by open cut excavations.

All temporary sloping, benching, excavation support, and excavation activities must conform to the requirements of OSHA and all other applicable local, municipal, state, and federal regulations. The soils at the project site are considered Type C based on OSHA 29 CFR Part 1926. Dewatered, temporary soil slopes of 1.5H:1V, or flatter, appear appropriate in the fill and natural soils but should be confirmed during construction based on conditions at the time of excavation.

Excavations for foundations, especially in the lower level area, could encounter groundwater depending on season and recent precipitation. Soil excavation may release pockets of perched water. Dewatering systems should be designed and operated to prevent pumping of fines, disturbance to subgrades, and undermining of previous construction. Groundwater should be maintained a minimum of 2 ft below the expected working elevation. We anticipate that dewatering may be accomplished using a system of deep wells, well points and/or sumps and pumps depending upon the extent of dewatering at the time of construction. Effective dewatering of excavations is the sole responsibility of the Contractor.

Dewatering effluent should be discharged into on-site excavations for recharge into the ground, if possible. Any effluent discharged to municipal systems must be discharged in accordance with regulatory requirements, and may require discharge (likely NPDES) permits depending on where the discharge is routed.

Excavations should be performed to direct accumulated water away from work areas to sump locations. Subgrades which become disturbed due to water infiltration should be re-excavated and stabilized. Stabilization methods may include placement of crushed stone and filter fabric and placement of thin lean concrete mud mats with approval of the CTDOT.

All filling, final excavation, subgrade preparation, and foundation construction should be conducted “in the dry.” Fill which is placed during the day should be fully compacted and smooth rolled at the end of the work day to protect the completed work.

Surface water should be directed away from excavations and should be removed promptly from exposed subgrades. Measures should be taken to avoid accumulation of surface water within the excavations or on soil subgrades, as they are susceptible to disturbance in the presence of water.

5.3 Existing Utilities and Slabs

The presence of slab and utilities from previous and existing structures, and associated construction debris, should be anticipated during excavation work and will need to be carefully removed to limit disturbance to underlying soils. In general, remnants of prior structures and utilities should be removed within the Zone of Influence beneath new foundations. Voids left by the removal of these foundations, utilities, etc. should be replaced with Compacted Granular Fill or lean concrete in the areas beneath the proposed structure. It may be acceptable to leave certain existing foundation or slab elements beneath the new structure, depending on actual conditions exposed in the field and the judgment of competent CTDOT personnel at the time of construction. Such determinations would have to be made on a case-by-case basis after the conditions are exposed during construction.

5.4 Excavation of Unsuitable Soil

As noted above, the existing fill material and upper portions of the alluvium are considered unsuitable for building foundation support and should be removed within the Zone of Influence of new foundations. These excavations to remove and replace soils may encounter groundwater. Dewatering systems should be operational to lower the groundwater in these areas prior to excavation; otherwise, subgrades may become saturated and unstable, necessitating further removal and replacement.

5.5 Preparation and Protection of Bearing Surfaces

5.5.1 Footing Foundations

After final excavation, the exposed subgrade soils should be observed in the field by an experienced competent geotechnical engineer to confirm the assumed foundation bearing conditions. It may be necessary to over-excavate and replace locally weak, disturbed or otherwise unacceptable foundation bearing materials. Final excavations in soil should be made by smooth-bladed equipment or by hand, to limit disturbance to the subgrades.

Following excavation to the suitable naturally-deposited bearing stratum or Compacted Granular Fill (placed as part of the removal and replacement Section 4.1.2), the exposed soil surfaces should be recompacted with a minimum of two passes with a small hand-guided vibratory roller or plate compactor prior to placing Compacted Granular Fill. This compaction requirement may be waived by the geotechnical engineer if it is judged to result in deterioration of the subgrade soils due to the presence of water. If weaving or other disturbance is noticed during recompaction, vibratory recompaction should be discontinued and alternate compaction procedures should be conducted.

In general, the bearing soils are expected to be susceptible to disturbance by water and worker traffic. Care should be taken to prevent surface water from collecting on exposed bearing surfaces. Worker and equipment traffic over bearing surfaces should be minimized.

Deeper subgrades, at or near the groundwater level could be protected by use of a thin, 3 in. thick mud mat consisting of lean concrete or a combination of geotextile and a minimum 6-in. thickness of compacted crushed stone fill. The decision to use these stabilization techniques should be made by competent CTDOT personnel.

5.5.2 Slabs

The slab excavation subgrades should be prepared in the manner recommended above for footing excavation subgrades Section 4.1.2. The area should then be backfilled with Compacted Granular Fill in controlled lifts to achieve the design slab subgrade elevation, including placement of the 8-in. base layer of Compacted Granular Fill directly beneath the slab.

5.5.3 Protection from Freezing

The natural soils and fill materials should be considered low to moderately frost susceptible. Soil bearing surfaces below foundations and slabs must be protected against freezing, before and after concrete placement. If construction is performed during freezing weather, footings on soil should be backfilled to a sufficient depth (up to 3.5 ft) as soon as possible after they are constructed. Alternatively, insulating blankets, lowering of footings, use of heating tubes or other means may be used for protection against freezing. In general winter construction in Connecticut will incur significantly higher earthwork costs.

5.6 Filling and Backfilling

Backfill in the building area should be placed and compacted in lifts as soon as possible after final excavation to limit disturbance to the bearing surfaces.

We recommend that Compacted Granular Fill be used as fill and backfill beneath footings and slabs. Where backfill is needed below soil supported footings, Compacted Granular Fill should be placed within the Zone of Influence of the footings. It may be feasible to use suitable compacted Borrow in lieu of Compacted Granular Fill beneath slabs (not footings), except for the uppermost 8-in. thick layer. The suitability of using Borrow beneath slabs should be judged based on the nature of the proposed fill material, construction conditions, and the care exercised by the Contractor. Soil containing greater than 10 percent by weight finer than a No. 200 sieve should not be used to backfill the inside of foundation walls unless the walls are fully insulated to prevent freezing temperatures from penetrating the walls.

Except for zones requiring special backfill such as directly beneath pavements, exterior slabs, or other ancillary structure features, the exterior of foundation walls and other site areas may be backfilled with Borrow.

Placement of compacted fills should not be conducted when air temperatures are low enough (approximately 30ºF, or below) to cause freezing of the moisture in the fill during or before placement. Fill materials should not be placed on snow, ice or uncompacted frozen soil. Compacted fill should not be placed on frozen soil. No fill should be allowed to freeze prior to compaction. At the end of each day's operations, the last lift of fill, after compaction, should be rolled by a smooth-wheeled roller to eliminate ridges of uncompacted soil.

Recommended compaction requirements are as follows:

Location	Minimum Compaction Requirements (See note below)
Beneath and around footings, beneath slabs	95 %
Parking, roadways and sidewalks	92 % up to 3 ft below finished grade 95 % in the upper 3 ft
Constructed Slopes (with no ancillary surface features)	92 %
Landscaped areas	90 % nominal compaction

Minimum compaction requirements refer to percentages of the maximum dry density determined in accordance with ASTM D1557.

Compacted Granular Fill and Borrow should be placed in lift thicknesses not exceeding 12 in. loose measure. Compaction equipment in open areas should consist of large self-propelled vibratory rollers. In confined areas, hand-guided equipment such as a large vibratory plate compactor can be used and the loose lift thickness should not exceed 6 in.

A minimum of eight systematic passes of the compaction equipment should be used to compact each lift unless otherwise indicated.

5.7 Compacted Granular Fill

Compacted Granular Fill beneath footings and building slabs should consist of bank-run sand and gravel, free of organic material, snow, ice, or other unsuitable materials and should consist of CTDOT Compacted Granular Fill (Bank or Crushed Gravel) CTDOT M.02.01 Grading A. Other materials could be acceptable for Compacted Granular Fill, and should be evaluated by the CTDOT personnel on a case-by-case basis if proposed by the Contractor.

5.8 Borrow

Borrow is defined by CTDOT 2.07. Additionally the Borrow should be able to be readily placed and compacted. Silty Borrow soils may require moisture control during placement and compaction.

5.9 Reuse of Excavated Soils

It is expected that the majority of excavated material will consist of sand and gravel fill with deleterious materials intermixed. The cleaner portions of the excavated soils that do not contain deleterious materials could potentially be reused as Borrow pending approval by the competent CTDOT for the intended application. These materials are likely to be sensitive to moisture and cold weather, and be very difficult or impossible to place in cold or wet weather.

Final determination of suitability for reuse of all excavated materials will have to be made when the materials are exposed during excavation. If visual or olfactory evidence of contamination in excavated

soil is detected, chemical analysis of soil samples would be needed to confirm the suitability of such materials for re-use or for off-site disposal.

5.10 Pump Stations

All temporary sloping, benching, excavation support, and excavation activities must conform to the requirements of OSHA and all other applicable local, municipal, state, and federal regulations. The soils at the proposed pump station locations are considered Type C based on OSHA 29 CFR Part 1926.

Excavations for the wet wells will most likely encounter groundwater. During excavation and preparation of subgrade for structure, dewatering systems should be designed and operated to prevent pumping of fines, disturbance to subgrades, and undermining of previous construction. Groundwater should be maintained a minimum of 2 ft below the expected working elevation. We anticipate that dewatering may be accomplished using a system of deep wells, well points and/or sumps and pumps depending upon the extent of dewatering at the time of construction.

Dewatering effluent should be discharged into on-site excavations for recharge into the ground, if possible. Any effluent discharged to municipal systems must be discharged in accordance with regulatory requirements, and may require discharge (likely NPDES) permits depending on where the discharge is routed.

The bearing surfaces for the pump stations should be prepared in accordance with the preparation for footing subgrades Section 5.5.1.

5.11 Slope Areas

The subgrades (prior to placement of fill) in the northern and western slope areas should be cleared and grubbed appropriately. The topsoil should be removed and the ground surface leveled. Fill should be placed in controlled lifts in accordance with Section 5.6. Fill material could consist of borrow soils in accordance with Section 5.8 or reused excavated materials in accordance with Section 5.9.

5.12 Concluding Comments

This report has been prepared for specific application to the proposed Waterbury Bus Maintenance Facility Replacement to be constructed in Watertown, Connecticut as understood by Haley & Aldrich at this time. In the event that changes in the design or location of the structures are planned, the conclusions and recommendations contained in this report should not be considered valid unless they are reviewed and modified or verified in writing by Haley & Aldrich. Our recommendations are based in part upon data obtained from the referenced subsurface exploration programs. The nature and extent of variations between explorations will not become evident until construction. If significant variations then appear, it may be necessary to reevaluate the recommendations of this report.

We recommend that Haley & Aldrich be provided the opportunity to review the proposed building configuration and permanent foundation drain layout after the design is completed, and to evaluate the continued applicability of our recommendations.

Recommendations for foundation and/or floor drainage, moisture protection, and/or waterproofing have been included herein, when appropriate. These recommendations address the conventional geotechnical engineering related aspects of design and construction and are not intended to provide an environment

that would prohibit infestation of mold or other biological pollutants. Our work scope did not include the development of criteria or procedures to minimize the risk of mold or other biological pollutant infestations in or near any structure.

G:\39192_Wendel Duchscherer\000\Deliverables\Updated Final Geotechnical Report 8-1-14\2014-0801-Waterbury Bus Maintenance Facility Replacement Watertown CT Final Geotechnical Report-REVISED 8-7-14.doc

TABLE 1

SUMMARY OF RECENT SUBSURFACE EXPLORATION INFORMATION

Waterbury Bus Maintenance Facility Replacement

Watertown, Connecticut

File No. 39192-000

Boring No.	Approximate Ground Surface Elevation	Approximate Top of Fill Elevation	Approximate Top of Alluvium Elevation	Approximate Top of Glaciofluvial Deposits Elevation	Approximate Top of Glacial Till Elevation	Approximate Elevation of Bottom of Exploration	Approximate Groundwater Elevation
HA-1	303.4	-	302.9	301.4	NA	271.4	294.0
HA-2	304.5	304.5	-	300.0	NA	273.7	298.0
HA-3	305.9	305.9	303.9	298.0	NA	273.0	298.0
HA-4	304.8	304.8	302.8	297.8	NA	272.8	299.0
HA-5	302.8	302.8	300.8	295.8	NA	270.8	296.0
HA-6							
HA-7	304.0	304.0	302.0	297.0	NA	272.0	299.0
HA-8	302.5	302.5	302.0	294.5	NA	270.5	297.0
HA-9							
HA-10							
HA-11	303.3	303.3	301.3	296.3	230.8	205.2	296.5
HA-12	302.9	302.9	300.9	297.9	NA	270.9	298.0
HA-13	302.7	-	302.7	298.2	NA	270.7	297.0
HA-14	302.6	302.1	301.6	297.6	NA	270.6	298.5
HA-15	303.7	303.2	301.2	296.7	NA	291.7	297.0
HA-16	301.6	301.6	299.6	295.6	NA	280.6	296.0
HA-17	302.8	-	302.8	295.8	NA	282.8	296.0
HA-18	301.8	-	301.8	299.8	NA	289.8	296.0
HA-19	303.2	-	303.2	296.2	NA	291.2	298.0
HA-20	304.5	304.5	302.0	297.0	NA	292.5	298.0
HA-21	305.5	305.5	303.0	NA	NA	293.5	301.0
HA-22	306.1	305.6	304.1	299.1	NA	294.1	299.0
PS-1	TBD	TBD	TBD	TBD	TBD	TBD	TBD
PS-2	TBD	TBD	TBD	TBD	TBD	TBD	TBD

TABLE 2

SUMMARY OF EXISTING SUBSURFACE EXPLORATION INFORMATION

Waterbury Bus Maintenance Facility Replacement

Watertown, Connecticut

File No. 39192-000

Boring No.	Approximate Ground Surface Elevation	Approximate Top of Fill Elevation	Approximate Top of Glaciofluvial Deposits Elevation	Approximate Elevation of Bottom of Exploration	Approximate Groundwater Elevation
SB-1	303.3	303.3	295.3	266.3	293.8
SB-2	305.2	305.2	298.2	273.2	296.2
SB-3	305.3	305.3	298.3	273.3	NA
SB-4	304.3	303.3	299.3	252.3	295.3
SB-5	303	303	298	270.5	294
SB-6	303.9	303.9	289.9	271.9	294.9
SB-7	304.2	304.2	297.2	272.2	294.7
SB-8	303.8	303.8	299.8	271.8	293.8
SB-9	302.4	302.4	298.4	270.4	292.5
SB-10	303.5	303.5	298.5	266.5	294.5
SB-11	302.9	302.9	297.9	270.9	294.3
SB-12	302.4	302.4	293.4	266.1	NA
SB-13	302.6	302.6	293.6	255.6	290.6
SB-14	302.5	302.5	298.5	270.5	293.5
SB-15	303	303	297	271	293.5
SB-16	302.1	302.1	295.1	265.1	293.1
SB-17	302.9	302.9	295.5	250.9	NA
SB-18	302	301	294	265	294
SB-19	302 (est.)	302 (est.)	294 (est.)	255 (est.)	288.5 (est.)
DB-1	303.3	303.3	295.3	271.3	293.3
DB-2	301.5	301.5	292.5	264.5	293.5
P-1	304.8	304.8	297.8	292.8	294.3
P-2	304.7	304.7	299.7	292.7	294.2
P-3	302.6	302.6	297.6	290.6	295.6
P-4	304.4	304.4	299.4	292.4	295.4
P-5	302.3	302.3	297.9	290.4	296.4
P-6	303.3	303.3	301.3	291.3	294.3
P-7	301.9	300.9	296.9	289.9	293.9

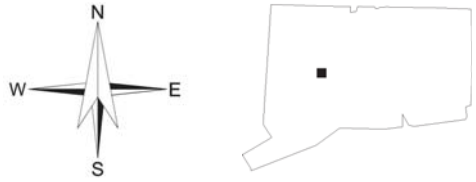
TABLE 3
SUMMARY OF FIELD HYDRAULIC CONDUCTIVITY TESTING
Waterbury Bus Maintenance Facility Replacment
Watertown, Connecticut
File No. 39192-000

TEST BORING LOCATION[1]	GROUND SURFACE ELEVATION	TOTAL DEPTH (FT)	WATER LEVEL (FT)		FIELD HYDRAULIC CONDUCTIVITY TESTING				
					BOREHOLE PERMEABILITY TEST[2]				
					TEST DEPTH (FT)		SOIL DESCRIPTION AT TEST DEPTH	GEOLOGIC DESCRIPTION AT TEST DEPTH	MEAN HYDRAULIC CONDUCTIVITY (CM/SEC)
			DEPTH	ELEVATION	DEPTH	ELEVATION			
HA16	301.6	21.0	6.0	295.6	10 - 12	291.6 - 289.6	Very dense sandy GRAVEL, trace silt	Glaciofluvial	1.6E-04
					12 - 14	289.6 - 287.6	Very dense medium to fine SAND, little gravel, trace coarse sand	Glaciofluvial	2.1E-04
					14 - 16	287.6 - 285.6	Very dense medium to fine sandy GRAVEL, trace silt	Glaciofluvial	2.9E-04
HA17	302.8	20.0	6.0	296.8	10 - 12	292.8 - 290.8	Medium dense gravelly SAND, little silt	Glaciofluvial	3.6E-04
					12 - 14	290.8 - 288.8	Loose coarse to fine SAND, trace gravel, trace silt	Glaciofluvial	4.7E-04
					14 - 16	288.8 - 286.8	Loose coarse to fine SAND, trace gravel, trace silt	Glaciofluvial	5.6E-04

NOTES:

1. Refer to Test Boring logs for soil descriptions
2. Test performed using Case g procedure, U.S. Army Corps of Engineers, Waterways Experiment Station, Bulletin No. 35, "Time Lag and Soil Permeability in Groundwater Observations," Vicksburg, Mississippi, by M. Juul Hvorslev, April 1951.
3. Ground surface elevations were provided by CONNDOT.
4. Water levels in boreholes were measured shortly after drilling and may not have stabilized.

SITE COORDINATES: 41°37'4"N,73°3'36"W



U.S.G.S. QUADRANGLE: WATERBURY, CT

HALEY & ALDRICH

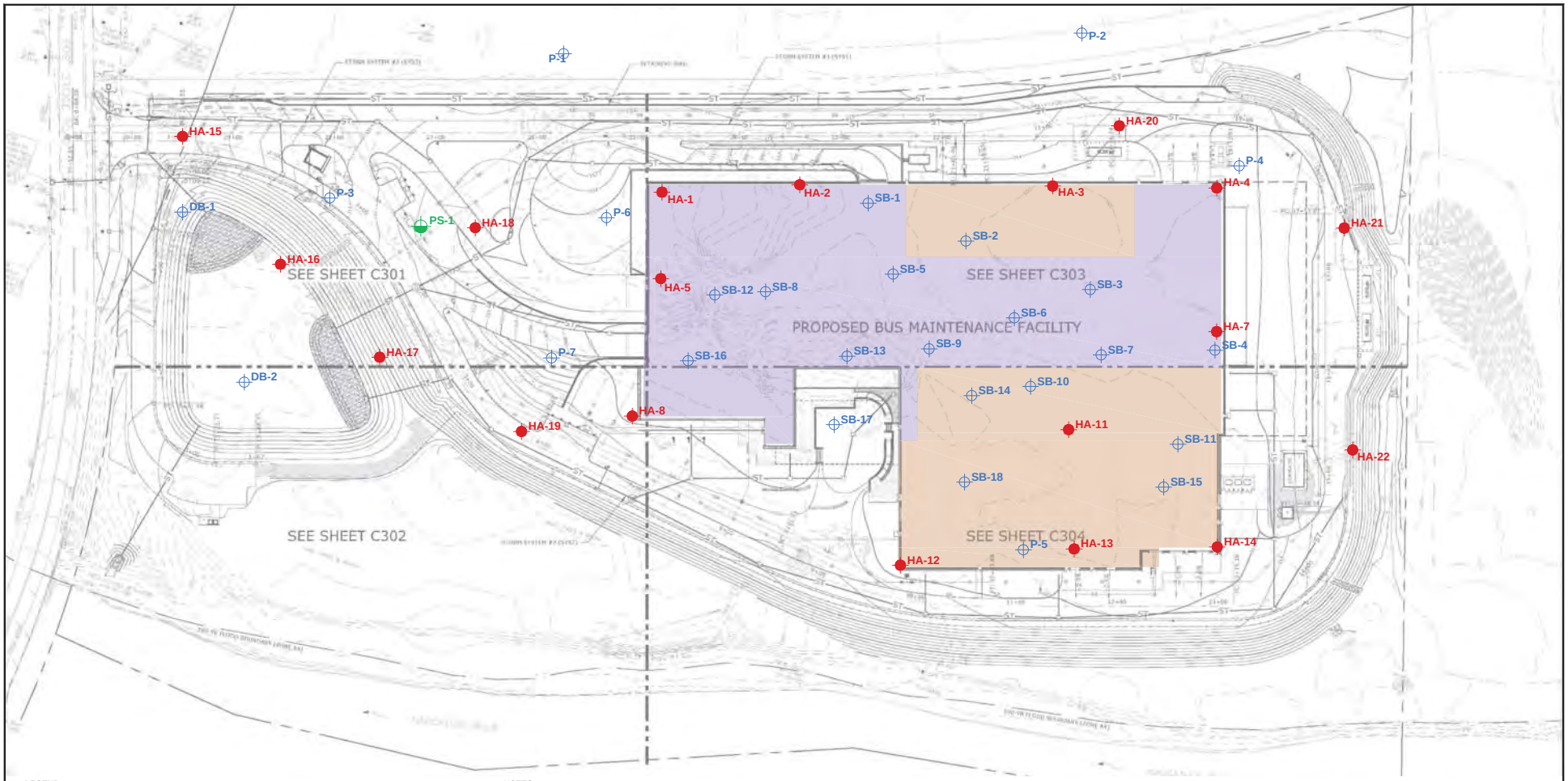
FINAL GEOTECHNICAL DESIGN EVALUATION
WATERBURY BUS MAINTENANCE FACILITY REPLACEMENT
WATERTOWN, CONNECTICUT

PROJECT LOCUS

SCALE: 1:24,000
AUGUST 2014

FIGURE 1

39192-000 1.PDF



LEGEND:

- HA-18 — DESIGNATION AND LOCATION OF TEST BORING DRILLED BY SEABOARD DRILLING, INC. OF CHICOPEE, MASSACHUSETTS FROM 18 TO 25 MARCH 2013
- PS-1 — DESIGNATION AND LOCATION OF ADDITIONAL TEST BORING DRILLED AT PROPOSED PUMP STATION BY SEABOARD DRILLING, INC. OF CHICOPEE, MASSACHUSETTS ON 19 DECEMBER 2013.
- P-3 — DESIGNATION AND LOCATION OF TEST BORING DRILLED BY GENERAL BORINGS, INC. OF PROSPECT, CONNECTICUT IN MARCH 2002.
- APPROXIMATE AREA OF PROPOSED BUILDING WITH LOWEST LEVEL FROM APPROXIMATE EL. 303.5 TO 304.
- APPROXIMATE AREA OF PROPOSED BUILDING WITH LOWEST LEVEL AT APPROXIMATE EL. 316.

NOTES:

1. BASE PLAN TITLED, "90% QA GRADING AND DRAINAGE PLAN" WAS PROVIDED BY WENDEL DUCHSCHERER ON 25 NOVEMBER 2013 VIA EMAIL.
2. RECENT EXPLORATION LOCATIONS FROM 2013 WERE LOCATED AND SURVEYED IN THE FIELD BY THE CONNECTICUT DEPARTMENT OF TRANSPORTATION. LOCATIONS WERE PROVIDED ON THE PLAN SHEET NO. 03.002 TITLED "EXISTING CONDITIONS."
3. ELEVATIONS ARE IN FEET AND REFER TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 1929).
4. RECENT EXPLORATIONS FROM 2013 WERE MONITORED IN THE FIELD BY A REPRESENTATIVE OF HALEY & ALDRICH, INC.
5. HISTORIC BORING LOCATIONS FROM 2002 WERE PROVIDED IN THE GEOTECHNICAL REPORT TITLED "FINAL DESIGN SOILS REPORT PROPOSED WATERBURY BUS MAINTENANCE AND STORAGE FACILITY FROS BRIDGE ROAD WATERTOWN, CONNECTICUT STATE PROJECT NO. 431-006" DATED 18 MARCH 2002 BY EARTH DESIGN ASSOCIATES, INC. HISTORIC LOCATION SB-19 WAS NOT LOCATED ON THE PROVIDED PLAN FROM THE HISTORIC GEOTECHNICAL REPORT.

N S E W

0 100 200
SCALE IN FEET

HALEY & ALDRICH

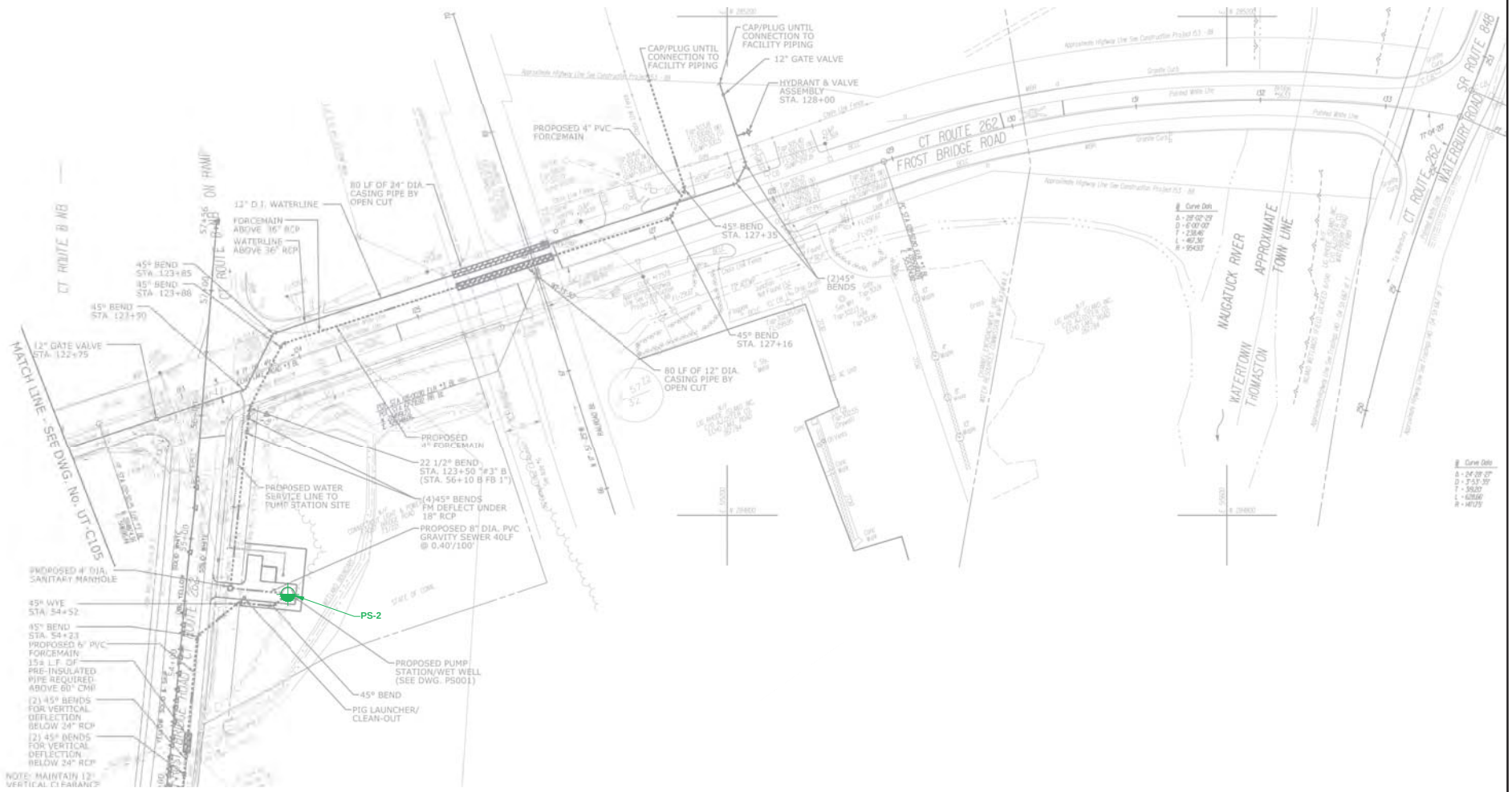
FINAL GEOTECHNICAL DESIGN EVALUATION
WATERBURY BUS MAINTENANCE FACILITY REPLACEMENT
WATERTOWN, CONNECTICUT

EXPLORATION LOCATION PLAN
SHEET 1 OF 2

SCALE: AS SHOWN
AUGUST 2014

FIGURE 2

G:\39192_WENDEL DUCHSCHERER\CAD\39192-200-ELP-FIG2.DWG



LEGEND:

PS-2 **DESIGNATION AND LOCATION OF ADDITIONAL TEST BORING DRILLED AT PROPOSED PUMP STATION BY SEABOARD DRILLING, INC. OF CHICOPEE, MASSACHUSETTS ON 19 DECEMBER 2013.**

NOTES:

1. TEST BORING LOCATION PROVIDED WENDEL DUCHSCHERER ON THE PLAN SHEET NO. 48 TITLED "WATERLINE & FORCEMAIN SEWER PLAN" VIA EMAIL ON 25 NOVEMBER 2013.
2. EXPLORATION LOCATION WAS LOCATED AND SURVEYED IN THE FIELD BY THE CONNECTICUT DEPARTMENT OF TRANSPORTATION.
3. RECENT EXPLORATIONS FROM 2013 WERE MONITORED IN THE FIELD BY A REPRESENTATIVE OF HALEY & ALDRICH, INC.

N
W E
S

0 80 160
SCALE IN FEET

HALEY & ALDRICH

FINAL GEOTECHNICAL DESIGN EVALUATION
WATERBURY BUS MAINTENANCE FACILITY REPLACEMENT
WATERTOWN, CONNECTICUT

EXPLORATION LOCATION PLAN
SHEET 2 OF 2

SCALE: AS SHOWN
AUGUST 2014

FIGURE 3

G:\39192_WENDEL DUCHSCHERER\CAD\39192-200-ELP-FIG3.DWG

APPENDIX A

Recent Test Boring Reports

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-1
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285609.06
Start Date:	March 22, 2013	Route No.:	Frost Bridge Road	Easting:	515070.48
Finish Date:	March 22, 2013	Bridge No.:	N/A	Surface Elevation:	303.40

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @9 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	2 3 5 5	2	17		TOPSOIL ALLUVIUM	Loose brown sandy SILT with roots, no odor, dry	303
1								302
2	S-2	14 26 27 30	2	13		GLACIOFLUVIAL DEPOSITS	Very dense brown sandy GRAVEL, trace silt, no odor, dry	301
3								300
4								299
5	S-3	60 35 43 38	2	11			Very dense brown sandy GRAVEL, little silt, no odor, dry	298
6								297
7								296
8								295
9								294
10	S-4	18 23 27 25	2	13			Dense brown gravelly SAND, trace silt, no odor, wet	293
11								292
12								291
13								290
14						GLACIOFLUVIAL DEPOSITS		289
15	S-5	14 12 16 15	2	17			Medium dense brown SAND, little silt and gravel, no odor, wet	288
16								287
17								286
18								285
19								284
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-1
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285609.06
Start Date:	March 22, 2013	Route No.:	Frost Bridge Road	Easting:	515070.48
Finish Date:	March 22, 2013	Bridge No.:	N/A	Surface Elevation:	303.40

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @9 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-6	19 15 21 17	2	24		GLACIOFLUVIAL DEPOSITS *(con't)*	Dense brown medium to fine SAND, little gravel, trace coarse sand and silt, no odor, wet	283
21								282
22								281
23								280
24								279
25	S-7	14 17 12 9	2	11			Medium dense brown sandy GRAVEL, trace silt, no odor, wet	278
26								277
27								276
28								275
29								274
30	S-8	8 8 7 8	2	9			Similar to S7	273
31								272
32							Note: Borehole backfilled with drill cuttings upon completion	271
33							END OF BORING 32 ft	270
34								269
35								268
36								267
37								266
38								265
39								264
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-2
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 285737.11
Start Date: March 22, 2013	Route No.: Frost Bridge Road	Easting: 515021.14
Finish Date: March 22, 2013	Bridge No.: N/A	Surface Elevation: 304.5

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	1 2 3 5	2	11		FILL	Loose brown medium to fine SAND, little silt, trace coarse sand with few organics, no odor, dry	304
1								303
2	S-2	2 2 6 8	2	13			Loose brown silty fine SAND, trace coarse to medium sand and gravel, no odor, dry	302
3								301
4								300
5	S-3	17 17 27 26	2	12		GLACIOFLUVIAL DEPOSITS	Dense brown sandy GRAVEL, trace silt, no odor, wet at 6 ft.	299
6								298
7	S-4	15 39 49 42	2	15			Very dense brown sandy GRAVEL, little silt, no odor, wet	297
8								296
9								295
10	S-5	18 19 27 30	2	12			Similar to S4, except dense	294
11								293
12								292
13								291
14								290
15	S-6	7 13 17 19	2	22			Medium dense brown sandy GRAVEL, trace silt, no odor, wet	289
16								288
17								287
18								286
19								285
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 1 of 2
Earth: 30.8 ft Rock: 0 ft		
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-2
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 285737.11
Start Date: March 22, 2013	Route No.: Frost Bridge Road	Easting: 515021.14
Finish Date: March 22, 2013	Bridge No.: N/A	Surface Elevation: 304.5

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	7 8 17 18	2	14		GLACIOFLUVIAL DEPOSITS *(con't)*	Similar to S6	284
21								283
22								282
23								281
24								280
25	S-8	7 10 13 14	2	12			Medium dense brown gravelly SAND, little silt, no odor, wet	279
26								278
27								277
28								276
29								275
30	S-9	34 50/3"	0.8	6			Very dense sandy GRAVEL, trace silt, no odor, wet	274
31							Note: Borehole backfilled with drill cuttings upon completion	273
32							END OF BORING 30.8 ft	272
33								271
34								270
35								269
36								268
37								267
38								266
39								265
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 2 of 2
Earth: 30.8 ft Rock: 0 ft		
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	J. Nitsch	**Connecticut DOT Boring Report**		Hole No.:	HA-3
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285976.57
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	514944.35
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	305.92

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	13 17 16 13	2	14		FILL	Dense brown gravelly SAND, trace silt, no odor, dry	
1								305
2	S-2	8 8 8 9	2	14		ALLUVIUM	Medium dense brown to dark brown silty fine SAND, few organics, no odor, dry	304
3								303
4								302
5	S-3	6 8 15 16	2	4		ALLUVIUM	Medium dense brown gravelly SAND, little silt, few organics, no odor, dry	301
6								300
7	S-4	29 44 30 30	2	20		GLACIOFLUVIAL DEPOSITS	Very dense brown gravelly SAND, little silt, no odor, wet	299
8								298
9								297
10	S-5	19 19 22 30	2	14			Dense brown gravelly SAND, little silt, no odor, wet	296
11								295
12								294
13								293
14								292
15	S-6	20 22 23 25	2	17			Dense brown sandy GRAVEL, trace silt, no odor, wet	291
16								290
17								289
18								288
19						GLACIOFLUVIAL DEPOSITS		287
20								286

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-3
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 285976.57
Start Date: March 18, 2013	Route No.: Frost Bridge Road	Easting: 514944.35
Finish Date: March 18, 2013	Bridge No.: N/A	Surface Elevation: 305.92

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	3 6 8 8	2	16		GLACIOFLUVIAL DEPOSITS *(con't)*	Medium dense brown medium to fine SAND, little gravel, trace silt, no odor, wet	
21								285
22								284
23								283
24								282
25	S-8	5 10 17 20	2	22			Medium dense brown mediumto fine SAND, trace gravel and silt, no odor, wet	281
26								280
27								279
28								278
29								277
30	S-9	19 46 33 23	2	12			Very dense brown medium to fine SAND, little gravel, trace silt, no odor, wet	276
31								275
32							Note: Borehole backfilled with drill cuttings upon completion	274
33							END OF BORING 32 ft	273
34								272
35								271
36								270
37								269
38								268
39								267
40								266

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 2 of 2
Earth: 32.0 ft Rock: 0 ft		
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-4
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286132.28
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	514895.75
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	304.8

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	12 12 11 10	2	18		FILL	Medium dense gravelly SAND, little silt, no odor, dry	
1								304
2	S-2	7 6 6 8	2	16		ALLUVIUM	Medium dense brown silty fine SAND, no odor, dry	303
3								302
4								301
5	S-3	10 8 7 7	2	20			Medium dense brown medium to fine SAND, little silt, no odor, dry	300
6								299
7	S-4	20 38 37 36	2	14		GLACIOFLUVIAL DEPOSITS	Very dense brown gravelly SAND, little silt, no odor, wet	298
8								297
9								296
10	S-5	13 18 14 5	2	20			Dense brown sandy GRAVEL, little silt, no odor, wet	295
11								294
12								293
13								292
14								291
15	S-6	16 18 21 20	2	12			Dense brown gravelly SAND, little silt, no odor, wet	290
16								289
17								288
18								287
19						GLACIOFLUVIAL DEPOSITS		286
20								285

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-4
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286132.28
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	514895.75
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	304.8

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	7 7 8 9	2	10		GLACIOFLUVIAL DEPOSITS *(con't)*	Medium dense brown SAND, little gravel, trace silt, no odor, wet	
21								284
22								283
23								282
24								281
							Note: Washed out 4 ft running sand at 25.0 ft prior to sampling	
25	S-8	4 4 4 5	2	15			Loose brown medium to fine SAND, trace coarse sand and silt, no odor, wet	280
26								279
27								278
28								277
29								276
							Note: Washed out 2 ft running sand at 30.0 ft prior to sampling	
30	S-9	14 18 29 27	2	14			Dense brown sandy GRAVEL, trace silt, no odor, wet	275
31								274
32								273
							Note: Borehole backfilled with drill cuttings upon completion	
33								272
							END OF BORING 32 ft	
34								271
35								270
36								269
37								268
38								267
39								266
40								265

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	J. Nitsch	**Connecticut DOT Boring Report**		Hole No.:	HA-5
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285633.82
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	515152.6
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	302.83

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	12 10 15 13	2	14		FILL	Medium dense brown gravelly SAND, little silt, no odor, dry	302
1								301
2	S-2	12 8 6 4	2	18		ALLUVIUM	Medium dense dark brown silty fine SAND, few organics, organic odor, moist	300
3								299
4						ALLUVIUM		298
5	S-3	2 1 1 1	2	3			Very loose brown silty fine SAND, few organics, no odor, moist	297
6								296
7	S-4	13 50/3"	0.8	9		GLACIOFLUVIAL DEPOSITS	Similar to S3 Very dense gray-brown gravelly SAND, little silt, no odor, wet	295
8								294
9								293
10	S-5	18 47 30 40	2	14			Very dense brown sandy GRAVEL, little silt, no odor, wet	292
11								291
12							Note: HSA refusal at 12.0 ft. Offset 6 ft northeast with HSA refusal at 8.0 ft. Offset 4 ft south of original location	290
13								289
14								288
15	S-6	10 20 44 34	2	14			Very dense brown gravelly SAND, little silt, no odor, wet	287
16								286
17								285
18								284
19								283
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-5
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 285633.82
Start Date: March 18, 2013	Route No.: Frost Bridge Road	Easting: 515152.6
Finish Date: March 18, 2013	Bridge No.: N/A	Surface Elevation: 302.83

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	9 10 10 13	2	12		GLACIOFLUVIAL DEPOSITS *(con't)*	Medium dense brown gravely SAND, trace silt, no odor, wet	
21								282
22								281
23								280
24								279
25	S-8	5 10 9 17	2	18			Medium dense brown medium to fine SAND, trace silt, no odor, wet	278
26								277
27								276
28								275
29								274
30	S-9	6 9 12 13	2	14			Similar to S8	273
31								272
32								271
33							END OF BORING 32 ft	270
34								269
35								268
36								267
37								266
38								265
39								264
40								263

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 2 of 2
Earth: 32.0 ft Rock: 0 ft		
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	J. Nitsch	**Connecticut DOT Boring Report**		Hole No.:	HA-7
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286178.01
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	515032
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	304.0

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	12 18 15 13	2	14		FILL	Dense brown gravelly SAND, little silt, no odor, dry	304
1								303
2	S-2	12 8 6 4	2	18		ALLUVIUM	Medium dense dark brown silty fine SAND, few organics, organic odor, moist	302
3								301
4						ALLUVIUM		300
5	S-3	2 1 1 1	2	3			Very loose brown silty fine SAND, few organics, no odor, dry	299
6								298
7	S-4	13 50/3"	0.8	9			Same as S3	297
8						GLACIOFLUVIAL DEPOSITS	Very dense gray-brown sandy GRAVEL, trace silt, no odor, wet	296
9								295
10	S-5	18 47 30 40	2	14			Very dense brown sandy GRAVEL, little silt, no odor, wet	294
11								293
12								292
13								291
14								290
15	S-6	10 20 44 34	2	14			Very dense brown gravelly SAND, little silt, no odor, wet	289
16								288
17								287
18								286
19								285
20								284

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-7
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 286178.01
Start Date: March 18, 2013	Route No.: Frost Bridge Road	Easting: 515032
Finish Date: March 18, 2013	Bridge No.: N/A	Surface Elevation: 304.0

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	9 10 10 13	2	12		GLACIOFLUVIAL DEPOSITS *(con't)*	Medium dense brown gravelly SAND, trace silt, no odor, wet	284
21								283
22								282
23								281
24								280
25	S-8	5 10 9 17	2	18			Medium dense brown medium to fine SAND, trace silt, no odor, wet	279
26								278
27								277
28								276
29								275
30	S-9	6 9 12 13	2	14			Similar to S8	274
31								273
32							Note: Borehole backfilled with drill cuttings upon completion	272
33							END OF BORING 32 ft	271
34								270
35								269
36								268
37								267
38								266
39								265
40								264

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 2 of 2
Earth: 32.0 ft Rock: 0 ft		
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-8
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285649.86
Start Date:	March 20, 2013	Route No.:	Frost Bridge Road	Easting:	515291.27
Finish Date:	March 20, 2013	Bridge No.:	N/A	Surface Elevation:	302.50

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	6 7 5 9	2	12		FILL ALLUVIUM	Medium dense brown medium to fine SAND, little gravel and silt with few organics, no odor, dry	302
1								301
2	S-2	7 7 7 8	2	15			Medium dense dark brown fine sandy SILT with few organics, no odor, dry Medium dense brown silty fine SAND with few organic, no odor, dry	300
3								299
4								298
5	S-3	2 2 2 2	2	4			Very loose dark brown silty fine SAND, few organics, organic odor, wet	297
6								296
7	S-4	2 3 13 35	2	12			Similar to S3	295
8						GLACIOFLUVIAL DEPOSITS	Medium dense gray brown sandy GRAVEL, little silt, organic odor, wet	294
9								293
10	S-5	6 7 7 9	2	15		GLACIOFLUVIAL DEPOSITS	Medium dense brown coarse to fine SAND, some medium to fine gravel, trace silt, no odor, wet	292
11								291
12								290
13								289
14								288
15	S-6	3 3 4 4	2	17			Loose brown coarse to fine SAND, some medium to fine gravel, no odor, wet	287
16								286
17								285
18								284
19								283
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: F. Harrington	**Connecticut DOT Boring Report**	Hole No.: HA-8
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 285649.86
Start Date: March 20, 2013	Route No.: Frost Bridge Road	Easting: 515291.27
Finish Date: March 20, 2013	Bridge No.: N/A	Surface Elevation: 302.50

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	4 5 5 8	2	22		GLACIOFLUVIAL DEPOSITS *(con't)*	Loose brown SAND, trace silt, no odor, wet	282
21								281
22								280
23								279
24								278
25	S-8	6 7 10 14	2	18			Medium dense brown medium to fine SAND, trace silt, no odor, wet	277
26								276
27								275
28								274
29								273
30	S-9	30 48 61 60	2	14			Very dense brown gravelly SAND, trace silt, no odor, wet	272
31								271
32							Note: Borehole backfilled with drill cuttings upon completion	270
33							END OF BORING 32 ft	269
34								268
35								267
36								266
37								265
38								264
39								263
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 2 of 2
Earth: 32.0 ft Rock: 0 ft		
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	J. Nitsch	**Connecticut DOT Boring Report**		Hole No.:	HA-11
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286066.18
Start Date:	March 20, 2013	Route No.:	Frost Bridge Road	Easting:	515169.82
Finish Date:	March 22, 2013	Bridge No.:	N/A	Surface Elevation:	303.3

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	7 21 14 12	2	15		FILL	Dense brown SAND, little gravel and silt, no odor, dry	303
1								302
2	S-2	9 6 5 5	2	20		ALLUVIUM	Medium dense brown silty fine SAND with few organics, no odor, dry	301
3								300
4						ALLUVIUM		299
5	S-3	2 2 2 2	2	16			Very loose dark brown silty fine SAND with few organics, no odor, dry	298
6								297
7	S-4	6 22 50/5"	2	10		GLACIOFLUVIAL DEPOSITS	Very dense brown gravelly SAND, trace silt, slight organic odor, wet	296
8								295
9	S-5	36 44 20 20	2	12			Similar to S4	294
10						GLACIOFLUVIAL DEPOSITS	Verd dense brown silty fine SAND, no odor, wet	293
11							Note: Remove HSA after sampling S4 (7-8.4 ft.) and begin driving HW 4.0 casing	292
12								291
13								290
14	S-6	4 4 4 4	2	13			Loose brown fine SAND, little silt, no odor, wet	289
15								288
16								287
17								286
18								285
19	S-7	4 3 3 3	2	10			Similar to S6	284
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 98.1 ft Rock: 0 ft	NOTES:	Sheet 1 of 5
No. of Soil Samples: 22 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-11
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 286066.18
Start Date: March 20, 2013	Route No.: Frost Bridge Road	Easting: 515169.82
Finish Date: March 22, 2013	Bridge No.: N/A	Surface Elevation: 303.3

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20						GLACIOFLUVIAL DEPOSITS *(con't)*		283
21								282
22								281
23								280
24	S-8	7 7 6 9	2	13			Medium dense fine SAND, little silt, no odor, wet	279
25								278
26								277
27								276
28								275
29	S-9	4 4 4 5	2	12			Loose brown fine sandy SILT, no odor, wet	274
30								273
31								272
32								271
33								270
34	S-10	4 3 3 4	2	12			Loose brown silty fine SAND, no odor, wet	269
35								268
36								267
37								266
38								265
39	S-11	4 5 6 8	2	9			Medium dense brown medium to fine SAND, little silt, no odor, wet	264
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 2 of 5
Earth: 98.1 ft Rock: 0 ft		
No. of Soil Samples: 22 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-11
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 286066.18
Start Date: March 20, 2013	Route No.: Frost Bridge Road	Easting: 515169.82
Finish Date: March 22, 2013	Bridge No.: N/A	Surface Elevation: 303.3

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40						GLACIOFLUVIAL DEPOSITS *(con't)*		263
41								262
42								261
43						GLACIOFLUVIAL DEPOSITS		260
44	S-12	5 6 7 8	2	5			Medium dense brown medium to fine SAND, trace fine gravel and silt, no odor, wet	259
45								258
46								257
47								256
48								255
49	S-13	14 14 12 11	2	8			Medium dense brown gravelly SAND, trace silt, no odor, wet	254
50								253
51								252
52								251
53								250
54	S-14	8 10 10 12	2	2			Probable wash (coarse sand to fine gravel) with gravel fragment lodge in spoon tip.	249
55								248
56								247
57								246
58								245
59	S-15	14 12 15 11	2	4			Medium dense brown gravelly SAND, trace silt, no odor, wet	244
60								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 3 of 5
Earth: 98.1 ft Rock: 0 ft		
No. of Soil Samples: 22 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-11
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 286066.18
Start Date: March 20, 2013	Route No.: Frost Bridge Road	Easting: 515169.82
Finish Date: March 22, 2013	Bridge No.: N/A	Surface Elevation: 303.3

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
60						GLACIOFLUVIAL DEPOSITS *(con't)*		243
61								242
62								241
63								240
64	S-16	20 17 18 20	2	9			Dense brown gravelly SAND, trace silt, no odor, wet	239
65								238
66								237
67								236
68								235
69	S-17	73 22 19 20	2	2			Dense brown SAND, little gravel, trace silt, no odor, wet (probably wash)	234
70								233
71								232
72								231
73						GLACIAL TILL DEPOSITS		230
74	S-18	44 100/5"	0.9	6			Very dense brown silty medium to fine SAND, little gravel, (rock fragment in spoon tip), no odor, wet	229
75							Note: Rollerbit to 76.0 ft. and core through boulder to 77.0 ft. Rollerbit ahead to 78.0 ft. and drive/wash casing to 79.0 ft. Drill action indicates few cobbles and boulders from 75.0 to 79.0 ft.	228
76								227
77								226
78								225
79	S-19	49 100/5"	0.9	4			Very dense brown gravelly SAND, little silt, no odor, wet	224
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 4 of 5
Earth: 98.1 ft Rock: 0 ft		
No. of Soil Samples: 22 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-11
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 286066.18
Start Date: March 20, 2013	Route No.: Frost Bridge Road	Easting: 515169.82
Finish Date: March 22, 2013	Bridge No.: N/A	Surface Elevation: 303.3

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
80						GLACIAL TILL DEPOSITS *(con't)*	Note: Rollerbit ahead to 83.0 ft.. Drill action indicates few cobbles and boulders. Drive/wash to 84.0 ft.	223
81								222
82								221
83								220
84	S-20	48 48 50/1"	1.1	7			Very dense silty medium to fine SAND, little gravel, no odor, wet (probable weathered boulder)	219
85							Note: HW casing refusal at 88.5 ft. Rollerbit to 89.0 ft. Drill action indicates few cobbles and boulders from 84.0 to 89.0 ft.	218
86								217
87								216
88								215
89	S-21	150/4"	0.3	4			Very dense gray silty medium to fine SAND, little gravel, no odor, dry (probable weathered boulder)	214
90							Note: Rollerbit to 98.0 ft. Drill action indicates few cobbles and boulders	213
91								212
92								211
93								210
94								209
95								208
96								207
97								206
98	S-22	100/1"	0.1	1			Probable boulder fragment.	205
99							Note: Borehole backfilled with drill cuttings upon completion	204
100							END OF BORING 98.1 ft	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 5 of 5
Earth: 98.1 ft Rock: 0 ft		
No. of Soil Samples: 22 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-12
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285949.31
Start Date:	March 20, 2013	Route No.:	Frost Bridge Road	Easting:	515349.7
Finish Date:	March 20, 2013	Bridge No.:	N/A	Surface Elevation:	302.9

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	5 6 8 8	2	15		FILL	Medium dense brown medium to fine SAND, trace gravel and silt with few fragments of asphalt, no odor, dry	302
1								
2	S-2	5 7 7 6	2	20		ALLUVIUM	Medium dense medium to fine SAND, little silt, no odor, dry	301
3								300
4								299
5	S-3	27 38 63 69	2	12		GLACIOFLUVIAL DEPOSITS	Very dense brown sandy GRAVEL, trace silt, no odor, wet	298
6								297
7								296
8								295
9								294
10	S-4	46 100/5"	1	4			Very dense brown sandy GRAVEL, little silt, no odor, wet	293
11								292
12								291
13								290
14								289
15	S-5	21 28 23 49	2	15			Very dense brown gravelly SAND, trace silt, no odor, wet	288
16								287
17								286
18								285
19								284
20								283

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-12
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285949.31
Start Date:	March 20, 2013	Route No.:	Frost Bridge Road	Easting:	515349.7
Finish Date:	March 20, 2013	Bridge No.:	N/A	Surface Elevation:	302.9

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-6	21 27 24 28	2	14		GLACIOFLUVIAL DEPOSITS *(con't)*	Very dense brown gravelly SAND, little silt, no odor, wet	
21								282
22								281
23								280
24								279
25	S-7	17 24 29 38	2	18			Very dense brown sandy GRAVEL, trace silt, no odor, wet	278
26								277
27								276
28								275
29								274
30	S-8	25 34 43 39	2	18			Very dense brown sandy SAND, little silt, no odor, wet	273
31								272
32								271
33							Note: Borehole backfilled with drill cuttings upon completion END OF BORING 32 ft	270
34								269
35								268
36								267
37								266
38								265
39								264
40								263

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	J. Nitsch	**Connecticut DOT Boring Report**		Hole No.:	HA-13
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286108.44
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	515280.97
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	302.71

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	4 5 4 4	2	12		ALLUVIUM	Loose dark brown silty fine SAND, few organics, no odor, dry	302
1								301
2	S-2	5 5 5 6	2	14			Loose brown fine SAND, little silt, few organics, no odor, dry	300
3								299
4								298
5	S-3	10 25 25 22	2	10		GLACIOFLUVIAL DEPOSITS	Dense brown sandy GRAVEL, little silt, no odor, wet	297
6								296
7	S-4	44 50/5"	0.8	10			Similar to S3, except very dense	295
8								294
9						GLACIOFLUVIAL DEPOSITS		293
10	S-5	7 6 5 7	2	13			Medium dense brown medium to fine SAND, little silt, trace coarse sand and fine gravel, no odor, wet	292
11								291
12								290
13								289
14								288
15	S-6	5 4 4 3	2	12			Loose brown medium to fine SAND, little silt, no odor, wet	287
16								286
17								285
18								284
19								283
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: J. Nitsch	**Connecticut DOT Boring Report**	Hole No.: HA-13
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 286108.44
Start Date: March 18, 2013	Route No.: Frost Bridge Road	Easting: 515280.97
Finish Date: March 18, 2013	Bridge No.: N/A	Surface Elevation: 302.71

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	7 5 4 6	2	16		GLACIOFLUVIAL DEPOSITS *(con't)*	Similar to S6	
21								282
22								281
23								280
24								279
25	S-8	30 17 18 17	2	20			Dense brown medium to fine SAND, little silt, trace gravel, no odor, wet	278
26								277
27								276
28								275
29								274
30	S-9	7 12 12 14	2	14			Medium dense gravelly SAND, trace silt, no odor, wet	273
31								272
32								271
33							Note: Borehole backfilled with drill cuttings upon completion END OF BORING 32 ft	270
34								269
35								268
36								267
37								266
38								265
39								264
40								263

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 2 of 2
Earth: 32.0 ft Rock: 0 ft		
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: F. Harrington	**Connecticut DOT Boring Report**	Hole No.: HA-14
Inspector: S. Brousseau	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 286243.38
Start Date: March 18, 2013	Route No.: Frost Bridge Road	Easting: 515234.83
Finish Date: March 18, 2013	Bridge No.: N/A	Surface Elevation: 302.6

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	7 14 9 8	2	15		TOPSOIL		
						FILL	Medium dense brown gravelly SAND, little silt, no odor, dry	302
1						ALLUVIUM	Medium dense dark brown silty fine SAND, few organics, no odor, dry	301
2	S-2	11 8 10 15	2	14		ALLUVIUM	Medium dense brown medium to fine SAND, little silt, no odor, dry	300
3								299
4								298
5	S-3	58 49 52 44	2	12		GLACIOFLUVIAL DEPOSITS	Very dense brown sandy GRAVEL, little silt, no odor, wet	297
6								296
7	S-4	27 41 58 46	2	14			Similar to S3	295
8								294
9								293
10	S-5	3 6 4 4	2	13		GLACIOFLUVIAL DEPOSITS	Loose brown medium to fine SAND, little silt, no odor, wet	292
11								291
12								290
13								289
14								288
15	S-6	4 5 5 4	2	3			Similar to S5	287
16								286
17								285
18								284
19								283
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 1 of 2
Earth: 32.0 ft Rock: 0 ft		
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-14
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286243.38
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	515234.83
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	302.6

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	4 5 6 6	2	18		GLACIOFLUVIAL DEPOSITS *(con't)*	Medium dense brown medium to fine SAND, little silt, no odor, wet	282
21								281
22								280
23								279
24								278
25	S-8	6 7 10 11	2	24			Medium dense brown medium to fine SAND, trace silt, no odor, wet	277
26								276
27								275
28								274
29								273
30	S-9	5 5 7 7	2	10			Medium dense medium to fine SAND, trace silt and fine gravel, no odor, wet	272
31								271
32							Note: Borehole backfilled with drill cuttings upon completion END OF BORING 32 ft	270
33								269
34								268
35								267
36								266
37								265
38								264
39								263
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32.0 ft Rock: 0 ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-15
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285139.28
Start Date:	March 20, 2013	Route No.:	Frost Bridge Road	Easting:	515165.11
Finish Date:	March 20, 2013	Bridge No.:	N/A	Surface Elevation:	303.7

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0								
1	S-1	17 35 29 15	2	14		BITUMONOUS CONCRETE FILL	Very dense brown gravelly SAND, little silt, no odor, dry	303
2								302
3	S-2	5 7 7 8	2	20		ALLUVIUM	Medium dense dark brown fine sandy SILT with few organics, no odor, dry	301
4								300
5	S-3	2 2 4 7	2	0		ALLUVIUM	No recovery	299
6								298
7	S-4	56 62 64 57	2	14		GLACIOFLUVIAL DEPOSITS	Very dense brown coarse to fine SAND, trace silt, trace gravel, no odor, wet	297
8								296
9								295
10	S-5	27 36 29 33	2	8			Very dense brown gravelly SAND, little silt, no odor, moist	294
11								293
12							Note: Borehole backfilled with drill cuttings upon completion END OF BORING 12 ft	292
13								291
14								290
15								289
16								288
17								287
18								286
19								285
20								284

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 12.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-16
Inspector:	P. Dunaj	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285270.83
Start Date:	March 21, 2013	Route No.:	Frost Bridge Road	Easting:	515255.79
Finish Date:	March 21, 2013	Bridge No.:	N/A	Surface Elevation:	301.56

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	3 27 33 19	2	8		FILL	Very dense to orange-brown medium to fine SAND, trace coarse sand 1 in. root mat layer at surface, no odor, moist	301
1								300
2	S-2	9 11 6 5	2	1		ALLUVIUM	Medium dense brown medium to fine SAND, no odor, dry	299
3								298
4								297
5	S-3	31 12 27 55	2	16			Dense orange-brown and gray-brown gravelly SAND, trace silt, stratified with dark black silty fine SAND LAYER (2 in. thick) from 5.0-5.2 ft., no odor, dry	296
6						GLACIOFLUVIAL DEPOSITS	Dense orange-brown coarse to fine SAND, little gravel, trace silt, no odor, wet	295
7	S-4	62 50/3"	2	4			Very dense SAND and GRAVEL fragments, no odor, wet	294
8								293
9								292
10	S-5	41 83 89 45	2	7			Very dense light brown sandy GRAVEL, trace silt, no odor, wet	291
11								290
12	S-6	23 39 62 33	2	5			Very dense light brown medium to fine SAND, little gravel, trace coarse sand, no odor, wet	289
13								288
14	S-7	33 38 34 26	2	8			Very dense light brown medium to fine sandy GRAVEL, trace silt, no odor, wet	287
15								286
16								285
17						GLACIOFLUVIAL DEPOSITS		284
18								283
19	S-8	11 12 12 18	2	9			Medium dense light brown medium to fine SAND, trace gravel, trace silt, no odor, wet	282
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 21.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller: F. Harrington	**Connecticut DOT Boring Report**	Hole No.: HA-16
Inspector: P. Dunaj	Town: Waterbury, Connecticut	Stat./Offset: N/A
Engineer: Haley & Aldrich, Inc.	Project No.: 39192-000	Northing: 285270.83
Start Date: March 21, 2013	Route No.: Frost Bridge Road	Easting: 515255.79
Finish Date: March 21, 2013	Bridge No.: N/A	Surface Elevation: 301.56

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20						GLACIOFLUVIAL DEPOSITS *(con't)*		281
21							END OF BORING 21 ft	280
22								279
23								278
24								277
25								276
26								275
27								274
28								273
29								272
30								271
31								270
32								269
33								268
34								267
35								266
36								265
37								264
38								263
39								262
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in	NOTES:	Sheet 2 of 2
Earth: 21.0 ft Rock: 0 ft		
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-17
Inspector:	P. Dunaj	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285393.09
Start Date:	March 21, 2013	Route No.:	Frost Bridge Road	Easting:	515313.06
Finish Date:	March 25, 2013	Bridge No.:	N/A	Surface Elevation:	302.75

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.				Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	2	2	2	3	2	22		ALLUVIUM	Very loose brown medium to fine SAND, no odor, dry	302
1											301
2	S-2	4	4	5	5	2				Same as S1, except loose with dark black silty fine SAND layer (3 in. thick) at 3.8 in.	300
3											299
4											298
5	S-3	4	7	11	17	2	9			Medium dense brown gravelly SAND, trace silt, no odor, wet	297
6											296
7	S-4	58	25	27	27	2	9		GLACIOFLUVIAL DEPOSITS	Very dense brown gravelly SAND, little silt, no odor, wet	295
8											294
9											293
10	S-5	15	15	12	11	2	7			Medium dense grayish-brown gravelly SAND, little silt, no odor, wet	292
11											291
12	S-6	5	4	4	3	2	0		GLACIOFLUVIAL DEPOSITS	No recovery	290
13											289
14	S-7	3	5	4	5	2	7			Loose brown coarse to fine SAND, trace fine gravel, trace silt, no odor, wet	288
15											287
16											286
17											285
18	S-8	4	6	4	6	2	4			Loose brown medium to fine SAND, trace silt, no odor, wet	284
19											283
20											

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 20 ft Rock: 0 ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-17
Inspector:	P. Dunaj	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285393.09
Start Date:	March 21, 2013	Route No.:	Frost Bridge Road	Easting:	515313.06
Finish Date:	March 25, 2013	Bridge No.:	N/A	Surface Elevation:	302.75

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20							Note: Borehole backfilled with drill cuttings upon completion	
21							END OF BORING 20 ft	282
22								281
23								280
24								279
25								278
26								277
27								276
28								275
29								274
30								273
31								272
32								271
33								270
34								269
35								268
36								267
37								266
38								265
39								264
40								263

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 20 ft Rock: 0 ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller:	F. Harrington			Hole No.:	HA-18
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285443.5
Start Date:	March 21, 2013	Route No.:	Frost Bridge Road	Easting:	515161.65
Finish Date:	March 21, 2013	Bridge No.:	N/A	Surface Elevation:	301.8

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	2 2 9 13	2	15		ALLUVIUM	Medium dense brown silty fine SAND, with few organic, no odor, dry	301
1							Medium dense brown sandy GRAVEL, little silt, no odor, dry	300
2	S-2	12 20 28 31	2	12		GLACIOFLUVIAL DEPOSITS	Dense brown sandy GRAVEL, trace silt, no odor, dry	299
3								298
4								297
5	S-3	24 37 40 39	2	18			Very dense brown sandy GRAVEL, trace silt, no odor, (wet at 5.0 ft.)	296
6								295
7	S-4	14 20 15 15	2	5			Dense brown sandy GRAVEL, trace silt, no odor, wet	294
8								293
9						GLACIOFLUVIAL DEPOSITS		292
10	S-5	24 7 7 9	2	24			Medium dense brown medium to fine SAND, trace silt, no odor, wet	291
11								290
12							Note: Borehole backfilled with drill cuttings upon completion END OF BORING 12 ft	289
13								288
14								287
15								286
16								285
17								284
18								283
19								282
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 12.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-19
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	285549.9
Start Date:	March 21, 2013	Route No.:	Frost Bridge Road	Easting:	515339.89
Finish Date:	March 21, 2013	Bridge No.:	N/A	Surface Elevation:	303.20

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @6 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.				Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	2	2	3	10	2	19		ALLUVIUM	Loose brown medium to fine SAND, little silt with few organics, no odor, dry	303
1										Loose brown medium to fine SAND, trace silt, no odor, dry	302
2	S-2	2	2	2	2	2	7		ALLUVIUM	Very loose brown medium to fine SAND, little silt, no odor, dry	301
3											300
4											299
5	S-3	2	2	2	2	2	18			Very loose brown silty fine SAND with trace fibers, no odor, wet (wet at 6.0 ft.)	298
6											297
7	S-4	7	7	11	16	2	10		GLACIOFLUVIAL DEPOSITS	Medium dense brown sandy GRAVEL, little silt, no odor, wet	296
8											295
9											294
10	S-5	19	15	7	79	2	13			Similar to S4	293
11											292
12										Note: Borehole backfilled with drill cuttings upon completion END OF BORING 12 ft	291
13											290
14											289
15											288
16											287
17											286
18											285
19											284
20											

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 12.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-20
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286020.01
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	514866.56
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	304.5

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	4 5 5 8	2	13		FILL	Loose dense brown gravelly SAND, trace silt, no odor, dry	304
1								303
2	S-2	6 8 10 8	2	17			Similar to S1	302
3						ALLUVIUM	Medium dense dark brown silty fine SAND, few organics, no odor, dry	301
4								300
5	S-3	1 5 7 10	2	20		ALLUVIUM	Medium dense brown silty fine SAND, no odor, moist	299
6								298
7	S-4	17 21 25 27	2	12			Similar to S3	297
8						GLACIOFLUVIAL DEPOSITS	Dense brown gravelly SAND, little silt, no odor, wet	296
9								295
10	S-5	15 17 14 21	2	15			Similar to S4 (below 7.5 ft)	294
11								293
12							Note: Borehole backfilled with drill cuttings upon completion	292
13							END OF BORING 12 ft	291
14								290
15								289
16								288
17								287
18								286
19								285
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 12.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-21
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286265.11
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	514894.37
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	305.5

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @5 ± after - hours

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	4 5 7 7	2	10		FILL	Medium dense brown gravelly SAND, little silt, few organics and asphalt fragments, no odor, dry	305
1								304
2	S-2	9 10 10 10	2	13		ALLUVIUM	Similar to S1 Medium dense dark brown silty fine SAND, organic odor, dry	303
3								302
4								301
5	S-3	22 6 5 18	2	14			Medium dense brown coarse to fine SAND, trace silt, no odor, wet	300
6								299
7	S-4	39 109 110/3"	1.3	12		GLACIOFLUVIAL DEPOSITS	Very dense brown sandy GRAVEL, little silt, no odor, wet	298
8								297
9								296
10	S-5	19 22 29 25	2	12			Similar to S4	295
11								294
12							Note: Borehole backfilled with drill cuttings upon completion END OF BORING 12 ft	293
13								292
14								291
15								290
16								289
17								288
18								287
19								286
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 12.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

Driller:	F. Harrington	**Connecticut DOT Boring Report**		Hole No.:	HA-22
Inspector:	S. Brousseau	Town:	Waterbury, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-000	Northing:	286341.42
Start Date:	March 18, 2013	Route No.:	Frost Bridge Road	Easting:	515101.46
Finish Date:	March 18, 2013	Bridge No.:	N/A	Surface Elevation:	306.11

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: 4 1/4 / HSA	Sampler Type/Size: S / 1 3/8	Core Barrel Type: n/a
Hammer Wt.: - Fall: -	Hammer Wt. (lb): 140 Fall: 30 in.	

Groundwater Observations: @7 ± after - hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	6 9 10 10	2	13		TOPSOIL FILL	Medium dense brown SAND, little silt and gravel, few organics, no odor, dry	306
1								305
2	S-2	13 12 8 7	2	20		ALLUVIUM	Similar to S1 Medium dense dark brown silty fine SAND, few organics, organic odor, dry	304
3								303
4								302
5	S-3	4 4 5 4	2	0			No recovery	301
6								300
7	S-4	18 22 27 33	1.3	10		GLACIOFLUVIAL DEPOSITS	Dense brown medium to fine SAND, little silt, trace fine gravel, few organics, no odor, wet	299
8								298
9								297
10	S-5	21 39 81 36	2	8			Very dense brown GRAVEL, little sand and silt, no odor, wet	296
11								295
12							Note: Borehole backfilled with drill cuttings upon completion END OF BORING 12 ft	294
13								293
14								292
15								291
16								290
17								289
18								288
19								287
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 12.0 ft Rock: 0 ft	NOTES:	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller:	J. Nitch			Hole No.:	PS1
Inspector:	S. Brousseau	Town:	Watertown, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-200	Northing:	TBD
Start Date:	19 December 2013	Route No.:	Frost Bride Road	Easting:	TBD
Finish Date:	19 December 2013	Bridge No.:	N/A	Surface Elevation:	TBD

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: HSA 4.25"	Sampler Type/Size: S / 1 3/8	Core Barrel Type: --
Hammer Wt.: 140lb Fall: 30	Hammer Wt. (lb): -- lb Fall: --	

Groundwater Observations: @7.0 ± after 0 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.				Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	6	7	5	4	2	13		FILL	Medium dense brown SAND, little silt, trace fine gravel	
1									ALLUVIUM	Medium dense dark brown fine sandy SILT, few organics, organic odor, dry	
2	S-2	4	5	4	3	2	18			Loose dark brown fine sandy SILT, with few organics and occasional sand layer, organic odor, dry	
3											
4											
5	S-3	3	2	2	3	2	0			No recovery	
6											
7	S-4	19	85	29	15	2	6		GLACIOFLUVIAL DEPOSITS	Very dense brown sandy GRAVEL, little silt, wet	
8											
9											
10	S-5	7	12	12	9	2	10			Medium dense brown sandy GRAVEL, trace silt, wet	
11											
12											
13											
14											
15	S-6	3	3	4	4	2	8			Loose brown medium to fine SAND, trace silt, wet	
16											
17											
18											
19											
20											

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 37.0 ft Rock: -- ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 10 No. of Core Runs: --		SM-001-M REV. 1/02

Driller:	J. Nitch	**Connecticut DOT Boring Report**		Hole No.:	PS1
Inspector:	S. Brousseau	Town:	Watertown, Connecticut	Stat./Offset:	N/A
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-200	Northing:	TBD
Start Date:	19 December 2013	Route No.:	Frost Bride Road	Easting:	TBD
Finish Date:	19 December 2013	Bridge No.:	N/A	Surface Elevation:	TBD

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: HSA 4.25"	Sampler Type/Size: S / 1 3/8	Core Barrel Type: --
Hammer Wt.: 140lb Fall: 30	Hammer Wt. (lb): -- lb Fall: --	

Groundwater Observations: @7.0 ± after 0 hours

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-7	3 4 5 6	2	12		GLACIOFLUVIAL DEPOSITS *(con't)*	Similar to S6, except with very few organic fibers	
21								
22								
23								
24								
25	S-8	4 5 8 11	2	12			Medium dense brown SAND, little gravel, trace silt, with very few organics, wet	
26								
27								
28								
29								
30	S-9	3 4 6 7	2	5			Loose brown medium to fine SAND, trace silt, wet	
31								
32								
33								
34								
35	S-10	5 7 8 14	2	4			Medium dense medium to fine SAND, trace silt, wet	
36								
37								
38							Note: Borehole backfilled with drill cuttings upon completion	
39							END OF BORING 37 ft	
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 37.0 ft Rock: -- ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 10 No. of Core Runs: --		SM-001-M REV. 1/02

Driller:	J. Nitch	**Connecticut DOT Boring Report**		Hole No.:	PS2
Inspector:	S. Brousseau	Town:	Watertown, Connecticut	Stat./Offset:	
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-200	Northing:	TBD
Start Date:	19 December 2013	Route No.:	Frost Bride Road	Easting:	TBD
Finish Date:	19 December 2013	Bridge No.:	N/A	Surface Elevation:	TBD

Project Description: Waterbury Bus Maintenance Facility Replacement

Casing Size (in.)/Type: HSA 4.25"	Sampler Type/Size: S / 1 3/8	Core Barrel Type: --
Hammer Wt.: 140lb Fall: 30	Hammer Wt. (lb): -- lb Fall: --	

Groundwater Observations: @18.5 ± after 0 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	2 19 85 17	2	7		TOPSOIL / FILL	TOPSOIL Very dense dark brown silty SAND, with few asphalt particles and few roots and organics	
1								
2	S-2	4 7 15 12	2	3			Medium dense brown SAND, trace find gravel and silt, gravel lodged in spoon tip	
3								
4								
5	S-3	7 11 13 33	2	10			Medium dense dark brown to brown silty SAND, little gravel	
6								
7	S-4	52 63 100/4"	1.3	4			Very dense brown gravelly SAND, little silt, probable boulder/cobble fragment lodged in spoon tip	
8								
9							Note: Drill action indicates cobbles and boulders from 1 to 10 ft.	
10	S-5	9 15 17 19	2	14		GLACIOFLUVIAL DEPOSITS	Dense brown medium to fine SAND, little silt	
11								
12	S-6	33 74 51 52	2	10			Very dense brown medium to fine SAND, little silt and gravel, moist	
13								
14								
15	S-7	11 8 9 9	2	18			Medium dense light brown fine SAND, little silt, moist	
16								
17								
18								
19								
20								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 27.0 ft Rock: -- ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: --		SM-001-M REV. 1/02

Driller:	J. Nitch	**Connecticut DOT Boring Report**		Hole No.:	PS2
Inspector:	S. Brousseau	Town:	Watertown, Connecticut	Stat./Offset:	
Engineer:	Haley & Aldrich, Inc.	Project No.:	39192-200	Northing:	TBD
Start Date:	19 December 2013	Route No.:	Frost Bride Road	Easting:	TBD
Finish Date:	19 December 2013	Bridge No.:	N/A	Surface Elevation:	TBD
Project Description:	Waterbury Bus Maintenance Facility Replacement				
Casing Size (in.)/Type:	HSA 4.25"	Sampler Type/Size:	S / 1 3/8	Core Barrel Type:	--
Hammer Wt.: 140lb	Fall: 30	Hammer Wt. (lb): -- lb	Fall: --		
Groundwater Observations:	@18.5 ± after 0 hours				

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 in.	Pen. (ft)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
20	S-8	7 13 13 17	2	15		GLACIOFLUVIAL DEPOSITS *(con't)*	Medium brown medium to fine SAND, trace silt, wet	
21								
22								
23								
24								
25	S-9	27 37 28 24	2	14			Similar to S8, except very dense	
26								
27								
28							Note: Borehole backfilled with drill cuttings upon completion	
29							END OF BORING 27 ft	
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 27.0 ft Rock: -- ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 9 No. of Core Runs: --		SM-001-M REV. 1/02

APPENDIX B

Previous Test Boring Reports

DRILLER		Hole No. SB-1
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **303.25**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-26-01**	Utilized				X				X					
Date Finished: **11-27-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.5** f after **24** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.0	SS1	5 5 7 6	303.3	SAND, fine to Coarse, little fine gravel, trace silt, medium dense, dark brown, FILL
		5.0-5.8	S2	0.8	0.5	SS2	100/3		SAND, fine to coarse, trace fine to coarse gravel V. dense, brown, FILL
7.5								8.0 / 295.3	
		10.0-12.0	S3	2.0	0.8	SS3	15 16 16 21		SAND, fine to coarse, little gravel, trace silt, Dense, brown
	44								
	46								
	39								
	41								
15	38	15.0-17.0	S4	2.0	0.7	SS4	12 12 21 24		SAND, fine to coarse, little gravel, trace silt, Dense, brown
	44								
	46								
	53								
	67								
	74	20.0-22.0	S5	2.0	0.5	SS5	26 21 19 22		SAND, fine to coarse, little fine to coarse gravel, little silt, Dense, brown,
	68								
22.5	73								
	87								
	94								
	112	25.0-27.0	S6	2.0	0.3	SS6	18 22 19 25		SAND, fine to coarse, little fine to coarse gravel little silt, Dense, brown,
	73								
	29							28.0 / 275.3	
	101								
	111								
30	109	30.0-32.0	S7	2.0	0.5	SS7	27 41 39 42		SAND, fine to coarse, little fine to coarse gravel, little silt, V. dense, brown
	88								
	89								
	96								
	99								
	99	35.0-37.0	S8	2.0	0.8	SS8	36 39 41 47		SAND, fine to coarse, little fine to coarse gravel, little silt, V. dense, brown
								37.0 / 266.3	
37.5									
									End of Boring =37.0

Casing			Feet of	
Size	From	To	Earth	Rock
			37.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: **Installed 2" well at 18'**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-1**

Sheet **1** Of **1**

DRILLER		Hole No. SB-2
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Assocaites Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **305.17**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-21-01**	Utilized						X		X					
Date Finished: **11-21-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	0.3	SS1	12 13 15 17	305.2	Fine SAND, trace gravel, root fibers, medium, brown, FILL
		2.0-4.0	S2	2.0	1.5	SS2	12 13 13 13		Fine SAND, little silt, medium, black, FILL
		5.0-7.0	S3	2.0	2.0	SS3	2 3 2 3	7.0	
7.5								298.2	SAND, some silt, trace clay, Loose, brown, FILL
		10.0-12.0	S4	2.0	1.7	SS4	9 14 17 18		SAND, Fine to coarse, some silt, trace gravel, Dense, brown, wet at 9'
								15.0	
15		15.0-15.3	S5	0.3	0.0	SS5	100/3	290.2	Large cobble in the tip
		20.0-22.0	S6	2.0	0.5	SS6	23 28 31 29		SAND fine to coarse and GRAVEL, trace silt, V. dense, brown
22.5									
		25.0-27.0	S7	2.0	1.0	SS7	24 37 39 48		SAND, fine to coarse ,some gravel, little silt, V. dense, brown, wet
30		30.0-32.0	S8	2.0	0.5	SS8	41 33 47 58		SAND, fine to coarse ,some gravel, little silt, V. dense, brown, wet
								32.0	
								273.2	End of boring = 32' 2" well set at 18'
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-2**

Sheet **1** Of **1**

DRILLER		Hole No. SB-3
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **305.30**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-21-01**	Utilized						X		X					
Date Finished: **11-21-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@_____ f after _____ hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@_____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.7	SS1	3 3 4 6	305.3	SAND, fine to coarse, trace gravel, trace silt, loose, brown, FILL
		2.0-4.0	S2	2.0	1.5	SS2	4 4 4 4		
		5.0-7.0	S3	2.0	2.0	SS3	3 4 4 6	7.0	Fine SAND, little silt, trace gravel, roots, loose, brown, FILL
7.5								298.3 9.0	
		10.0-12.0	S4	2.0	0.8	SS4	17 19 20 24	296.3	Fine SAND, little silt, trace gravel, roots, loose, brown, FILL
15		15.0-17.0	S5	2.0	1.0	SS5	29 31 34 38		SAND, fine to coarse and GRAVEL, trace silt, dense, brown
		20.0-22.0	S6	2.0	0.3	SS6	24 31 36 31		SAND, fine to coarse, trace gravel V. dense, gray and brown
22.5									SAND, fine to coarse, V. dense, gray and brown
		25.0-27.0	S7	2.0	1.3	SS7	17 16 14 14		SAND, fine to coarse, trace gravel, medium, gray and brown
30		30.0-32.0	S8	2.0	1.7	SS8	14 15 13 13	32.0	Fine SAND, trace gravel, trace silt, medium, brown, moist to wet
								273.3	End of boring at 32'
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-3**

Sheet **1** Of **1**

DRILLER		Hole No. SB-4
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **304.25**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-19-01**	Utilized				X				X					
Date Finished: **11-19-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0								304.3	ASPHALT = 3", ROAD
		1.0-3.0	S1	2.0	1.5	SS1	7 6 4 3	1.0	BASE = 5"
								303.3	Fine SAND, trace to
		3.0-5.0	S2	2.0	2.0	SS2	3 3 2 2	5.0	some silt, trace
		5.0-7.0	S3	2.0	1.0	SS3	4 10 29 33	299.3	gravel, loose, gray to black, moist, FILL
7.5									Fine SAND, trace gravel, trace silt, V. loose, gray moist, FILL
		10.0-11.3	S4	1.3	0.8	SS4	28 34 100/3		
	72								SAND, fine to coarse, and gravel, some cobbles, dense, brown, v. moist
	86								
	200								
15	41	14.5-17.0	S5	2.5	2.0	C1	1		
	149								SAND, fine to coarse, gravel, cobble, V. dense,V. moist
	188								
	103	17.0-17.2	S6	0.2	0.0	SS5	100/2		
	140							19.0	Run #1, cored rock
	136							285.3	from 14.5'-17',
	87	20.0-22.0	S7	2.0	1.3	SS6	12 11 12 10		recovered 24" boulder
	60								Bouncing on large
22.5	49								cobble, Roller bit
	54								ahead of large
	61								cobbles
	78	25.0-27.0	S8	2.0	0.3	SS7	9 11 13 15		
	34								Coarse SAND, little
	51								fine to coarse
	58								gravel, trace silt,
	66								medium, brown
30	69	30.0-32.0	S9	2.0	0.0	SS8	11 14 16 19		Coarse SAND, little
	41								fine to coarse
	48								gravel, trace silt,
	56								medium, brown
	65								
	74	35.0-37.0	S10	2.0	0.5	SS9	12 14 17 17		Large cobble piece in spoon tip
	39								
37.5	41								SAND, fine to coarse,
	44								little gravel, trace
	57								silt, dense, brown
	68	40.0-42.0	S11	2.0	0.5	SS10	16 18 13 17		gray
	86								Coarse SAND, little
	86								fine sand, trace
	89								gravel, trace silt,

Casing			Feet of	
Size	From	To	Earth	Rock
			No. of Samples	
			12	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. SB-4

DRILLER		Hole No. SB-4
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **304.25**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-19-01**	Utilized				X				X					
Date Finished: **11-19-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
45	60								dense, brown
	82	45.0-47.0	S12	2.0	0.5	SS11	16 17 15 14		Fine SAND, little
	75								coarse sand, little
	78								silt, little gravel,
	73								dense, brown
	73								
	82	50.0-52.0	S13	2.0	0.0	SS12	14 9 9 11		No recovery
								52.0	
52.5								252.3	End of boring at 52'
60									
67.5									
75									
82.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			No. of Samples	
			12	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-4**

Sheet **2** Of **2**

DRILLER		Hole No. SB-5
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **303.00**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-21-01**	Utilized						X		X					
Date Finished: **11-26-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.0	SS1	4 5 5 7	303.0	SAND, some silt, trace root fibers, medium, dark brown, moist, FILL
		2.0-4.0	S2	2.0	0.0	SS2	4 7 12 16	5.0	
		5.0-6.3	S3	1.3	0.3	SS3	18 24 100/3	298.0	No recovery, broken cobble in tip
7.5								8.0 295.0	SAND, fine to coarse, some gravel, dense, brown, moist,
		10.0-12.0	S4	2.0	0.4	SS4	16 23 25 29		SAND, fine to coarse, some gravel, dense, brown, moist,
15		15.0-17.0	S5	2.0	0.1	SS5	21 23 19 22		SAND, fine to coarse, some gravel, trace silt, dense, brown
		20.0-22.0	S6	2.0	0.6	SS6	24 47 31 29		SAND, fine to coarse, some gravel, trace silt, V. dense, brown
22.5									
		25.0-27.0	S7	2.0	0.2	SS7	29 31 34 23		SAND, fine to coarse, some gravel, trace silt, V. dense, brown
30		30.0-32.0	S8	2.0	0.3	SS8	26 33 29 29	32.5	SAND, fine to coarse, some gravel, trace silt, V. dense, brown
								270.5	End of boring at 32.5'
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-5**

Sheet **1** Of **1**

DRILLER		Hole No. SB-6
Edward Pelkey		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **303.90**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-21-01**	Utilized						X		X					
Date Finished: **11-21-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4		•		1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	7 18 10 12	303.9	SAND, fine to coarse, trace gravel, medium, brown, FILL
		2.0-4.0	S2	2.0	0.9	SS2	5 6 7 7	4.5	Fine SAND, trace silt, medium, dark brown, FILL
		5.0-7.0	S3	2.0	1.5	SS3	6 4 4 15	299.4	SAND, fine to coarse, some silt, trace gravel, loose, brown, FILL
7.5									
		10.0-12.0	S4	2.0	1.3	SS4	51 40 25 18	14.0	Coarse SAND, some gravel, V. dense, brown
15		15.0-17.0	S5	2.0	1.0	SS5	11 16 14 19	289.9	SAND, fine to coarse, little gravel, trace silt, trace small cobbles, dense
		20.0-20.4	S6	0.4	0.3	SS6	100/5		SAND, fine to coarse, trace cobbles, V. dense, brown
22.5									
		25.0-27.0	S7	2.0	0.5	SS7	19 25 29 32		Coarse SAND and GRAVEL, V. dense, brown
30		30.0-32.0	S8	2.0	0.8	SS8	24 30 32 36	32.0	Coarse SAND and GRAVEL, V. dense, brown
								271.9	End of boring at 32'
37.5									

Casing Size	From	To	Feet of Earth	Feet of Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-6**

Sheet **1** Of **1**

DRILLER		Hole No. SB-7
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
Mary Hossieni	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **304.16**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-20-01**	Utilized						X		X					
Date Finished: **11-20-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.5** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	2 3 3 5	304.2	SAND, fine to coarse, little fine gravel, loose, brown, FILL
		2.0-4.0	S2	2.0	0.7	SS2	3 4 4 4		SAND, fine to coarse, loose, brown, FILL
		4.0-6.0	S3	2.0	0.8	SS3	21 37 60 78	7.0	SAND, coarse to fine, little meduim to fine gravel, trace coarse gravel, V. dense, brown
7.5								297.2	
		10.0-12.0	S4	2.0	1.3	SS4	67 71 53 61		SAND, coarse to fine, some medium to fine gravel, V. dense, brown
15		15.0-17.0	S5	2.0	0.5	SS5	29 32 36 42	19.0	Coarse SAND, and medium to fine gravel, trace coarse gravel, V. dense, brown
		20.0-22.0	S6	2.0	0.1	SS6	12 14 15 19	285.2	GRAVEL,coarse, medium dense
22.5								23.0	
		25.0-27.0	S7	2.0	0.8	SS7	15 18 15 13	281.2	SAND, coarse to fine, some fine gravel, little medium gravel, dense, brown
30		30.0-32.0	S8	2.0	0.8	SS8	12 17 19 16	32.0	SAND, coarse to fine, some fine gravel, little medium gravel, dense, brown
								272.2	End of boring at 32'
37.5									

Casing Size	From	To	Feet of Earth	Feet of Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-7**

Sheet **1** Of **1**

DRILLER		Hole No. SB-8
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **303.79**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-26-01**	Utilized						X		X					
Date Finished: **11-26-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **10.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	1 5 10 10	303.8	Fine SAND, medium, brown, FILL
		2.0-4.0	S2	2.0	0.8	SS2	9 7 6 6	4.0	Fine SAND, trace silt, medium, brown, FILL
		4.0-6.0	S3	2.0	1.3	SS3	19 50 49 52	299.8	GRAVEL, fine to coarse, and SAND, fine to coarse, trace cobbles, V. dense, brown
7.5									
		10.0-12.0	S4	2.0	0.8	SS4	37 49 48 55		GRAVEL, fine to coarse, and SAND, fine to coarse, trace cobbles, V. dense, brown
15		15.0-17.0	S5	2.0	1.0	SS5	29 39 56 70	19.0	GRAVEL, fine to coarse, and SAND, fine to coarse, trace cobbles, V. dense, brown
		20.0-22.0	S6	2.0	1.3	SS6	22 22 30 36	284.8	Fine SAND, little gravel, little cobbles, dense, brown, wet
22.5									
		25.0-27.0	S7	2.0	1.0	SS7	27 24 29 38		Fine SAND, little gravel, little cobbles, dense, brown, wet
30		30.0-32.0	S8	2.0	1.5	SS8	29 22 36 30	32.0	Fine SAND, little gravel, little cobbles, dense, brown, wet
								271.8	End of boring at 32'
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-8**

Sheet **1** Of **1**

DRILLER		Hole No. SB-9
Edward Pelkey		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.43**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-21-01**	Utilized						X		X					
Date Finished: **11-21-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **10.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.3	SS1	4 4 7 8	302.4	Fine SAND, little silt, medium, brown, FILL
		2.0-4.0	S2	2.0	1.1	SS2	6 5 7 9	4.0	
								298.4	Fine SAND, medium, browm, FILL
		5.0-5.9	S3	0.9	0.3	SS3	32 100/5		Coarse SAND, some gravel, trace cobbles, V. dense, brown
7.5									
		10.0-12.0	S4	2.0	1.3	SS4	23 21 19 18		Coarse SAND, some gravel, trace cobbles, V. dense, brown
15		15.0-17.0	S5	2.0	0.8	SS5	17 19 17 13		Coarse SAND, some gravel, trace cobbles, V. dense, brown
		20.0-22.0	S6	2.0	1.2	SS6	18 26 30 32		SAND, fine to coarse, trace gravel, trace cobbles, V. dense, brown
22.5									
		25.0-27.0	S7	2.0	1.5	SS7	12 14 15 10		SAND, coarse, trace gravel, trace fine sand, medium, brown, wet
30		30.0-32.0	S8	2.0	1.3	SS8	9 10 11 11	32.0	SAND, fine to coarse, trace gravel, medium, brown, wet
								270.4	End of boring at 32'
37.5									

Casing Size	From	To	Feet of Earth	Feet of Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-9**

Sheet **1** Of **1**

DRILLER		Hole No. SB-10
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **303.50**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-28-01**	Utilized						X		X					
Date Finished: **11-28-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	8 7 8 9	303.5	Fine SAND, some silt, trace coarse sand, medium, tan brown
								5.0	
		5.0-7.0	S2	2.0	1.3	SS2	21 28 35 57	298.5	SAND, fine to coarse, and GRAVEL, fine to coarse, trace cobbles and boulders, V. dense, brown
7.5								8.0	
								295.5	Fine SAND, little silt, trace coarse sand, trace cobbles, medium, tan
		10.0-12.0	S3	2.0	1.5	SS3	3 7 10 10		
15		15.0-17.0	S4	2.0	1.5	SS4	6 11 9 17		Fine SAND, little silt, trace coarse sand, trace cobbles, medium, tan
		20.0-22.0	S5	2.0	1.5	SS5	3 7 8 10		SAND, fine to coarse, trace silt, medium, tan
22.5									
		25.0-27.0	S6	2.0	2.0	SS6	8 6 9 14		SAND, fine to coarse, trace fine gravel , trace silt, medium, tan
30		30.0-32.0	S7	2.0	2.0	SS7	6 10 17 35		Fine SAND, trace coarse sand, medium, tan
		35.0-37.0	S8	2.0	2.0	SS8	14 18 21 19	37.0	Fine SAND, trace coarse sand, dense, tan
37.5								266.5	End of boring at 37'

Casing Size	From	To	Feet of Earth	Feet of Rock
			37.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-10**

Sheet **1** Of **1**

DRILLER		Hole No. SB-11
Edward Pelkey		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.90**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-20-01**	Utilized				X				X					
Date Finished: **11-20-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **8.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.0	SS1	6 14 9 7	302.9	Fine SAND, trace gravel, medium, brown, FILL
	3								
	12	2.0-4.0	S2	2.0	1.5	SS2	5 5 6 9		SAND, some silt, trace oragnic matter, medium, dark brown, FILL
	13								
	10	4.0-6.0	S3	2.0	0.8	SS3	20 25 56 60	5.0	
	10							297.9	GRAVEL, coarse, some sand, V. dense, gray to brown, moist
	47								
7.5	69								
	100								
	120								
	99	10.0-12.0	S4	2.0	1.0	SS4	48 60 75 40		
	45								GRAVEL, coarse, some sand, V. dense, gray to brown, moist
	60							13.0	
	65							289.9	
	40								
15	43	15.0-17.0	S5	2.0	0.4	SS5	10 8 11 11		Fine SAND, trace silt, trace gravel, medium, brown
	56								
	75								
	109								
	90								
	77	20.0-22.0	S6	2.0	1.0	SS6	10 11 13 11		SAND, some gravel, trace to some silt, medium, gray, moist
	53								
22.5	68								
	90								
	95								
	100	25.0-27.0	S7	2.0	1.5	SS7	9 10 13 13		SAND, some gravel, trace to some silt, medium, gray, moist
	45								
	60								
	63								
	72								
30	80	30.0-32.0	S8	2.0	1.5	SS8	7 8 9 13		SAND, some gravel, trace to some silt, medium, gray, moist
								32.0	
								270.9	End of boring at 32'
37.5									

Casing Size	From	To	Feet of Earth	Feet of Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-11**

Sheet **1** Of **1**

DRILLER		Hole No. SB-12
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
I.Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.40**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-28-01**	Utilized				X				X					
Date Finished: **11-28-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@_____ f after _____ hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@_____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.2	SS1	1 2 3 3	302.4	Fine SAND, some silt, trace roots, trace fine to medium gravel, loose, black brown, FILL
	2								
	7	2.0-4.0	S2	2.0	1.3	SS2	4 4 5 7		
	14								
	25							5.0	
	29	5.0-7.0	S3	2.0	1.0	SS3	17 45 74 100	297.4	Fine SAND, trace fine gravel, trace silt, loose, dark brown, FILL
	53								
7.5	79								
	121							9.0	
	134							293.4	Fine SAND, trace fine gravel, trace silt, cobbles, boulders, V. dense, brown, FILL
	92	10.0-11.3	S4	1.3	0.3	SS4	45 72 100/3		
	110								
	85								
	94								
	113								SAND, fine to coarse, and GRAVEL, fine to coarse, trace silt, V. dense, brown
15	130	15.0-17.0	S5	2.0	1.5	SS5	17 26 34 29		
	75								
	79								
	82								
	124								SAND, fine to coarse, and GRAVEL, fine to medium, trace coarse gravel, V. dense, brown
	114	20.0-22.0	S6	2.0	1.2	SS6	17 26 34 29		
	102								
22.5	117							23.0	
	131							279.4	SAND, fine to coarse, and GRAVEL, fine to medium, trace coarse gravel, V. dense, brown
	125								
	160	25.0-27.0	S7	2.0	1.5	SS7	18 26 31 40		
	104								
	107								
	142								
	125								SAND, fine to coarse, some gravel, fine to medium, trace, cobbles, V. dense, brown
30	171	30.0-31.0	S8	1.0	0.8	SS8	35 100/6		
	132								
	102							33.0	
	97							269.4	
	154								
	119	35.0-36.3	S9	1.3	1.0	SS9	24 49 100/4	36.3	SAND, fine to coarse, some gravel, fine to coarse, trace cobbles, V. dense, brown
								266.1	
37.5									GRAVEL, fine to coarse
									End of boring at

Casing			Feet of	
Size	From	To	Earth	Rock
			36.3 f	**0.0 f**
			No. of Samples	
			9	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-12**

Sheet **1** Of **2**

DRILLER		Hole No. SB-12
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
I.Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.40**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-28-01**	Utilized				X				X					
Date Finished: **11-28-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@_____ f after _____ hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@_____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
45									36.3'
52.5									
60									
67.5									
75									
82.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			36.3 f	**0.0 f**
			No. of Samples	
			9	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-12**

Sheet **2** Of **2**

DRILLER		Hole No. SB-13
Richard Posa		Line N/A
INSPECTOR		Station N/A
I. Okonkwo	TOWN: Waterbury, Connecticut	Offset N/A
SOILS ENGINEER	PROJECT NAME: Waterbury Bus Maintenance Garage	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: 1002-0003GT	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): 302.60		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: 11-27-01	Utilized				X				X					
Date Finished: 11-27-01	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ 12.0 f after 0 hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.0	SS1	3 3 4 4	302.6	SAND, fine to coarse, trace gravel, trace silt, loose, brown, FILL
		2.0-4.0	S2	2.0	1.5	SS2	3 4 4 5		
		4.0-6.0	S3	2.0	1.5	SS3	3 3 4 4		Fine SAND, trace gravel ,trace silt, loose, dark gray, Fill
		6.0-8.0	S4	2.0	1.0	SS4	3 4 4 23		
7.5								9.0	
								293.6	Fine SAND, trace gravel, trace root fibers, loose, dark brown, FILL
		10.0-10.2	S5	0.2	0.0	SS5	100/2		
	76								
	89								
	78								Top 6" = Fine SAND, trace gravel, trace root fibers, loose, dark brown, FILL Bottom 6" = SAND, fine to coarse and GRAVEL, trace silt
	83								
15	72	15.0-17.0	S6	2.0	0.5	SS6	7 8 9 13		
	76								
	48								
	45								
	39								
	46	20.0-22.0	S7	2.0	0.2	SS7	12 15 19 21		
	20								No recovery, bouncing on cobble
22.5	22								
	27								SAND, fine to coarse, little fine to coarse gravel, trace silt, medium, brown
	23								
	21	25.0-27.0	S8	2.0	0.0	SS8	7 9 12 10		
	26								
	26							28.0	Large cobble piece in the tip of the spoon, dense
	24							274.6	
	28								
30	31	30.0-32.0	S9	2.0	0.8	SS9	6 7 8 8		No recovery
	24								SAND, fine to coarse, trace gravel, medium, brown
	28								
	30								
	33								
	37	35.0-37.0	S10	2.0	0.3	SS10	8 13 16 19		SAND, fine to coarse, little fine to coarse gravel, dense, brown
	42								
37.5	41								
	45								
	52								
	59	40.0-42.0	S11	2.0	1.0	SS11	12 15 16 12		Fine SAND, trace gravel, dense, brown
	36								
	41								
	41								

Casing Size	From	To	Feet of Earth	Feet of Rock
			47.0 f	0.0 f
			No. of Samples	
			12	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. SB-13

DRILLER		Hole No. SB-13
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.60**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-27-01**	Utilized				X				X					
Date Finished: **11-27-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **12.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
45	45								
	53	45.0-47.0	S12	2.0	0.3	SS12	14 15 16 19		Fine SAND, trace
								47.0	gravel, dense, brown
								255.6	End of boring at 47'
52.5									
60									
67.5									
75									
82.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			47.0 f	**0.0 f**
			No. of Samples	
			12	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-13**

Sheet **2** Of **2**

DRILLER		Hole No. SB-14
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.50**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-28-01**	Utilized						X		X					
Date Finished: **11-28-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	5 8 9 9	302.5	Fine SAND, some silt, medium, dark brown, FILL
								4.0	
		5.0-7.0	S2	2.0	1.2	SS2	19 25 39 60	298.5	SAND, fine to coarse, and GRAVEL, fine to coarse, trace silt, V. dense, brown
7.5								8.0	
								294.5	
		10.0-12.0	S3	2.0	1.7	SS3	5 5 9 11		Fine SAND, little silt, trace fine gravel, medium, brown
15		15.0-17.0	S4	2.0	2.0	SS4	10 9 11		Fine SAND, little silt, medium, brown
		20.0-22.0	S5	2.0	1.7	SS5	4 9 8 13		Fine SAND, little coarse sand, trace silt, medium, brown
22.5									
		25.0-27.0	S6	2.0	1.7	SS6	10 8 15 27		Fine SAND, trace coarse sand, trace silt, medium, brown gray
30		30.0-32.0	S7	2.0	1.7	SS7	10 11 15 34		Fine SAND, little coarse sand, trace fine gravel, medium, brown gray
								32.0	
								270.5	
									End of boring at 32'
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			32.0 f	**0.0 f**
			No. of Samples	
			7	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-14**

Sheet **1** Of **1**

DRILLER		Hole No. SB-15
Edward Pelkey		Line **N/A**
INSPECTOR		Station **N/A**
Mary Hossieni	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.95**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-20-01**	Utilized				X				X					
Date Finished: **11-20-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.5** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.0	SS1	17 20 21 14	303.0	Fine SAND, little gravel, trace silt, dense, brown, FILL
	6								
	10	2.0-4.0	S2	2.0	1.5	SS2	14 15 15 16		SAND, trace silt, medium, brown, FILL
	16								
	16	4.0-6.0	S3	2.0	1.7	SS3	9 7 7 12		
	15							6.0	Fine SAND, trace silt, medium, brown, FILL
	10	6.0-8.0	S4	2.0	1.5	SS4	48 52 75 69	297.0	
7.5	14								GRAVEL, medium to coarse, and coarse SAND, little, cobbles, V. dense, brown
	55								
	71								
	90	10.0-10.4	S5	0.4	0.4	SS5	100/5		
	98								
	46							13.0	
	52							290.0	GRAVEL, medium to coarse, and coarse SAND, little, cobbles, V. dense, brown
	19								
15	20	15.0-17.0	S6	2.0	1.0	SS6	4 5 6 8		
	21								
	20								
	30								
	19								
	18	20.0-22.0	S7	2.0	1.2	SS7	3 4 4 5		Fine SAND, trace silt, medium, brown
	35								
22.5	45								Fine SAND, trace silt, loose, brown
	62								
	61								
	70	25.0-27.0	S8	2.0	0.8	SS8	7 5 8 9		Fine SAND, little silt, medium, brown
	45								
	50								
	52								
	49								
30	60	30.0-32.0	S9	2.0	1.5	SS9	10 16 17 20		Fine SAND, dense, brown
								32.0	
								271.0	End of boring at 32'
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			32.0 f	**0.0 f**
			No. of Samples	
			9	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-15**

Sheet **1** Of **1**

DRILLER		Hole No. SB-16
Edward Pelkey		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.10**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-26-01**	Utilized						X		X					
Date Finished: **11-27-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	6 14 15 15	302.1	Fine SAND, trace gravel, trace asphalt, medium, brown, FILL
	10								
	50	2.0-4.0	S2	2.0	0.3	SS2	11 13 15 16		
	66								
	59								
	90	5.0-5.2	S3	0.2	0.1	SS3	100/2		SAND, some silt, trace gravel, medium, dark brown, FILL
	200							7.0	
7.5	125							295.1	Fine SAND, trace gravel, trace cobbles, V. dense, brown, FILL
	179								
	153								
	167	10.0-12.0	S4	2.0	1.2	SS4	69 54 45 49		
	80								
	95								GRAVEL, fine to coarse, trace sand, fine to coarse, trace cobbles, V. dense, brown
	35							14.0	
	46							288.1	
15	49	15.0-17.0	S5	2.0	1.7	SS5	20 29 32 26		
	40								
	35								SAND, fine to coarse, little gravel, V. dense, brown
	33								
	46								
	51	20.0-22.0	S6	2.0	0.7	SS6	11 10 13 15		
	29								SAND, fine to coarse, trace gravel, medium, brown
22.5	33								
	30								
	40								
	39	25.0-27.0	S7	2.0	0.6	SS7	8 11 11 15		SAND, fine to coarse, trace gravel, medium, brown
	25								
	35								
	30								
	33								
30	41	30.0-32.0	S8	2.0	0.7	SS8	8 9 9 10		SAND, fine to coarse, trace gravel, medium, brown
	29								
	40								
	33								
	29								
	32	35.0-37.0	S9	2.0	0.8	SS9	7 8 9 9		SAND, fine to coarse, trace gravel, medium, brown
								37.0	
37.5								265.1	End of boring at 37'

Casing Size	From	To	Feet of Earth	Feet of Rock
			37.0 f	**0.0 f**
			No. of Samples	
			9	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-16**

Sheet **1** Of **1**

DRILLER		Hole No. SB-17
Edward Pelkey		Line **N/A**
INSPECTOR		Station **N/A**
IOO	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.90**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-27-01**	Utilized				X				X					
Date Finished: **11-27-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ _____ f after _____ hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	0.8	SS1	9 12 12 15	302.9	SAND, fine to coarse, little gravel, medium, brown, FILL
	10								
	30	2.0-4.0	S2	2.0	1.0	SS2	13 18 22 20		SAND, fine to coarse, some gravel, dense, brown, FILL
	41								
	63								
	40	5.0-5.1	S3	0.1	0.0	SS3	100/1		
	260							7.0	Drill small boulders, cobbles, gravel, V. dense
7.5	231							295.9	
	200								
	190								
	145	10.0-12.0	S4	2.0	1.3	SS4	22 25 20 19		SAND, fine to coarse and GRAVEL, dense, brown
	107								
	46								
	32								
	30								
15	35	15.0-17.0	S5	2.0	0.8	SS5	21 29 23 30		SAND, fine to coarse and GRAVEL, V. dense, brown
	35								
	28								
	30							19.0	
	30							283.9	
	40	20.0-22.0	S6	2.0	0.7	SS6	13 15 15 28		SAND, fine to coarse, dense, brown
	78								
22.5	20								
	23								
	25								
	28	25.0-27.0	S7	2.0	0.5	SS7	8 11 21 16		Fine SAND, dense, brown
	20								
	25								
	38								
	43								
30	54	30.0-32.0	S8	2.0	1.0	SS8	7 11 11 13		SAND, fine to coarse, trace fine gravel, medium, brown
	25								
	29								
	30								
	48								
	52	35.0-37.0	S9	2.0	1.2	SS9	8 9 10 15		SAND, fine to coarse, trace fine gravel, medium, brown
	58								
37.5	60								
	53								
	60								
	68	40.0-42.0	S10	2.0	0.5	SS10	13 14 22 44		SAND, fine to coarse, some gravel, dense, brown
	125								
	260							43.0	
	319							259.9	

Casing Size	From	To	Feet of Earth	Feet of Rock
			52.0 f	**0.0 f**
			No. of Samples	
			12	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-17**

DRILLER		Hole No. SB-17
Edward Pelkey		Line **N/A**
INSPECTOR		Station **N/A**
IOO	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.90**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-27-01**	Utilized				X				X					
Date Finished: **11-27-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@_____ f after _____ hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@_____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
45	220								
	229	45.0-47.0	S11	2.0	0.8	SS11	50 56 75 70		SAND, fine to coarse, and GRAVEL, little cobbles, V. dense, brown
	185								
	212								
	193								
	266								
	291	50.0-52.0	S12	2.0	1.2	SS12	53 68 69 91		SAND, fine to coarse, and GRAVEL, little cobbles, V. dense, brown
								52.0	
52.5								250.9	End of boring at 52'
60									
67.5									
75									
82.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			52.0 f	**0.0 f**
			No. of Samples	
			12	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-17**

Sheet **2** Of **2**

DRILLER		Hole No. SB-18
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
IOO	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.00**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-28-01**	Utilized				X				X					
Date Finished: **11-28-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4		•		1 3/8		1 3/8			
@ **8.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0								1.0	
		1.0-3.0	S1	2.0	1.7	SS1	17 10 13 10	301.0	Fine SAND, some silt, little fine to medium gravel, medium, brown black, FILL
	23								
	19	3.0-5.0	S2	2.0	1.3	SS2	9 7 5 5		
	17								
	21	5.0-7.0	S3	2.0	0.0	SS3	1 1 2 2		SAND, fine to coarse, little silt, trace fine gravel, medium, brown, FILL
	3								
7.5	7							8.0	
	11							294.0	No recovery
	52								
	78	10.0-12.0	S4	2.0	1.3	SS4	45 51 79 23		SAND, fine to coarse, and GRAVEL, fine to coarse, V. dense, brown
	231								
	215								
	150								
	87								
15	92	15.0-17.0	S5	2.0	1.2	SS5	24 49 32 31		SAND, fine to coarse, some fine to coarse gravel, V. dense, brown
	74								
	83								
	89								
	103								
	124	20.0-22.0	S6	2.0	1.3	SS6	30 41 67 41		SAND, fine to coarse and GRAVEL, fine to coarse, V. dense, brown
	63								
22.5	74								
	77								
	81								
	95	25.0-27.0	S7	2.0	1.5	SS7	22 55 73 27		SAND, fine to coarse, little fine to coarse gravel, V. dense, brown tan
	86								
	89							28.0	
	113							274.0	
	142								
30	125	30.0-32.0	S8	2.0	1.5	SS8	13 12 14 11		SAND, fine to coarse, some fine to medium gravel, trace coarse gravel, medium, brown gray
	71								
	52								
	35								
	31								
	29	35.0-37.0	S9	2.0	1.5	SS9	15 14 21 17		SAND, fine to coarse, some fine to medium gravel, trace coarse gravel, medium, brown gray
								37.0	
37.5								265.0	
									End of boring at 37'

Casing Size	From	To	Feet of Earth	Feet of Rock
			37.0 f	**0.0 f**
			No. of Samples	
			9	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-18**

Sheet **1** Of **1**

DRILLER		Hole No. SB-19
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
IOO	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f):		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-27-01**	Utilized				X				X					
Date Finished: **11-29-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **13.5** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	2.0	SS1	2 3 3 3	0.0	Fine SAND, trace gravel, trace silt, trace root fibers, loose, dark gray, FILL
		2.0-4.0	S2	2.0	2.0	SS2	3 3 4 3		
		4.0-6.0	S3	2.0	1.5	SS3	3 3 3 3		
		6.0-8.0	S4	2.0	1.7	SS4	3 3 3 4		Fine SAND, trace gravel, trace silt, trace root fibers, loose, dark gray, FILL
7.5								8.0	
		8.0-10.0	S5	2.0	1.5	SS5	3 4 19 33	-8.0	Fine SAND, trace gravel, trace silt, trace root fibers, loose, dark gray, FILL
		10.0-12.0	S6	2.0	0.0	SS6	36 29 27 31		
	58								Fine SAND, trace gravel, trace silt, trace root fibers, loose, dark gray, FILL
	71								
	82								
	69								
15	33	15.0-17.0	S7	2.0	0.8	SS7	6 8 8 10		
	21								Fine SAND, trace gravel, trace silt, loose, dark gray brown, FILL
	24								
	25								
	28								
	28	20.0-22.0	S8	2.0	0.0	SS8	12 15 18 21		
	26								SAND, fine to coarse, some gravel, medium, gray brown
22.5	30							23.0	
	31							-23.0	No recovery
	34								SAND, fine to coarse, little fine to coarse gravel, medium, gray brown
	42	25.0-27.0	S9	2.0	0.0	SS9	7 9 12 10		
	19								
	20								
	23								
	23								No recovery, large cobble piece in tip
30	24	30.0-32.0	S10	2.0	0.8	SS10	6 7 8 8		
	20								No recovery
	20								Fine, SAND, trace gravel, medium, brown
	22								
	23								
	26	35.0-37.0	S11	2.0	0.5	SS11	13 16 18 21		Coarse SAND, trace gravel, dense, brown
	25								
37.5	31								
	36								
	34								
	33	40.0-42.0	S12	2.0	1.3	SS12	9 14 17 19		Coarse SAND, trace fine gravel, dense, brown
	35								
	32								
	37								

Casing			Feet of	
Size	From	To	Earth	Rock
			47.0 f	**0.0 f**
			No. of Samples	
			13	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-19**

Sheet **1** Of **2**

DRILLER		Hole No. SB-19
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
IOO	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f):		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-27-01**	Utilized				X				X					
Date Finished: **11-29-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **13.5** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
	40								
45	42	45.0-47.0	S13	2.0	0.8	SS13	8 15 15 15		Coarse SAND, trace fine gravel, dense, brown
								47.0	
								-47.0	End of boring at 47'
52.5									
60									
67.5									
75									
82.5									

Casing Size	From	To	Feet of Earth	Feet of Rock
			47.0 f	**0.0 f**
			No. of Samples	
			13	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **SB-19**

Sheet **2** Of **2**

DRILLER		Hole No. DB-1
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **303.28**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-30-01**	Utilized						X		X					
Date Finished: **11-30-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **10.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	10 15 10 10	303.3	Fine SAND, some silt, trace fine gravel, medium, black brown, FILL
		2.0-4.0	S2	2.0	1.3	SS2	8 7 8 13		
		5.0-7.0	S3	2.0	2.0	SS3	1 3 4 4		SAND, fine to coarse, some fine gravel, trace silt, medium, brown, FILL
7.5								8.0	
								295.3	Fine SAND and SILT, trace coarse sand, loose, brown, FILL
		10.0-12.0	S4	2.0	1.0	SS4	15 25 31 27		
									SAND, fine to coarse and GRAVEL, fine to coarse, V. dense, brown
15		15.0-17.0	S5	2.0	1.0	SS5	19 24 35 38		
								20.0	Fine SAND, and GRAVEL, fine to coarse, V. dense, brown
		20.0-22.0	S6	2.0	1.3	SS6	18 31 33 29	283.3	SAND, fine to coarse, some fine to coarse gravel, V. dense, brown
22.5									
		25.0-27.0	S7	2.0	1.7	SS7	5 7 11 19		SAND, fine to coarse, trace fine gravel, medium, brown
30		30.0-32.0	S8	2.0	1.7	SS8	4 8 13 21		
								32.0	SAND, fine to coarse, trace fine gravel, medium, brown
								271.3	End of boring at 32'
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			32.0 f	**0.0 f**
			No. of Samples	
			8	

NOTES: **Installed well at 20'**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **DB-1**

Sheet **1** Of **1**

DRILLER		Hole No. DB-2
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **301.49**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-30-01**	Utilized						X		X					
Date Finished: **11-30-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **8.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.7	SS1	3 4 6 6	301.5	Fine SAND, trace gravel ,trace roots, medium, dark brown, FILL
		2.0-4.0	S2	2.0	1.5	SS2	4 5 5 5		
		5.0-7.0	S3	2.0	0.8	SS3	4 4 5 6		Fine SAND, trace fine gravel ,trace silt, loose, brown, FILL
7.5								9.0	Fine SAND, trace silt, trace root fibers, loose, dark brown, FILL
		10.0-12.0	S4	2.0	0.2	SS4	12 15 15 17	292.5	
								13.0	Fine SAND, trace silt, dense, gray brown
								288.5	
15		15.0-17.0	S5	2.0	0.8	SS5	16 18 22 47		SAND, fine to coarse, some, fine to coarse gravel, trace silt, dense, brown
		20.0-22.0	S6	2.0	0.8	SS6	14 17 18 19		SAND, fine to coarse, some, fine to coarse gravel, trace silt, dense, brown
22.5								23.0	
								278.5	
		25.0-27.0	S7	2.0	1.3	SS7	12 14 16 16		Fine SAND, dense, brown
30		30.0-32.0	S8	2.0	0.5	SS8	10 14 15 17		Fine SAND, dense, brown
		35.0-37.0	S9	2.0	0.5	SS9	11 13 16 19		Fine SAND, dense, brown
								37.0	
37.5								264.5	End of boring at 37'

Casing			Feet of	
Size	From	To	Earth	Rock
			37.0 f	**0.0 f**
			No. of Samples	
			9	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **DB-2**

Sheet **1** Of **1**

DRILLER **Erik Delpriore**		Hole No. **P-1**
INSPECTOR **IOO**	TOWN: **Waterbury, Connecticut**	Line **N/A** Station **N/A** Offset **N/A**
SOILS ENGINEER **Earth Design Associates Inc.**	PROJECT NAME: **Waterbury Bus Maintenance Garage** PROJECT NUMBER: **1002-0003GT**	N. Coordinate E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation (f): **304.82**														
Date Started: **11-30-01**	Utilized						X		X					
Date Finished: **11-30-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **10.5** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.2	SS1	6 11 15 19	304.8	SAND, fine to coarse, and GRAVEL, fine to coarse, medium, brown
		2.0-4.0	S2	2.0	1.5	SS2	15 17 16 35		SAND, fine to coarse, and GRAVEL, fine to coarse, dense, brown
		5.0-7.0	S3	2.0	1.3	SS3	24 35 53 81	7.0	SAND, fine to coarse, and GRAVEL, fine to coarse, V. dense, brown
7.5								297.8	
		10.0-12.0	S4	2.0	0.8	SS4	11 10 29 45	12.0	SAND, fine to coarse, and GRAVEL, fine to coarse, V. dense, brown
								292.8	
15									End of boring at 12'
22.5									
30									
37.5									

Casing Size	From	To	Feet of Earth	Feet of Rock
			12.0 f	**0.0 f**
			No. of Samples	
			4	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **P-1**

Sheet **1** Of **1**

DRILLER		Hole No. P-2
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
I.Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **304.65**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-30-01**	Utilized						X		X					
Date Finished: **11-30-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **10.5** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	10 7 6 11	304.7	SAND, fine to coarse, some silt, trace fine to coarse gravel, medium, brown black
		2.0-4.0	S2	2.0	1.5	SS2	13 15 11 29	5.0	
		5.0-5.8	S3	0.8	0.3	SS3	52 100/3	299.7	SAND, fine to coarse, and GRAVEL, fine to coarse, medium, brown tan
7.5									
		10.0-12.0	S4	2.0	1.6	SS4	12 16 19 34	12.0	SAND, fine to coarse, and GRAVEL, fine to coarse, V. dense, brown
								292.7	SAND, fine to coarse and GRAVEL, fine to coarse, trace silt, V. dense, brown
15									End of boring at 12'
22.5									
30									
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			12.0 f	**0.0 f**
			No. of Samples	
			4	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **P-2**

Sheet **1** Of **1**

DRILLER		Hole No. P-3
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I.Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.55**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-29-01**	Utilized						X		X					
Date Finished: **11-29-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **7.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	6 5 3 4	302.6	Fine SAND, little silt, loose, black brown, FILL
		2.0-4.0	S2	2.0	0.3	SS2	3 3 3 5	5.0	Fine SAND, little silt, loose, black brown, FILL
		5.0-7.0	S3	2.0	0.3	SS3	14 18 19 22	297.6	SAND, fine to coarse, some fine to coarse gravel, little silt, dense, brown
7.5								10.0	
		10.0-12.0	S4	2.0	0.3	SS4	24 28 26 30	292.6	SAND, fine to coarse and GRAVEL, little silt, V. dense, brown
								12.0	
								290.6	End of boring at 12'
15									
22.5									
30									
37.5									

Casing Size	From	To	Feet of Earth	Feet of Rock
			12.0 f	**0.0 f**
			No. of Samples	
			4	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **P-3**

Sheet **1** Of **1**

DRILLER		Hole No. P-4
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
IOO	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **304.40**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-29-01**	Utilized						X		X					
Date Finished: **11-29-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.0	SS1	3 4 5 6	304.4	Coarse SAND, little, fine to medium gravel, loose, brown, FILL
		2.0-4.0	S2	2.0	1.3	SS2	3 3 5 4	5.0	
		5.0-7.0	S3	2.0	0.7	SS3	3 2 14 27	299.4	Fine SAND, little silt, loose, black brown, FILL
7.5								10.0	Fine SAND, little silt, trace fine gravel, medium, brown
		10.0-12.0	S4	2.0	0.4	SS4	16 19 19 27	294.4	
								12.0	SAND, fine to coarse and GRAVEL, little silt, dense, brown
								292.4	
15									End of boring at 12'
22.5									
30									
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			12.0 f	**0.0 f**
			No. of Samples	
			4	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **P-4**

Sheet **1** Of **1**

DRILLER		Hole No. P-5
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
IOO	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **302.35**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-28-01**	Utilized				X				X					
Date Finished: **11-28-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **6.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ _____ f after _____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	1.5	SS1	5 6 7 9	302.4	Fine SAND, some silt, little, fine to coarse gravel, medium, black brown, FILL
		2.0-4.0	S2	2.0	1.0	SS2	7 8 11 13	4.5	
		5.0-7.0	S3	2.0	1.0	SS3	19 35 41 35	297.9	Fine SAND, some silt, little, fine to coarse gravel, medium, black brown, FILL
7.5									
		10.0-12.0	S4	2.0	1.3	SS4	15 35 40 50	12.0	SAND, fine to coarse, and GRAVEL, fine to coarse, V. dense, brown orange
								290.4	SAND, fine to coarse, and GRAVEL, fine to coarse, V. dense, brown orange
15									
									End of boring at 12'
22.5									
30									
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			12.0 f	**0.0 f**
			No. of Samples	
			4	

NOTES: _____

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **P-5**

Sheet **1** Of **1**

DRILLER		Hole No. P-6
Richard Posa		Line **N/A**
INSPECTOR		Station **N/A**
I.Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **303.26**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-29-01**	Utilized						X		X					
Date Finished: **11-29-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **9.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0		0.0-2.0	S1	2.0	0.6	SS1	4 5 7 15	303.3	Fine SAND, trace gravel, trace silt, trace roots, medium, dark brown, FILL
								2.0	
		2.0-3.3	S2	1.3	0.8	SS2	29 37 100/3	301.3	SAND, fine to coarse and GRAVEL, trace silt, V. dense, brown
		5.0-6.3	S3	1.3	0.3	SS3	28 34 100/3		
7.5									
								10.0	SAND, fine to coarse and GRAVEL, trace silt, V. dense, brown
		10.0-12.0	S4	2.0	0.8	SS4	19 33 29 38	293.3	
								12.0	Fine SAND, little fine to coarse gravel, trace silt, V. dense, brown
								291.3	
15									End of boring at 12'
22.5									
30									
37.5									

Casing			Feet of	
Size	From	To	Earth	Rock
			12.0 f	**0.0 f**
			No. of Samples	
			4	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. **P-6**

Sheet **1** Of **1**

DRILLER		Hole No. P-7
Erik Delpriore		Line **N/A**
INSPECTOR		Station **N/A**
I. Okonkwo	TOWN: **Waterbury, Connecticut**	Offset **N/A**
SOILS ENGINEER	PROJECT NAME: **Waterbury Bus Maintenance Garage**	N. Coordinate
Earth Design Associates Inc.	PROJECT NUMBER: **1002-0003GT**	E. Coordinate

Boring Contractor: **General Borings Inc.** Client: **Wendel Dushscherer Design, P.C.**

Surface Elevation (f): **301.90**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **11-28-01**	Utilized						X		X					
Date Finished: **11-28-01**	Type	BW	NW	HW	FJ	Solid	Hollow		SS		B (st)	B (dt)	NX (st)	NX (dt)
Groundwater Observations	Size I.D. (in)	2 1/2	3	4	4				1 3/8		1 3/8			
@ **8.0** f after **0** hours	Hammer (lbs)	300	300	300	300			Bit	140		Type		Diamond	
@ ____ f after ____ hours	Fall (in)	30	30	30	24				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. F	REC. F	Type	Blows per 6 inches or RQD	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
0								301.9	4" BLACKTOP, 8"
		1.0-3.0	S1	2.0	1.5	SS1	6 6 5 7	1.0	GRAVEL, COBBLES
								300.9	Fine SAND and SILT,
		3.0-5.0	S2	2.0	1.3	SS2	8 11 10 12	5.0	medium, dark brown, FILL
		5.0-7.0	S3	2.0	1.2	SS3	14 25 37 80	296.9	Fine SAND, some silt,
7.5									trace fine gravel, medium, dark brown, FILL
		10.0-12.0	S4	2.0	1.5	SS4	14 21 39 53	12.0	SAND, fine to coarse and GRAVEL, fine to
								289.9	medium, trace coarse gravel, V. dense,
15									brown
									SAND, fine to coarse, and GRAVEL, fine to coarse, V. dense, brown
									End of boring at 12'
22.5									
30									
37.5									

Casing Size	From	To	Feet of Earth	Feet of Rock
			12.0 f	0.0 f
			No. of Samples	
			4	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test

PROPORTIONS USED: Trace = 1 - 10%, Little = 10 - 20%, SOME = 20 - 35%, And = 35 - 50%

Hole No. P-7

Sheet 1 Of 1

APPENDIX C

Geotechnical Laboratory Test Results

GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	04/03/13	Checked By:	jdt
Depth :	---	Test Id:	263137		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
---	HA1-S1	0-2 ft.	Moist, brown sandy silt	27.2
---	HA1-S3	5-7 ft.	Moist, brown sand with silt and gravel	5.3
---	HA7-S4	7-9 ft.	Moist, brown gravel with sand	9.5
---	HA8-S5	10-12 ft.	Moist, brown sand	18.3
---	HA8-S6	15-17 ft.	Moist, grayish brown sand with gravel	15.9
---	HA11-S6	14-16 ft.	Moist, brown silty sand	28.9
---	HA11-S9	29-31 ft.	Moist, brown sandy silt	29.3
---	HA13-S2	2-4 ft.	Moist, brown silty sand	32.8
---	HA15-S4	7-9 ft.	Moist, brown sand with silt	20.0
---	HA16-S3	5-7 ft.	Moist, brown sand with silt and gravel	17.1

Notes: Temperature of Drying : 110° Celsius

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	04/03/13	Checked By:	jdt
Depth :	---	Test Id:	263160		

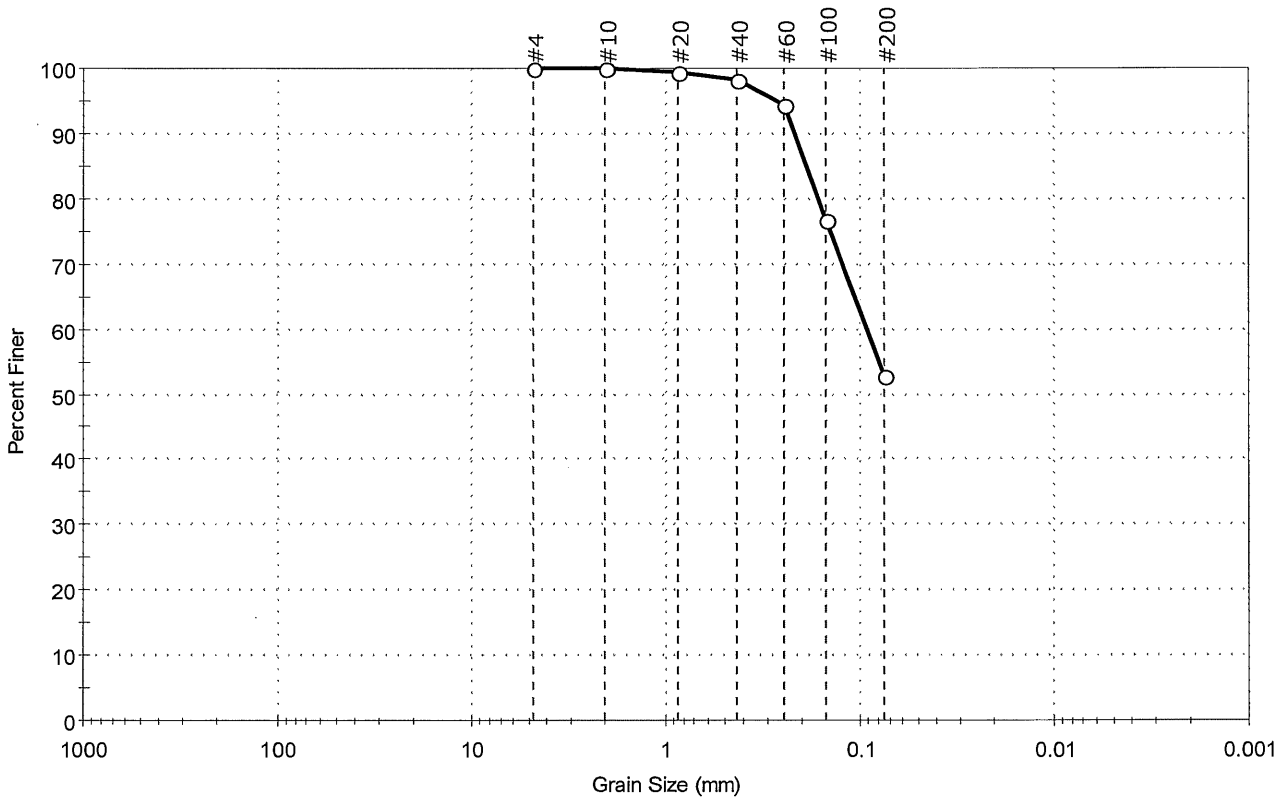
Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
---	HA16-S5	10-12 ft.	Moist, brown gravel with sand	8.5
---	HA16-S7	14-16 ft.	Moist, grayish brown sand with silt and gravel	9.4
---	HA17-S3	5-7 ft.	Moist, brown sand with silt and gravel	15.9
---	HA17-S5	10-12 ft.	Moist, grayish brown sand with silt and gravel	15.1
---	HA17-S7	14-16 ft.	Moist, brown sand with silt	21.6
---	HA21-S3	5-7 ft.	Moist, grayish brown sand	26.4

Notes: Temperature of Drying : 110° Celsius

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA1-S1	Test Date:	04/03/13	Checked By:	jdt
Depth :	0-2 ft.	Test Id:	263144		
Test Comment:	---				
Sample Description:	Moist, brown sandy silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	47.2	52.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	98		
#60	0.25	94		
#100	0.15	77		
#200	0.075	53		

Coefficients

D_{85} = 0.1907 mm D_{30} = N/A

D_{60} = 0.0924 mm D_{15} = N/A

D_{50} = N/A D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

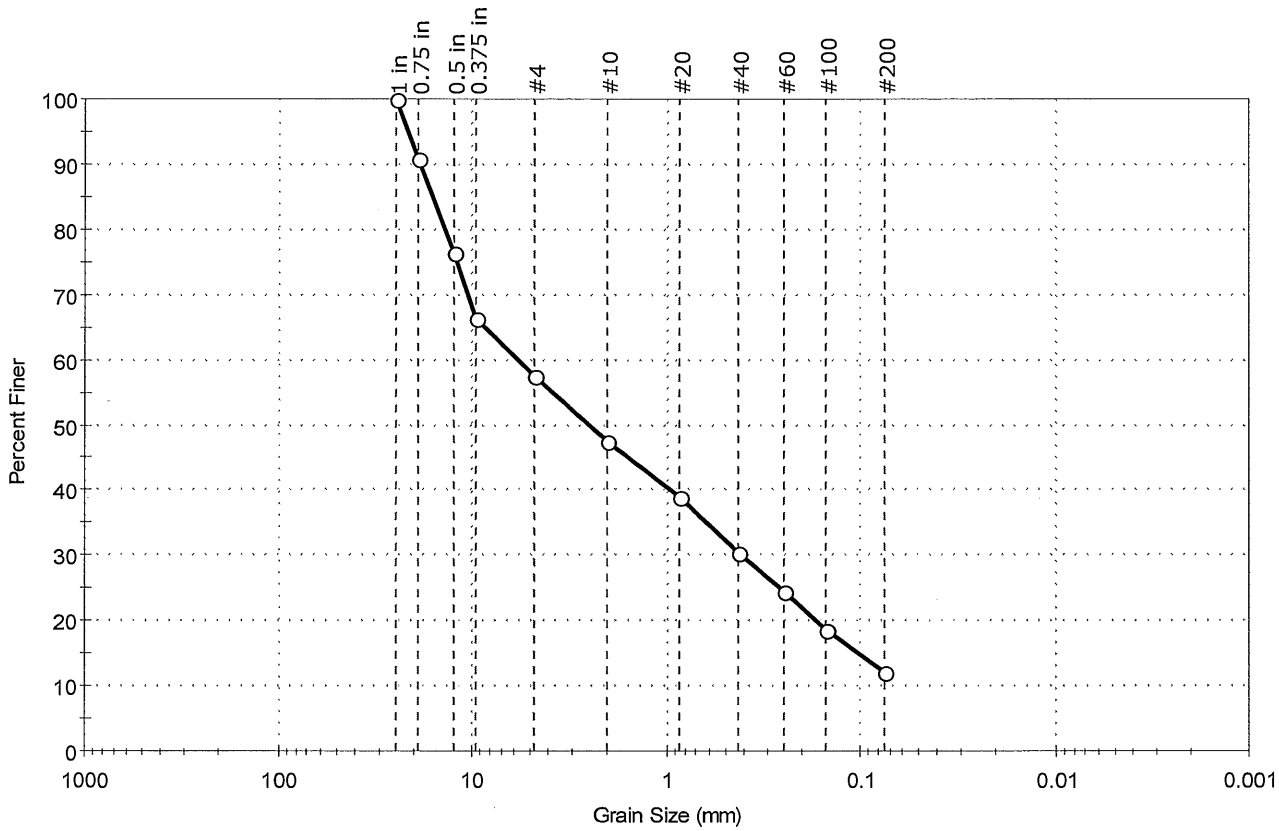
Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.		
Project:	Proposed ConnDOT Bus Facility		
Location:	---	Project No:	GTX-300405
Boring ID:	---	Sample Type: jar	Tested By: jbr
Sample ID:	HA1-S3	Test Date: 04/03/13	Checked By: jdt
Depth :	5-7 ft.	Test Id: 263145	
Test Comment:	---		
Sample Description:	Moist, brown sand with silt and gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	42.6	45.4	12.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	91		
0.5 in	12.50	76		
0.375 in	9.50	66		
#4	4.75	57		
#10	2.00	47		
#20	0.85	39		
#40	0.42	30		
#60	0.25	24		
#100	0.15	18		
#200	0.075	12		

Coefficients

D_{85} = 16.1009 mm D_{30} = 0.4104 mm

D_{60} = 5.8052 mm D_{15} = 0.1035 mm

D_{50} = 2.4914 mm D_{10} = 0.0607 mm

C_u = 95.638 C_c = 0.478

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

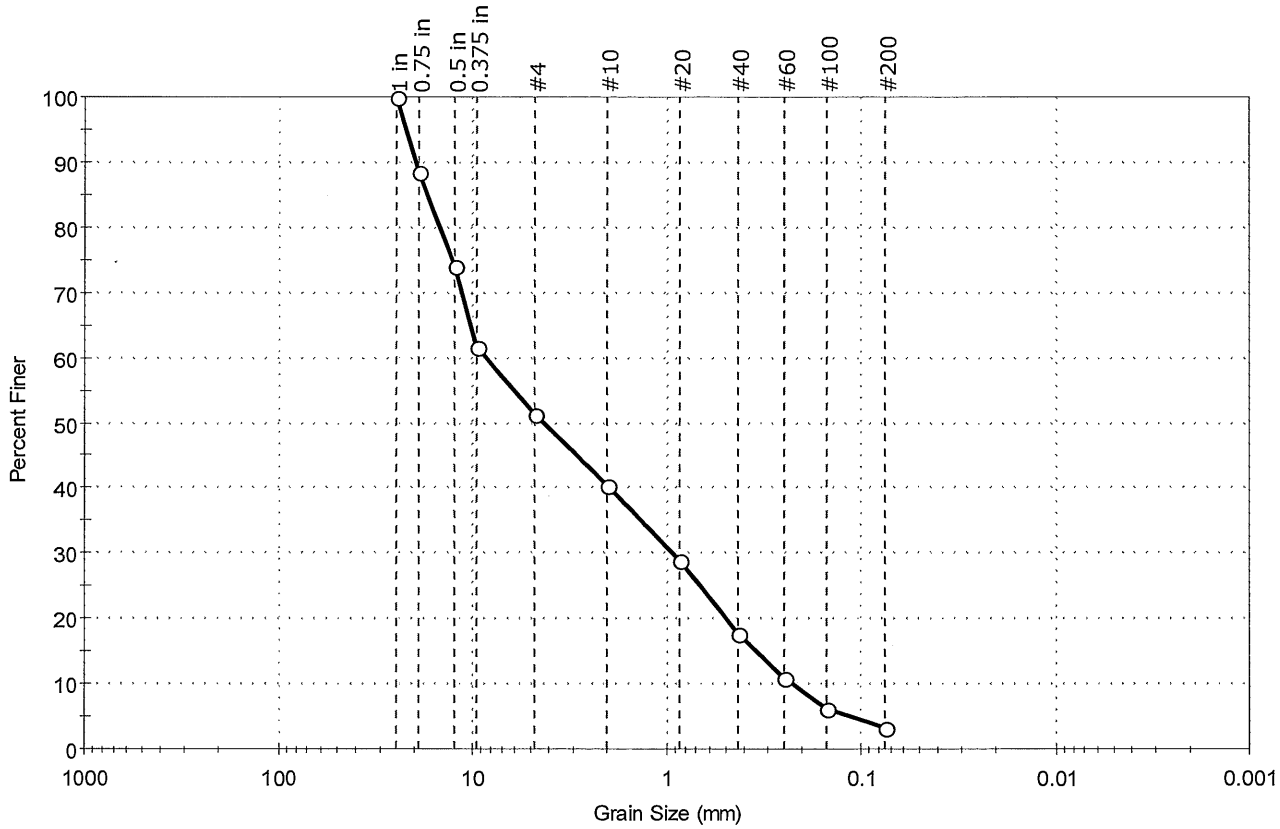
Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA7-S4	Test Date:	04/04/13	Checked By:	jdt
Depth :	7-9 ft.	Test Id:	263146		
Test Comment:	---				
Sample Description:	Moist, brown gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	48.8	47.9	3.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	88		
0.5 in	12.50	74		
0.375 in	9.50	62		
#4	4.75	51		
#10	2.00	40		
#20	0.85	29		
#40	0.42	18		
#60	0.25	11		
#100	0.15	6		
#200	0.075	3		

Coefficients

D_{85} = 17.2061 mm D_{30} = 0.9276 mm

D_{60} = 8.4578 mm D_{15} = 0.3442 mm

D_{50} = 4.3144 mm D_{10} = 0.2286 mm

C_u = 36.998 C_c = 0.445

Classification

ASTM Poorly graded gravel with sand (GP)

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

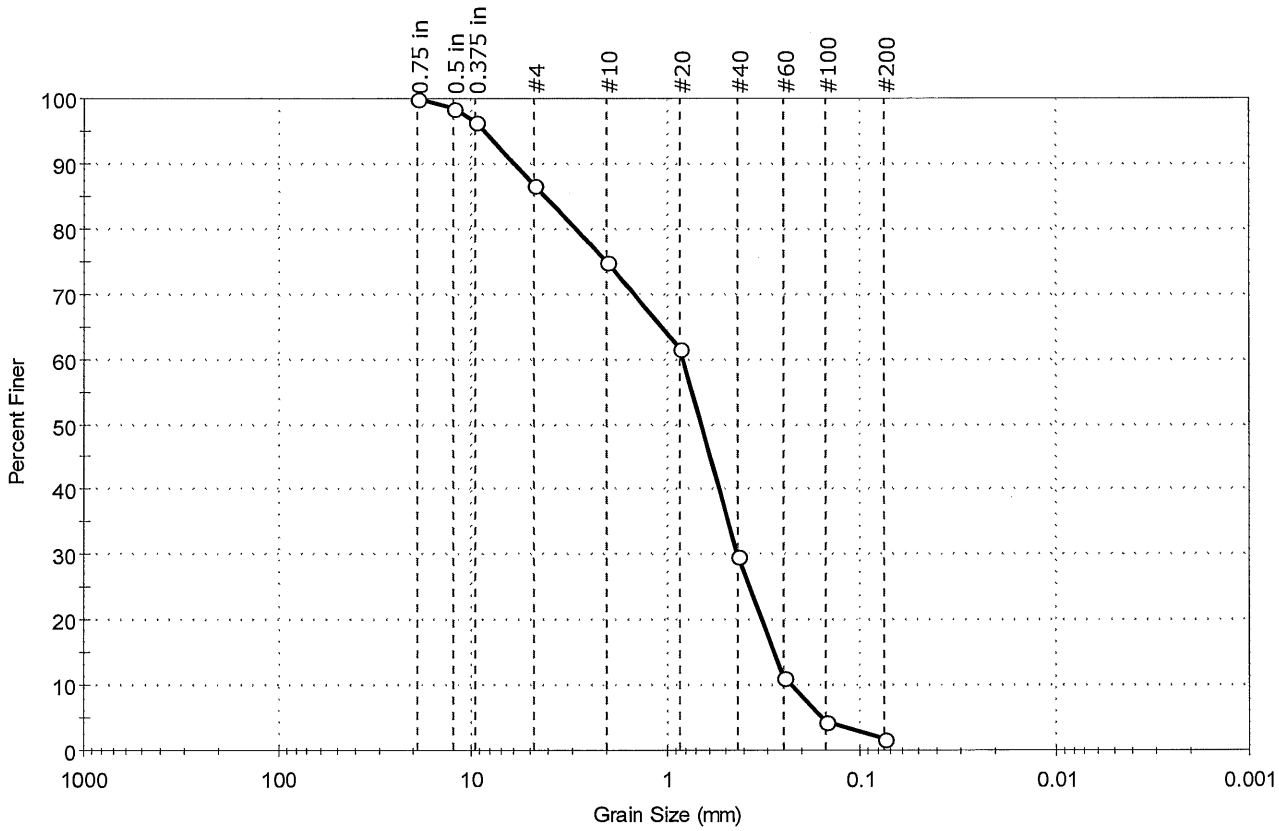
Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA8-S5	Test Date:	04/03/13	Checked By:	jdt
Depth :	10-12 ft.	Test Id:	263147		
Test Comment:	---				
Sample Description:	Moist, brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	13.4	84.7	1.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	99		
0.375 in	9.50	96		
#4	4.75	87		
#10	2.00	75		
#20	0.85	62		
#40	0.42	30		
#60	0.25	11		
#100	0.15	4		
#200	0.075	2		

Coefficients

D_{85} =4.2204 mm D_{30} =0.4266 mm

D_{60} =0.8208 mm D_{15} =0.2790 mm

D_{50} =0.6599 mm D_{10} =0.2296 mm

C_u =3.575 C_c =0.966

Classification

ASTM Poorly graded sand (SP)

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

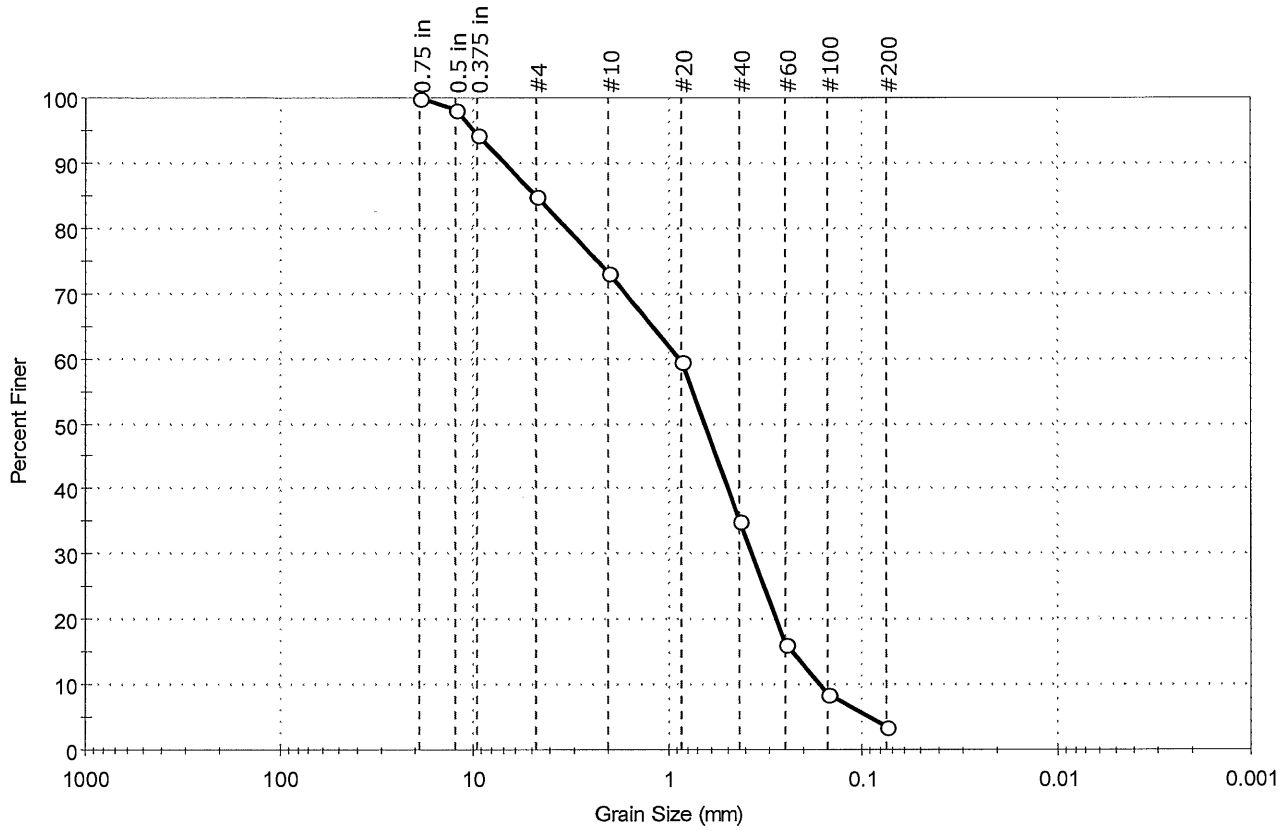
Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA8-S6	Test Date:	04/04/13	Checked By:	jdt
Depth :	15-17 ft.	Test Id:	263148		
Test Comment:	---				
Sample Description:	Moist, grayish brown sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	15.2	81.4	3.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	98		
0.375 in	9.50	94		
#4	4.75	85		
#10	2.00	73		
#20	0.85	60		
#40	0.42	35		
#60	0.25	16		
#100	0.15	8		
#200	0.075	3		

Coefficients

D_{85} =4.8036 mm D_{30} =0.3689 mm

D_{60} =0.8674 mm D_{15} =0.2290 mm

D_{50} =0.6479 mm D_{10} =0.1656 mm

C_u =5.238 C_c =0.947

Classification

ASTM Poorly graded sand with gravel (SP)

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

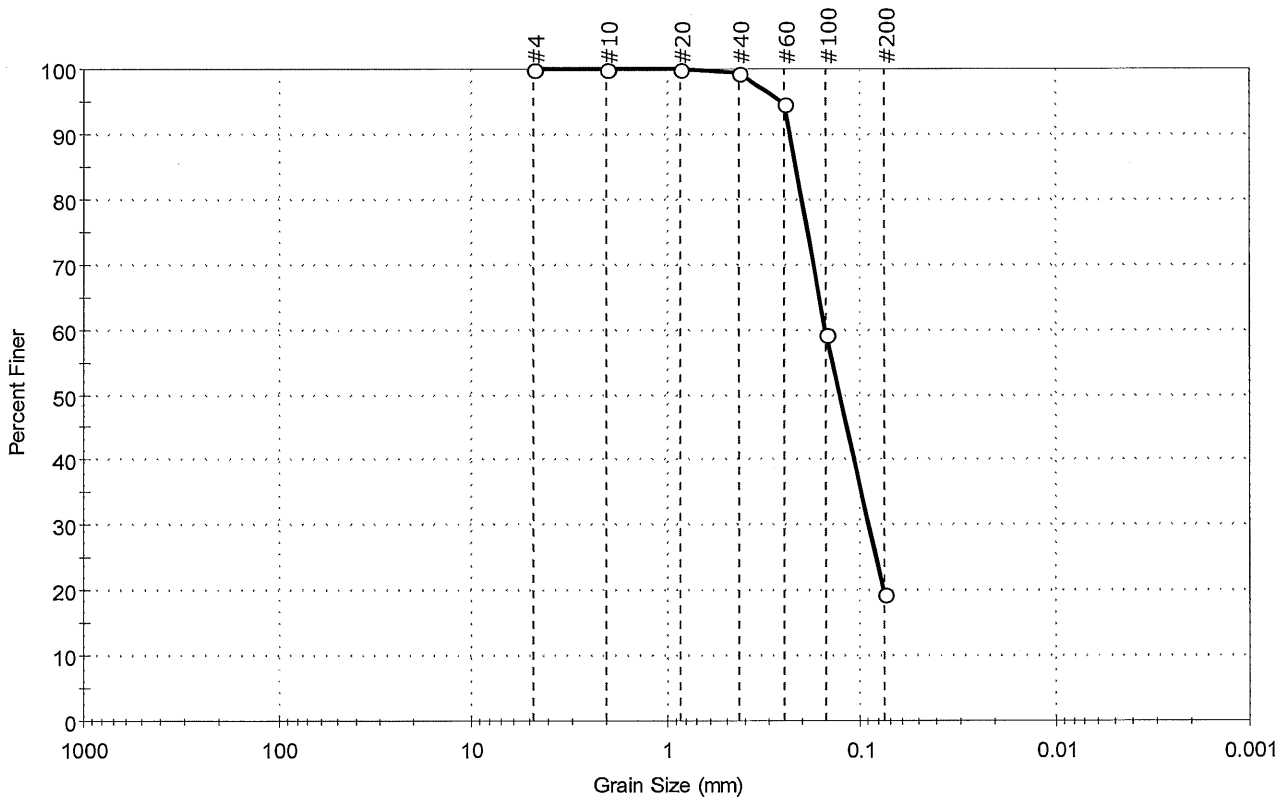
Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA11-S6	Test Date:	04/04/13	Checked By:	jdt
Depth :	14-16 ft.	Test Id:	263149		
Test Comment:	---				
Sample Description:	Moist, brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	80.5	19.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	95		
#100	0.15	59		
#200	0.075	20		

Coefficients

D_{85} =0.2175 mm D_{30} =0.0900 mm

D_{60} =0.1514 mm D_{15} =N/A

D_{50} =0.1275 mm D_{10} =N/A

C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

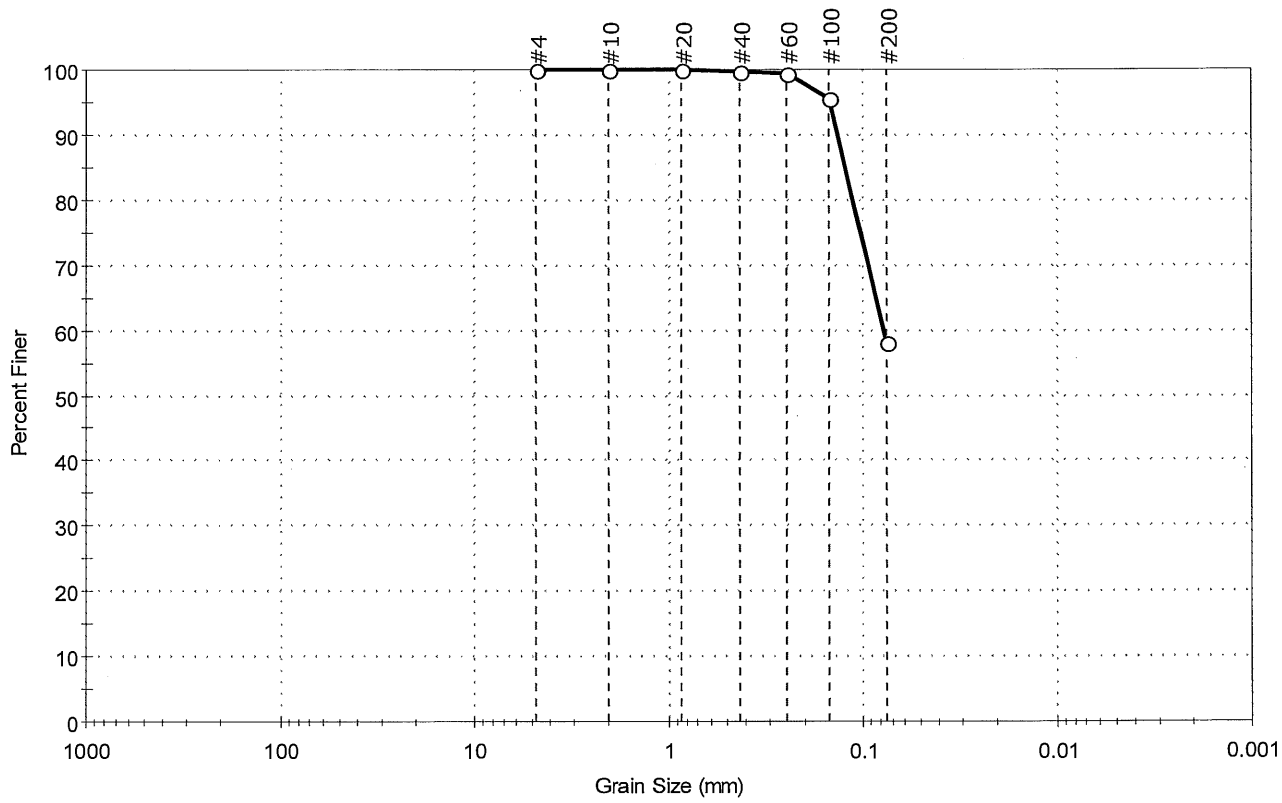
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA11-S9	Test Date:	04/04/13	Checked By:	jdt
Depth :	29-31 ft.	Test Id:	263150		
Test Comment:	---				
Sample Description:	Moist, brown sandy silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	41.8	58.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	95		
#200	0.075	58		

Coefficients

D_{85} = 0.1234 mm D_{30} = N/A
D_{60} = 0.0775 mm D_{15} = N/A
D_{50} = N/A D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

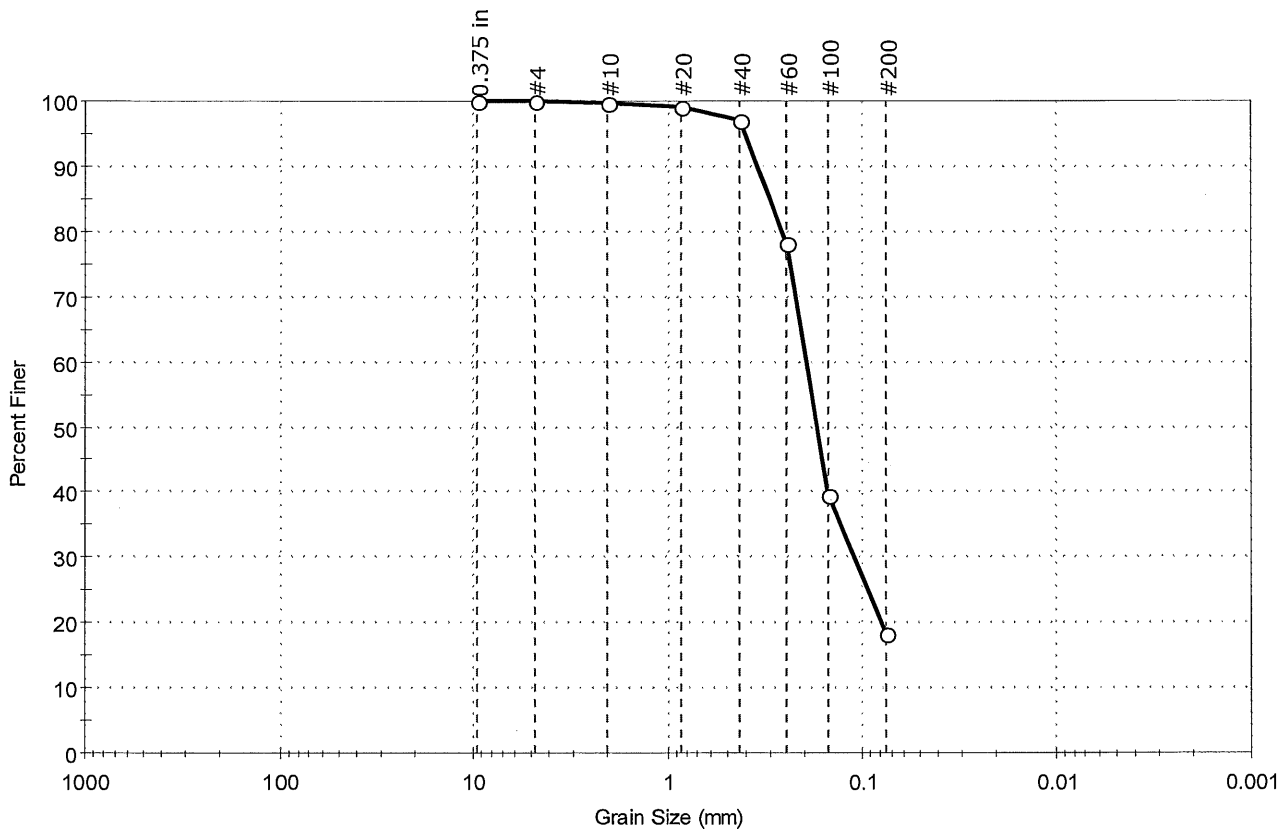
Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA13-S2	Test Date:	04/04/13	Checked By:	jdt
Depth :	2-4 ft.	Test Id:	263151		
Test Comment:	---				
Sample Description:	Moist, brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	81.8	18.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	97		
#60	0.25	78		
#100	0.15	39		
#200	0.075	18		

Coefficients

D_{85} = 0.3031 mm D_{30} = 0.1102 mm
D_{60} = 0.1968 mm D_{15} = N/A
D_{50} = 0.1724 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

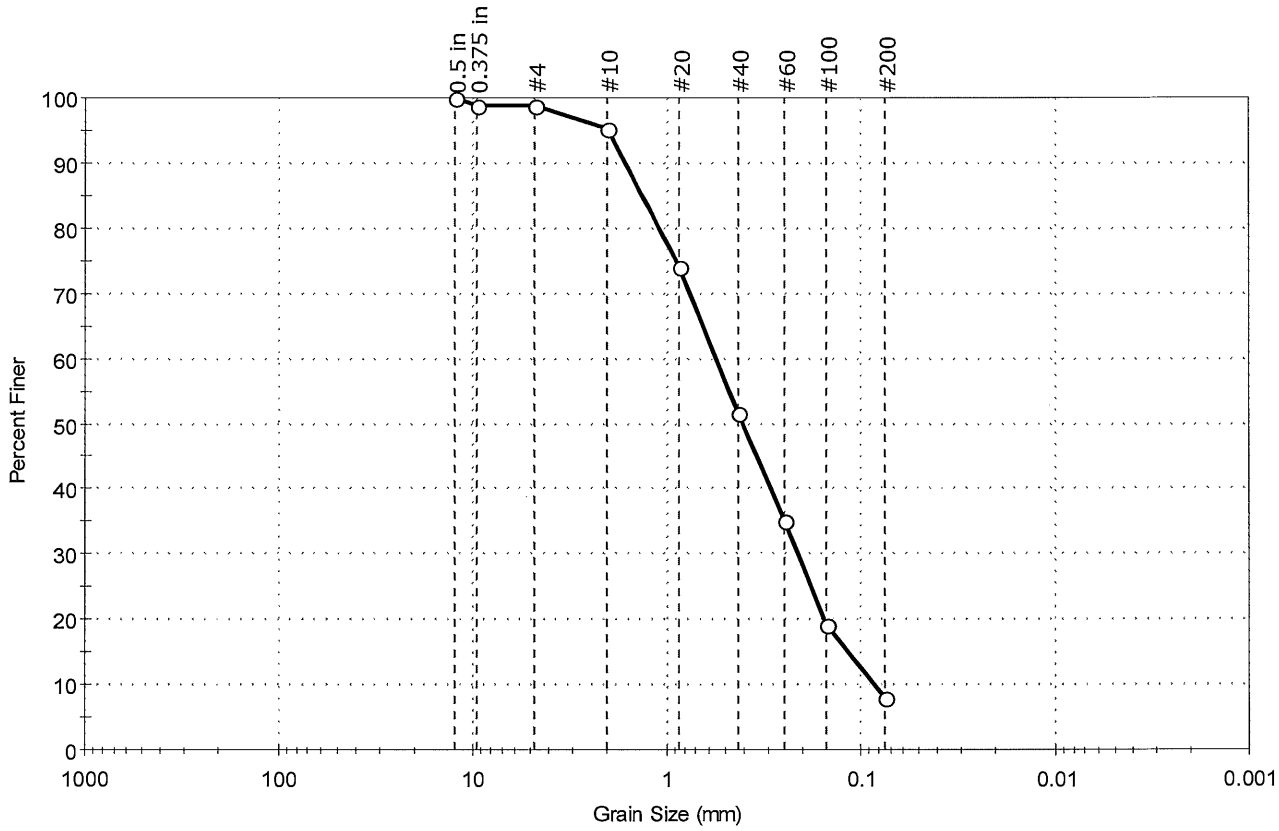
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA15-S4	Test Date:	04/04/13	Checked By:	jdt
Depth :	7-9 ft.	Test Id:	263152		
Test Comment:	---				
Sample Description:	Moist, brown sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	1.3	90.6	8.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	99		
#10	2.00	95		
#20	0.85	74		
#40	0.42	52		
#60	0.25	35		
#100	0.15	19		
#200	0.075	8		

Coefficients

D_{85} =1.3232 mm D_{30} =0.2120 mm

D_{60} =0.5521 mm D_{15} =0.1163 mm

D_{50} =0.4043 mm D_{10} =0.0848 mm

C_u =6.511 C_c =0.960

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (0))

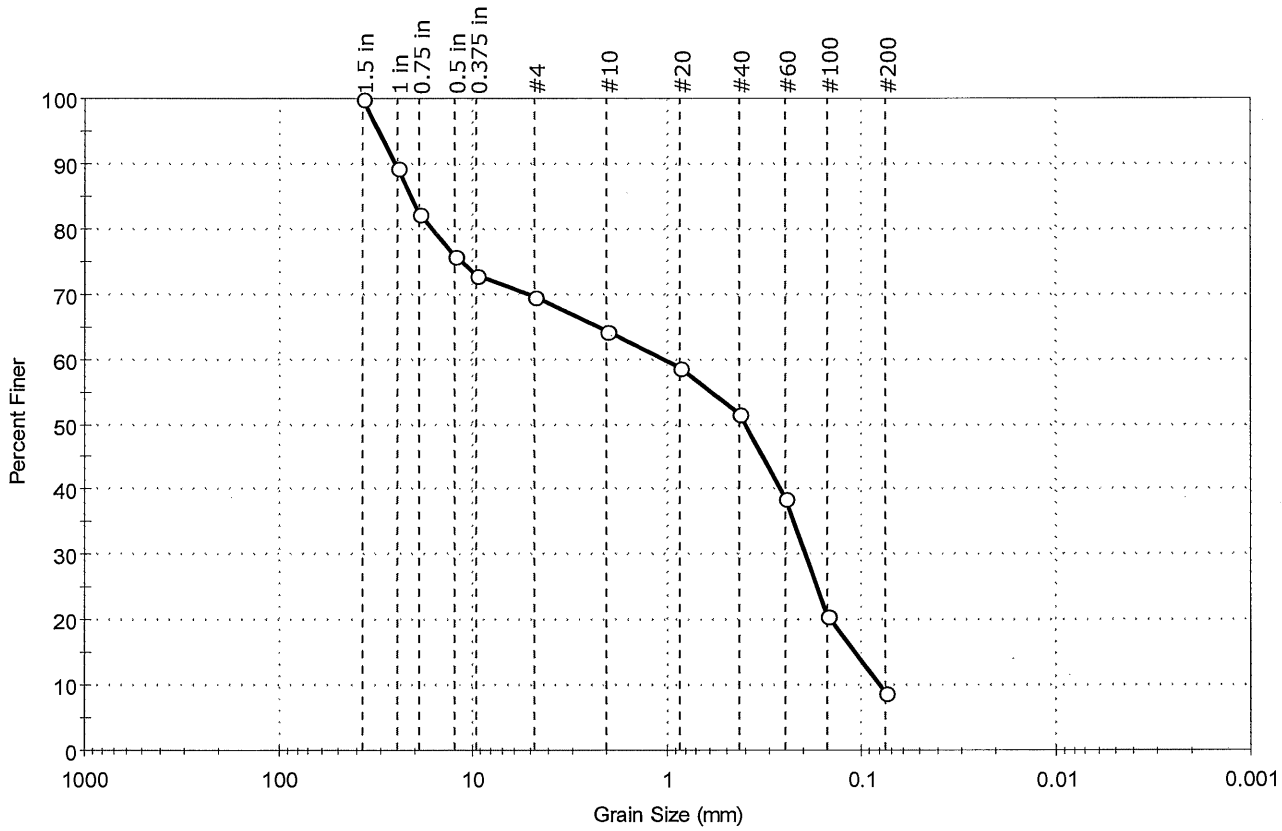
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA16-S3	Test Date:	04/03/13	Checked By:	jdt
Depth :	5-7 ft.	Test Id:	263153		
Test Comment:	---				
Sample Description:	Moist, brown sand with silt and gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	30.5	60.6	8.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	90		
0.75 in	19.00	82		
0.5 in	12.50	76		
0.375 in	9.50	73		
#4	4.75	70		
#10	2.00	64		
#20	0.85	59		
#40	0.42	52		
#60	0.25	39		
#100	0.15	21		
#200	0.075	9		

Coefficients

D_{85} =21.0299 mm D_{30} =0.1957 mm
D_{60} =1.0336 mm D_{15} =0.1074 mm
D_{50} =0.3978 mm D_{10} =0.0799 mm
C_u =12.936 C_c =0.464

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (0))

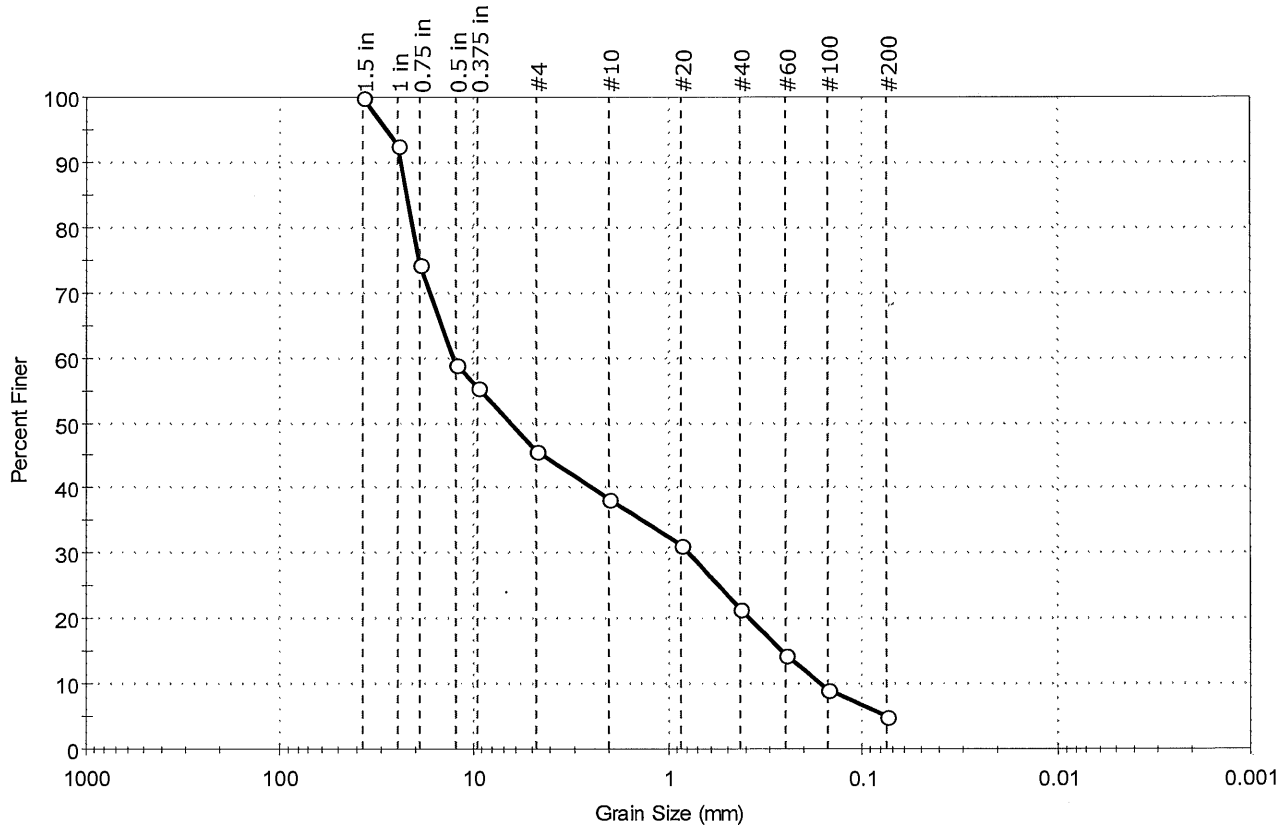
Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA16-S5	Test Date:	04/04/13	Checked By:	jdt
Depth :	10-12 ft.	Test Id:	263154		
Test Comment:	---				
Sample Description:	Moist, brown gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	54.2	40.9	4.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	93		
0.75 in	19.00	74		
0.5 in	12.50	59		
0.375 in	9.50	55		
#4	4.75	46		
#10	2.00	38		
#20	0.85	31		
#40	0.42	21		
#60	0.25	14		
#100	0.15	9		
#200	0.075	5		

Coefficients

D_{85} = 22.3320 mm D_{30} = 0.7751 mm
D_{60} = 12.8706 mm D_{15} = 0.2612 mm
D_{50} = 6.4450 mm D_{10} = 0.1640 mm
C_u = 78.479 C_c = 0.285

Classification

ASTM Poorly graded gravel with sand (GP)

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

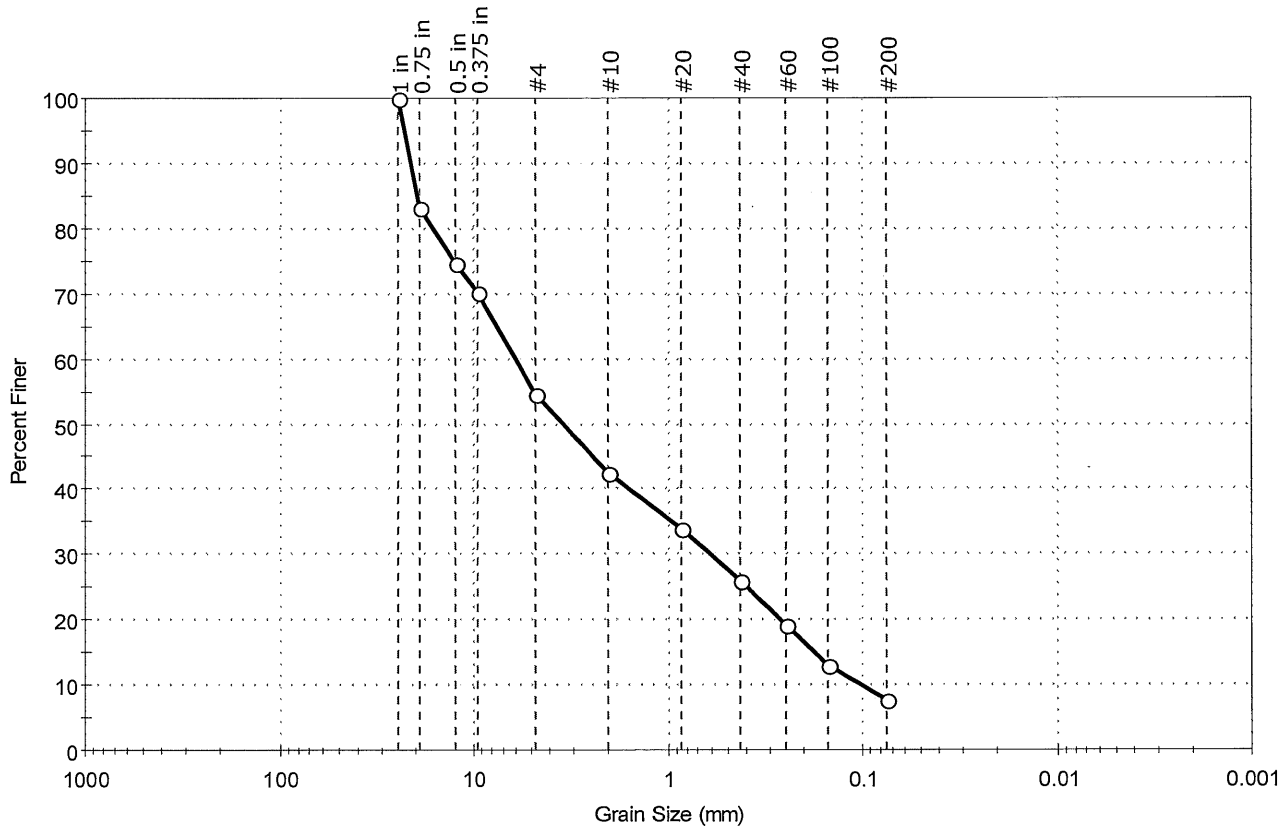
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.		
Project:	Proposed ConnDOT Bus Facility		
Location:	---	Project No:	GTX-300405
Boring ID:	---	Sample Type: jar	Tested By: jbr
Sample ID:	HA16-S7	Test Date: 04/04/13	Checked By: jdt
Depth :	14-16 ft.	Test Id: 263155	
Test Comment:	---		
Sample Description:	Moist, grayish brown sand with silt and gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	45.5	46.9	7.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	83		
0.5 in	12.50	75		
0.375 in	9.50	70		
#4	4.75	55		
#10	2.00	43		
#20	0.85	34		
#40	0.42	26		
#60	0.25	19		
#100	0.15	13		
#200	0.075	8		

Coefficients

D_{85} =19.6055 mm D_{30} =0.5991 mm

D_{60} =6.0363 mm D_{15} =0.1763 mm

D_{50} =3.4190 mm D_{10} =0.1013 mm

C_u =59.588 C_c =0.587

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

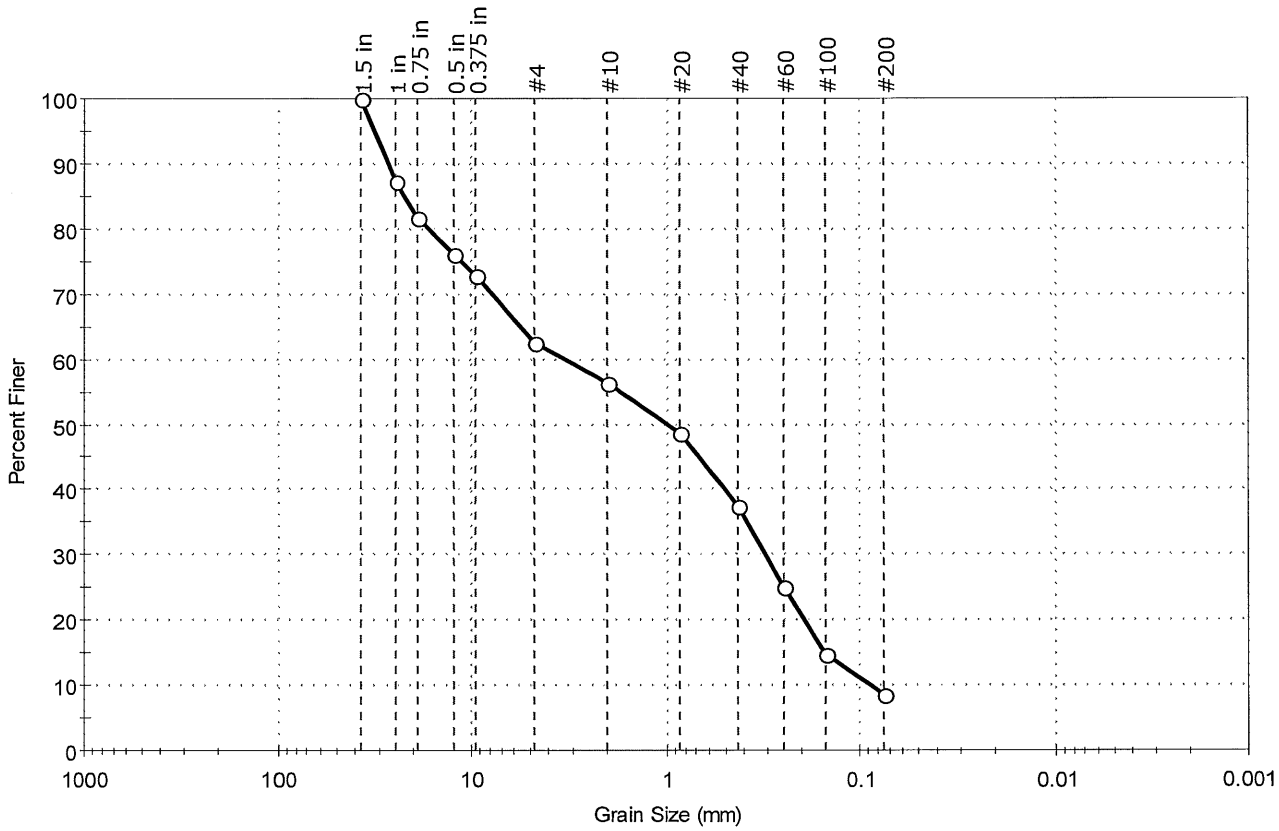
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.		
Project:	Proposed ConnDOT Bus Facility		
Location:	---	Project No:	GTX-300405
Boring ID:	---	Sample Type: jar	Tested By: jbr
Sample ID:	HA17-S3	Test Date: 04/04/13	Checked By: jdt
Depth :	5-7 ft.	Test Id: 263156	
Test Comment:	---		
Sample Description:	Moist, brown sand with silt and gravel		
Sample Comment:	--		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	37.5	54.0	8.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	87		
0.75 in	19.00	82		
0.5 in	12.50	76		
0.375 in	9.50	73		
#4	4.75	63		
#10	2.00	56		
#20	0.85	49		
#40	0.42	37		
#60	0.25	25		
#100	0.15	15		
#200	0.075	9		

Coefficients

D_{85} =22.3477 mm D_{30} =0.3088 mm

D_{60} =3.3216 mm D_{15} =0.1510 mm

D_{50} =0.9815 mm D_{10} =0.0881 mm

C_u =37.703 C_c =0.326

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

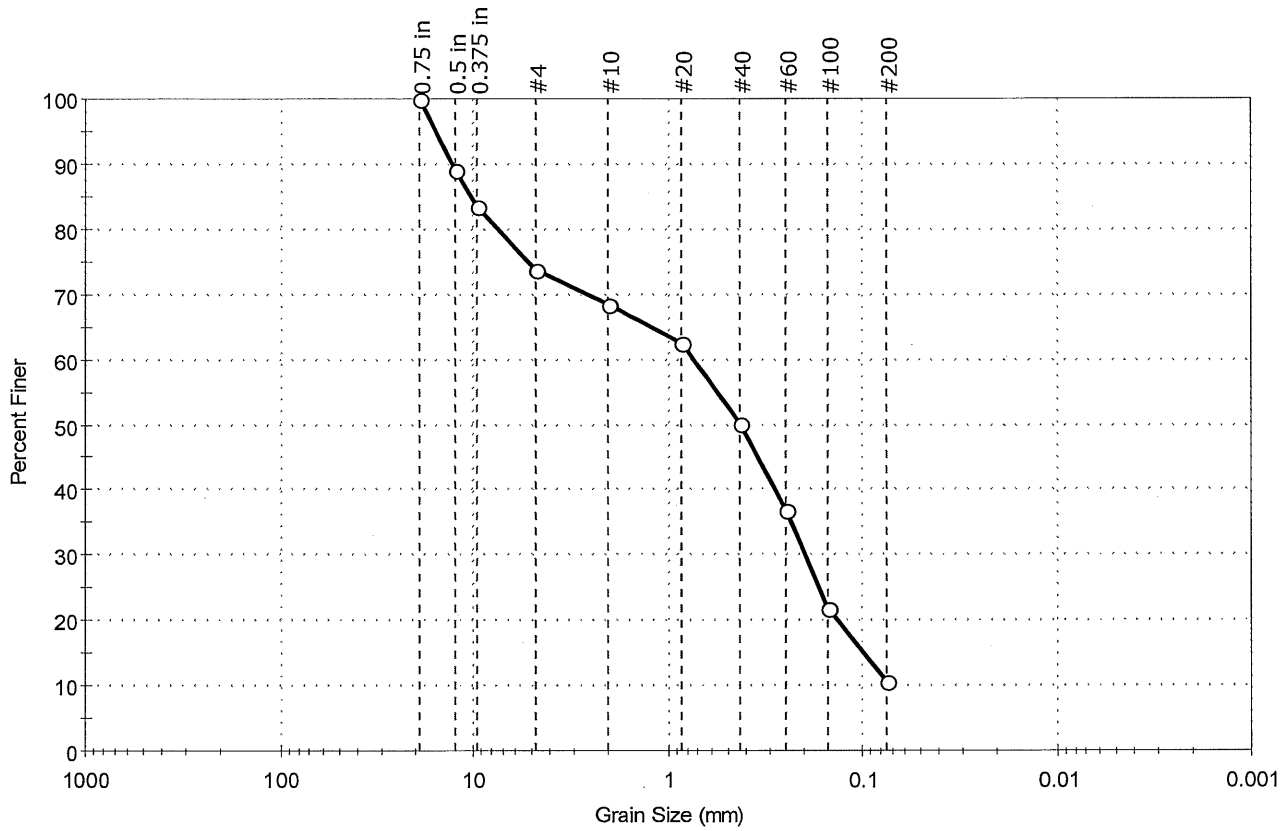
Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA17-S5	Test Date:	04/03/13	Checked By:	jdt
Depth :	10-12 ft.	Test Id:	263157		
Test Comment:	---				
Sample Description:	Moist, grayish brown sand with silt and gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	26.3	63.0	10.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	89		
0.375 in	9.50	84		
#4	4.75	74		
#10	2.00	68		
#20	0.85	63		
#40	0.42	50		
#60	0.25	37		
#100	0.15	22		
#200	0.075	11		

Coefficients

D_{85} =10.2050 mm D_{30} =0.1978 mm

D_{60} =0.7356 mm D_{15} =0.0977 mm

D_{50} =0.4218 mm D_{10} =0.0716 mm

C_u =10.274 C_c =0.743

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

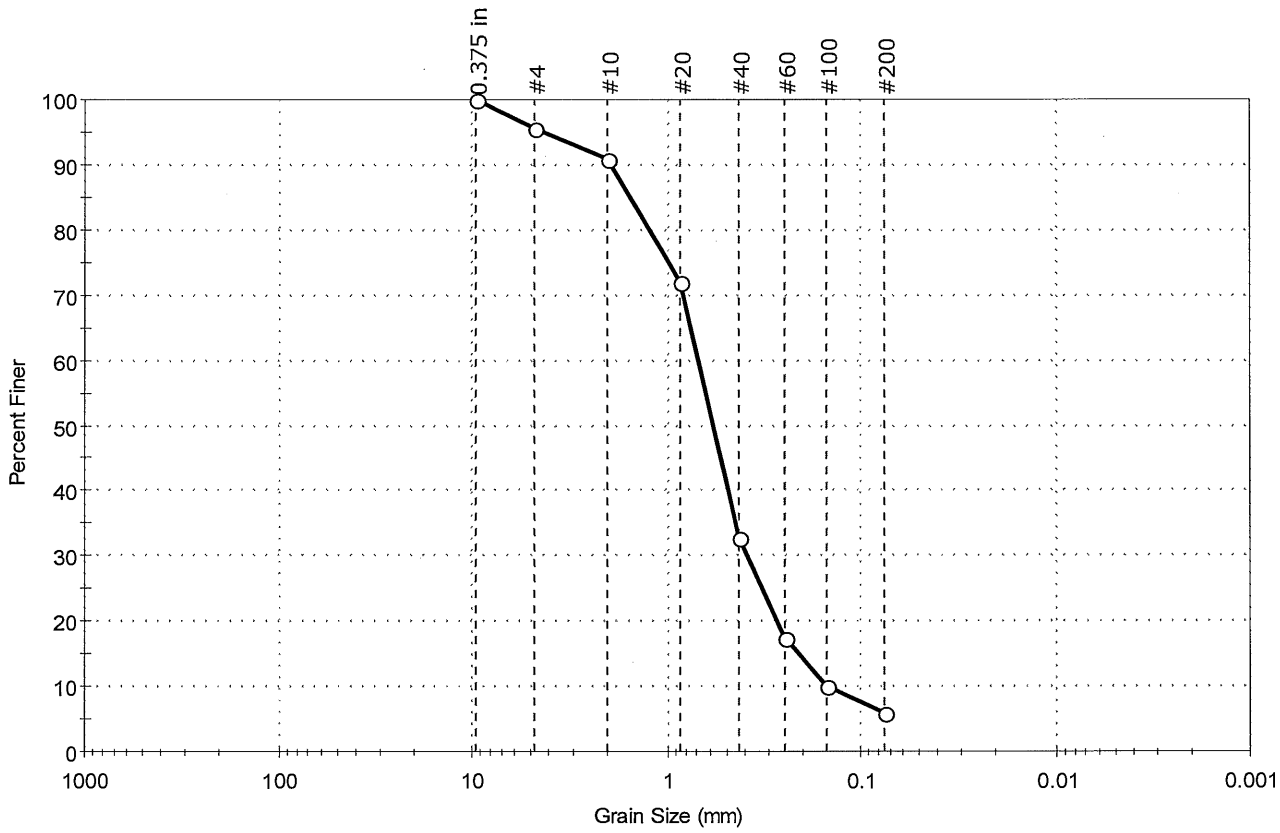
Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA17-S7	Test Date:	04/02/13	Checked By:	jdt
Depth :	14-16 ft.	Test Id:	263158		
Test Comment:	---				
Sample Description:	Moist, brown sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	4.5	89.7	5.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	96		
#10	2.00	91		
#20	0.85	72		
#40	0.42	33		
#60	0.25	17		
#100	0.15	10		
#200	0.075	6		

Coefficients

D_{85} =1.5371 mm D_{30} =0.3852 mm

D_{60} =0.6883 mm D_{15} =0.2114 mm

D_{50} =0.5762 mm D_{10} =0.1463 mm

C_u =4.705 C_c =1.474

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

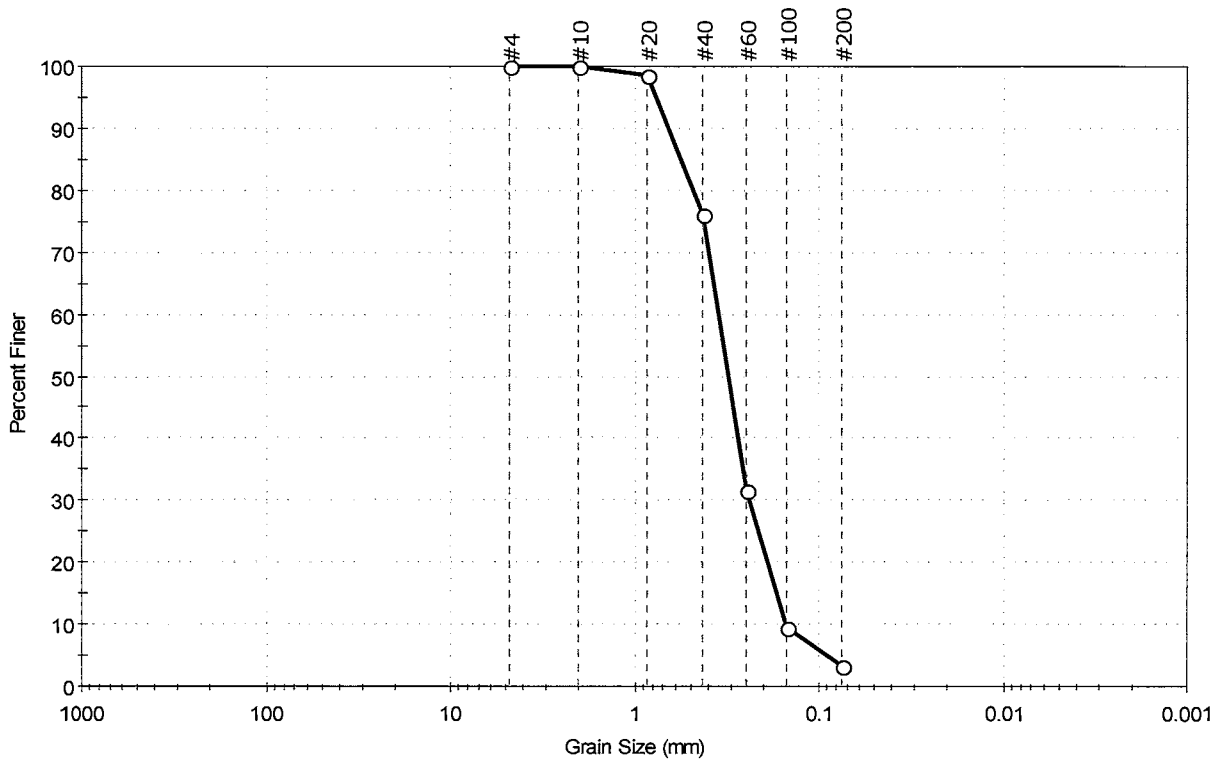
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	Proposed ConnDOT Bus Facility				
Location:	---			Project No:	GTX-300405
Boring ID:	---	Sample Type:	jar	Tested By:	jbr
Sample ID:	HA21-S3	Test Date:	04/04/13	Checked By:	jdt
Depth :	5-7 ft.	Test Id:	263161		
Test Comment:	---				
Sample Description:	Moist, grayish brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	—	96.7	3.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	98		
#40	0.42	76		
#60	0.25	31		
#100	0.15	9		
#200	0.075	3		

Coefficients

D_{85} = 0.5583 mm D_{30} = 0.2418 mm

D_{60} = 0.3506 mm D_{15} = 0.1711 mm

D_{50} = 0.3115 mm D_{10} = 0.1524 mm

C_u = 2.301 C_c = 1.094

Classification

ASTM Poorly graded sand (SP)

AASHTO Fine Sand (A-3 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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APPENDIX D

Bearing Capacity Calculations

HALEY & ALDRICH	CALCULATIONS	File No.	39192-000
		Sheet	1 of 3
Client	Wendel Duchscherer Architects & Engineers	Date	17-Jul-13
Project	Waterbury Bus Maintenance Facility in Watertown, CT	Computed by	MMH
Subject	Bearing Resistance for Footings	Checked by	PJD

Objective:

-estimate the nominal bearing resistance for the footings at the proposed Waterbury Bus Maintenance Facility.

References:

-AASHTO LRFD Bridge Design Specifications 2012

Available Information:

-Foundation Plans for Areas A through E from set titled, "Waterbury Bus Maintenance Facility Replacement" received 3 April 2013

-Boring logs by Haley & Aldrich from 18 to 25 March 2013

-Boring logs by others from March 2002

Assumptions:

-use AASHTO LRFD references to calculate the nominal bearing resistance (ultimate), use ASD F.S. to obtain allowable

-Footing sizes range from 3 ft x 3 ft to 14.5 ft x 14.5 ft

-For Ground Floor Area Footings: Bottom of Interior Footings El. between 299 and 301; Bottom of Exterior Footings El. between 298 and 300

-For First Floor Area Footings: Bottom of Interior Footings El. between 312 and 314; Bottom of Exterior Footings El. between 311 and 313

-Water elevation depth is at approximate El. 301 (from Boring HA-21, highest observed water elevation)

-Unit weight of soil is 125 pcf, phi angle is 37 degrees (assuming bearing soil is Glaciofluvial Deposits or Compacted Structural Fill)

-Depth of footing below ground surface is assumed 3.5 ft

-Max width eccentricities assumed (B/3 from AASHTO)

-Length eccentricies assumed at 0

Calculations:

Article *10.6.3.1.2a- Basic Formulation for Nominal Bearing Resistance*

$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$$ Equation 10.6.3.1.2a-1

$$N_{cm} = N_c s_c i_c$$ Equation 10.6.3.1.2a-2

$$N_{qm} = N_q s_q d_q i_q$$ Equation 10.6.3.1.2a-3

$$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$$ Equation 10.6.3.1.2a-4

c =	cohesion, taken as undrained shear strength (ksf)
N_c =	cohesion term (undrained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)
N_q =	surcharge (embedment) term (drained or undrained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)
N_γ =	unit weight (footing width) term (drained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)
γ =	total (moist) unit weight of soil above or below the bearing depth of the footing (kcf)
D_f =	footing embedment depth (ft)
B =	footing width (ft)
C_{wq},$C_{w\gamma}$ =	correction factors to account for the location of the groundwater table as specified in Table 10.6.3.1.2a-2 (dim)
s_c,s_q,s_γ =	footing shape correction factors as specified in Table 10.6.3.1.2a-3 (dim)
d_q =	correction factor to account for the shearing resistance along the failure surface passing through cohesionless material above the bearing elevation as specified in Table 10.6.3.1.2a-4 (dim)
i_c,i_q,i_γ =	load inclination factors determined from Eqs. 10.6.3.1.2a-5 or 10.6.3.1.2a-6, and 10.6.3.1.2a-7 and 10.6.3.1.2a-8 (dim)

HALEY & ALDRICH	CALCULATIONS	File No.	39192-000
		Sheet	2 of 3
Client	Wendel Duchscherer Architects & Engineers	Date	17-Jul-13
Project	Waterbury Bus Maintenance Facility in Watertown, CT	Computed by	MMH
Subject	Bearing Resistance for Footings	Checked by	PJD

Estimated Bearing Resistance For 3 ft x 3 ft Footing:

c =	0	ksf	
γ =	125	pcf	
e_B =	1.00	ft	
e_L =	0	ft	
D_w =	0	ft	
ϕ =	37	degrees	
D_f =	3.5	ft	
B =	3	ft	
B' =	1	ft	
L =	3	ft	
L'=	3	ft	
$N_\phi = f(\phi)$	4.02		
depth correction	N		for estimation of d_q
N_c	55.6	Table 10.6.3.1.2a-1	
s_c	1.26	Table 10.6.3.1.2a-3	
i_c	1	Equations 10.6.3.1.2a-5 through 10.6.3.1.2a-9 ; estimated at 1	
N_{cm}	70	Equation 10.6.3.1.2a-2	
N_q	42.9	Table 10.6.3.1.2a-1	
s_q	1.25	Table 10.6.3.1.2a-3	
d_q	1	Table 10.6.3.1.2a-4	
i_q	1	Equations 10.6.3.1.2a-5 through 10.6.3.1.2a-9 ; estimated at 1	
N_{qm}	53.68	Equation 10.6.3.1.2a-3	
N_γ	66.2	Table 10.6.3.1.2a-1	
s_γ	0.87	Table 10.6.3.1.2a-3	
i_γ	1	Equations 10.6.3.1.2a-5 through 10.6.3.1.2a-9 ; estimated at 1	
$N_{\gamma m}$	57.37	Equation 10.6.3.1.2a-4	
C_{wq}	0.5	Table 10.6.3.1.2a-2	
$C_{w\gamma}$	0.5	Table 10.6.3.1.2a-2	
q_n	13,535	psf	Equation 10.6.3.1.2a-1
ϕ_b	0.45		Table 10.5.5.2.2-1
q_R	6,091	psf	

HALEY & ALDRICH	CALCULATIONS	File No.	39192-000
		Sheet	3 of 3
Client	Wendel Duchscherer Architects & Engineers	Date	17-Jul-13
Project	Waterbury Bus Maintenance Facility in Watertown, CT	Computed by	MMH
Subject	Bearing Resistance for Footings	Checked by	PJD

Estimated Bearing Resistance For 14.5 ft x 14.5 ft Footing:

c =	0	ksf	
γ =	125	pcf	
e_B =	4.83	ft	
e_L =	0	ft	
D_w =	0	ft	
ϕ =	37	degrees	
D_f =	3.5	ft	
B =	14.5	ft	
B' =	4.83	ft	
L =	14.5	ft	
L'=	14.5	ft	
$N_\phi = f(\phi)$	4.02		
depth correction	N		for estimation of d_q
N_c	55.6	Table 10.6.3.1.2a-1	
s_c	1.26	Table 10.6.3.1.2a-3	
i_c	1	Equations 10.6.3.1.2a-5 through 10.6.3.1.2a-9 ; estimated at 1	
N_{cm}	70	Equation 10.6.3.1.2a-2	
N_q	42.9	Table 10.6.3.1.2a-1	
s_q	1.25	Table 10.6.3.1.2a-3	
d_q	1	Table 10.6.3.1.2a-4	
i_q	1	Equations 10.6.3.1.2a-5 through 10.6.3.1.2a-9 ; estimated at 1	
N_{qm}	53.68	Equation 10.6.3.1.2a-3	
N_γ	66.2	Table 10.6.3.1.2a-1	
s_γ	0.87	Table 10.6.3.1.2a-3	
i_γ	1	Equations 10.6.3.1.2a-5 through 10.6.3.1.2a-9 ; estimated at 1	
$N_{\gamma m}$	57.37	Equation 10.6.3.1.2a-4	
C_{wq}	0.5	Table 10.6.3.1.2a-2	
$C_{w\gamma}$	0.5	Table 10.6.3.1.2a-2	
q_n	20,407	psf	Equation 10.6.3.1.2a-1
ϕ_b	0.45		Table 10.5.5.2.2-1
q_R	9,183	psf	

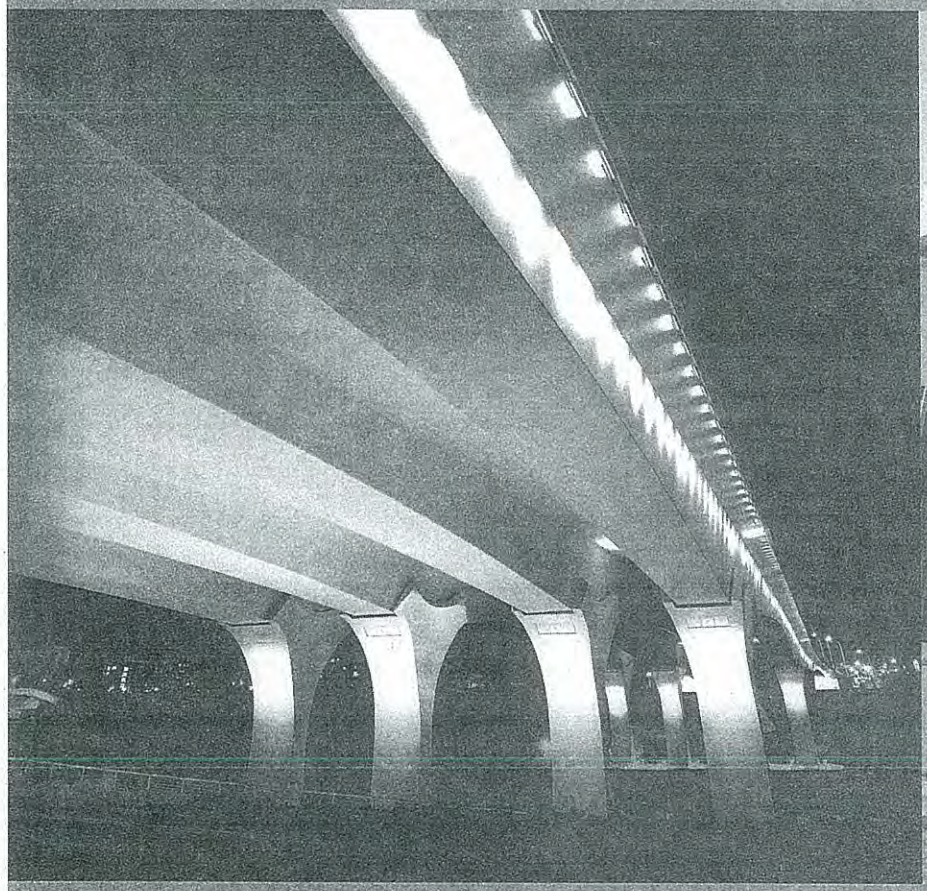
Conclusions:

Nominal bearing resistance for 3 ft x 3 ft ft Footing is	13.53	ksf
Nominal bearing resistance for 14.5 ft x 14.5 ft Footing is	20.41	ksf

Assuming a F.S. of 3.0 (per ASD Methods), from the nominal (ultimate) bearing resistance of 13.53 ksf (minimum for 3 ft x 3 ft footing), then allowable bearing resistance is approximately 4 ksf.

Note: proposed retaining wall bearing resistance is based on a footing width of 9 ft and F.S. = 2.5; allowable bearing resistance is 4 ksf.

AASHTO LRFD BRIDGE



DESIGN SPECIFICATIONS

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elements, failure of one of these foundation elements usually does not cause the entire foundation unit to reach failure, i.e., due to load sharing and overall redundancy. Therefore, the reliability of the foundation unit is usually more, and in many cases considerably more, than the reliability of the individual foundation element. Hence, a lower reliability can be successfully used for redundant foundations than is typically the case for the superstructure.

Note that not all of the resistance factors provided in this Article have been derived using statistical data from which a specific β value can be estimated, since such data were not always available. In those cases, where data were not available, resistance factors were estimated through calibration by fitting to past allowable stress design safety factors, e.g., the AASHTO *Standard Specifications for Highway Bridges* (2002).

Additional discussion regarding the basis for the resistance factors for each foundation type and limit state is provided in Articles 10.5.5.2.2, 10.5.5.2.3, 10.5.5.2.4, and 10.5.5.2.5. Additional, more detailed information on the development of the resistance factors for foundations provided in this Article, and a comparison of those resistance factors to previous Allowable Stress Design practice, e.g., AASHTO (2002), is provided in Allen (2005).

The foundation resistance after scour due to the design flood shall provide adequate foundation resistance using the resistance factors given in this Article.

Scour design for the design flood must satisfy the requirement that the factored foundation resistance after scour is greater than the factored load determined with the scoured soil removed. The resistance factors will be those used in the Strength Limit State, without scour.

10.5.5.2.2—Spread Footings

The resistance factors provided in Table 10.5.5.2.2-1 shall be used for strength limit state design of spread footings, with the exception of the deviations allowed for local practices and site specific considerations in Article 10.5.5.2.

C10.5.5.2.2

Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State

Do not use LRFD resistance factor, only calculate nominal bearing resistance

Method/Soil/Condition			Resistance Factor
Bearing Resistance	φ_b	Theoretical method (Munfakh et al., 2001), in clay	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *CPT*	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *SPT*	0.45
		Semi-empirical methods (Meyerhof, 1957), all soils	0.45
		Footings on rock	0.45
		Plate Load Test	0.55
Sliding	φ_τ	Precast concrete placed on sand	0.90
		Cast-in-Place Concrete on sand	0.80
		Cast-in-Place or precast Concrete on Clay	0.85
		Soil on soil	0.90
	φ_{ep}	Passive earth pressure component of sliding resistance	0.50

Table C10.6.2.6.1-1—Presumptive Bearing Resistance for Spread Footing Foundations at the Service Limit State Modified after U.S. Department of the Navy (1982)

Type of Bearing Material	Consistency in Place	Bearing Resistance (ksf)	
		Ordinary Range	Recommended Value of Use
Massive crystalline igneous and metamorphic rock: granite, diorite, basalt, gneiss, thoroughly cemented conglomerate (sound condition allows minor cracks)	Very hard, sound rock	120–200	160
Foliated metamorphic rock: slate, schist (sound condition allows minor cracks)	Hard sound rock	60–80	70
Sedimentary rock: hard cemented shales, siltstone, sandstone, limestone without cavities	Hard sound rock	30–50	40
Weathered or broken bedrock of any kind, except highly argillaceous rock (shale)	Medium hard rock	16–24	20
Compaction shale or other highly argillaceous rock in sound condition	Medium hard rock	16–24	20
Well-graded mixture of fine- and coarse-grained soil: glacial till, hardpan, boulder clay (GW-GC, GC, SC)	Very dense	16–24	20
Gravel, gravel-sand mixture, boulder-gravel mixtures (GW, GP, SW, SP)	Very dense Medium dense to dense Loose	12–20 8–14 4–12	14 10 6
Coarse to medium sand, and with little gravel (SW, SP)	Very dense Medium dense to dense Loose	8–12 4–8 2–6	8 6 4
Fine to medium sand, silty or clayey medium to coarse sand (SW, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Fine sand, silty or clayey medium to fine sand (SP, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Homogeneous inorganic clay, sandy or silty clay (CL, CH)	Very dense Medium dense to dense Loose	6–12 2–6 1–2	8 4 1
Inorganic silt, sandy or clayey silt, varved silt-clay-fine sand (ML, MH)	Very stiff to hard Medium stiff to stiff Soft	4–8 2–6 1–2	6 3 1

Presumptive Values (nominal service limit state bearing resistances for up to 1 in. settlement show a 6 ksf resistance for this type of soil that is medium dense)

10.6.2.6.2—Semiempirical Procedures for Bearing Resistance

Bearing resistance on rock shall be determined using empirical correlation to the Geomechanic Rock Mass Rating System, RMR, as specified in Article 10.4.6.4. Local experience should be considered in the use of these semi-empirical procedures.

If the recommended value of presumptive bearing resistance exceeds either the unconfined compressive strength of the rock or the nominal resistance of the concrete, the presumptive bearing resistance shall be taken as the lesser of the unconfined compressive strength of the rock or the nominal resistance of the concrete. The nominal resistance of concrete shall be taken as $0.3 f'_c$.

10.6.3—Strength Limit State Design

10.6.3.1—Bearing Resistance of Soil

10.6.3.1.1—General

Bearing resistance of spread footings shall be determined based on the highest anticipated position of groundwater level at the footing location.

The factored resistance, q_R, at the strength limit state shall be taken as:

$$q_R = \varphi_b \, q_n \qquad (10.6.3.1.1\text{-}1)$$

where:

φ_b = resistance factor specified in Article 10.5.5.2.2

q_n = nominal bearing resistance (ksf)

Where loads are eccentric, the effective footing dimensions, L' and B', as specified in Article 10.6.1.3, shall be used instead of the overall dimensions L and B in all equations, tables, and figures pertaining to bearing resistance.

C10.6.3.1.1

The bearing resistance of footings on soil should be evaluated using soil shear strength parameters that are representative of the soil shear strength under the loading conditions being analyzed. The bearing resistance of footings supported on granular soils should be evaluated for both permanent dead loading conditions and short-duration live loading conditions using effective stress methods of analysis and drained soil shear strength parameters. The bearing resistance of footings supported on cohesive soils should be evaluated for short-duration live loading conditions using total stress methods of analysis and undrained soil shear strength parameters. In addition, the bearing resistance of footings supported on cohesive soils, which could soften and lose strength with time, should be evaluated for permanent dead loading conditions using effective stress methods of analysis and drained soil shear strength parameters.

The position of the groundwater table can significantly influence the bearing resistance of soils through its effect on shear strength and unit weight of the foundation soils. In general, the submergence of soils will reduce the effective shear strength of cohesionless (or granular) materials, as well as the long-term (or drained) shear strength of cohesive (clayey) soils. Moreover, the effective unit weights of submerged soils are about half of those for the same soils under dry conditions. Thus, submergence may lead to a significant reduction in the bearing resistance provided by the foundation soils, and it is essential that the bearing resistance analyses be carried out under the assumption of the highest groundwater table expected within the service life of the structure.

Footings with inclined bases should be avoided wherever possible. Where use of an inclined footing base cannot be avoided, the nominal bearing resistance determined in accordance with the provisions herein should be further reduced using accepted corrections for inclined footing bases in Munfakh, et al. (2001).

Because the effective dimensions will vary slightly for each limit state under consideration, strict adherence to this provision will require re-computation of the nominal bearing resistance at each limit state.

Further, some of the equations for the bearing resistance modification factors based on L and B were not necessarily or specifically developed with the intention that effective dimensions be used. The designer should ensure that appropriate values of L and B are used, and that effective footing dimensions L' and B' are used appropriately.

Consideration should be given to the relative change in the computed nominal resistance based on effective versus gross footing dimensions for the size of footings typically used for bridges. Judgment should be used in deciding whether the use of gross footing dimensions for computing nominal bearing resistance at the strength limit state would result in a conservative design.

10.6.3.1.2—Theoretical Estimation

10.6.3.1.2a—Basic Formulation

C10.6.3.1.2a

The nominal bearing resistance shall be estimated using accepted soil mechanics theories and should be based on measured soil parameters. The soil parameters used in the analyses shall be representative of the soil shear strength under the considered loading and subsurface conditions.

The nominal bearing resistance of spread footings on cohesionless soils shall be evaluated using effective stress analyses and drained soil strength parameters.

The nominal bearing resistance of spread footings on cohesive soils shall be evaluated for total stress analyses and undrained soil strength parameters. In cases where the cohesive soils may soften and lose strength with time, the bearing resistance of these soils shall also be evaluated for permanent loading conditions using effective stress analyses and drained soil strength parameters.

For spread footings bearing on compacted soils, the nominal bearing resistance shall be evaluated using the more critical of either total or effective stress analyses.

Except as noted below, the nominal bearing resistance of a soil layer, in ksf, should be taken as:

$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma \quad BN_{\gamma m} C_{w\gamma} \tag{10.6.3.1.2a-1}$$

The bearing resistance formulation provided in Eqs. 10.6.3.1.2a-1 though 10.6.3.1.2a-4 is the complete formulation as described in the Munfakh, et al. (2001). However, in practice, not all of the factors included in these equations have been routinely used.

in which:

$$N_{cm} = N_c s_c i_c \tag{10.6.3.1.2a-2}$$

$$N_{qm} = N_q s_q d_q i_q \tag{10.6.3.1.2a-3}$$

$$N_\gamma m = N_\gamma s_\gamma i_\gamma \tag{10.6.3.1.2a-4}$$

where:

c = cohesion, taken as undrained shear strength (ksf)

N_c = cohesion term (undrained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)

N_q = surcharge (embedment) term (drained or undrained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)

N_γ = unit weight (footing width) term (drained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)

γ = total (moist) unit weight of soil above or below the bearing depth of the footing (kcf)

D_f = footing embedment depth (ft)

B = footing width (ft)

$C_{wq}, C_{w\gamma}$ = correction factors to account for the location of the groundwater table as specified in Table 10.6.3.1.2a-2 (dim)

s_c, s_γ, s_q = footing shape correction factors as specified in Table 10.6.3.1.2a-3 (dim)

d_q = correction factor to account for the shearing resistance along the failure surface passing through cohesionless material above the bearing elevation as specified in Table 10.6.3.1.2a-4 (dim)

i_c, i_γ, i_q = load inclination factors determined from Eqs. 10.6.3.1.2a-5 or 10.6.3.1.2a-6, and 10.6.3.1.2a-7 and 10.6.3.1.2a-8 (dim)

For ϕ_f = 0:

$$i_c = 1 - (mH/cBLN_c) \qquad (10.6.3.1.2a\text{-}5)$$

For ϕ_f > 0:

$$i_c = i_q - [(1 - i_q)/(N_q - 1)] \qquad (10.6.3.1.2a\text{-}6)$$

in which:

$$i_q = \left[1 - \frac{H}{(V + cBL\cot\phi_f)}\right]^n \qquad (10.6.3.1.2a\text{-}7)$$

$$i_\gamma = \left[1 - \frac{H}{V + cBL\cot\phi_f)}\right]^{(n+1)} \qquad (10.6.3.1.2a\text{-}8)$$

$$n = [(2 + L/B)/(1 + L/B)]\cos^2\theta + [(2 + B/L)/(1 + B/L)]\sin^2\theta \qquad (10.6.3.1.2a\text{-}9)$$

Most geotechnical engineers nationwide have not used the load inclination factors. This is due, in part, to the lack of knowledge of the vertical and horizontal loads at the time of geotechnical explorations and preparation of bearing resistance recommendations.

Furthermore, the basis of the load inclination factors computed by Eqs. 10.6.3.1.2a-5 to 10.6.3.1.2a-8 is a combination of bearing resistance theory and small scale load tests on 1 in. wide plates on London Clay and Ham River Sand (Meyerhof, 1953). Therefore, the factors do not take into consideration the effects of depth of embedment. Meyerhof further showed that for footings with a depth of embedment ratio of $D_f/B = 1$, the effects of load inclination on bearing resistance are relatively small. The theoretical formulation of load inclination factors were further examined by Brinch-Hansen (*1970*), with additional modification by Vesic (*1973*) into the form provided in Eqs. 10.6.3.1.2a-5 to 10.6.3.1.2a-8.

It should further be noted that the resistance factors provided in Article 10.5.5.2.2 were derived for vertical loads. The applicability of these resistance factors to design of footings resisting inclined load combinations is not currently known. The combination of the resistance factors and the load inclination factors may be overly conservative for footings with an embedment of approximately $D_f/B = 1$ or deeper because the load inclination factors were derived for footings without embedment.

where:

B = footing width (ft)

L = footing length (ft)

H = unfactored horizontal load (kips)

V = unfactored vertical load (kips)

θ = projected direction of load in the plane of the footing, measured from the side of length L (degrees)

In practice, therefore, for footings with modest embedment, consideration may be given to omission of the load inclination factors.

Figure C10.6.3.1.2a-1 shows the convention for determining the θ angle in Eq. 10.6.3.1.2a-9.

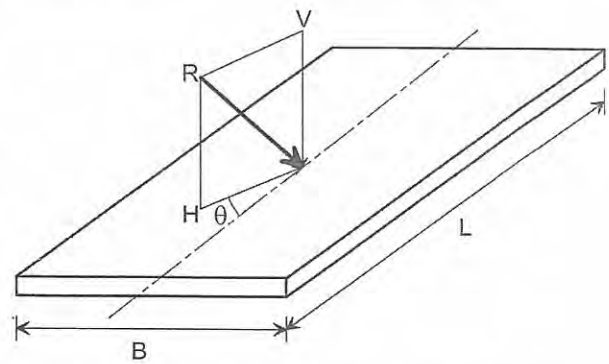

Figure C10.6.3.1.2a-1—Inclined Loading Conventions

Table 10.6.3.1.2a-1—Bearing Capacity Factors N_c (Prandtl, 1921), N_q (Reissner, 1924), and N_γ (Vesic, 1975)

ϕ_f	N_c	N_q	N_γ	ϕ_f	N_c	N_q	N_γ
0	5.14	1.0	0.0	23	18.1	8.7	8.2
1	5.4	1.1	0.1	24	19.3	9.6	9.4
2	5.6	1.2	0.2	25	20.7	10.7	10.9
3	5.9	1.3	0.2	26	22.3	11.9	12.5
4	6.2	1.4	0.3	27	23.9	13.2	14.5
5	6.5	1.6	0.5	28	25.8	14.7	16.7
6	6.8	1.7	0.6	29	27.9	16.4	19.3
7	7.2	1.9	0.7	30	30.1	18.4	22.4
8	7.5	2.1	0.9	31	32.7	20.6	26.0
9	7.9	2.3	1.0	32	35.5	23.2	30.2
10	8.4	2.5	1.2	33	38.6	26.1	35.2
11	8.8	2.7	1.4	34	42.2	29.4	41.1
12	9.3	3.0	1.7	35	46.1	33.3	48.0
13	9.8	3.3	2.0	36	50.6	37.8	56.3
14	10.4	3.6	2.3	37	55.6	42.9	66.2
15	11.0	3.9	2.7	38	61.4	48.9	78.0
16	11.6	4.3	3.1	39	67.9	56.0	92.3
17	12.3	4.8	3.5	40	75.3	64.2	109.4
18	13.1	5.3	4.1	41	83.9	73.9	130.2
19	13.9	5.8	4.7	42	93.7	85.4	155.6
20	14.8	6.4	5.4	43	105.1	99.0	186.5
21	15.8	7.1	6.2	44	118.4	115.3	224.6
22	16.9	7.8	7.1	45	133.9	134.9	271.8

Table 10.6.3.1.2a-2—Coefficients C_{wq} and $C_{w\gamma}$ for Various Groundwater Depths

D_w	C_{wq}	$C_{w\gamma}$
0.0	0.5	0.5
D_f	1.0	0.5
$>1.5B + D_f$	1.0	1.0

Where the position of groundwater is at a depth less than 1.5 times the footing width below the footing base, the bearing resistance is affected. The highest anticipated groundwater level should be used in design.

Table 10.6.3.1.2a-3—Shape Correction Factors s_c, s_γ, s_q

Factor	Friction Angle	Cohesion Term (s_c)	Unit Weight Term (s_γ)	Surcharge Term (s_q)
Shape Factors s_c, s_γ, s_q	$\phi_f = 0$	$1+\left(\frac{B}{5L}\right)$	1.0	1.0
	$\phi_f > 0$	$1+\left(\frac{B}{L}\right)\left(\frac{N_q}{N_c}\right)$	$1-0.4\left(\frac{B}{L}\right)$	$1+\left(\frac{B}{L}\tan\phi_f\right)$

Table 10.6.3.1.2a-4—Depth Correction Factor d_q

Friction Angle, ϕ_f (degrees)	D_f/B	d_q
32	1	1.20
	2	1.30
	4	1.35
	8	1.40
37	1	1.20
	2	1.25
	4	1.30
	8	1.35
42	1	1.15
	2	1.20
	4	1.25
	8	1.30

The parent information from which Table 10.6.3.1.2a-4 was developed covered the indicated range of friction angle, ϕ_f. Information beyond the range indicated is not available at this time.

The depth correction factor should be used only when the soils above the footing bearing elevation are as competent as the soils beneath the footing level; otherwise, the depth correction factor should be taken as 1.0.

Linear interpolations may be made for friction angles in between those values shown in Table 10.6.3.1.2a-4.

10.6.3.1.2b—Considerations for Punching Shear

If local or punching shear failure is possible, the nominal bearing resistance shall be estimated using reduced shear strength parameters c^* and ϕ^* in Eqs. 10.6.3.1.2b-1 and 10.6.3.1.2b-2. The reduced shear parameters may be taken as:

$$c^* = 0.67c \qquad (10.6.3.1.2b\text{-}1)$$

C10.6.3.1.2b

Local shear failure is characterized by a failure surface that is similar to that of a general shear failure but that does not extend to the ground surface, ending somewhere in the soil below the footing. Local shear failure is accompanied by vertical compression of soil below the footing and visible bulging of soil adjacent to the footing but not by sudden rotation or tilting of the

analyses shall be performed to account for the effects of weathering and the presence and condition of discontinuities.

The designer shall judge the competency of a rock mass by taking into consideration both the nature of the intact rock and the orientation and condition of discontinuities of the overall rock mass. Where engineering judgment does not verify the presence of competent rock, the competency of the rock mass should be verified using the procedures for *RMR* rating in Article 10.4.6.4.

10.6.3.2.2—Semiempirical Procedures

The nominal bearing resistance of rock should be determined using empirical correlation with the Geomechanics Rock Mass Rating system. Local experience shall be considered in the use of these semi-empirical procedures.

The factored bearing stress of the foundation shall not be taken to be greater than the factored compressive resistance of the footing concrete.

C10.6.3.2.2

The bearing resistance of jointed or broken rock may be estimated using the semi-empirical procedure developed by Carter and Kulhawy (1988). This procedure is based on the unconfined compressive strength of the intact rock core sample. Depending on rock mass quality measured in terms of *RMR* system, the nominal bearing resistance of a rock mass varies from a small fraction to six times the unconfined compressive strength of intact rock core samples.

10.6.3.2.3—Analytic Method

The nominal bearing resistance of foundations on rock shall be determined using established rock mechanics principles based on the rock mass strength parameters. The influence of discontinuities on the failure mode shall also be considered.

C10.6.3.2.3

Depending upon the relative spacing of joints and rock layering, bearing capacity failures for foundations on rock may take several forms. Except for the case of a rock mass with closed joints, the failure modes are different from those in soil. Procedures for estimating bearing resistance for each of the failure modes can be found in Kulhawy and Goodman (1987), Goodman (1989), and Sowers (1979).

10.6.3.2.4—Load Test

Where appropriate, load tests may be performed to determine the nominal bearing resistance of foundations on rock.

10.6.3.3—Eccentric Load Limitations

The eccentricity of loading at the strength limit state, evaluated based on factored loads shall not exceed:

- One-third of the corresponding footing dimension, B or L, for footings on soils, or 0.45 of the corresponding footing dimensions B or L, for footings on rock.

C10.6.3.3

A comprehensive parametric study was conducted for cantilevered retaining walls of various heights and soil conditions. The base widths obtained using the LRFD load factors and eccentricity of $B/3$ were comparable to those of ASD with an eccentricity of $B/6$. For foundations on rock, to obtain equivalence with ASD specifications, a maximum eccentricity of $B/2$ would be needed for LRFD. However, a slightly smaller maximum eccentricity has been specified to account for the potential unknown future loading that could push the resultant outside the footing dimensions.

FOUNDATION ANALYSIS AND DESIGN

Fourth Edition

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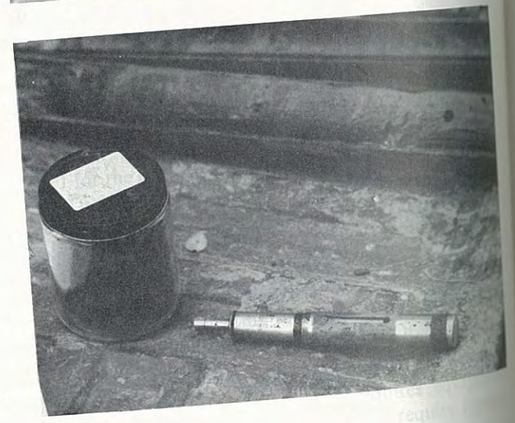
Consulting Engineer/Software Consultant
Engineering Computer Software
Peoria, Illinois

McGraw-Hill Book Company

New York St. Louis San Francisco Auckland Bogotá Caracas
Colorado Springs Hamburg Lisbon London Madrid Mexico Milan
Montreal New Delhi Oklahoma City Panama Paris San Juan
São Paulo Singapore Sydney Tokyo Toronto

(*a*) Split tube opened to display sample and taking a pocket penetrometer test for q_u.

(*b*) Placing representative sample into jar for laboratory use.



(*c*) Sample in jar with identification label. Pocket penetrometer in foreground. Dark band is marker for q_u on calibrated stem.

FIGURE 3-9 Field SPT sampling sequence.

N'_{60}

$$N'_{70} = \frac{60}{70} \times 11 = \underline{9}$$

////

Example 3-4

Same as Example 3-2 but $E_r = 55$; $p'_o = 100$ kPa; 205 mm hollow stem auger; hole depth = 6 m

$$C_N = \left(\frac{95.76}{100}\right)^{1/2} = 0.98$$

$$\eta_1 = \frac{55}{70} = 0.79 \qquad \eta_2 = 0.95 \quad 6 < 10\,\text{m}$$

$$\eta_3 = 1.0 \quad \text{no liner} \qquad \eta_4 = 1 \quad \text{using hollow stem auger}$$

$$N'_{70} = 0.98 \times 20 \times 0.79 \times 0.95 \times 1.0 \times 1.0 = \underline{15}$$

$$N'_{60} = \frac{70}{60} \times 15 = \underline{17}$$

////

3-8 SPT CORRELATIONS

The SPT has been used in correlations for unit weight, relative density D_r, angle of internal friction ϕ, and undrained compressive strength q_u. For reasons in the preceding section these will be of questionable value—particularly since many were suggested prior to extensive study of the large number of variables affecting the N values. The data shown in Table 3-4 for D_r and ϕ relate roughly to N'_{70} and for borehole depths on the order of 4 to 6 m as for spread foundations.

TABLE 3-4 Empirical values for ϕ, D_r, and unit weight of granular soils based on the SPT at about 6 m depth and normally consolidated

Description	Very loose	Loose	Medium	Dense	Very dense
Relative density D_r	0	0.15	0.35	0.65	0.85
SPT N'_{70}: fine	1–2	3–6	7–15	16–30	?
medium	2–3	4–7	8–20	21–40	>40
coarse	3–6	5–9	10–25	26–45	>45
ϕ: fine	26–28	28–30	30–34	33–38	
medium	27–28	30–32	32–36	36–42	<50
coarse	28–30	30–34	33–40	40–50	
γ_{wet}, pcf	70–100†	90–115	110–130	110–140	130–150
(kN/m³)	(11–16)	(14–18)	(17–20)	(17–22)	(20–23)

† Excavated soil or material dumped from a truck will weigh 11 to 14 kN/m³ and must be quite dense to weigh much over 21 kN/m³. No existing soil has a $D_r = 0.00$ nor a value of 1.00—common ranges are from 0.3 to 0.7.

Assume a phi of 34 degrees and a unit weight of 125 pcf

APPENDIX E

Settlement Calculations

HALEY & ALDRICH	CALCULATIONS	File No.	39192-000
		Sheet	1 of 2
Client	Wendel Duchscherer Architects & Engineers	Date	24-Apr-13
Project	Waterbury Bus Maintenance Facility in Watertown, CT	Computed by	MMH
Subject	Settlement of Footings	Checked by	PJD

Objective:

-to estimate the settlement of the footings for the proposed bus facility based on a 4 ksf loading.

References:

-AASHTO LRFD Bridge Design Specifications 2012

Available Information:

-Foundation Plans for Areas A through E from set titled, "Waterbury Bus Maintenance Facility Replacement" received 3 April 2013

-Boring logs by Haley & Aldrich from 18 to 25 March 2013

-Boring logs by others from March 2002

Assumptions:

-Assume no eccentricity, use full dimensions of footings to estimate settlement (conservative)

-Assume a load of 4 ksf on the footings

-Footing sizes range from 3 ft x 3 ft to 14.5 ft x 14.5 ft

-Bearing soil for footing is Glaciofluvial Deposits or Compacted Structural Fill

-Assume flexible foundation

Calculations:

$$S_e = \frac{q_0 (1 - v^2)\sqrt{A'}}{144\, E_s \beta_z}$$

Equation 10.6.2.4.2-1

where

q_0 =	applied vertical stress (ksf)
A' =	effective area of footing (ft^2)
E_s =	Young's Modulus of soil taken as specified in Article 10.4.6.3 if direct measurements of Es are not available from the results of insitu or laboratory tests (ksi)
β_z =	shape factor taken as specified in Table 10.6.2.4.2-1 (dim)
v =	Poisson's Ratio, taken as specified in Article 10.4.6.2 if direct measurements of v are not available from the results of insitu or laboratory tests (dim)

Unless Es varies significantly with depth, Es should be determined at a depth of about 1/2 to 2/3 of B below the footing, where B is the footing width. If the soil modulus varies significantly with depth, a weighted average value of Es should be used.

HALEY & ALDRICH	CALCULATIONS	File No.	39192-000
		Sheet	2 of 2
Client	Wendel Duchscherer Architects & Engineers	Date	24-Apr-13
Project	Waterbury Bus Maintenance Facility in Watertown, CT	Computed by	MMH
Subject	Settlement of Footings	Checked by	PJD

3 ft x 3 ft Footing

width	B	3	ft	
eccentricity	e	0	ft	
effective width	B'	3	ft	
length	L	3	ft	
effective area	A'	9	ft^2	
Poisson's Ratio	v	0.3		Table C10.4.6.3-1
Young's Modulus	Es	7	ksi	
shape factor	βz	1.06		Table 10.6.2.4.2-1
load	q_0	4	ksf	
estimated settlement	Se	0.12	in	

14.5 ft x 14.5 ft Footing

width	B	14.5	ft	
eccentricity	e	0	ft	
effective width	B'	14.5	ft	
length	L	14.5	ft	
effective area	A'	210.25	ft^2	
Poisson's Ratio	v	0.3		Table C10.4.6.3-1
Young's Modulus	Es	7	ksi	
shape factor	βz	1.06		Table 10.6.2.4.2-1
load	q_0	4	ksf	
estimated settlement	Se	0.59	in	

Conclusions:

A settlement up to 1 in. is estimated with a differential settlement estimated at no more than 1/2 in. for the individal footings

AASHTO LRFD BRIDGE

DESIGN SPECIFICATIONS

Customary U.S. Units • 2012

ISBN: 978-1-56051-523-4
Publication Code: LRFDUS-6

American Association of
State Highway and
Transportation Officials
AASHTO
The Voice of Transportation

The effects of the zone of stress influence, or vertical stress distribution, beneath a footing shall be considered in estimating the settlement of the footing.

Spread footings bearing on a layered profile consisting of a combination of cohesive soil, cohesionless soil and/or rock shall be evaluated using an appropriate settlement estimation procedure for each layer within the zone of influence of induced stress beneath the footing.

The distribution of vertical stress increase below circular or square and long rectangular footings, i.e., where $L > 5B$, may be estimated using Figure 10.6.2.4.1-1.

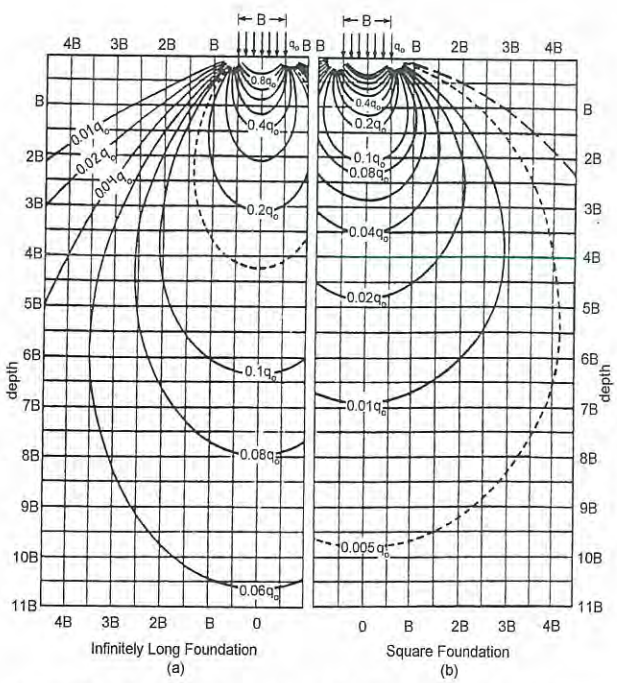


Figure 10.6.2.4.1-1—Boussinesq Vertical Stress Contours for Continuous and Square Footings Modified after Sowers (1979)

10.6.2.4.2—Settlement of Footings on Cohesionless Soils

The settlement of spread footings bearing on cohesionless soil deposits shall be estimated as a function of effective footing width and shall consider the effects of footing geometry and soil and rock layering with depth.

Secondary settlement, or creep, occurs as a result of the plastic deformation of the soil skeleton under a constant effective stress. Secondary settlement is of principal concern in highly plastic or organic soil deposits. Such deposits are normally so obviously weak and soft as to preclude consideration of bearing a spread footing on such materials.

The principal deformation component for footings on rock is elastic settlement, unless the rock or included discontinuities exhibit noticeable time-dependent behavior.

For guidance on vertical stress distribution for complex footing geometries, see Poulos and Davis (1974) or Lambe and Whitman (1969).

Some methods used for estimating settlement of footings on sand include an integral method to account for the effects of vertical stress increase variations. For guidance regarding application of these procedures, see Gifford et al. (1987).

C10.6.2.4.2

Although methods are recommended for the determination of settlement of cohesionless soils, experience has indicated that settlements can vary considerably in a construction site, and this variation may not be predicted by conventional calculations.

Settlements of cohesionless soils occur rapidly, essentially as soon as the foundation is loaded. Therefore, the total settlement under the service loads may not be as important as the incremental settlement between intermediate load stages. For example, the total and differential settlement due to loads applied by columns and cross beams is generally less important than the total and differential settlements due to girder placement and casting of continuous concrete decks.

Settlements of footings on cohesionless soils shall be estimated using elastic theory or empirical procedures.

Generally conservative settlement estimates may be obtained using the elastic half-space procedure or the empirical method by Hough. Additional information regarding the accuracy of the methods described herein is provided in Gifford et al. (1987) and Kimmerling (2002). This information, in combination with local experience and engineering judgment, should be used when determining the estimated settlement for a structure foundation, as there may be cases, such as attempting to build a structure grade high to account for the estimated settlement, when overestimating the settlement magnitude could be problematic.

Details of other procedures can be found in textbooks and engineering manuals, including:

- Terzaghi and Peck (1967)
- Sowers (1979)
- U.S. Department of the Navy (1982)
- D'Appolonia (Gifford et al., 1987)—This method includes consideration for over-consolidated sands.
- Tomlinson (1986)
- Gifford et al. (1987)

For general guidance regarding the estimation of elastic settlement of footings on sand, see Gifford et al. (1987) and Kimmerling (2002).

The elastic half-space method assumes the footing is flexible and is supported on a homogeneous soil of infinite depth. The elastic settlement of spread footings, in feet, by the elastic half-space method shall be estimated as:

$$S_e = \frac{\left[q_o\left(1-\nu^2\right)\sqrt{A'}\right]}{144\ E_s \beta_z} \qquad (10.6.2.4.2\text{-}1)$$

where:

q_o = applied vertical stress (ksf)

A' = effective area of footing (ft^2)

E_s = Young's modulus of soil taken as specified in Article 10.4.6.3 if direct measurements of E_s are not available from the results of in situ or laboratory tests (ksi)

The stress distributions used to calculate elastic settlement assume the footing is flexible and supported on a homogeneous soil of infinite depth. The settlement below a flexible footing varies from a maximum near the center to a minimum at the edge equal to about 50 percent and 64 percent of the maximum for rectangular and circular footings, respectively. The settlement profile for rigid footings is assumed to be uniform across the width of the footing.

Spread footings of the dimensions normally used for bridges are generally assumed to be rigid, although the actual performance will be somewhere between perfectly rigid and perfectly flexible, even for relatively thick concrete footings, due to stress redistribution and concrete creep.

The accuracy of settlement estimates using elastic theory are strongly affected by the selection of soil modulus and the inherent assumptions of infinite elastic half space. Accurate estimates of soil moduli are difficult to obtain because the analyses are based on

β_z = shape factor taken as specified in Table 10.6.2.4.2-1 (dim)

ν = Poisson's Ratio, taken as specified in Article 10.4.6.3 if direct measurements of ν are not available from the results of in situ or laboratory tests (dim)

Unless E_s varies significantly with depth, E_s should be determined at a depth of about 1/2 to 2/3 of B below the footing, where B is the footing width. If the soil modulus varies significantly with depth, a weighted average value of E_s should be used.

Table 10.6.2.4.2-1—Elastic Shape and Rigidity Factors, EPRI (1983)

L/B	Flexible, β_z (average)	β_z Rigid
Circular	1.04	1.13
1	1.06	1.08
2	1.09	1.10
3	1.13	1.15
5	1.22	1.24
10	1.41	1.41

Estimation of spread footing settlement on cohesionless soils by the empirical Hough method shall be determined using Eqs. 10.6.2.4.2-2 and 10.6.2.4.2-3. *SPT* blow counts shall be corrected as specified in Article 10.4.6.2.4 for depth, i.e. overburden stress, before correlating the *SPT* blow counts to the bearing capacity index, C'.

$$S_e = \sum_{i=1}^{n} \Delta H_i \qquad (10.6.2.4.2\text{-}2)$$

in which:

$$\Delta H_i = H_c \frac{1}{C'} \log\left(\frac{\sigma'_o + \Delta\sigma_v}{\sigma'_o}\right) \qquad (10.6.2.4.2\text{-}3)$$

where:

n = number of soil layers within zone of stress influence of the footing

ΔH_i = elastic settlement of layer i (ft)

H_C = initial height of layer i (ft)

C' = bearing capacity index from Figure 10.6.2.4.2-1 (dim)

In Figure 10.5.2.4.2-1, N′ shall be taken as $N1_{60}$, Standard Penetration Resistance, N (blows/ft), corrected for overburden pressure as specified in Article 10.4.6.2.4.

only a single value of soil modulus, and Young's modulus varies with depth as a function of overburden stress. Therefore, in selecting an appropriate value for soil modulus, consideration should be given to the influence of soil layering, bedrock at a shallow depth, and adjacent footings.

For footings with eccentric loads, the area, A', should be computed based on reduced footing dimensions as specified in Article 10.6.1.3.

The Hough method was developed for normally consolidated cohesionless soils.

The Hough method has several advantages over other methods used to estimate settlement in cohesionless soil deposits, including express consideration of soil layering and the zone of stress influence beneath a footing of finite size.

The subsurface soil profile should be subdivided into layers based on stratigraphy to a depth of about three times the footing width. The maximum layer thickness should be about 10 ft.

While Cheney and Chassie (2000), and Hough (1959), did not specifically state that the SPT N values should be corrected for hammer energy in addition to overburden pressure, due to the vintage of the original work, hammers that typically have an efficiency of approximately 60 percent were in general used to develop the empirical correlations contained in the method. If using SPT hammers with efficiencies that differ significantly from this 60 percent value, the N values should also be corrected for hammer energy, in effect requiring that $N1_{60}$ be used.

Table C10.4.6.3-1—Elastic Constants of Various Soils (modified after U.S. Department of the Navy, 1982; Bowles, 1988)

Assume soil is at the high end of medium dense sand - elastic modulus Es about 7 ksi ; Assume Poisson's Ratio of 0.3

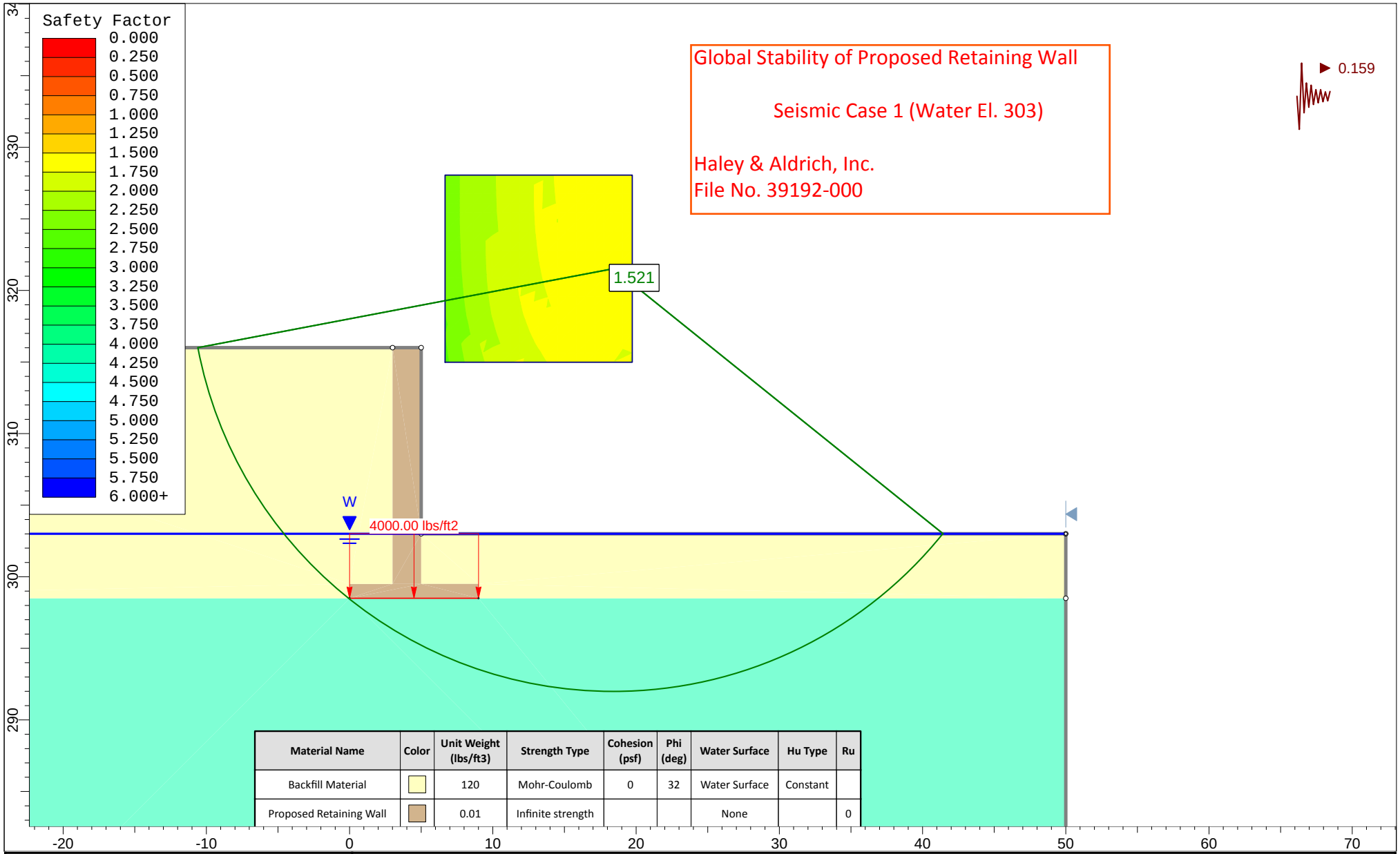
Soil Type	Typical Range of Young's Modulus Values, E_s (ksi)	Poisson's Ratio, ν (dim)
Clay:		
Soft sensitive	0.347–2.08	0.4–0.5 (undrained)
Medium stiff to stiff	2.08–6.94	
Very stiff	6.94–13.89	
Loess	2.08–8.33	0.1–0.3
Silt	0.278–2.78	0.3–0.35
Fine Sand:		
Loose	1.11–1.67	0.25
Medium dense	1.67–2.78	
Dense	2.78–4.17	
Sand:		
Loose	1.39–4.17	0.20–0.36
Medium dense	4.17–6.94	
Dense	6.94–11.11	0.30–0.40
Gravel:		
Loose	4.17–11.11	0.20–0.35
Medium dense	11.11–13.89	
Dense	13.89–27.78	0.30–0.40

Estimating E_s from *SPT N* Value	
Soil Type	E_s (ksi)
Silts, sandy silts, slightly cohesive mixtures	$0.056\ N1_{60}$
Clean fine to medium sands and slightly silty sands	$0.097\ N1_{60}$
Coarse sands and sands with little gravel	$0.139\ N1_{60}$
Sandy gravel and gravels	$0.167\ N1_{60}$

Estimating E_s from q_c (static cone resistance)	
Sandy soils	$0.028q_c$

APPENDIX F

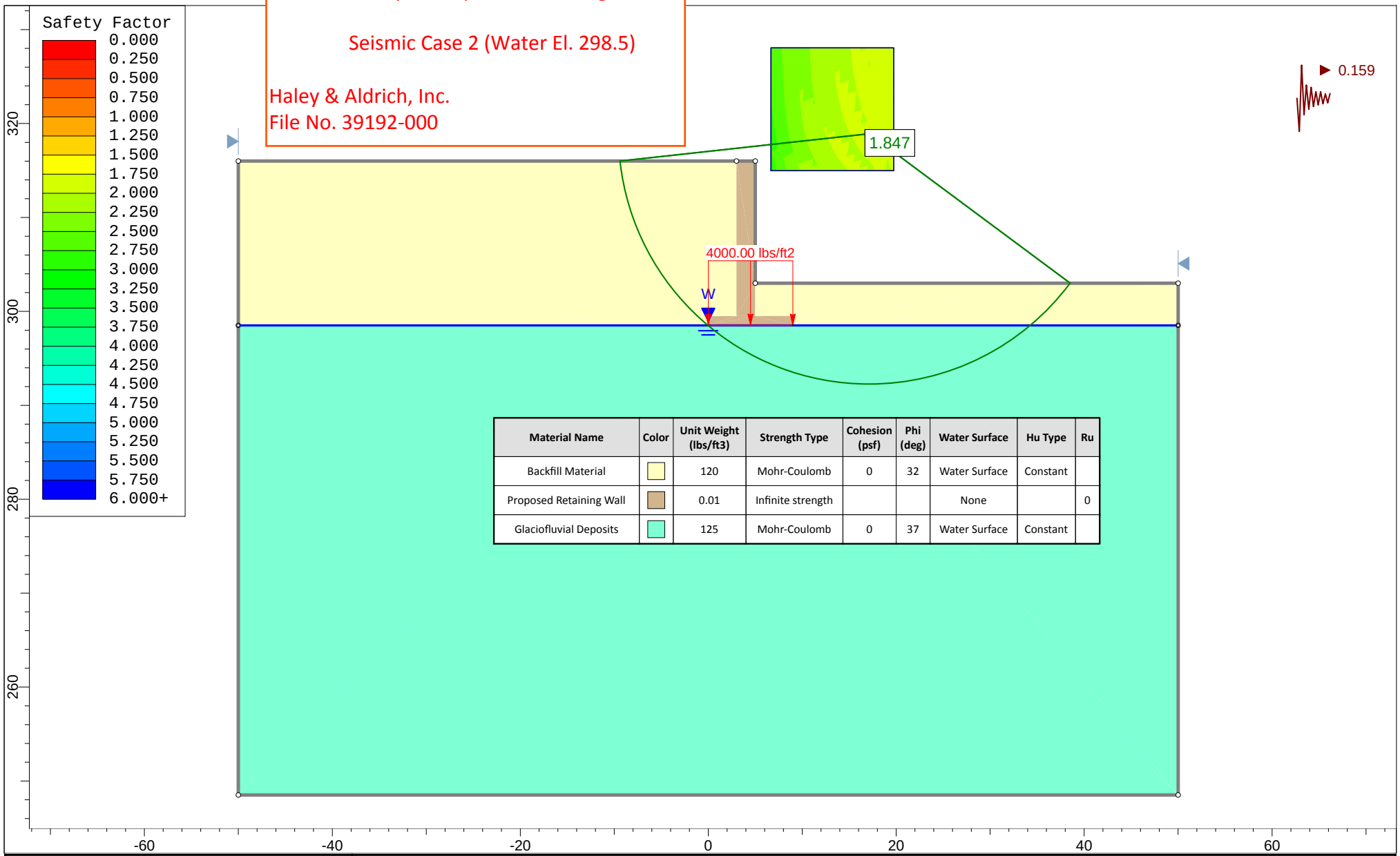
Global Stability Calculations – Retaining Walls



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Ru
Backfill Material		120	Mohr-Coulomb	0	32	Water Surface	Constant	
Proposed Retaining Wall		0.01	Infinite strength			None		0

SLIDEINTERPRET 6.020

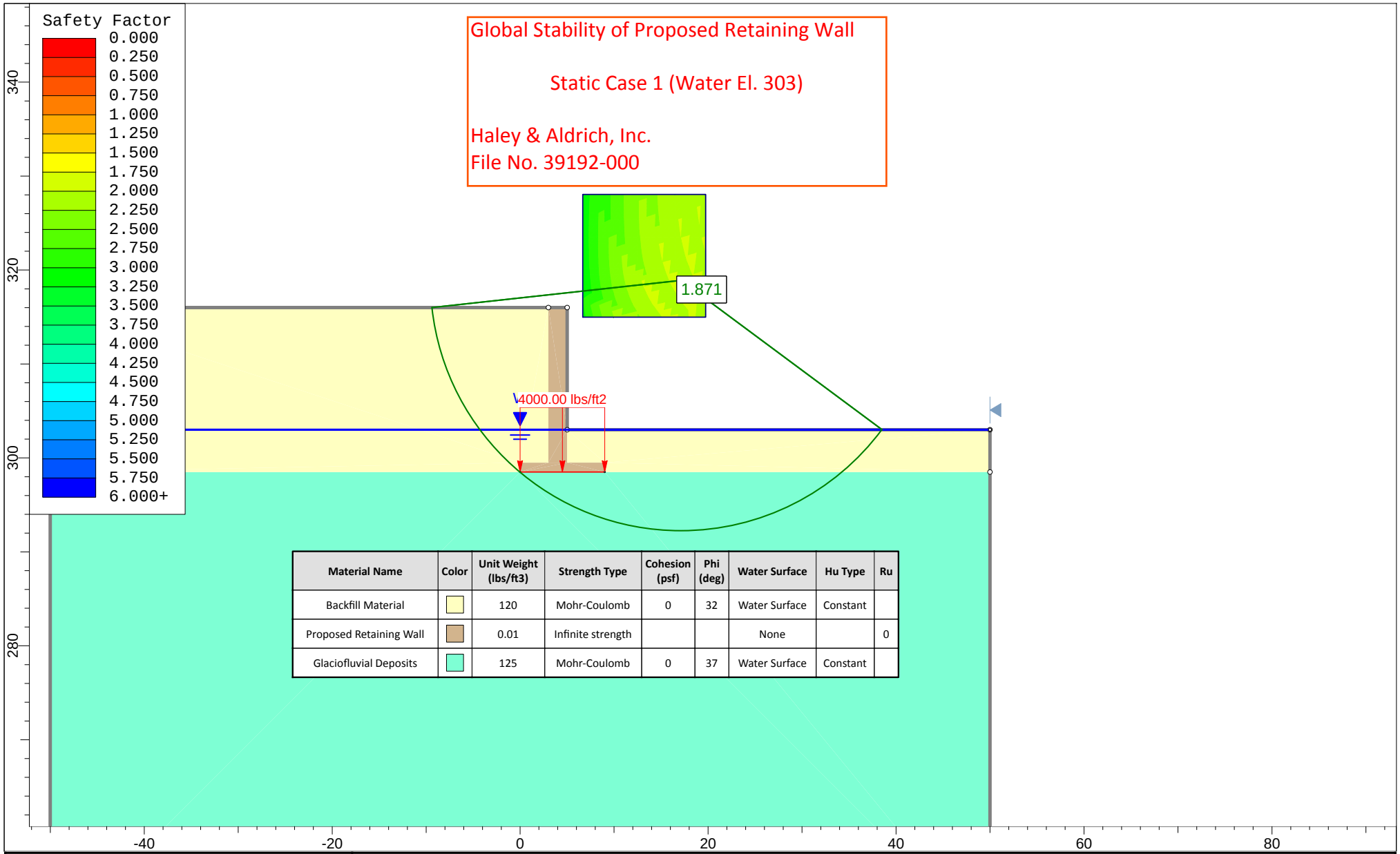
Project	Waterbury Bus Maintenance Facility - Watertown, CT
Analysis Description	Global Stability
Drawn By	MHH/JGD
Scale	1:111
Company	Haley & Aldrich, Inc.
Date	7/23/2013, 4:12:41 PM
File Name	2013-0723-HAI-Waterbury Proposed Retaining Wall-Seismic-Case 1.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Ru
Backfill Material		120	Mohr-Coulomb	0	32	Water Surface	Constant	
Proposed Retaining Wall		0.01	Infinite strength			None		0
Glaciofluvial Deposits		125	Mohr-Coulomb	0	37	Water Surface	Constant	

SLIDEINTERPRET 6.020

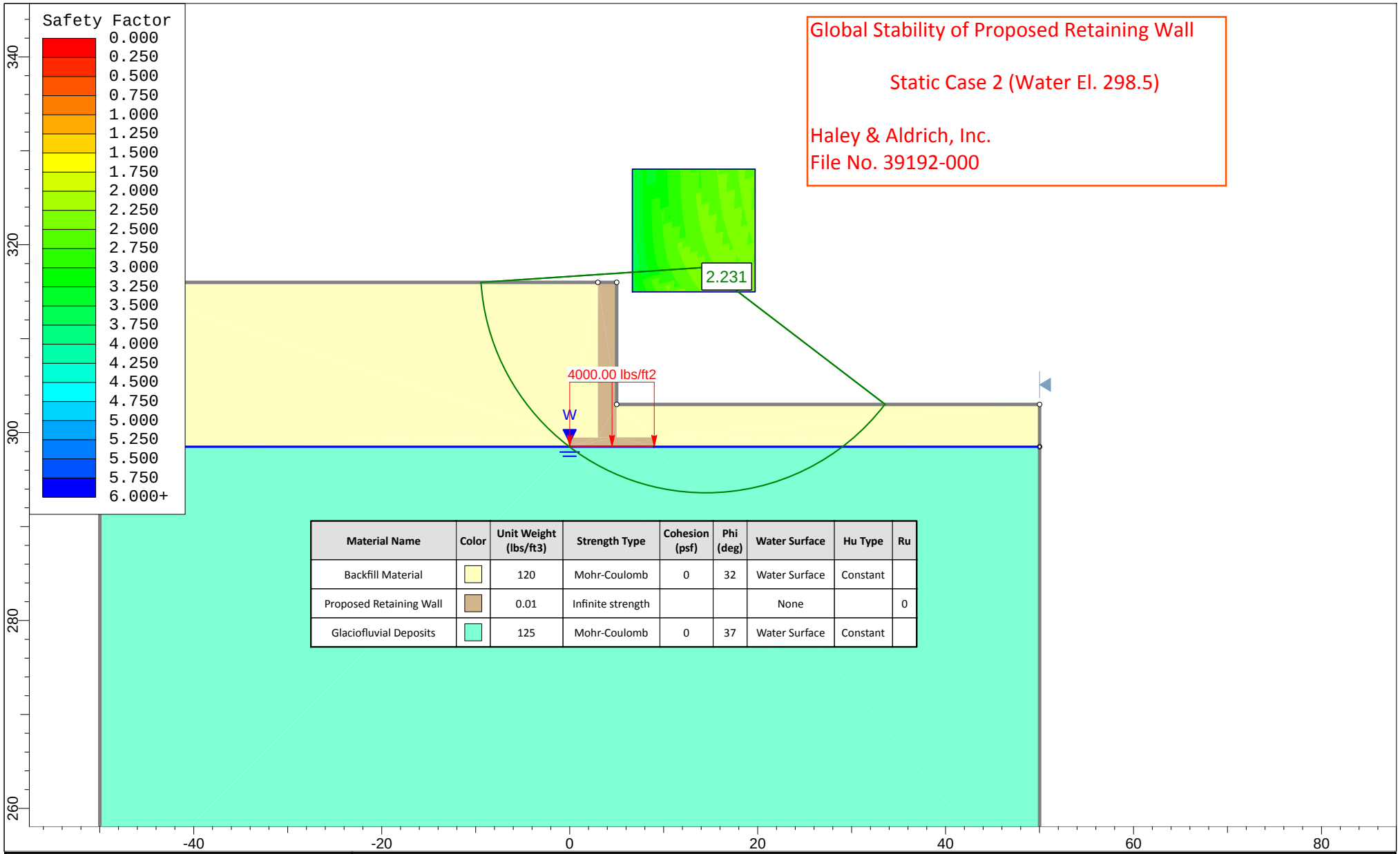
Project	Waterbury Bus Maintenance Facility - Watertown, CT
Analysis Description	Global Stability
Drawn By	MHH/JGD
Scale	1:169
Company	Haley & Aldrich, Inc.
Date	7/23/2013, 4:12:41 PM
File Name	2013-0723-HAI-Waterbury Proposed Retaining Wall-Seismic-Case 2.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Ru
Backfill Material		120	Mohr-Coulomb	0	32	Water Surface	Constant	
Proposed Retaining Wall		0.01	Infinite strength			None		0
Glaciofluvial Deposits		125	Mohr-Coulomb	0	37	Water Surface	Constant	

SLIDEINTERPRET 6.020

Project	Waterbury Bus Maintenance Facility - Watertown, CT		
Analysis Description	Global Stability		
Drawn By MHH/JGD	Scale 1:169	Company Haley & Aldrich, Inc.	
Date 7/23/2013, 4:12:41 PM		File Name 2013-0723-HAI-Waterbury Proposed Retaining Wall-Static-Case 1.slim	



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Ru
Backfill Material		120	Mohr-Coulomb	0	32	Water Surface	Constant	
Proposed Retaining Wall		0.01	Infinite strength			None		0
Glaciofluvial Deposits		125	Mohr-Coulomb	0	37	Water Surface	Constant	

SLIDEINTERPRET 6.020

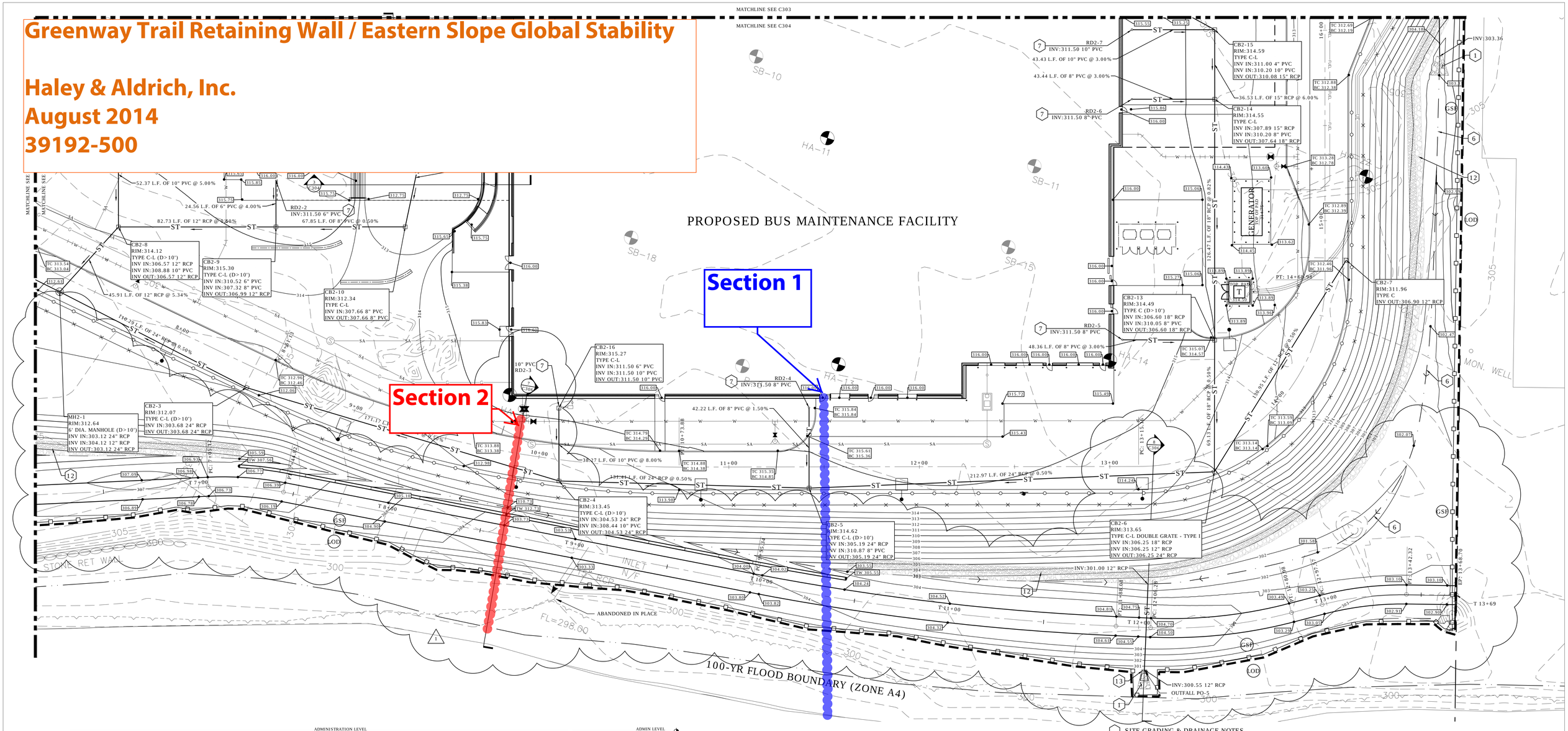
Project	Waterbury Bus Maintenance Facility - Watertown, CT		
Analysis Description	Global Stability		
Drawn By MHH/JGD	Scale 1:169	Company Haley & Aldrich, Inc.	
Date 7/23/2013, 4:12:41 PM		File Name 2013-0723-HAI-Waterbury Proposed Retaining Wall-Static-Case 2.slim	

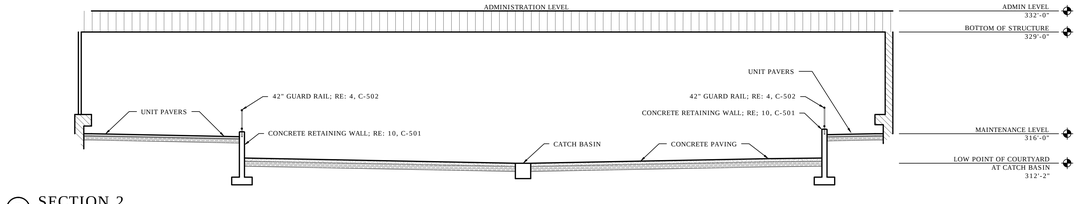
APPENDIX G

Global Stability Calculations - Northern and Eastern Slopes

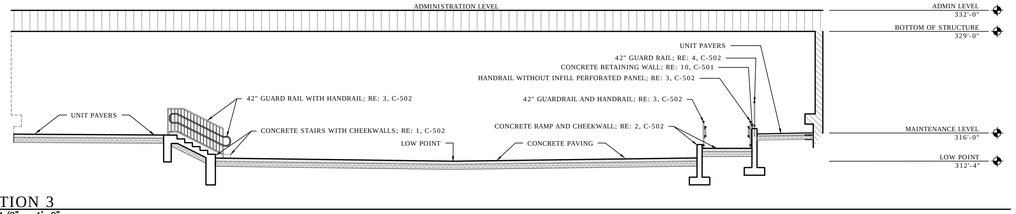
Greenway Trail Retaining Wall / Eastern Slope Global Stability

Haley & Aldrich, Inc.
August 2014
39192-500

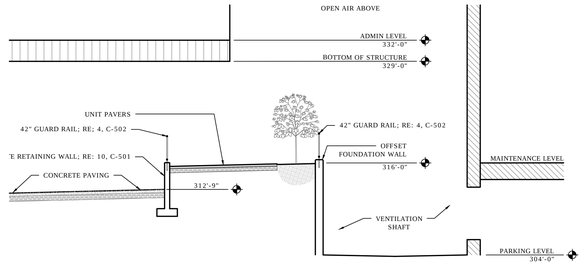




2 SECTION 2
SCALE: 1/8" = 1'-0"



3 SECTION 3
SCALE: 1/8" = 1'-0"



4 SECTION 4
SCALE: 1/8" = 1'-0"

SITE GRADING & DRAINAGE NOTES

(NOT ALL NOTES APPLY TO THIS SHEET)

1. MODIFIED RIP-RAP APRON, TYPE B: La=10', W1=3', W2=7', d=12"; RE: 10, C504.
2. MODIFIED RIP-RAP APRON, TYPE A: La=10', W1=3', W2=10', d=12"; RE: 10, C504 .
3. MODIFIED RIP-RAP APRON, TYPE C: La (min)=10', W1=W2=11', d=12". EXTEND LENGTH TO EDGE OF WETLANDS, La=+/-35'; RE: 11, C504.
4. RIP RAP CHANNEL: 4' WIDE BOTTOM WITH 3:1 SIDESLOPES, S=3.0%
5. FOREBAY WITH MODIFIED RIP-RAP, d=12". SPILLWAY TO MAIN INFILTRATION BASIN TO BE 1' HIGH, 3' WIDE AT TOP WITH 3:1 SIDESLOPES.
6. GRASSED SWALE @ 0.5% SLOPE WITH 3:1 MAX SIDESLOPES.
7. REFER TO PLUMBING DRAWINGS FOR CONTINUATION INTO THE BUILDING.
8. STANDARD END WALL; RE: CTDOT STD. DWG. HW-506_01
9. FLAP GATE MOUNTED TO STANDARD END WALL; RE: 5, C504.
10. INFILTRATION BASIN.
11. EMERGENCY SPILLWAY (GRASSED): CREST ELEVATION APPROXIMATELY 303.10. GRADE SPILLWAY TO DRAIN TO NEW CULVERT UNDER ACCESS ROAD/MULIT-USE PATH ENTRANCE.
12. SLOPE TOE PROTECTION; RE:9, C504.
13. CONCRETE END SECTION; RE: CTDOT STD. DWG. HW-652_01.
14. CONSERVATION SEED MIX ON SIDESLOPES AND BOTTOM OF INFILTRATIONBASIN. REFER TO DRAWINGS L401-L405.
15. YARD DRAIN; RE:3, C504. RIM AND TOP OF STONE IN AREA WAY TO GRADED EVENLY AT 304.00. UNDERDRAIN: RE 13, C501.

1 GRADING AND DRAINAGE PLAN
SCALE: 1"=20'

0 10 20 40

SYMBOL LEGEND

LOD = LIMITS OF DISTURBANCE

GSF = GEOTEXTILE SILT FENCE

GENERAL NOTES:

A. ALL NEW DRAINAGE INLETS IN LAWN OR LANDSCAPED AREAS TO BE PROTECTED WITH GEOTEXTILE INLET PROTECTION.

B. ALL NEW DRAINAGE INLETS IN PAVED AREAS TO BE PROTECTED WITH GEOTEXTILE SACKS BELOW THE GRATES.

C. PERIMETER SILTFENCE IS TO BE PROPERLY MAINTAINED THROUGHOUT CONSTRUCTION.

D. MATCH EXISTING PAVEMENT FLUSH. CONTRACTOR TO NOTIFY ENGINEER IF THIS DOES NOT PROVIDE POSITIVE DRAINAGE.

REV.	DATE	DESCRIPTION	SHEET NO.
1	8/27/14	ADDED GRADING AND DRAINAGE FOR MULTI-USE PATH	03.025.A1

REVISIONS

FILENAME:

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

DESIGNER/DRAFTER: TJZ

CHECKED BY: DLK/SMR

SCALE: AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

ARCHITECT: WENDEL

APPROVED BY: DCD

ENGINEERS: ReSTL DESIGNERS, CLOUGH HARBOUR ASSOC., AI ENGINEERS, WENDEL

DATE: 6/11/14

DESIGNED BY:
WENDEL
140 JOHN JAMES
AUDUBON PKWY.,
SUITE 201
AMHERST, NEW YORK
14228

PROJECT TITLE:
WATERBURY BUS MAINTENANCE FACILITY REPLACEMENT

ADDRESS:
FROST BRIDGE ROAD
WATERTOWN, CONNECTICUT 06787

DRAWING TITLE:
GRADING & DRAINAGE PLAN

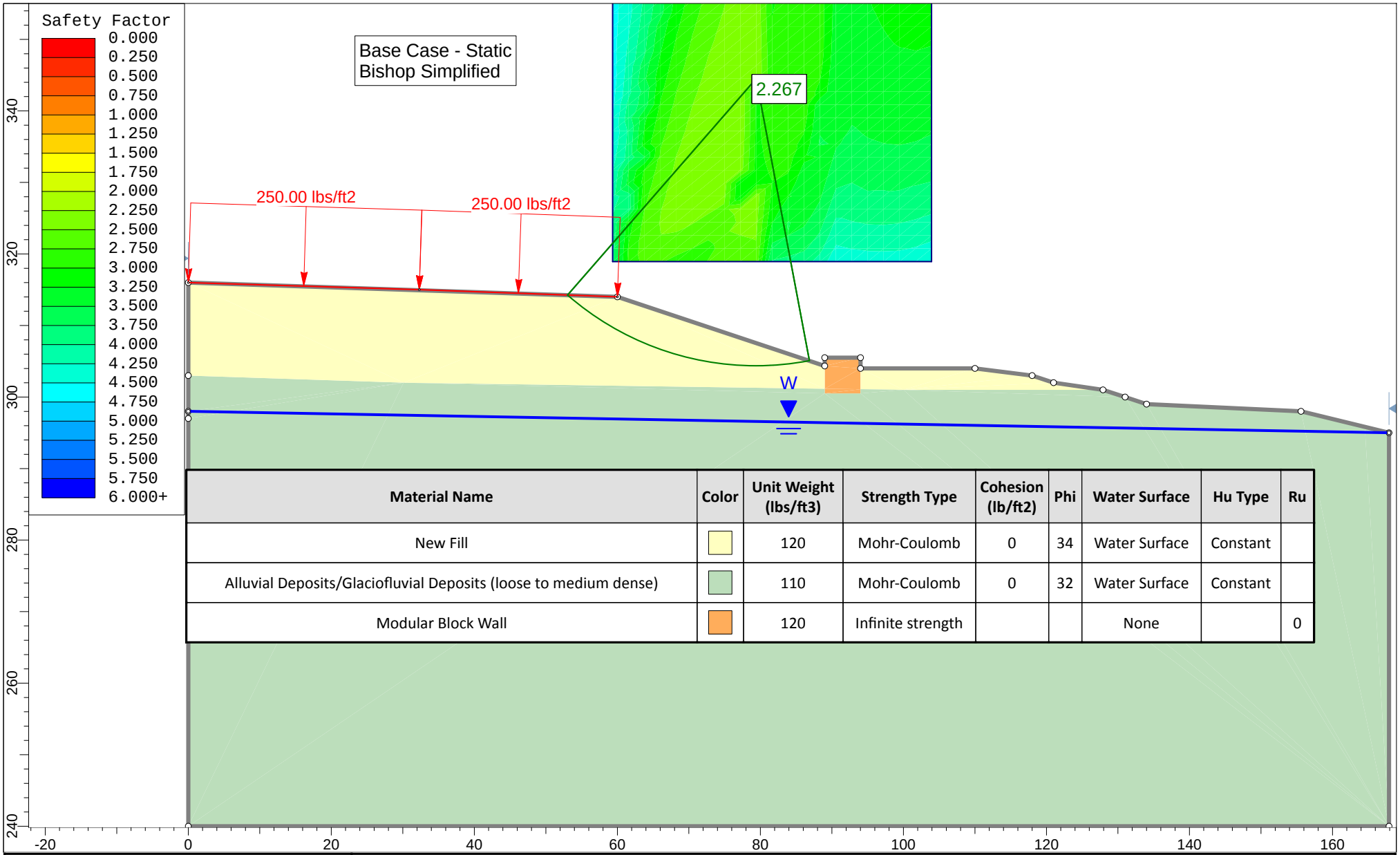
PROJECT NO. **0431-0006**

DRAWING NO. **C-304**

SHEET NO. 03.025.A1

APPENDIX G

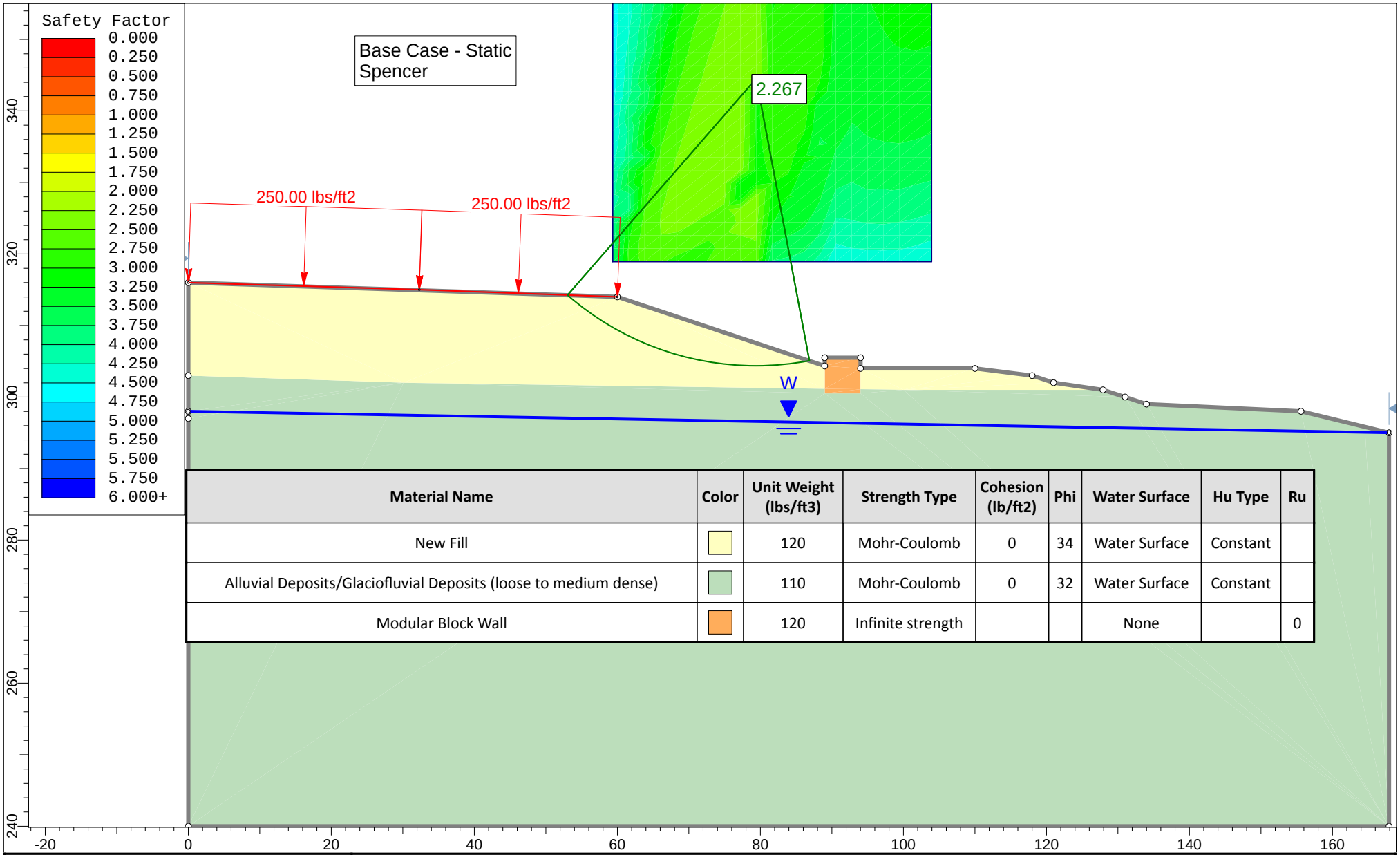
Section 1



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type	Ru
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant	
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant	
Modular Block Wall		120	Infinite strength			None		0

SLIDEINTERPRET 6.005

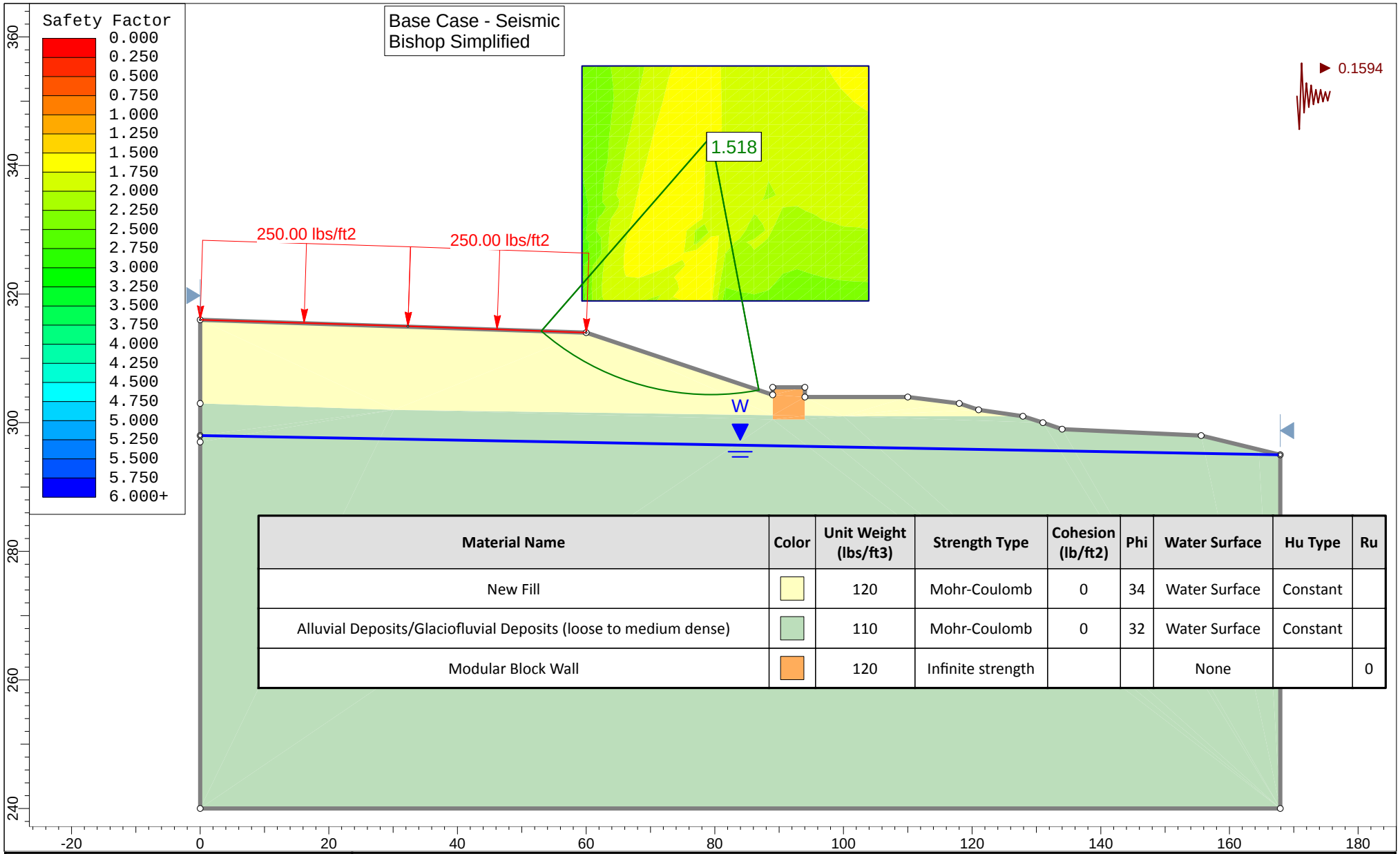
Project	Waterbury Bus Maintenance Facility - Watertown, CT
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:222.6
Company	Haley & Aldrich, Inc.
Date	
File Name	2013-1210-HAI-Waterbury Bus Facility Global Stability-base-static-with bike trail.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type	Ru
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant	
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant	
Modular Block Wall		120	Infinite strength			None		0

SLIDEINTERPRET 6.005

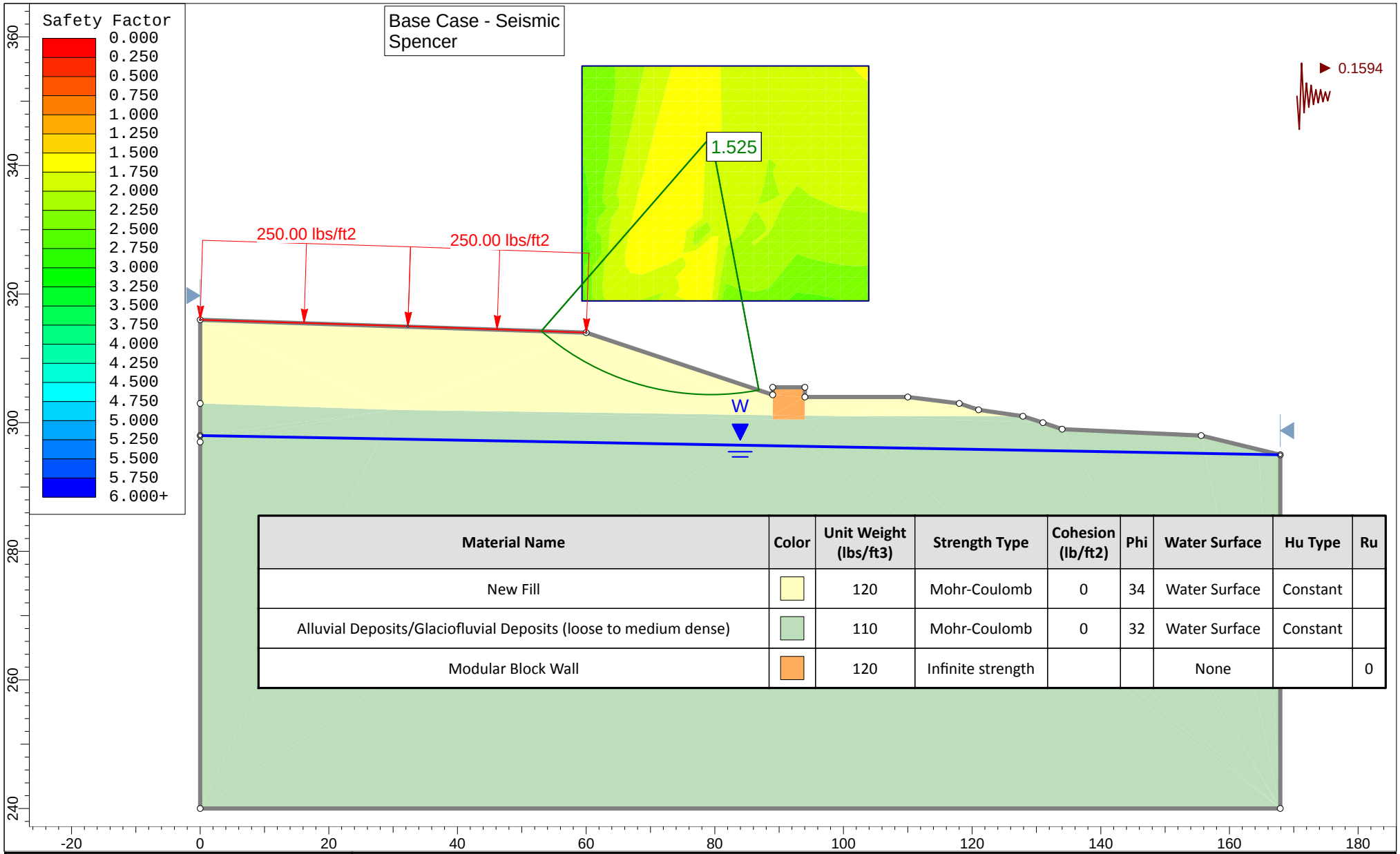
Project	Waterbury Bus Maintenance Facility - Watertown, CT
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:222.6
Company	Haley & Aldrich, Inc.
Date	
File Name	2013-1210-HAI-Waterbury Bus Facility Global Stability-base-static-with bike trail.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type	Ru
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant	
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant	
Modular Block Wall		120	Infinite strength			None		0

SLIDEINTERPRET 6.005

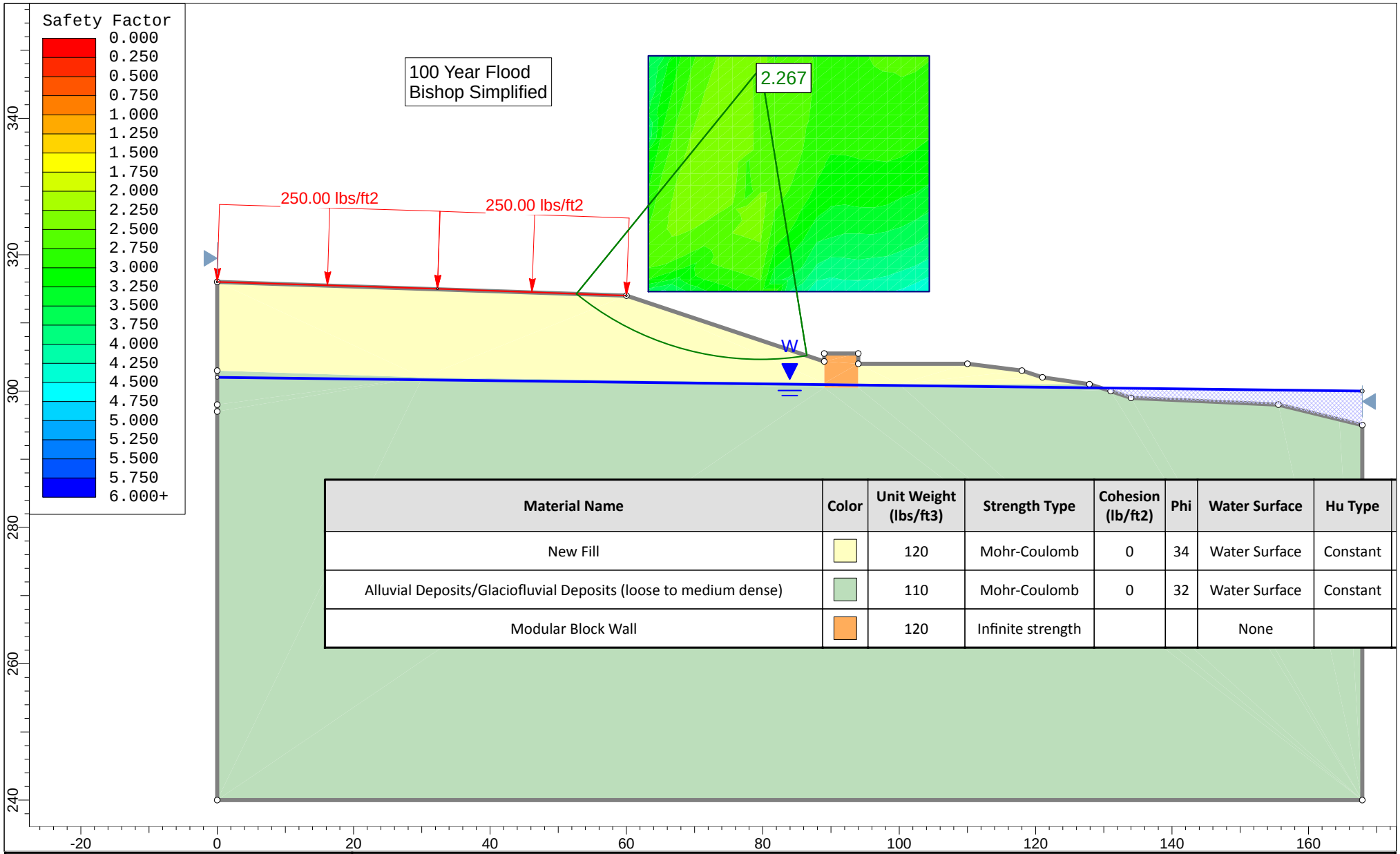
Project	Waterbury Bus Maintenance Facility - Watertown, CT		
Analysis Description	Global Stability		
Drawn By: MMH	Scale: 1:247.4	Company: Haley & Aldrich, Inc.	
Date		File Name: 2013-1210-HAI-Waterbury Bus Facility Global Stability-base-seismic-with bike trail slim	



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type	Ru
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant	
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant	
Modular Block Wall		120	Infinite strength			None		0

SLIDEINTERPRET 6.005

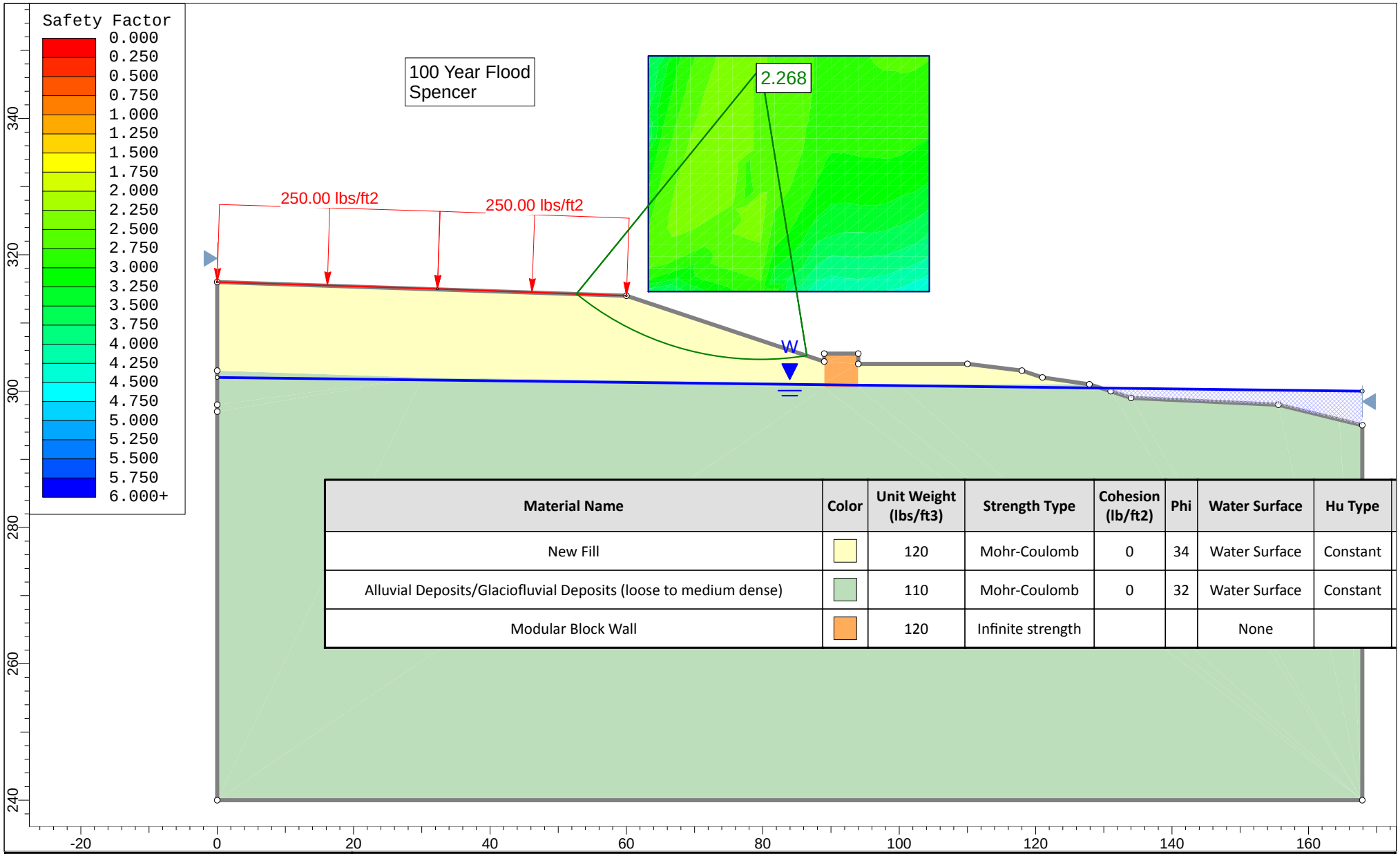
Project	Waterbury Bus Maintenance Facility - Watertown, CT		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:247.4
Company	Haley & Aldrich, Inc.		
Date		File Name	2013-1210-HAI-Waterbury Bus Facility Global Stability-base-seismic-with bike trail slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant
Modular Block Wall		120	Infinite strength			None	

SLIDEINTERPRET 6.005

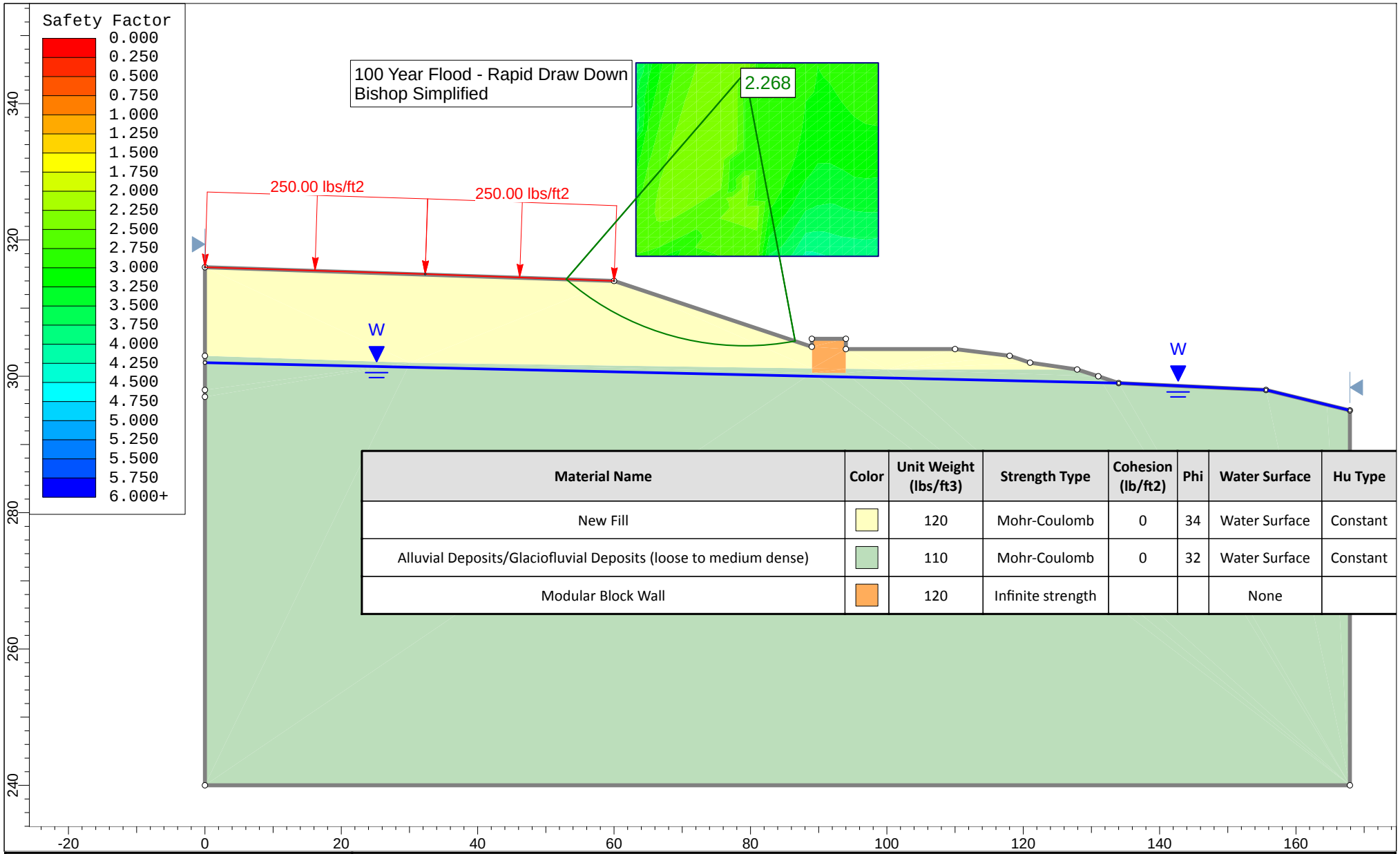
Project	Waterbury Bus Maintenance Facility - Watertown, CT		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:233.3
Company	Haley & Aldrich, Inc.		
Date		File Name	2013-1210-HAI-Waterbury Bus Facility Global Stability-100 yr flood-static-with bike trail.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant
Modular Block Wall		120	Infinite strength			None	

SLIDEINTERPRET 6.005

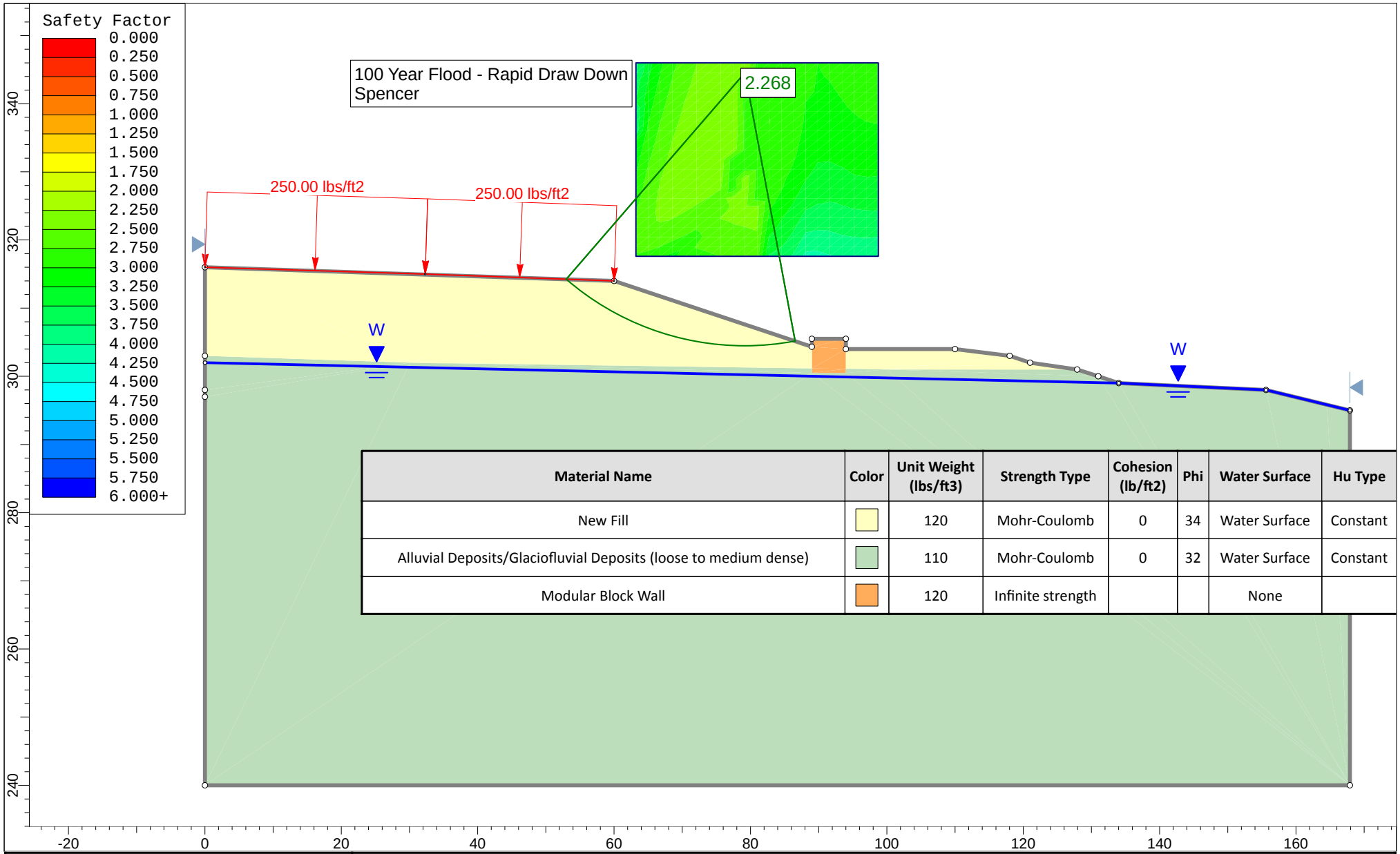
Project	Waterbury Bus Maintenance Facility - Watertown, CT		
Analysis Description	Global Stability		
Drawn By	MMH	Scale 1:233.3	Company Haley & Aldrich, Inc.
Date			File Name 2013-1210-HAI-Waterbury Bus Facility Global Stability-100 yr flood-static-with bike trail slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant
Modular Block Wall		120	Infinite strength			None	

SLIDEINTERPRET 6.005

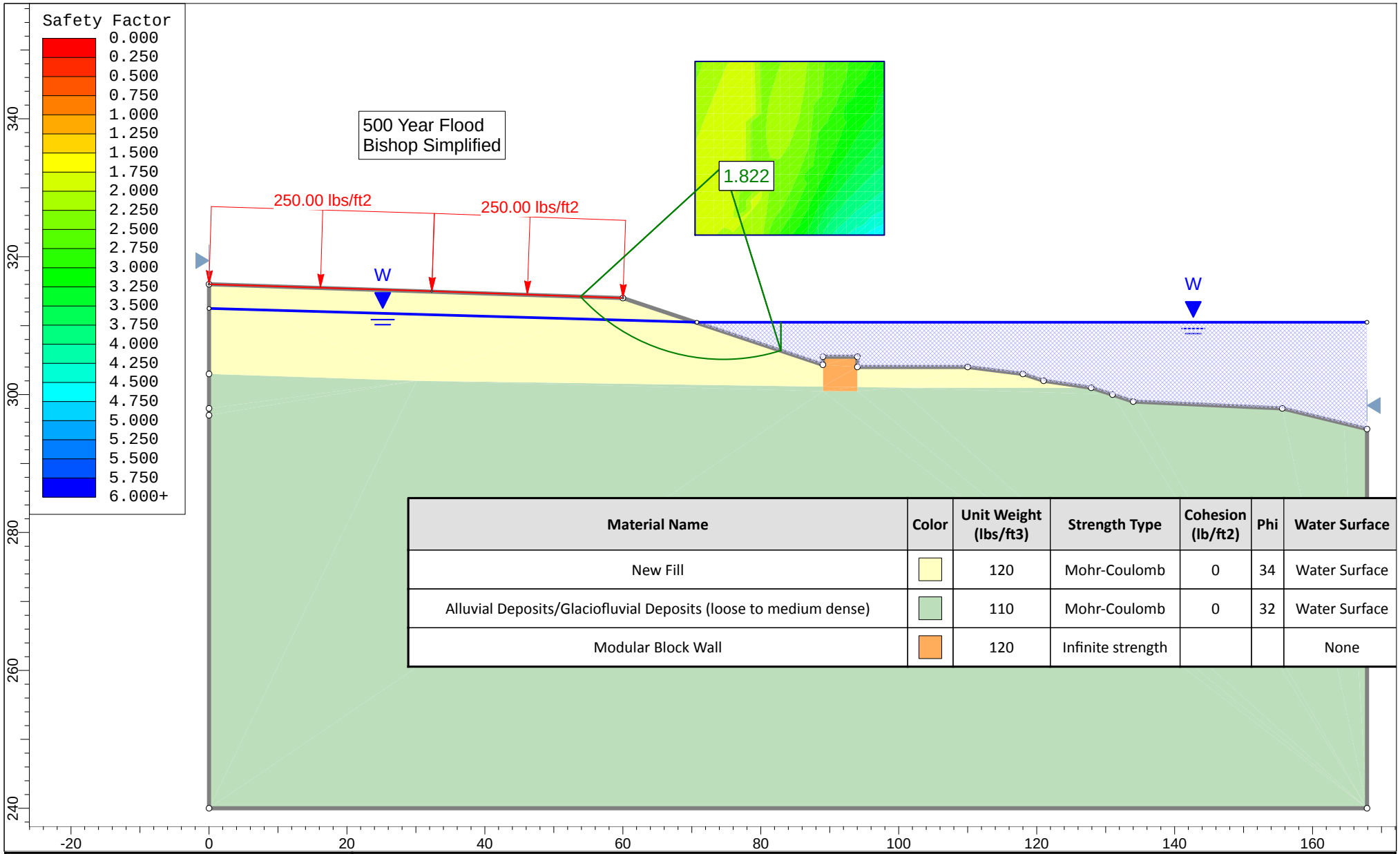
Project	Waterbury Bus Maintenance Facility - Watertown, CT
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:233.3
Company	Haley & Aldrich, Inc.
Date	
File Name	2013-1210-HAI-Waterbury Bus Facility Global Stability-100 yr flood rapid draw down-static-with bike trail.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant
Modular Block Wall		120	Infinite strength			None	

SLIDEINTERPRET 6.005

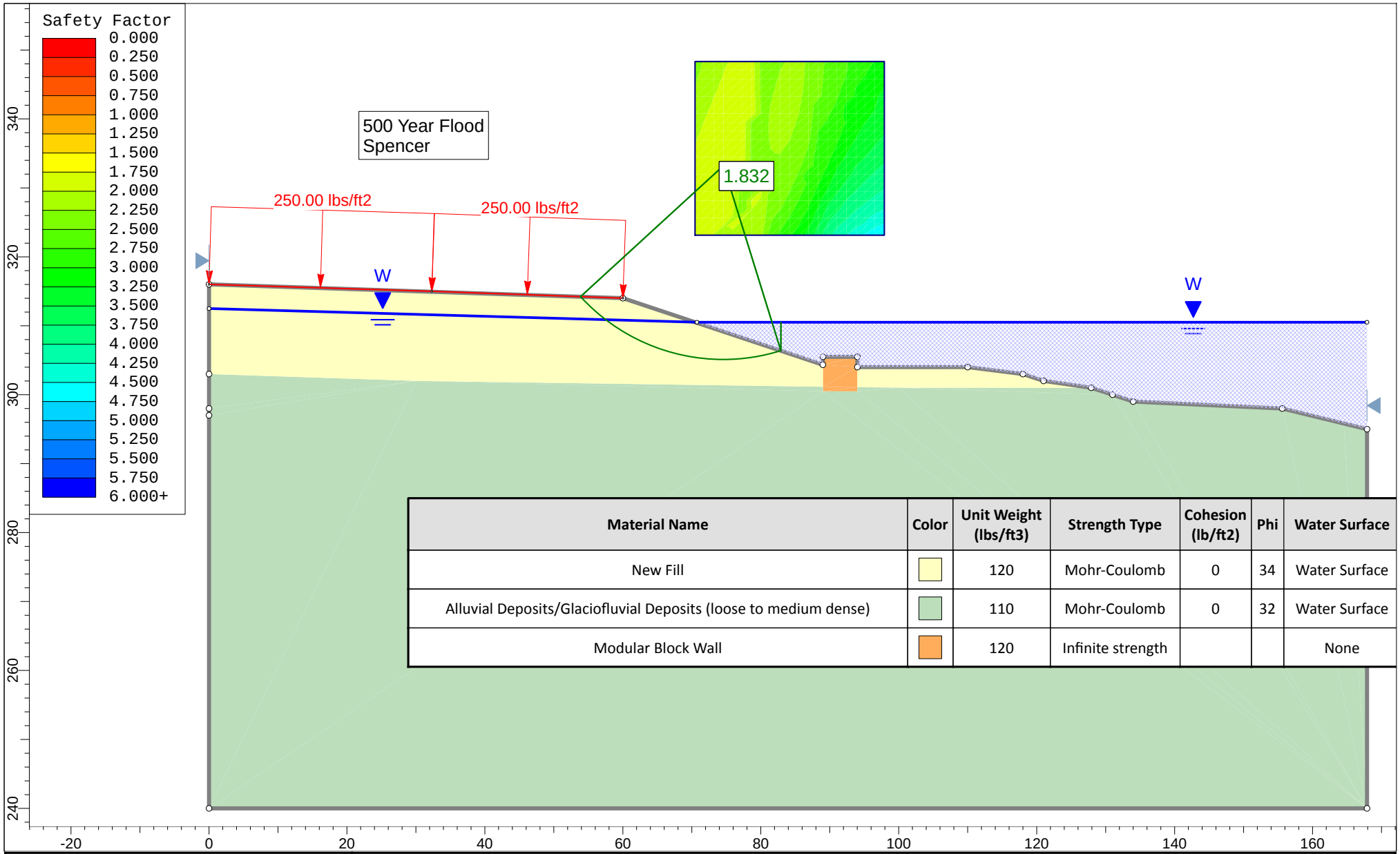
Project	Waterbury Bus Maintenance Facility - Watertown, CT
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:233.3
Company	Haley & Aldrich, Inc.
Date	
File Name	2013-1210-HAI-Waterbury Bus Facility Global Stability-100 yr flood rapid draw down-static-with bike trail.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

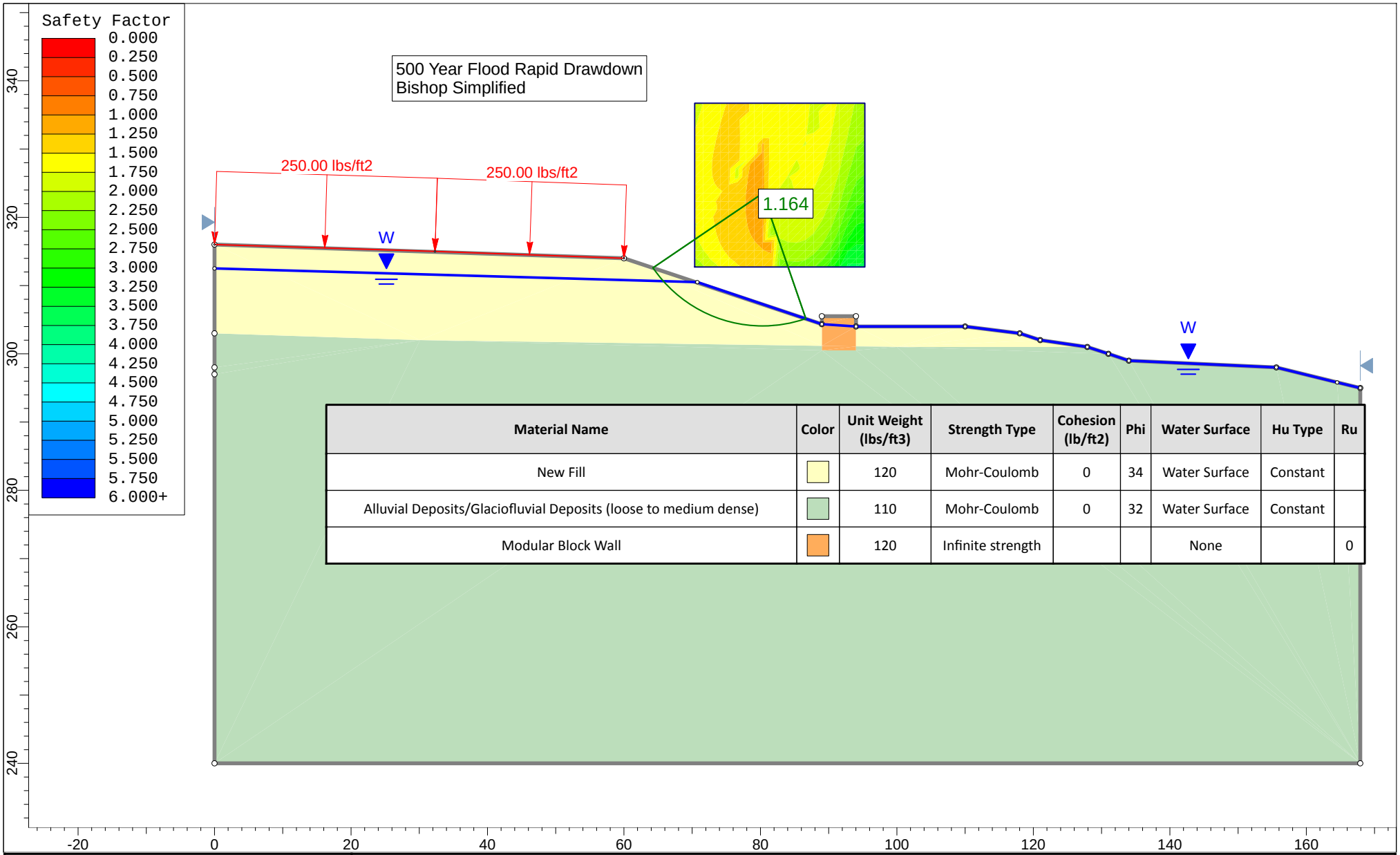
Project	Waterbury Bus Maintenance Facility - Watertown, CT		
Analysis Description	Global Stability		
Drawn By MMH	*Scale* 1:230.7	*Company* Haley & Aldrich, Inc.	
Date		*File Name* 2013-1210-HAI-Waterbury Bus Facility Global Stability-500 yr flood-static-with bike trail slim	



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

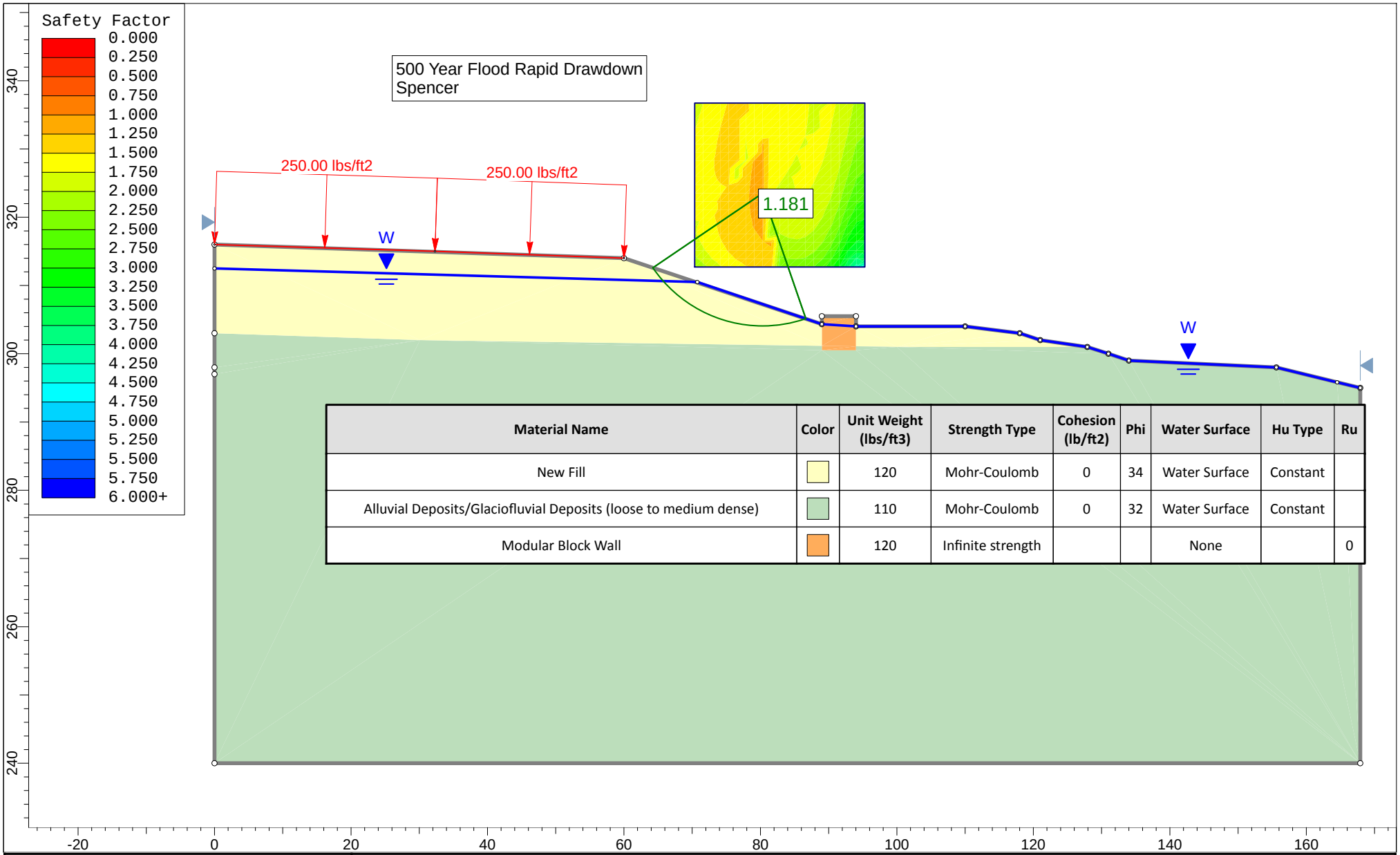
Project	Waterbury Bus Maintenance Facility - Watertown, CT		
Analysis Description	Global Stability		
Drawn By MMH	*Scale* 1:230.7	*Company* Haley & Aldrich, Inc.	
Date		*File Name* 2013-1210-HAI-Waterbury Bus Facility Global Stability-500 yr flood-static-with bike trail slim	



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type	Ru
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant	
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant	
Modular Block Wall		120	Infinite strength			None		0

SLIDEINTERPRET 6.005

Project	Waterbury Bus Maintenance Facility - Watertown, CT
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:233.3
Company	Haley & Aldrich, Inc.
Date	
File Name	2013-1210-HAI-Waterbury Bus Facility Global Stability-500 yr flood rapid draw down-static-with bike trail.slim



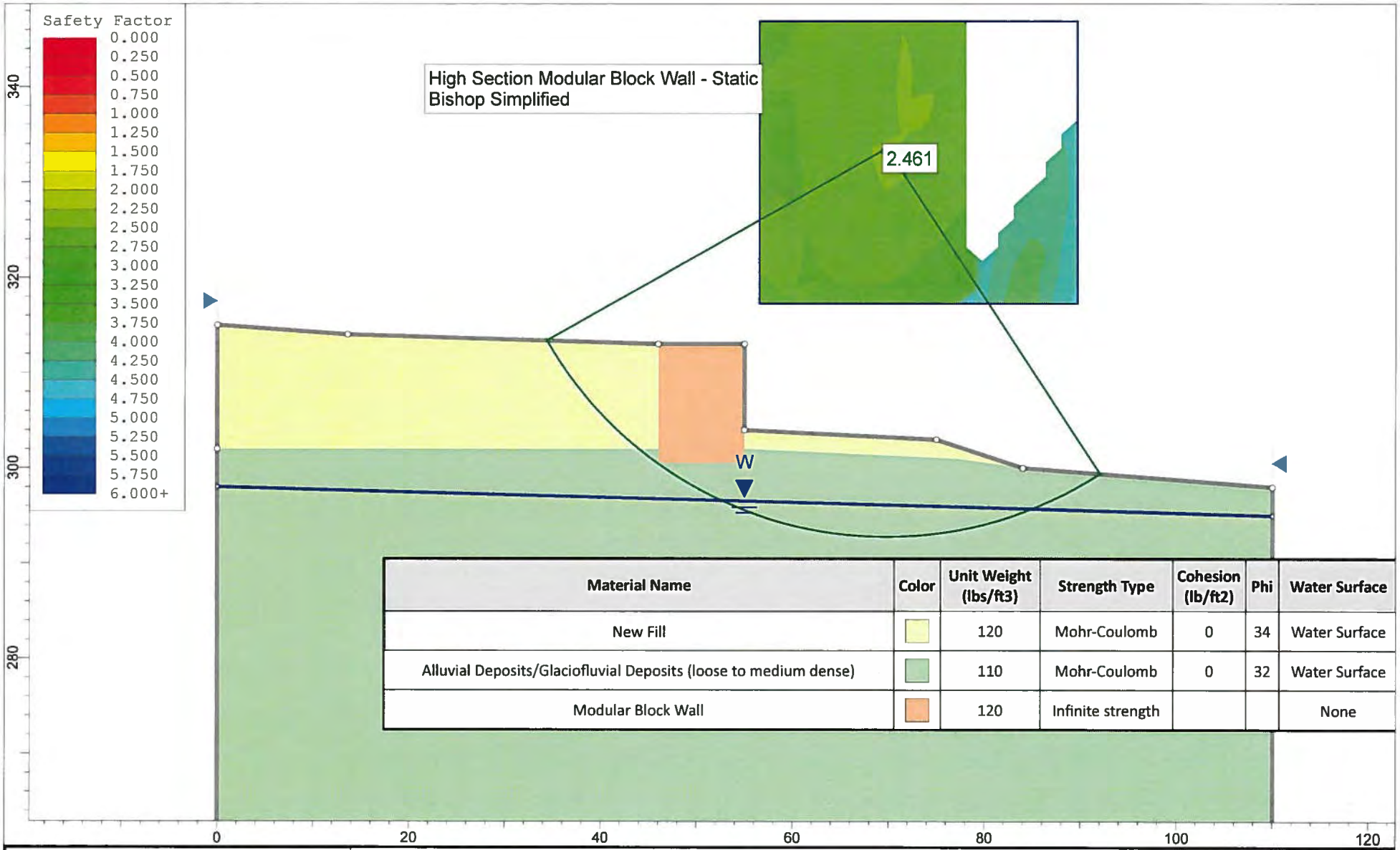
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type	Ru
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant	
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant	
Modular Block Wall		120	Infinite strength			None		0

SLIDEINTERPRET 6.005

Project	Waterbury Bus Maintenance Facility - Watertown, CT
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:233.3
Company	Haley & Aldrich, Inc.
Date	
File Name	2013-1210-HAI-Waterbury Bus Facility Global Stability-500 yr flood rapid draw down-static-with bike trail.slim

APPENDIX G

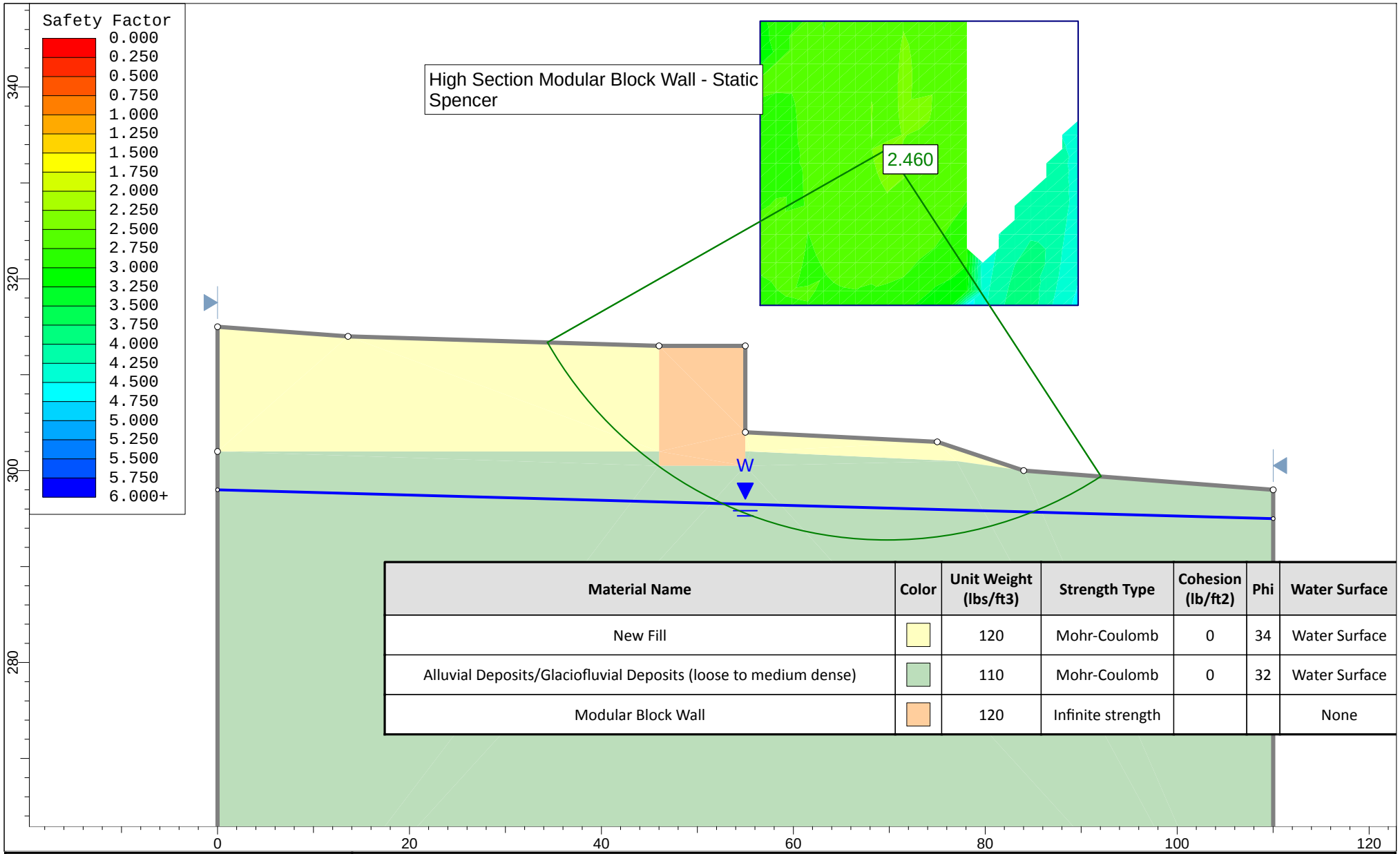
Section 2



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

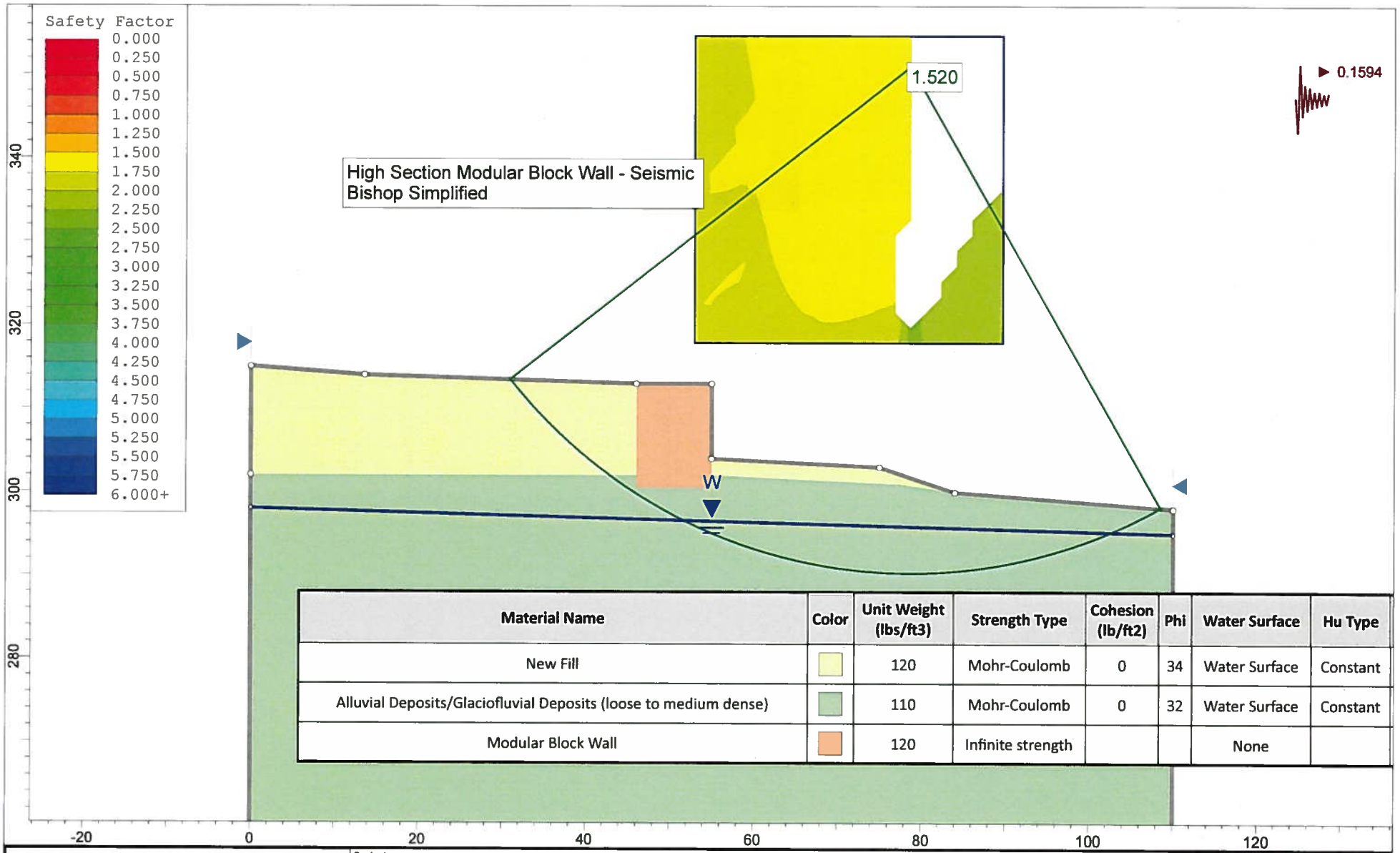
Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:165.8
Company	Haley & Aldrich, Inc.		
Date	8/5/2014, 12:18:50 PM	File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block wall slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

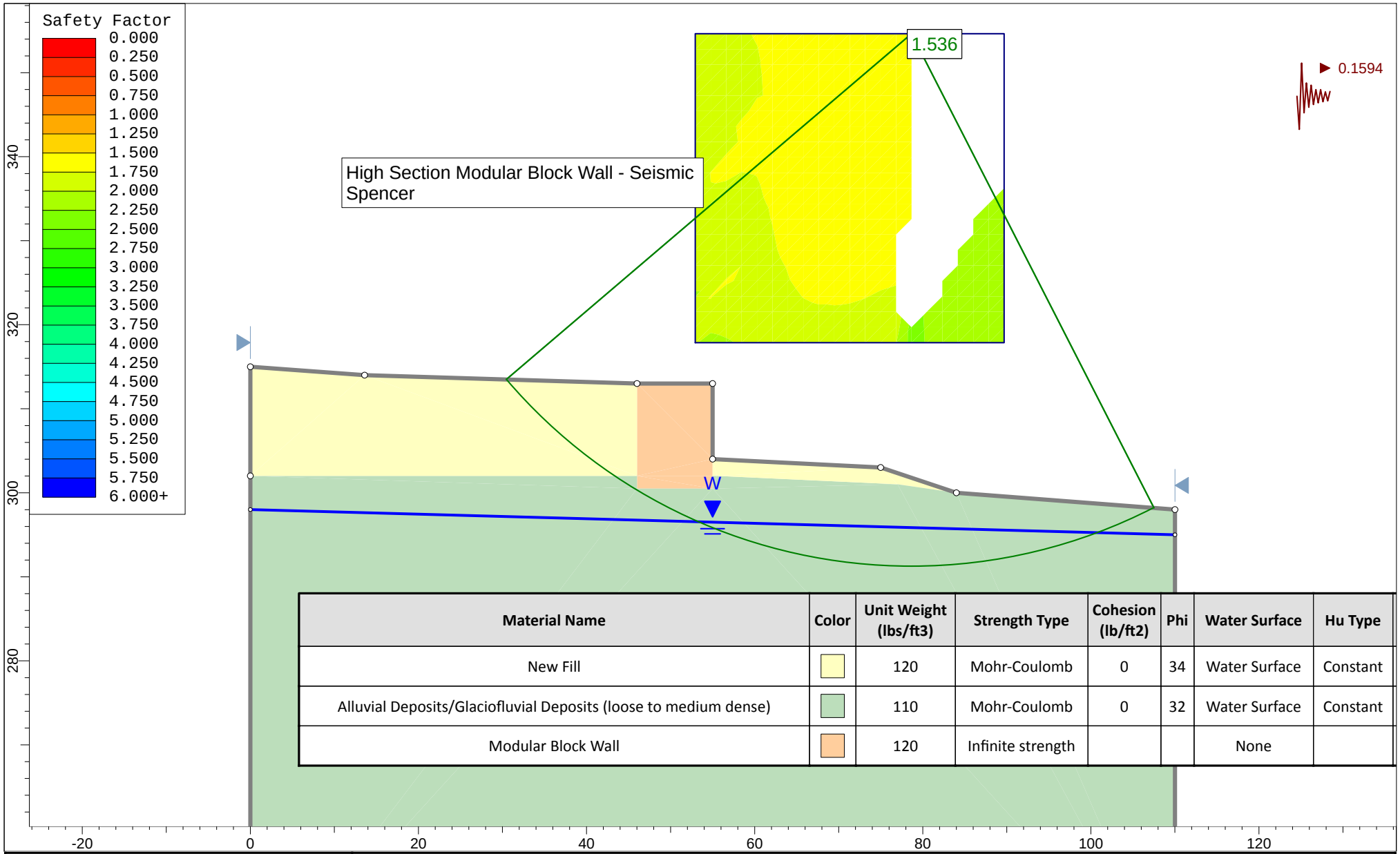
Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:165.8
Company	Haley & Aldrich, Inc.		
Date	8/5/2014, 12:18:50 PM	File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block walll.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant
Modular Block Wall		120	Infinite strength			None	

SLIDEINTERPRET 6.005

Project	High Section of Modular Block Wall
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:189.3
Company	Haley & Aldrich, Inc.
Date	8/5/2014, 12:18:50 PM
File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-seismic-high section of modular block walll.slim

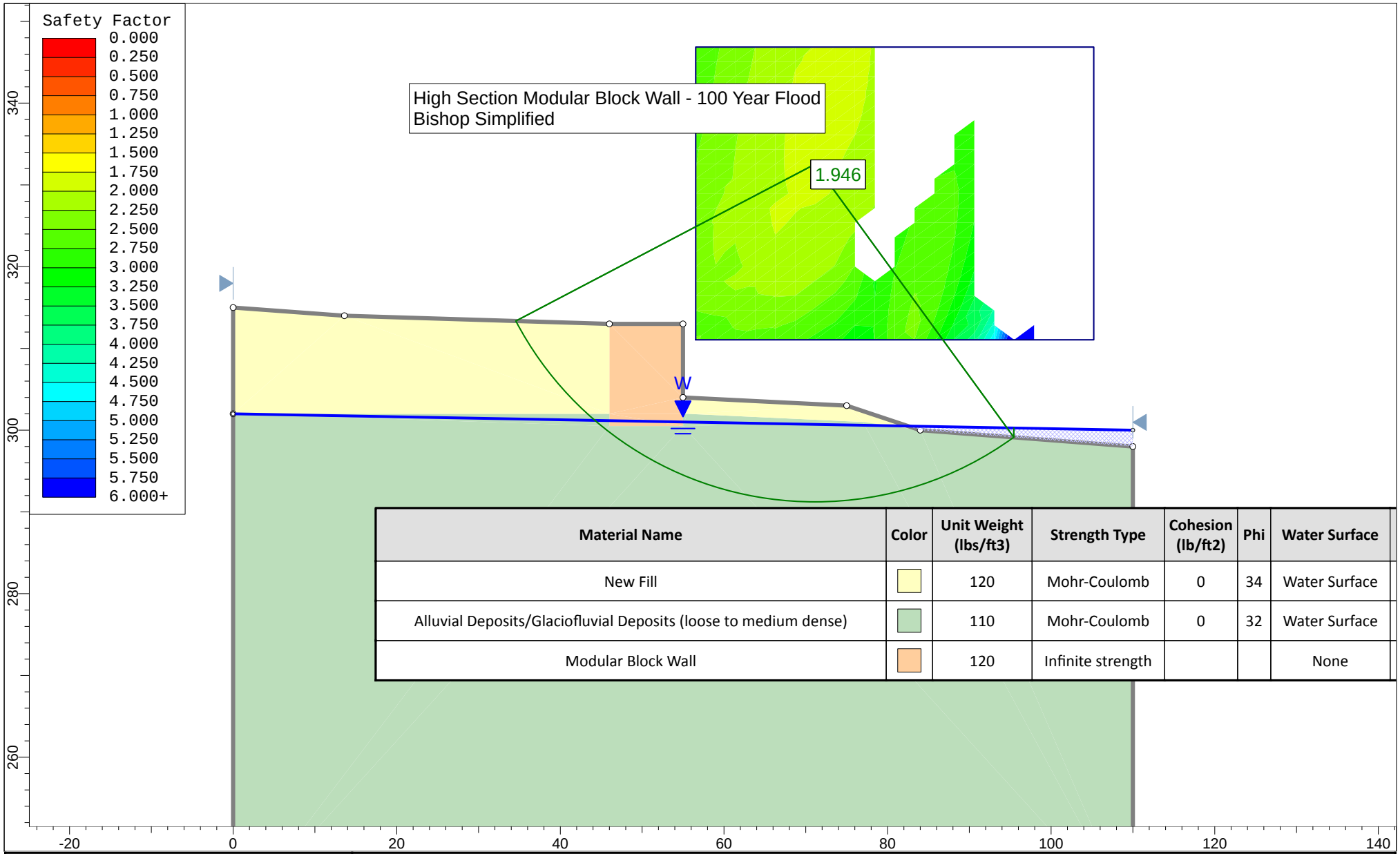


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Constant
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Constant
Modular Block Wall		120	Infinite strength			None	

rocscience

SLIDEINTERPRET 6.005

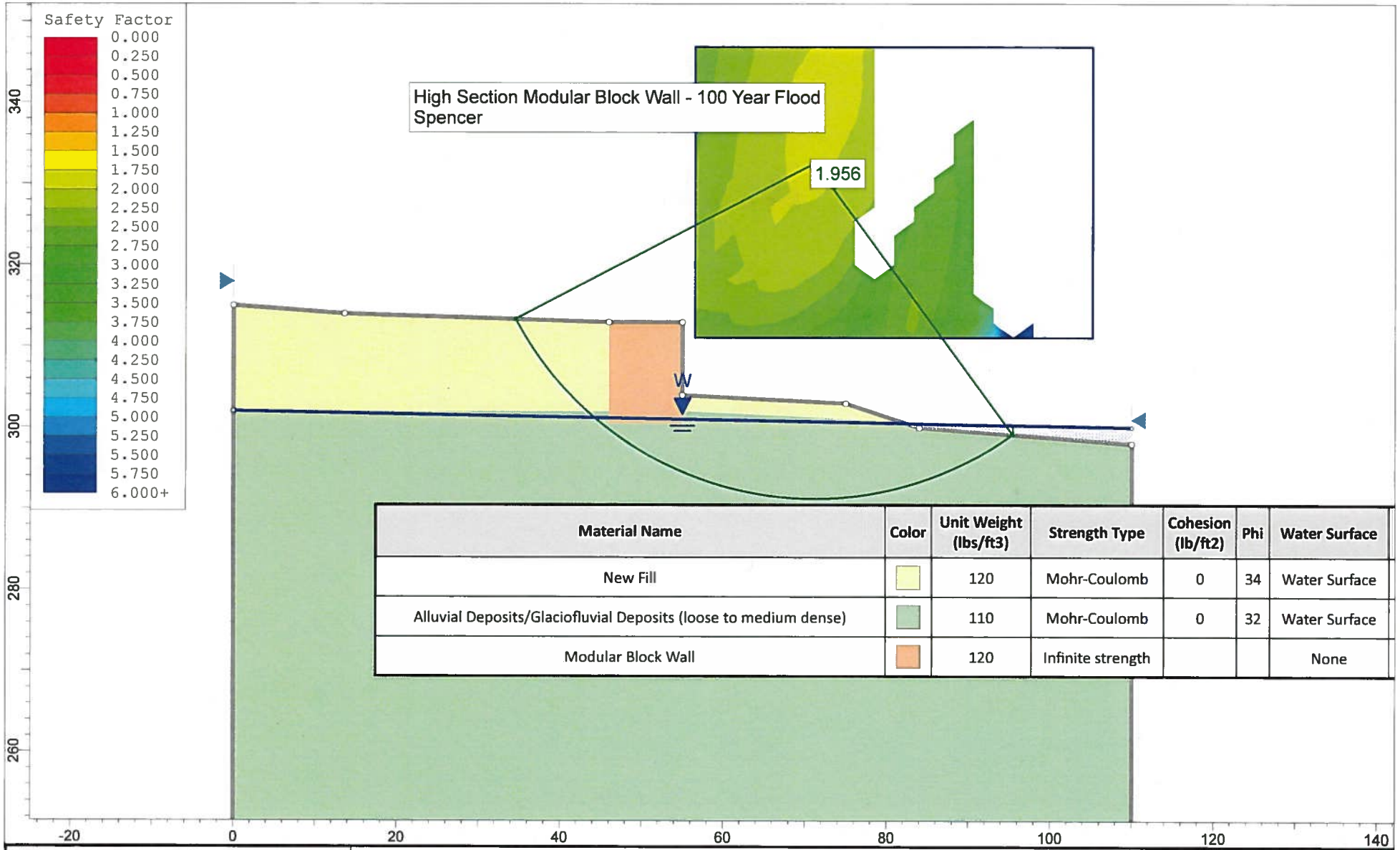
Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By MMH	*Scale* 1:189.3	*Company*	Haley & Aldrich, Inc.
Date 8/5/2014, 12:18:50 PM		*File Name*	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-seismic-high section of modular block walll.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

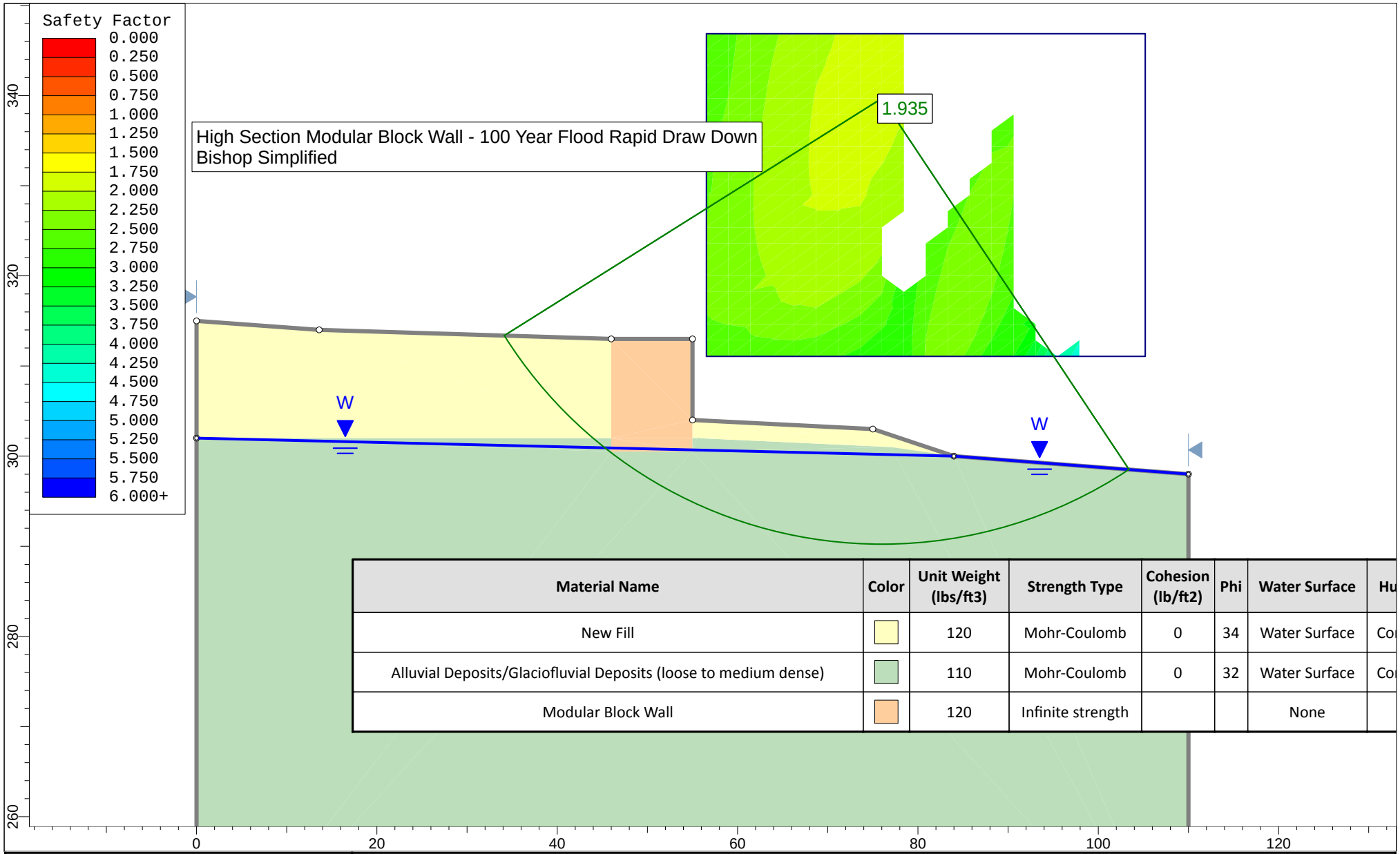
Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:194.5
Company	Haley & Aldrich, Inc.		
Date	8/5/2014, 12:18:50 PM	File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block walll-100 year flood.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

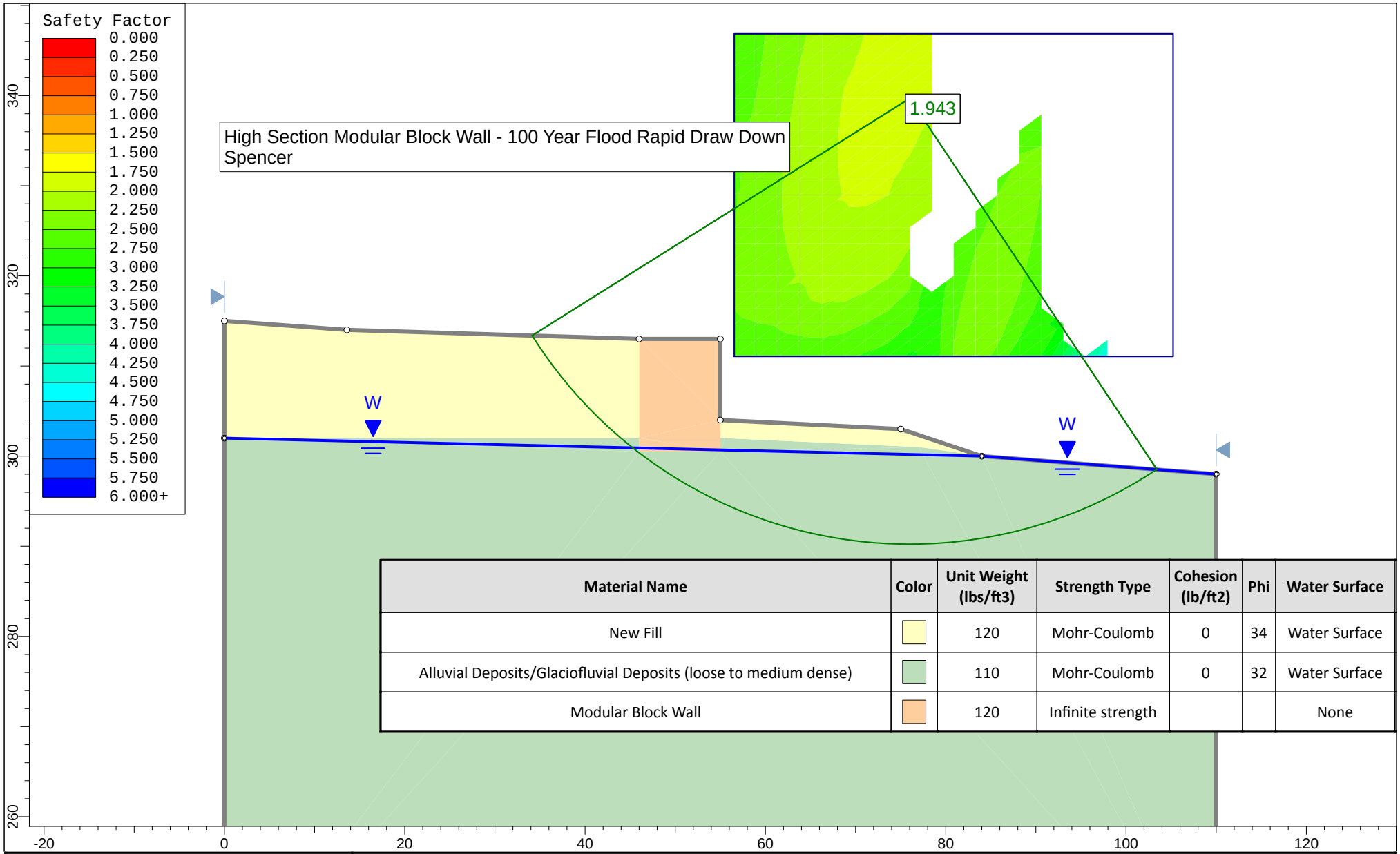
Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:194.5
Company	Haley & Aldrich, Inc.		
Date	8/5/2014, 12:18:50 PM	File Name	4014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block wall-100 year flood.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu
New Fill		120	Mohr-Coulomb	0	34	Water Surface	Co
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface	Co
Modular Block Wall		120	Infinite strength			None	

SLIDEINTERPRET 6.005

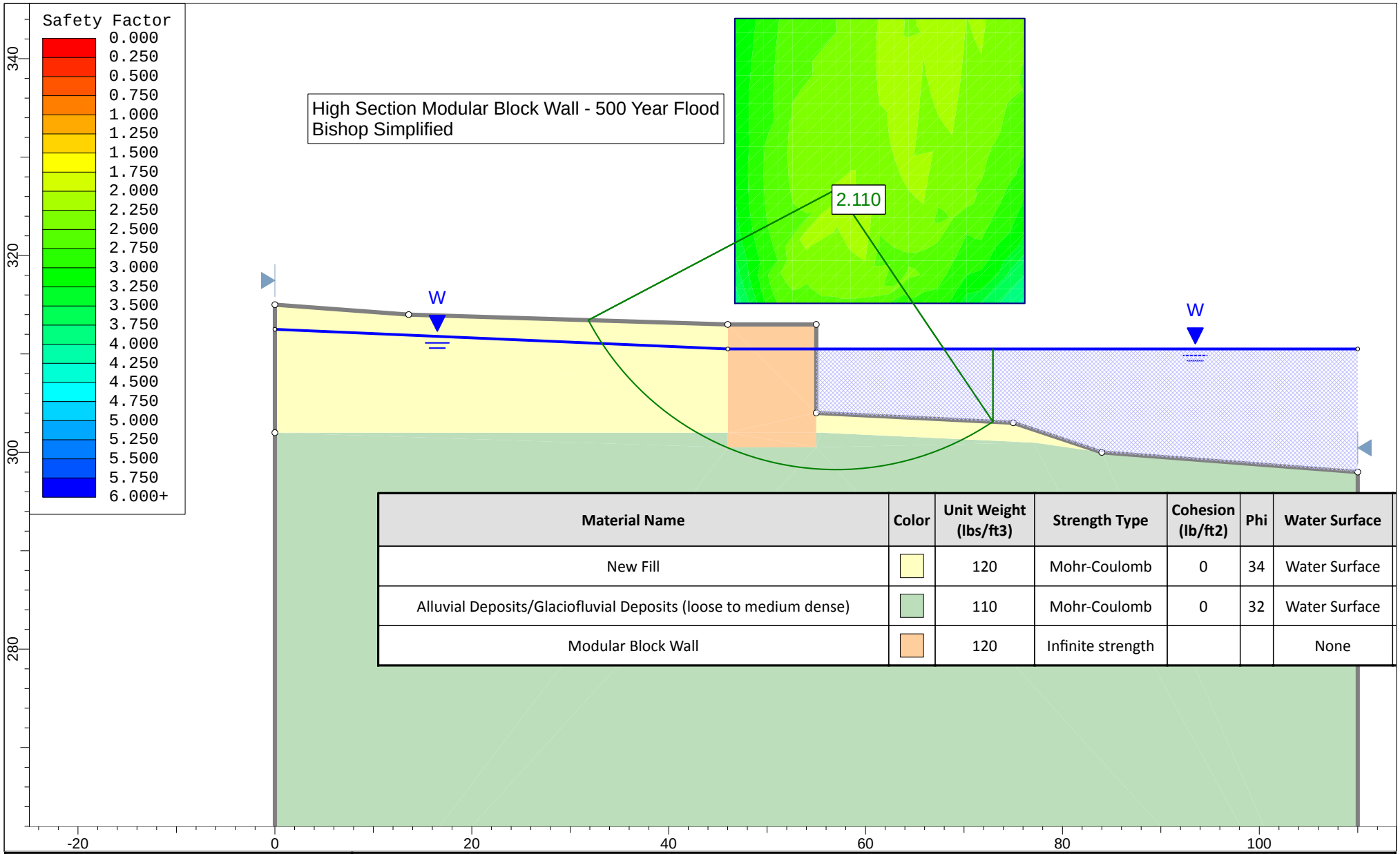
Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:176.5
Company	Haley & Aldrich, Inc.		
Date	8/5/2014, 12:18:50 PM	File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block walll-100 year flood rapid drawdown.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

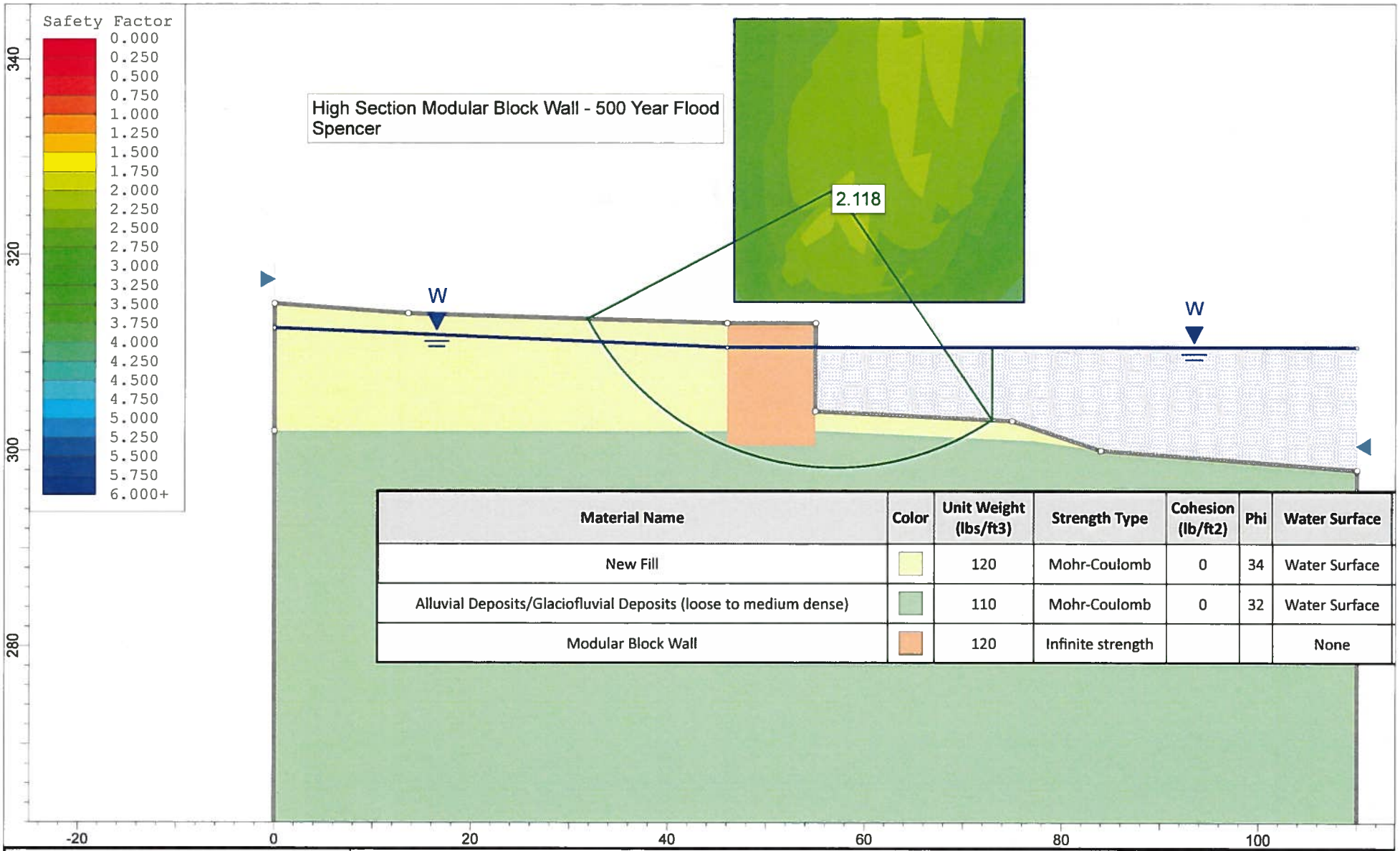
Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:176.5
Company	Haley & Aldrich, Inc.		
Date	8/5/2014, 12:18:50 PM	File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block walll-100 year flood rapid drawdown.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

Project	High Section of Modular Block Wall
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:161.6
Company	Haley & Aldrich, Inc.
Date	8/5/2014, 12:18:50 PM
File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block walll-500 year flood.slim

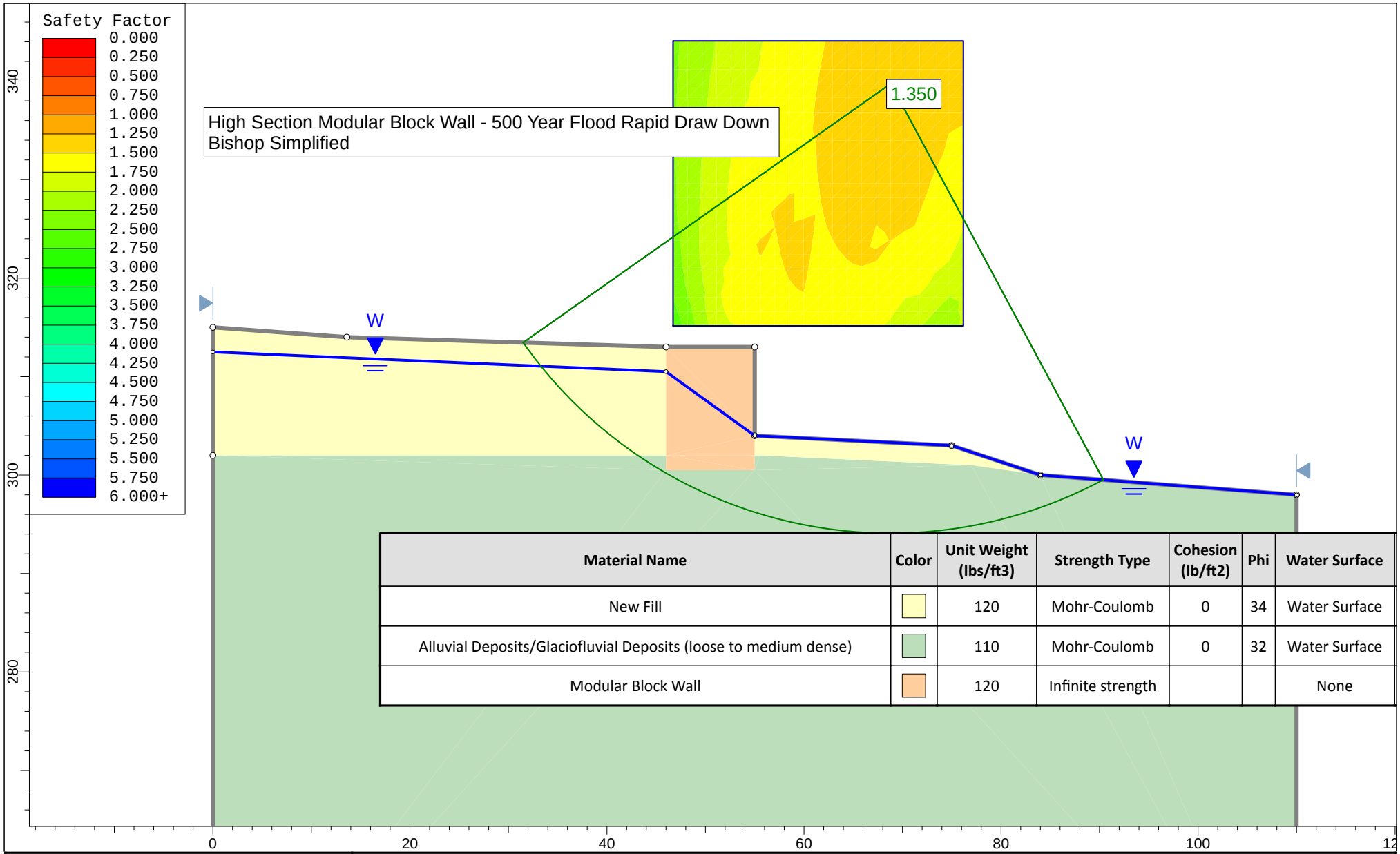


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

rocscience

SLIDEINTERPRET 6.005

Project	High Section of Modular Block Wall
Analysis Description	Global Stability
Drawn By	MMH
Scale	1:161.6
Company	Haley & Aldrich, Inc.
Date	8/5/2014, 12:18:50 PM
File Name	0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block walll-500 year flood.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
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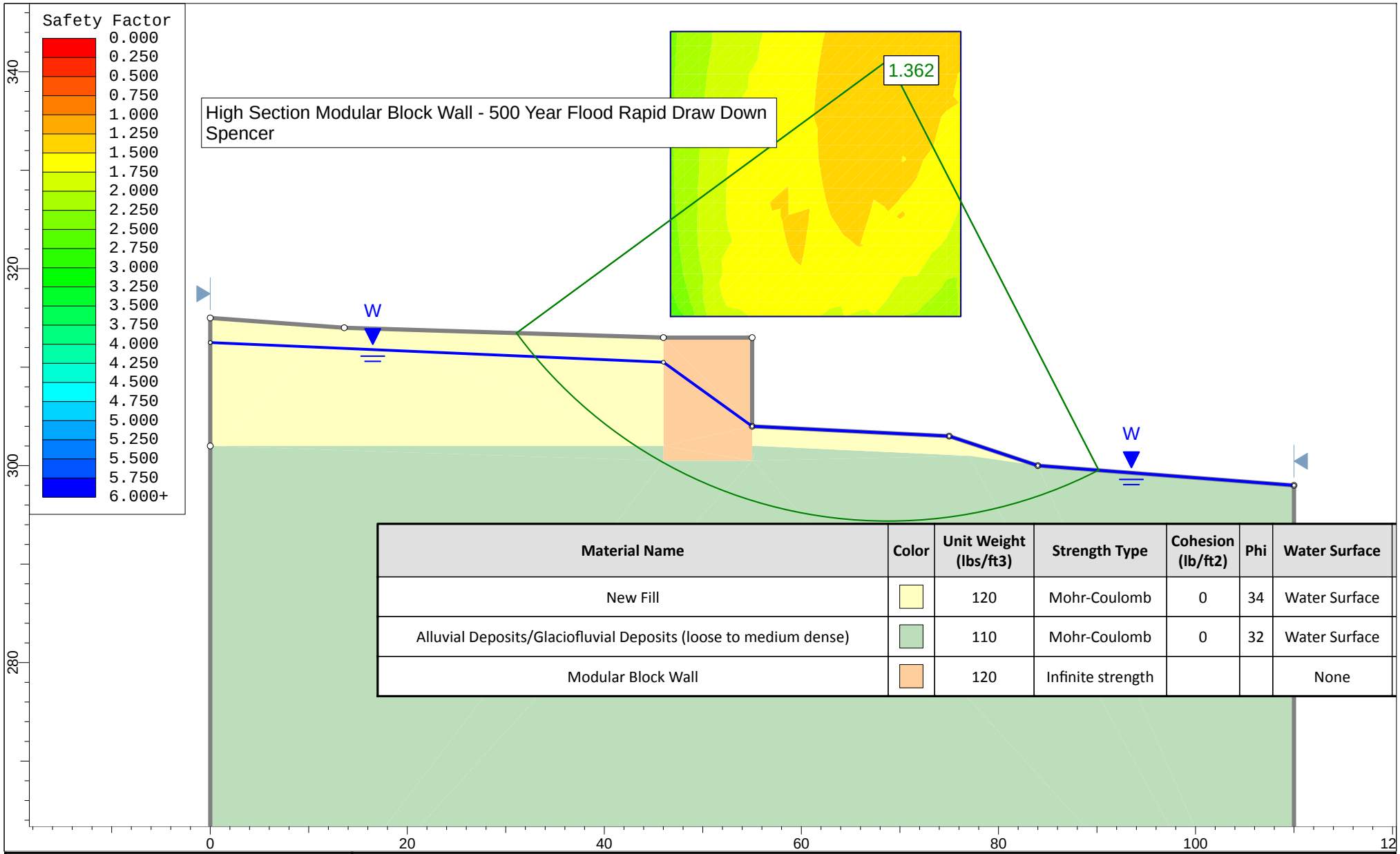
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:161.5
Company	Haley & Aldrich, Inc.		
Date	8/5/2014, 12:18:50 PM	File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block walll-500 year flood rapid draw down slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface
New Fill		120	Mohr-Coulomb	0	34	Water Surface
Alluvial Deposits/Glaciofluvial Deposits (loose to medium dense)		110	Mohr-Coulomb	0	32	Water Surface
Modular Block Wall		120	Infinite strength			None

SLIDEINTERPRET 6.005

Project	High Section of Modular Block Wall		
Analysis Description	Global Stability		
Drawn By	MMH	Scale	1:161.5
Company	Haley & Aldrich, Inc.		
Date	8/5/2014, 12:18:50 PM	File Name	2014-0805-HAI-Waterbury Bus Facility Global Stability-base-static-high section of modular block walll-500 year flood rapid draw down.slim

HALEY & ALDRICH

Calculations

Client	Wendel Duchscherer	File No.	39192-500
Project	Waterbury Bus Maintenance Facility	Sheet	1 of 5
Subject	External Stability Check - Greenway Trail R.W.	Date	08/04/2014
		Computed By	MMH
		Checked By	JGD

Objective: check sliding, overturning, eccentricity, and bearing capacity.

Available Information:

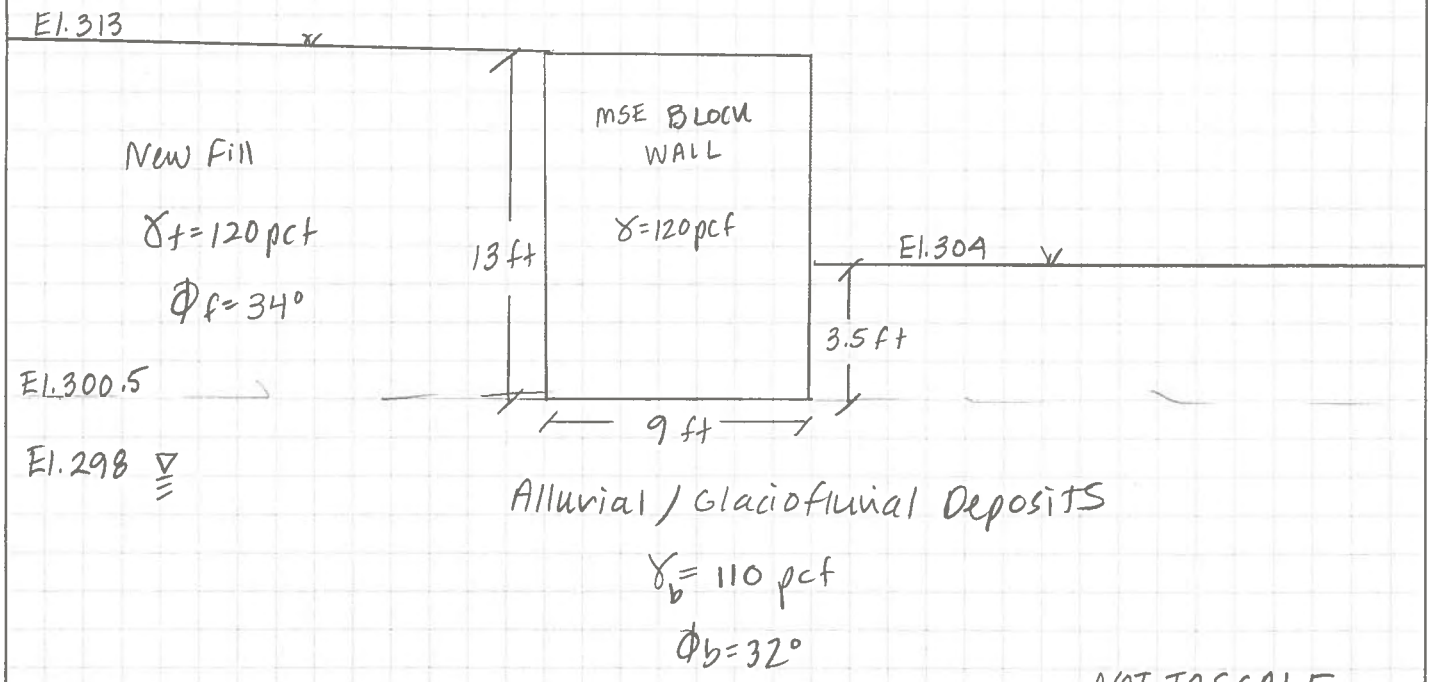
- Cross Section 7 from Wendel Duchscherer Drawing Title "Multi Use Path Profile and Sections" drawing no. C-305-1.

References:

- FHWA "Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines."

Assumptions:

- passive resistance ignored
- wall height with a 3.5 ft buried depth is ~13 ft
- reinforcement length = 0.7H = 9.1 ft, say 9 ft
- bearing soils are Alluvial / Glaciofluvial Deposits
- water table at El. 298
- no surcharge
- backslope angle ~0°, use horizontal procedure. in vicinity of wall

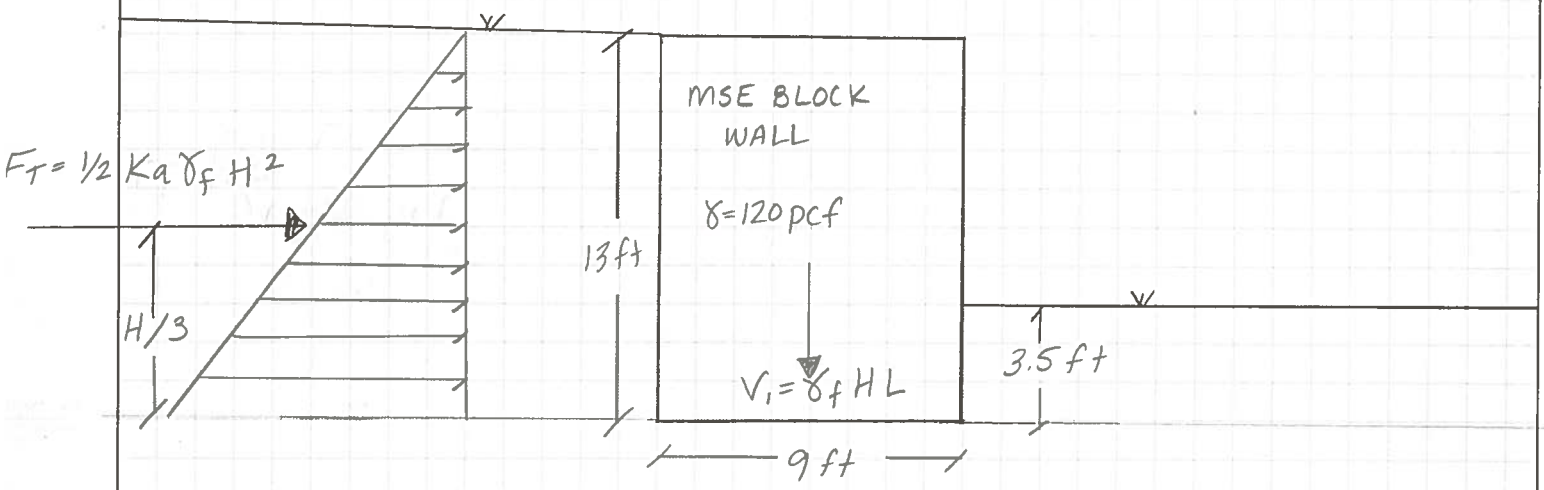


HALEY & ALDRICH

Calculations

Client	Wendel Duchscherer	File No.	39192-500
Project	Waterbury Bus Maintenance Facility	Sheet	2 of 5
Subject	External Stability check – Greenway Trail R.W	Date	08/04/2014
		Computed By	MMH
		Checked By	JGD

Pressure Diagram: NOT TO SCALE



Static active earth pressure coefficient, K_a

$$K_a = \tan^2(45 - \phi_f/2)$$
$$= \tan^2(45 - 34°/2)$$
$$= 0.28$$

Active horizontal force, F_T

$$F_T = 1/2\, K_a \gamma_f H^2$$
$$= 1/2\,(0.28)\left(120 \frac{lb}{ft^3}\right)(13\,ft)^2$$
$$= 2{,}839\ lb/ft$$

Reinforced Block Wall Weight, V_1

$$V_1 = \gamma_f H L$$
$$= 120 \frac{lb}{ft^3}(13\,ft)(9\,ft)$$
$$= 14{,}040\ lb/ft$$

HALEY & ALDRICH

Calculations

File No.	39192-500		
Sheet	3 of 5		
Client	Wendel Duchscherer	Date	08/04/2014
Project	Waterbury Bus Maintenance Facility	Computed By	MMH
Subject	External Stability Check – Greenway Trail RW	Checked By	JGD

Check eccentricity, e, of resulting force on base

$$e = \frac{L}{2} - \left[\frac{\Sigma M_R - \Sigma M_O}{\Sigma V} \right]$$

$M_R = V_i (L/2)$

$= (14{,}040 \text{ lb/ft})(9 \text{ ft}/2)$

$= 63{,}180 \dfrac{\text{lb-ft}}{\text{ft}}$

$M_O = F_T (H/3)$

$= (2{,}839 \text{ lb/ft})(13 \text{ ft}/3)$

$= 12{,}302 \dfrac{\text{lb-ft}}{\text{ft}}$

$$e = \left(\frac{9 \text{ ft}}{2}\right) - \left[\frac{63{,}180 \frac{\text{lb-ft}}{\text{ft}} - 12{,}302 \frac{\text{lb-ft}}{\text{ft}}}{14{,}040 \text{ lb/ft}} \right]$$

$= 4.5 \text{ ft} - 3.6 \text{ ft}$

$= 0.9 \text{ ft}$

e must be $\leq L/6$

$0.9 \text{ ft} \leq 9 \text{ ft}/6 = 1.5 \text{ ft}$ ✓ O.K.

HALEY & ALDRICH

Calculations

Client	Wendel Duchscherer	File No.	39192-500
Project	Waterbury Bus Maintenance Facility	Sheet	4 of 5
Subject	External Stability Check – Greenway Trail R.W.	Date	08/04/2014
		Computed By	MMH
		Checked By	JGD

Check F.S. for overturning moment

$$F.S. = \frac{\Sigma M_R}{\Sigma M_O}$$

$$= \frac{63{,}180 \ \frac{lb\text{-}ft}{ft}}{12{,}302 \ \frac{lb\text{-}ft}{ft}}$$

$$= 5.1$$

F.S. overturning must be ≥ 2.0

$5.1 > 2.0$ ✓ O.K.

Check F.S. for sliding

$$F.S. = \frac{\Sigma \text{ Forces resisting}}{\Sigma \text{ Forces driving}}$$

Σ forces resisting = friction force at base of wall

use minimum friction coefficient $\tan \delta = 2/3 \tan \phi_b$

$= 2/3 \tan(32°)$

$= 0.417$

resisting force = friction force = $\tan \delta (V_1)$

$= (0.417)(14{,}040 \ lb/ft)$

$= 5{,}854 \ lb/ft$

Σ forces driving = active lateral earth force F_T

$= 2{,}839 \ lb/ft$

F.S. sliding must be ≥ 1.5

$F.S. = 5854 \ lb/ft / 2839 \ lb/ft = 2.1 > 1.5$ ✓ O.K.

HALEY & ALDRICH

Calculations

Client	Wendel Duchscherer	File No.	39192-500
Project	Waterbury Bus Maintenance Facility	Sheet	5 of 5
Subject	External Stability Check - Greenway Trail R.W.	Date	08/04/2014
		Computed By	MMH
		Checked By	JGD

Check F.S. bearing capacity

$$\sigma_v \leq q_{all} = \frac{q_{ult}}{2.5}$$

where σ_v = equivalent uniform vertical stress at base

$$= \frac{\Sigma V}{L-2e}$$

$$= \frac{14{,}040 \text{ lb/ft}}{9\text{ft} - 2(0.9\text{ft})}$$

$$= 1{,}950 \text{ lb/ft}^2$$

$q_{ult} = cN_c + 0.5(L-2e)\gamma_b N_\gamma$ wall embedment ignored

for $\phi = 32°$

$N_\gamma = 30.22$ Table 10

assume saturated to be conservative

$$q_{ult} = \emptyset + 0.5(9\text{ft} - 2(0.9\text{ft}))(120 - 62.4 \tfrac{\text{lb}}{\text{ft}^3})(30.22)$$

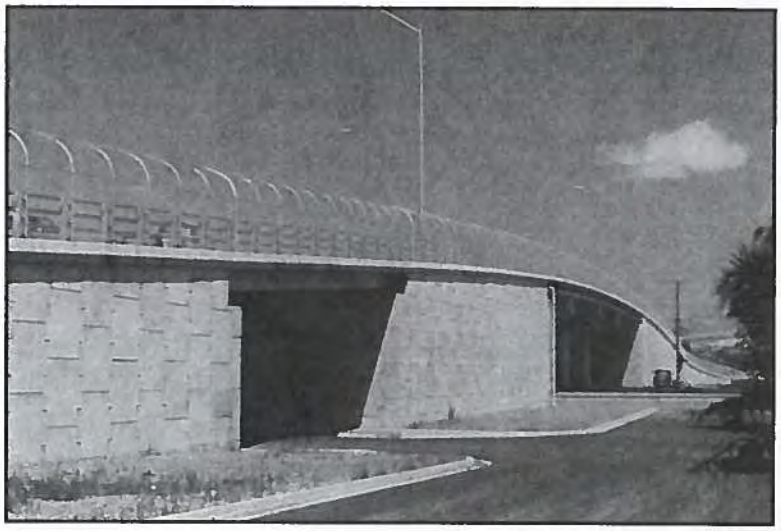
$$= 6{,}266 \text{ lb/ft}^2$$

$$q_{all} = \frac{6{,}266 \text{ lb/ft}^2}{2.5}$$

$$= 2{,}506 \text{ lb/ft}^2$$

$\sigma_v = 1{,}950 \text{ lb/ft}^2 < 2{,}506 \text{ lb/ft}^2$ ✓ O.K.

Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines



FHWA
DEMONSTRATION
PROJECT 82
REINFORCED SOIL
STRUCTURES
MSEW AND RSS

U.S. Department
of Transportation
**Federal Highway
Administration**

Publication No. FHWA-SA-96-071

d. Earth Pressures for External Stability

Stability computations for walls with a vertical face are made by assuming that the MSE wall mass acts as a rigid body with earth pressures developed on a vertical pressure plane arising from the back end of the reinforcements, as shown in figures 23 to 25.

The active coefficient of earth pressure is calculated for vertical walls (defined as walls with a face batter of less than 10 degrees) and a horizontal backslope from:

$$K_a = \tan^2 (45 - \frac{\phi}{2}) \tag{15}$$

for vertical wall with a surcharge slope from:

$$K_a = \cos \beta \left[\frac{\cos \beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos \beta + \sqrt{\cos^2\beta - \cos^2\phi}} \right] \tag{16}$$

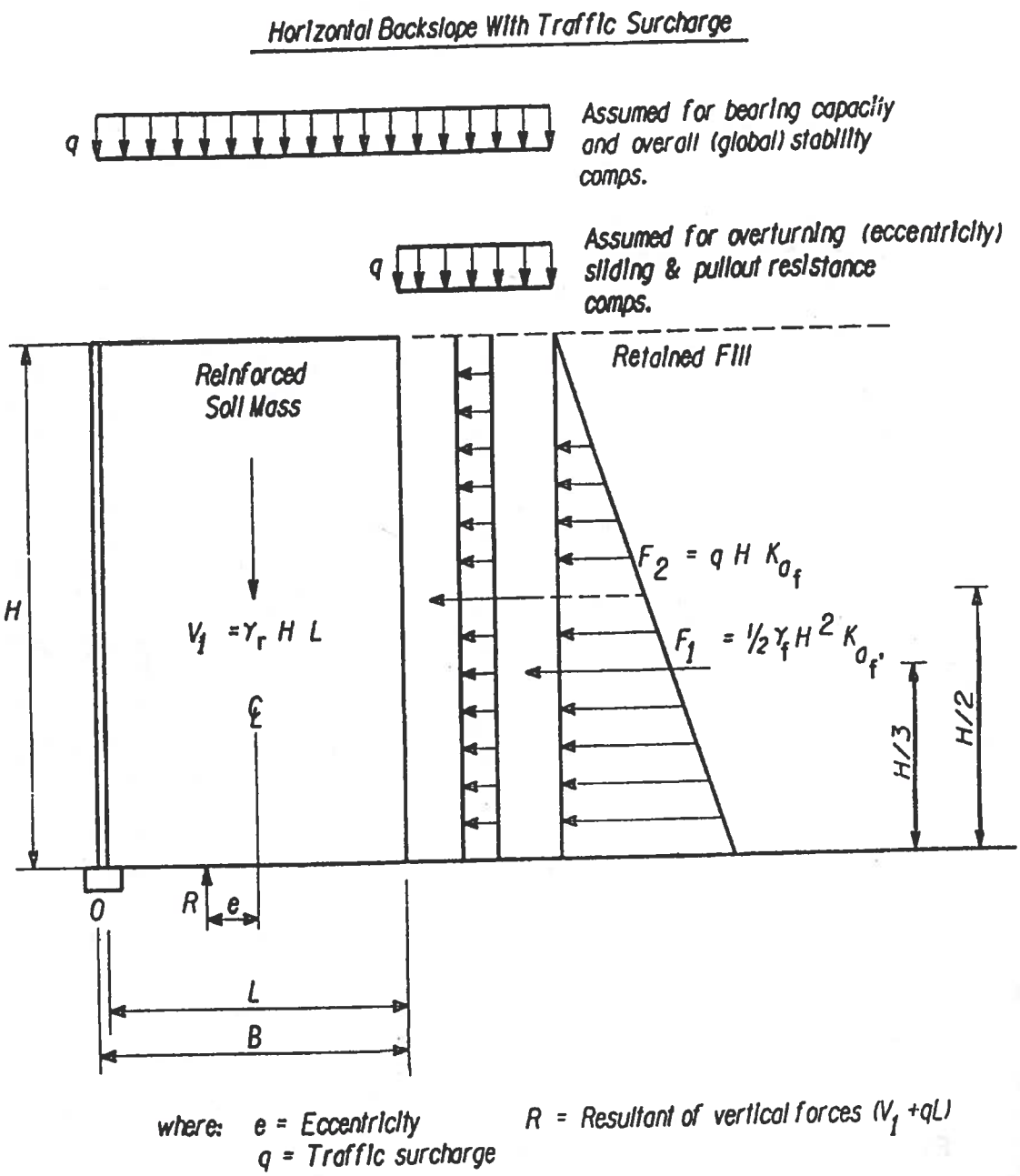
where β = surcharge slope angle.

For broken back surcharge conditions, the angle I (see figure 25) is substituted for the infinite surcharge slope angle β.

For an inclined front face greater than 10 degrees, the coefficient of earth pressure can be calculated from the general Coulomb case as:

$$K_a = \frac{\sin^2 (\theta+\phi)}{\sin^2\theta \sin(\theta-\delta) \left[1 + \sqrt{\frac{\sin(\phi+\delta) \sin(\phi-\beta)}{\sin(\theta-\delta) \sin(\theta+\beta)}} \right]^2} \tag{17}$$

where θ is the face inclination from a horizontal, and β the surcharge slope angle as shown in figure 22. The wall friction angle δ is assumed to be equal to β.



where: e = Eccentricity
q = Traffic surcharge
R = Resultant of vertical forces (V_1 +qL)

Figure 23. External analysis: earth pressures/eccentricity. Horizontal backslope with traffic surcharge.

Vertical Pressure Computations

Computations for vertical stresses at the base of the wall defined by the height h are shown on figure 26. It should be noted that the weight of any wall facing is typically neglected in the calculations. Calculation steps for the determination of a vertical bearing stress are:

(1) Calculate $F_T = \frac{1}{2} K_{af\,(\phi,\beta)} \gamma_f h^2$ (18)

(2) Calculate eccentricity, e, of the resulting force on the base by summing the moments of the mass of the reinforced soil section about the center line of mass. Noting that R in figure 26 must equal the sum of the vertical forces on the reinforced fill, this condition yields:

$$e = \frac{F_T (\cos\beta)\ h/3 - F_T (\sin\beta)\ L/2 - V_2\ (L/6)}{V_1 + V_2 + F_T \sin\beta} \qquad (19)$$

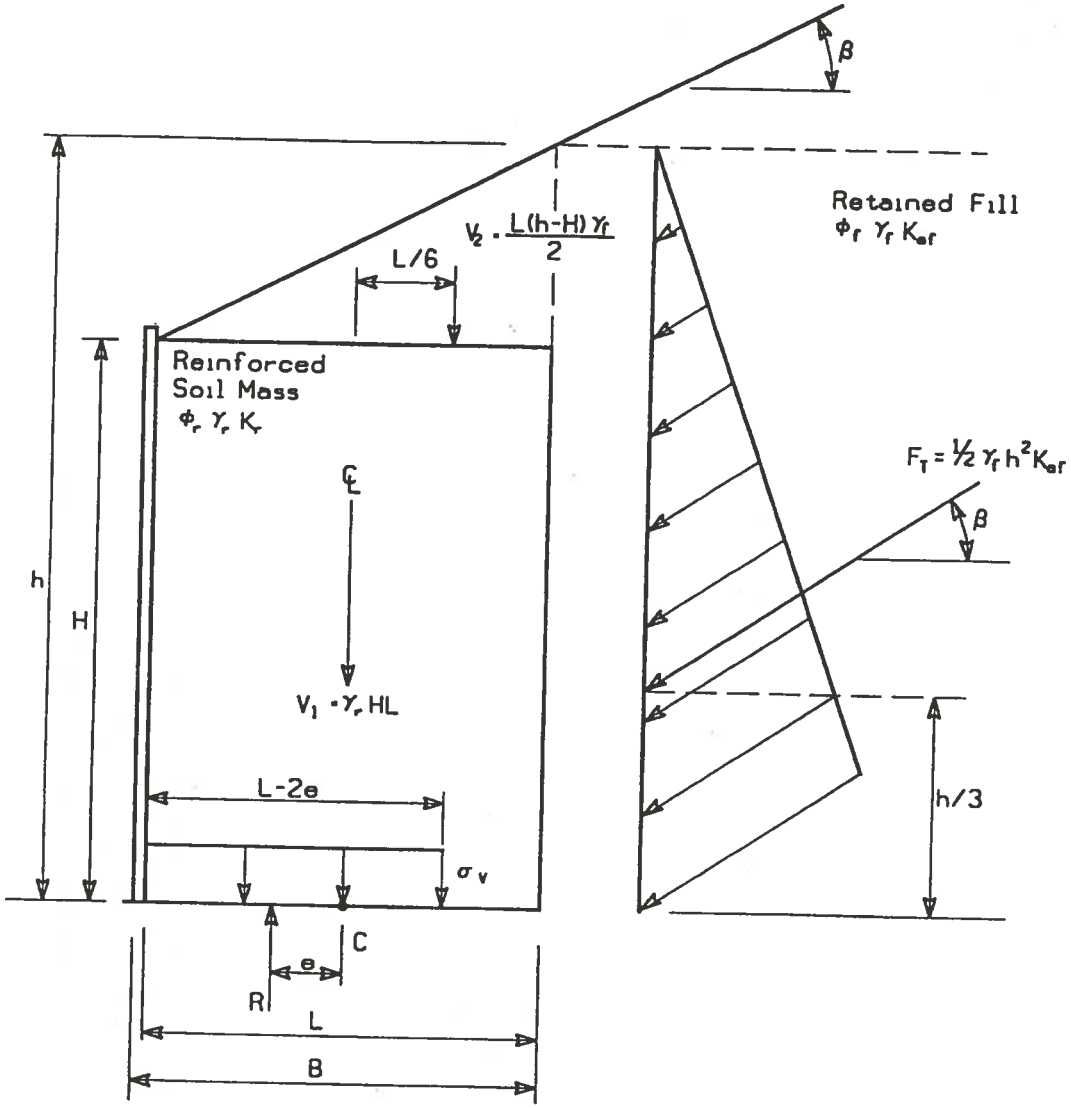
(3) e must be less than L/6 in soil or L/4 in rock. If e is greater, than a longer length of reinforcement is required.

(4) Calculate the equivalent uniform vertical stress on the base, σ_v:

$$\sigma_v = \frac{V_1 + V_2 + F_T \sin\beta}{L - 2e} \qquad (20)$$

This approach, proposed originally by Meyerhof, assumes that eccentric loading results in a uniform redistribution of pressure over a reduced area at the base of the wall. This area is defined by a width equal to the wall width less twice the eccentricity as shown in figure 26.

(5) Add the influence of surcharge and concentrated loads to σ_v, where applicable.



R = Resultant of vertical forces

<u>Note:</u> For relatively thick facing elements (e.g., segmental concrete facing blocks) it may be desirable to include the facing dimensions and weight in bearing capacity calculations (i.e., use "B" in lieu of "L").

Figure 26. Calculation of vertical stress σ_v at the foundation level.

e. **Sliding Stability** (FS = 1.5)

Check the preliminary sizing with respect to sliding at the base layer, which is the most critical depth as follows:

$$FS_{sliding} = \frac{\sum \text{ horizontal resisting forces}}{\sum \text{ horizontal driving forces}} = \frac{\sum P_R}{\sum P_d} \geq 1.5 \qquad (21)$$

where the resisting force is the lesser of the shear resistance along the base of the wall or of a weak layer near the base of the MSE wall, and the sliding force is the horizontal component of the thrust on the vertical plane at the back of the wall (see figures 23 through 25).

Note that any soil passive resistance at the toe due to embedment is ignored due to the potential for the soil to be removed through natural or manmade processes during its service life (e.g. erosion, utility installation, etc.). The shear strength of the facing system is also conservatively neglected.

Additional surcharge loads may include live and dead load surcharges.

The calculation steps for an MSE wall with a sloping surcharge are:

(1) Calculate thrust $F_T = K_{af\ (\phi,\ \beta)}\ \frac{1}{2}\ \gamma_f\ h^2$ (22)

where $h = H + L \tan \beta$ (23)

(2) Calculate the driving force:

$$P_d = F_H = F_T \cos \beta. \qquad (24)$$

(3) Determine the most critical frictional properties at the base. Choose the minimum ϕ for three possibilities:

- Sliding along the foundation soil, if its shear strength (c_f, ϕ_f) is smaller than that of the backfill material.

- Sliding along the reinforced backfill (ϕ_r).

- For sheet type reinforcement, sliding along the weaker of the upper and lower soil-reinforcement interfaces. The soil-reinforcement friction angle ρ, should preferably be measured by means of interface direct shear tests. Alternatively, it may be taken as $\frac{2}{3}$ tan ϕ.

(4) Calculate the resisting force per unit length of wall:

$$P_R = (V_1 + V_2 + F_T \sin \beta) \cdot \mu \qquad (25)$$

where

$$\mu = \min [\tan \phi_f, \tan \phi_r, \text{ or (for continuous reinforcement) } \tan\rho]$$

The effect of external loadings on the MSE mass, which increases sliding resistance, should only be included if the loadings are permanent. For example, live load traffic surcharges should be excluded.

(5) Calculate the factor of safety with respect to sliding and check if it is greater than the required value.

(6) If Not:

- Increase the reinforcement length, L, and repeat the calculations.

f. Bearing Capacity Failure (FS = 2.5)

Two modes of bearing capacity failure exist, general shear failure and local shear failure. Local shear is characterized by a "squeezing" of the foundation soil when soft or loose soils exist below the wall.

- General Shear

To prevent bearing capacity failure, it is required that the vertical stress at the base calculated with the Meyerhof distribution does not exceed the allowable bearing capacity of the foundation soil determined, considering a safety factor of 2.5 with respect to Group I loading applied to the ultimate bearing capacity:

$$\sigma_v \leq q_a = \frac{q_{ult}}{FS} \qquad (26)$$

A lesser FS of 2.0 could be used if justified by geotechnical analysis.

Calculation steps for an MSE wall with a *sloping discharge* are as follows:

(1) Obtain the eccentricity e of the resulting force at the base of the wall. Remember that under preliminary sizing if the eccentricity exceeded L/6, the reinforcement length at the base was increased.

(2) Calculate the vertical stress σ_v at the base assuming Meyerhof distribution.

$$\sigma_v = \frac{V_1 + V_2 + F_T \sin\beta}{L - 2e} \qquad (27)$$

(3) Determine the ultimate bearing capacity for eccentrically loaded footing q_{ult}, using classical soil mechanics methods, e.g.:

$$q_{ult} = c_f N_c + 0.5(L - 2e)\gamma_f N_\gamma \qquad (28)$$

where c_f is the cohesion, γ_f the unit weight and N_c and N_γ are dimensionless bearing capacity coefficients and can be obtained from 4.4.7.1A of 1996 AASHTO and by considering that q_{ult} is reduced when the ground at the base of the wall slopes away from the structure in accordance with 4.4.7.1.1.4B of AASHTO. Again, the beneficial effect of wall embedment is neglected. For convenience, the dimensionless bearing capacity factors are shown in table 10.

(4) Check that:

$$\sigma_v \le q_a = q_{ult} / FS \qquad (26)$$

(5) As indicated in step (2) and step (3), σ_v can be decreased and q_{ult} increased by lengthening the reinforcements. If adequate support conditions cannot be achieved or lengthening reinforcements significantly increases costs, improvement of the foundation soil is needed (dynamic compaction, soil replacement, stone columns, precompression) etc.

Table 10. Bearing Capacity Factors

ϕ	N_c	N_q	N_γ	ϕ	N_c	N_q	N_γ
0	5.14	1.00	0.00	26	22.25	11.85	12.54
1	5.38	1.09	0.07	27	23.94	13.20	14.47
2	5.63	1.20	0.15	28	25.80	14.72	16.72
3	5.90	1.31	0.24	29	27.86	16.44	19.34
4	6.19	1.43	0.34	30	30.14	18.40	22.40
5	6.49	1.57	0.45	31	32.67	20.63	25.90
6	6.81	1.72	0.57	32	35.49	23.18	30.22
7	7.16	1.88	0.71	33	38.64	26.09	35.19
8	7.53	2.06	0.86	34	42.16	29.44	41.06
9	7.92	2.25	1.03	35	46.12	33.30	48.03
10	8.35	2.47	1.22	36	50.59	37.75	56.31
11	8.80	2.71	1.44	37	55.63	42.92	66.19
12	9.28	2.97	1.69	38	61.35	48.93	78.03
13	9.81	3.26	1.97	39	37.87	55.96	92.25
14	10.37	3.59	2.29	40	75.31	64.20	109.41
15	10.98	3.94	2.65	41	83.86	73.90	130.22
16	11.63	4.34	3.06	42	93.71	85.38	155.55
17	12.34	4.77	3.53	43	105.11	99.02	186.54
18	13.10	5.26	4.07	44	118.37	115.31	224.64
19	13.93	5.80	4.68	45	133.88	134.88	271.76
20	14.83	6.40	5.39	46	152.10	158.51	330.35
21	15.82	7.07	6.20	47	173.64	187.21	403.67
22	16.88	7.82	7.13	48	199.26	222.31	496.01
23	18.05	8.66	8.20	49	229.93	265.51	613.16
24	19.32	9.60	9.44	50	266.89	319.07	762.89
25	20.72	10.66	10.88	-	-	-	-

- Local Shear

To prevent large horizontal movements of the structure on weak cohesive soils:

$$\gamma H \leq 3c \tag{29}$$

If adequate support conditions cannot be achieved, ground improvement of the foundation soils is indicated.

g. Overall Stability (FS = 1.3)

Overall stability is determined using rotational or wedge analyses, as appropriate, which can be performed using a classical slope stability analysis method. Computer programs are available for these analyses (see chapter 6). The reinforced soil wall is considered as a rigid body and only failure surfaces completely outside a reinforced mass are considered. For simple structures with rectangular geometry, relatively uniform reinforcement spacing, and a near vertical face, compound failures passing both through the unreinforced and reinforced zones will not generally be critical. However, if complex conditions exist such as changes in reinforced soil types or reinforcement lengths, high surcharge loads, sloping faced structures, or stacked structures, compound failures must be considered.

If the minimum safety factor is less than the usually recommended minimum FS of 1.3, increase the reinforcement length or improve the foundation soil.

h. Seismic Loading

During an earthquake, the retained fill exerts a dynamic horizontal thrust, P_{AE}, on the MSE wall in addition to the static thrust. Moreover, the reinforced soil mass is subjected to a horizontal inertia force $P_{IR} = M\ A_m$, where M is the mass of the active portion of the reinforced wall section assumed at a base width of 0.5H, and A_m is the maximum horizontal acceleration in the reinforced soil wall.

Force P_{AE} can be evaluated by the pseudo-static Mononobe-Okabe analysis as shown in figure 27 and added to the static forces acting on the wall (weight, surcharge, and static thrust). The dynamic stability with respect to external stability is then evaluated. Allowable minimum dynamic safety factors are assumed as 75 percent of the static safety