PRELIMINARY GEOTECHNICAL SUMMARY
FOR
PROPOSED PARKING FACILITY
FIRST STREET LOT
DOVER, NH
CITY OF DOVER
OFFICE OF THE FINANCE DIRECTOR
288 CENTRAL AVENUE
DOVER, NH 03820-4169
ATTN: DANIEL BARUFALDI

JTC Project # 11-GEO-005
TABLE OF CONTENTS

Geotechnical Summary

Boring Location Plan & Boring Logs

Site Photos
MEMORANDUM

TO: City of Dover
Office of the Finance Director
288 Central Avenue
Dover, NH 03820-4169

FROM: Kyle Urso
Field Engineer

Kevin Martin, P.E.
Geotechnical Engineer

DATE: February 24, 2011

RE: PRELIMINARY GEOTECHNICAL SUMMARY
PROPOSED PARKING FACILITY
FIRST STREET LOT
DOVER, NEW HAMPSHIRE

This memorandum report presents the findings of a subsurface exploration program and a preliminary evaluation of the conditions encountered as they relate to the feasibility of a proposed parking facility. The contents of this report are subject to the attached Limitations.

BACKGROUND

The purpose of this preliminary geotechnical study is to review the subgrade conditions and feasibility for potential re-use of city owned lots. Future development is uncertain but may include a parking lot or parking garage. A parking garage may be up to 4-7 stories with considerable load.

SITE & PROJECT DESCRIPTION

The project site is presently utilized as a parking lot. The site is relatively level based on visual estimate. Survey of the test bores indicates grades to vary from elevation =45-47 ft. The site is bordered by the Cochecho River to the immediate south. A Site Plan is in the process of being complied for the project. An Environmental Site Assessment (ESA) is also being completed for the project. This ESA report was not completed at the time of this study. It is noted that the site was prior used for residential development. Prior Sanborn Fire Maps show several dwellings throughout the property.
SUBSURFACE EXPLORATIONS

Test Borings

The subgrade conditions were reviewed with the completion of four (4) test borings throughout the lot. The test borings (identified as B9 to B12) were advanced to refusal depths of about ~10-35 ft utilizing 2¼ inch hollow stem augers. Soil samples were typically retrieved at no greater than 5 ft intervals with a 2-inch diameter split-spoon sampler. Standard Penetration Tests (SPTs) were performed at the sampling intervals in general accordance with ASTM-D1586 (Standard Method for Penetration Test and Split-Barrel Sampling of Soils). Field descriptions and penetration resistance of the soils encountered, observed depth to groundwater, depth to apparent bedrock refusal and other pertinent data are contained on the attached Test Boring Logs. The test borings were located by survey as shown on the Test Boring Location Plan.

SUBGRADE CONDITIONS

The subgrade conditions, in general, consist of (1) undocumented Fill underlain by (2) unconsolidated alluvial deposits then (3) Hardpan or Refusal. Some buried organic soils were present below the fill towards the western portion of the site. A Subsurface Profile is attached for review.

Fill was encountered throughout the site to depths of ~9 ft. The Fill extends near or below the groundwater table suggesting a prior low area associated with the adjacent river. Some black organic Silt was encountered about ~9-10 ft below grade towards the west (B9 & B10). These organic laden soils may be prior river bed deposits. The fill generally consists of a dark brown, fine to medium Sand with gravel, little silt. There are trace amounts of brick, asphalt, rubble, ash, organics, cobbles and other matter embedded in the fill. The density of the fill varies from loose to medium dense suggesting inconsistent compaction.

The parent site soils include unconsolidated alluvium associated with the adjacent river. Specifically, the site soils include a Fine Sand with Silt which transitions into a silty Clay. Based on the Profile, the alluvium is thickest in the central portion of the site (B11). The alluvium soils are typically loose to very soft thereby rendered weak and unstable.

Test boring refusal, presumably bedrock, was met in all the test borings at varying depths of ~10-35 ft below grade. It is suspected that shallow ledge (10 ft) was met at B12 but it may also be a boulder obstruction. Nonetheless, the bedrock is expected to possess a variable and sloping contour. The USGS Bedrock Geologic Map of New Hampshire (1996) depicts bedrock in the area to include biotite granofels, mica schist, quartzite and/or phyllite. Such rock types are characteristically hard and of sound quality.
Groundwater was encountered in the test borings about 8-9 ft below grade. It should be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time of the measurements. The study was completed at a time of seasonally low groundwater. The groundwater should be directly impacted by the adjacent river.

PRELIMINARY GEOTECHNICAL EVALUATION

The subgrade conditions warrant concern for support of a spread footing foundation. The undocumented fill, discontinuous organic layer and soft alluvium will impact both strength and compressibility for foundation support. The variable depth to bedrock will also impact differential movement throughout a parking structure. Given the high foundation loads associated with a parking garage, it is expected that end-bearing piles driven to bedrock would be the most feasible means of foundation support. Driven piles may include steel (concrete filled pipe or H-sections) or precast concrete. Pile loads upwards of 50-150 tons should be feasible given the bedrock. Pile loads greater than 100 tons will likely be necessary for a multi-level parking garage.

The subsurface conditions were reviewed with respect to seismic criteria set forth in the International Building Code (2009). Based on the fine-grained composition of the site soils (silt/clay), the site is not susceptible to liquefaction (complete loss of shear resistance) in the event of an earthquake. Based on interpretation of the Building Code together with the project and site conditions, the Site Classification (Table 1613.5.2) is “E” (Soft Soil). This Classification will likely impact the structural design of the garage due to increased shear (lateral) loads.

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

Explorations

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

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

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

Review

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

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

Construction

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

Use of Report

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

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

**JOHN TURNER CONSULTING, INC.**  
**603-749-1841**  
**19 DOVER STREET**  
**DOVER, NH 03820**

**PROJECT NO:** Geo-Analysis: 4 City Parking Lots  
**DATE:** 04-Feb-11

<table>
<thead>
<tr>
<th>FT</th>
<th>NO.</th>
<th>SAMPLE</th>
<th>REC. (IN.)</th>
<th>SOIL &amp; ROCK CLASSIFICATION-DESCRIPTION</th>
<th>STRATUM CHANGE</th>
<th>BLOWS (FT.)</th>
<th>PEN (INCHES)</th>
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<td></td>
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<td>0.25</td>
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<tr>
<td></td>
<td></td>
<td>S-2</td>
<td>5-7</td>
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<tr>
<td></td>
<td>S-3a</td>
<td>10-12</td>
<td>24</td>
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<td>3</td>
<td></td>
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<tr>
<td></td>
<td>S-3b</td>
<td>15</td>
<td>17</td>
<td>Wet, Grayish Brown, Silt, Some Fine Sand, Pushed Rods with Hammer to 17.0'</td>
<td>10.5</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>S-4</td>
<td>17-19</td>
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<td>Spoon Refusal @ 17.5' in Probable Intact Bedrock</td>
<td>50/5.5&quot;</td>
<td>50</td>
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**REMARKS:** Acker Drill Rig, 2.25" Internal Diameter Hollow Stem Auger

**GROUNDWATER OBSERVATIONS**

**TYPE OF BORING:** 2.25" H.S.A.  
**DATE:** 4-Feb-11  
**TIME:** During Drilling

**REMARKS:** The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated in the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made. Proportions used: trace (0-10%), little (10-20%), some (20-35%), and (35-50%)

**Standard Penetration Tests (SPT) = 140# hammer falling 30" (ASTM D1586)**  
Blows are per 6 inches with a 24" long by 2" O.D. by 1 3/8" I.D. split spoon sampler unless otherwise noted  
S = split spoon sample; C = rock core sample; U = undisturbed
# Boring Log

**Client:** City of Dover  
**Project:** Geo-Analysis: 4 City Parking Lots, First Street Parking Lot  
**Location:** See Plan  
**Surface Elevation:** 47.1  
**Date:** 07-Feb-11  
**Type of Boring:** 2.25° H.S.A.  
**Drilling Co:** Great Works Test Boring  
**Driller:** Jeff Lee  
**JTC Rep:** Kyle Urso

<table>
<thead>
<tr>
<th>FT</th>
<th>No.</th>
<th>Sample Depth (FT.)</th>
<th>REC. (IN.)</th>
<th>Soil &amp; Rock Classification-Description</th>
<th>Burmeister System (Soil)</th>
<th>U.S. Corps of Engineers System (Rock)</th>
<th>Stratm Change (ft.)</th>
<th>Blows Per 6 inches</th>
<th>Pen (N)</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td>Asphalt</td>
<td></td>
<td></td>
<td>0.21</td>
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<td></td>
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<tr>
<td></td>
<td>S-1</td>
<td>3-5</td>
<td>14</td>
<td>Moist, Dark Brown, Medium-Fine Sand, Some Gravel, Little Silt (FILL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td>Brick remnants in sample (FILL)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>S-2</td>
<td>5-7</td>
<td>11</td>
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<td>Brick and mortar remnants in sample (FILL)</td>
<td></td>
<td>2-4-14-22</td>
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<tr>
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<td></td>
<td>S-3</td>
<td>7-9</td>
<td>12</td>
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<td></td>
</tr>
<tr>
<td>10</td>
<td>S-4</td>
<td>10-12</td>
<td>20</td>
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<td></td>
<td></td>
<td>6-6-4-5</td>
<td>10</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>15</td>
<td>S-5</td>
<td>15-17</td>
<td>16</td>
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<td></td>
<td>1-2-2-2</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>20</td>
<td>S-6</td>
<td>20-21.8</td>
<td>20</td>
<td>Wet, Gray, SILT/CLAY, trace Fine Sand</td>
<td>Weathered Rock in shee</td>
<td></td>
<td>WOH/22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

**Remarks:** Acker Drill Rig, 2.25° Internal Diameter Hollow Stem Auger

**Remarks:** Standard Penetration Tests (SPT) = 140# hammer falling 30" (ASTM D1586)  
Blows are per 6 inches with 24" long by 2" O.D. by 1 3/8" I.D. split spoon sampler unless otherwise noted  
S = split-spoon sample; C = rock core sample; U = undisturbed

**Remarks:** The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated in the test boring logs. Fluctuations in the level of the ground water may occur due to other factors than those present at the time measurements were made.  
Proportions used: trace (0-10%), little (10-20%), some (20-35%), and (35-50%)
# Boring Log

**Client:** City of Dover  
**Project:** Geo-Analysis: 4 City Parking Lots  
**Boring No.:** B11  
**Type of Boring:** 2.25" H.S.A.  
**Groundwater Observations:**

<table>
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<th>Date</th>
<th>Depth</th>
<th>Time</th>
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<tbody>
<tr>
<td>08-Feb-11</td>
<td>9.0</td>
<td>During Drilling</td>
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<table>
<thead>
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<th>Driller:</th>
<th>JTC Rep.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeff Lee</td>
<td>Kyle Usos</td>
</tr>
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</table>

### Soil & Rock Classification

<table>
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<tr>
<th>Footing</th>
<th>Sample Depth</th>
<th>Rec. No.</th>
<th>Soil &amp; Rock Classification</th>
<th>Description</th>
<th>Stratum Change</th>
<th>Błows Per 6 Inches</th>
<th>Penetrability (N)</th>
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<td>0</td>
<td>S-1</td>
<td>3-5</td>
<td>Moist, Dark Brown, Medium-Fine Sand, Some Gravel, little Silt</td>
<td>Full</td>
<td>0.21</td>
<td>3-3-2-5</td>
<td>5</td>
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<td>S-2</td>
<td>5-7</td>
<td>Moist, Dark Brown, Medium-Fine Sand, Some Gravel, little Silt</td>
<td>Brick remnants in sample (FULL)</td>
<td>7-9-10-17</td>
<td>19</td>
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<tr>
<td></td>
<td>S-3</td>
<td>7-9</td>
<td>Moist, Dark Brown, Medium-Fine Sand, Some Gravel, little Silt</td>
<td>Brick remnants in sample (FULL)</td>
<td>43-8-12-10</td>
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<tr>
<td></td>
<td>S-4</td>
<td>10-12</td>
<td>Moist, Light and Rust Brown, Mottled, Fine SAND, some Silt, trace Gravel</td>
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<td>S-5</td>
<td>15-17</td>
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<td>4-8-9-11</td>
<td>17</td>
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<td>S-6</td>
<td>20-22</td>
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<td>WOH/24</td>
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<td></td>
<td>S-8</td>
<td>30-32</td>
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<td>WHO/24</td>
<td>0</td>
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</table>

### Remarks:
- **Acker Drill Rigs, 2.25" Internal Diameter Hollow Stem Auger**
- **Standard Penetration Tests (SPT) = 140# hammer falling 30" (ASTM D1586)**
- Blows are per 6 inches with a 24" long by 2" O.D. by 1 3/8" I.D. split spoon sampler unless otherwise noted
- S = split-spoon sample; C = core cone sample; U = undisturbed

### Remarks:
The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated in the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made. Proportions used: trace (0-10%), little (10-20%), some (20-35%), and (35-50%)
## BORING LOG

<table>
<thead>
<tr>
<th>CLIENT:</th>
<th>City of Dover</th>
<th>BORING #:</th>
<th>B11</th>
<th>Page 2 of 2</th>
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<tbody>
<tr>
<td>PROJECT:</td>
<td>Geo-Analysis: 4 City Parking Lots</td>
<td>LOCATION:</td>
<td>See Plan</td>
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<td>PROJECT NO:</td>
<td>11-GEO-005</td>
<td>SURFACE ELEVATION:</td>
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<td>DATE:</td>
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<td>GROUNDWATER OBSERVATIONS</td>
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<tr>
<td>TYPE OF BORING:</td>
<td>2.25&quot; H.S.A.</td>
<td>DATE:</td>
<td></td>
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<tr>
<td>DRILLER:</td>
<td>Jeff Lee</td>
<td>DEPTH:</td>
<td></td>
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<tr>
<td>JTC REP.:</td>
<td>Kyle Urso</td>
<td>TIME:</td>
<td></td>
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<td>SAMPLE DEPTH (FT.)</td>
<td>RECORDED (IN.)</td>
<td>SOIL &amp; ROCK CLASSIFICATION-DESCRIPTION</td>
<td>STRATUM</td>
<td>BLOWS</td>
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<td>DESCRIPTION</td>
<td>CHANGE</td>
<td>PER</td>
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<td>Tril/Weathered Rock</td>
<td>34.5</td>
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</tr>
</tbody>
</table>

**Tri-Cone Drill Bit Refusal @ 39.0" in Probable Intact BEDROCK**

**REMARKS:**
Acker Drill Rig, 2.25" Internal Diameter Hollow Stem Auger

Standard Penetration Tests (SPT) = 140# hammer falling 30" (ASTM D1586)

Blows are per 6 inches with a 24" long by 2" O.D. by 1 3/8" I.D. split spoon sampler unless otherwise noted

S = split-spoon sample; C = rock core sample; U = undisturbed

**REMARKS:** The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test bores at times and under conditions stated in the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

*Proportions used: trace (0-10%), little (10-20%), some (20-35%), and (35-50%)*
### Boring Log

**Client:** City of Dover  
**Project:** Geo-Analysis: 4 City Parking Lots, First Street Parking Lot  
**Project No.:** 11-GEO-005  
**Boring #:** B12  
**Location:** See Plan  
**Surface Elevation:** 45.4  
**Date:** 08-Feb-11

### Drilling Details

**Driller:** Jeff Lee  
**JTC Rep.:** Kyle Urso

<table>
<thead>
<tr>
<th>FT</th>
<th>No.</th>
<th>Sample Depth (FT.)</th>
<th>Rec. (IN.)</th>
<th>Soil &amp; Rock Classification - Description</th>
<th>Burmeister System (Soil)</th>
<th>U.S. Corps of Engineers System (Rock)</th>
<th>Stratum Change (FT.)</th>
<th>Bows per 6 Inches</th>
<th>Pen (N)</th>
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<tr>
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<td></td>
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<td>Asphalt</td>
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<td></td>
<td>0.21</td>
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<td></td>
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<tr>
<td>5</td>
<td>3-1</td>
<td>3-5</td>
<td>10</td>
<td>Moist, Dark Brown, Medium-Fine Sand, Some Gravel, little Silt (FILL)</td>
<td></td>
<td></td>
<td>5-7-12-6</td>
<td>19</td>
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</tr>
<tr>
<td></td>
<td>5-2</td>
<td>5-7</td>
<td>0</td>
<td>Moist, Dark Brown, Medium-Fine Sand, Some Gravel, little Silt Brick remnants in sample (FILL)</td>
<td></td>
<td></td>
<td>7-5-2-3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-3</td>
<td>7-9</td>
<td>8</td>
<td>Moist, Dark Brown, Medium-Fine Sand, Some Gravel, little Silt Brick remnants in sample (FILL) Crushed Rock in sample, Possible Boulder (FILL)</td>
<td></td>
<td></td>
<td>5-9-2-3</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10-12</td>
<td>5&quot;</td>
<td>Wet, Dark Gmy, Medium-Fine SAND, some Sili, trace Gravel trace Gravel Spoon Refusal @ 10.5' in Probable intact Bedrock Auger Refusal @ 10.5' in Probable Intact Bedrock</td>
<td></td>
<td></td>
<td>50/5&quot;</td>
<td>50+</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Acker Drill Rig, 2.25" Internal Diameter Hollow

**Standard Penetration Tests (SPT) = 140# hammer falling 30" (ASTM D1586)**  
Blows are per 6 inches with a 24" long by 2" O.D. by 1 3/8" I.D. split spoon sampler unless otherwise noted  
S = split-spoon sample; C = rock core sample; U = undisturbed

**Remarks:** The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated in the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made. Proportions used: trace (0-10%), little (10-20%), some (20-33%), and (33-50%)
City of Dover
First Street
Dover, NH 03820

Northwest Entrance of Property Looking North Across 1st Street
Northwest Entrance of Property Looking North Across 1st Street
Northwest Entrance of Property Looking East Across 1st Street
Northwest Corner of Property Looking East
Northwest Corner of Property Looking South
Southeast Corner of Property Looking East