Track Investigation Report
Wesleyan University Track

Wesleyan University
Office of Construction Services
186 College Street
Middletown, CT 06459

CHA Project Number: 13722.1000.1103

Prepared for:
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January 5, 2005
Final Report
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1.0 INTRODUCTION

A condition survey and investigation has been completed at the Freeman Athletic Center Running Track at Wesleyan University. Over the past few years, it was reported that some deterioration was occurring to the track which appeared to be related to the asphalt base. In photographs received from the University it was observed that a delamination was occurring within the asphalt causing the track surface to blister. Many of these had been repaired.

The University presently wishes to upgrade the track facility constructed in 1990 and wishes to understand the condition of the existing track and whether the deterioration problem can be addressed or whether more intensive remedial work is required.

This investigation has been completed to attempt to identify the cause of the deterioration and to provide recommendations for remedial options.

2.0 TRACK STRUCTURE

The track surface consists of a “full pour” polyurethane approximately ½-inch thick, as originally supplied and installed by Martin Surfacing Inc. The track surface was installed on a Hot Mix Asphalt Concrete (HMAC) base, which has been constructed over compacted fill.

The track is located in somewhat of a low-lying area and may be subject to elevated groundwater levels.

3.0 FIELD AND LABORATORY INVESTIGATION

3.1 Visual Inspection

In general the track appears in a serviceable and functional state. During the investigation the track was in constant use with runners, joggers and walkers. The deterioration that has occurred to date has been temporarily repaired and there was no evident impedance to the users.

However, there has been deterioration of the track surface as is evidenced by the extensive patching of the surface. A typical patched area is depicted in the adjacent photograph and the occurrence of patches is illustrated on the Boring Location Sketch (Appendix A). The patches do not
appear to have a significant pattern; however they are concentrated in certain areas of the track. There are areas of the track that are free of patches and may be free of blisters.

According to photographs provided by Wesleyan University, the patches were installed to repair blisters that had occurred. It appeared in the photographs that the blister interface was occurring within the asphalt layer and not at the interface with the track surfacing. Consequently, we have carried out cut tests at other locations where there was an un-repaired blister; to further examine the delamination interface. These cut tests also revealed that the delamination interface was within the top ¼ inch of the top lift of asphalt. Of the un-repaired blisters there appear to be relatively few within the track surface, however the high jump area at the west end of the infield is literally covered with blisters. As illustrated in the adjacent photograph, there appears to be a blister every few feet. The blisters are fairly easily detected visually or by sounding the surface with a rubber mallet when a distinct “drummy” or hollow sound can be heard.

The condition of the track surface excluding the repaired areas is considered to be sound. Other than the blisters, no other form of deterioration was evident on the track surface.

3.2 Bond Tests

In the evaluation of a track system, an additional piece of information that is measured is the bond of the track surfacing to the base. This is measured in order to determine if there may be an overall potential for surface delamination from the base. The test is carried out using a hydraulic jack to debond a 2 x 4 inch piece of the track and measuring the debonding load. The test is illustrated in the adjacent photograph and the test results are listed in Table 1.
Table 1. Bond Test data

<table>
<thead>
<tr>
<th>Location</th>
<th>Stress (psi)</th>
<th>Debonding interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1a</td>
<td>73</td>
<td>Rubber and R/A interface 50/50 % Ditto</td>
</tr>
<tr>
<td>b</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>P2a</td>
<td>86</td>
<td>Rubber/asphalt interface 100%</td>
</tr>
<tr>
<td>b</td>
<td>77</td>
<td>Rubber and R/A interface 85/15 %</td>
</tr>
<tr>
<td>P3a</td>
<td>69</td>
<td>Rubber and R/A interface 50/50 %</td>
</tr>
<tr>
<td>b</td>
<td>61</td>
<td>Rubber and Glue-bond</td>
</tr>
<tr>
<td>P4a</td>
<td>55</td>
<td>Rubber and Glue-bond</td>
</tr>
<tr>
<td>b</td>
<td>35</td>
<td>Rubber and Glue-bond</td>
</tr>
<tr>
<td>P5a</td>
<td>81</td>
<td>Rubber and R/A interface 90/10 %</td>
</tr>
<tr>
<td>b</td>
<td>75</td>
<td>Rubber and Glue-bond</td>
</tr>
<tr>
<td>P6a</td>
<td>67</td>
<td>Rubber and Glue-bond</td>
</tr>
<tr>
<td>b</td>
<td>81</td>
<td>Rubber and R/A interface 70/30 %</td>
</tr>
</tbody>
</table>

R/A = Rubber/Asphalt

The performance of the track bond is considered to be satisfactory. Some of the test results were low however as shown in the table, in these cases, the test block had pulled away from track surface and therefore this is a reflection of the test methodology. In general where the failure surface occurred at the Rubber/Asphalt interface the debonding load was 80 psi or greater and in the only case where 100% of the failure surface was at the Rubber/Asphalt interface the debonding load was 86 psi.

### 3.3 Geotechnical & Subsurface Evaluation

A subsurface investigation for the running track investigation was conducted on October 19, 2004 and was completed on October 20, 2004. Ten soil borings, identified as B-1 through B-10, were advanced around the running track, typically at locations where the bubbling was prominent. Asphalt cores were obtained in all the soil borings and sampling of the subsurface soils and groundwater conditions was conducted.

A geotechnical and subsurface investigation report providing details of the investigation, testing, evaluation and recommendations in provided in Appendix B.
3.4 Laboratory Testing

The cause of the blistering may be caused by a number of various mechanisms. We have discussed this with several asphalt pavement experts and they have not observed this form of deterioration before. However some scenarios can be suggested:

1. That a contaminant came into contact with the paved surface before the track surfacing was laid. The size and circular form of the blisters suggest that a volatile organic contaminant may have dripped onto the pavement.

2. That moisture may have become trapped in the surface during the pavement compaction process thus producing water vapor that could create the initial delamination. This could initiate the blister, which then may take several years to appear through many temperature cycles.

3. That there is something fundamentally wrong with the asphalt mix design. The top lift of HMAC is a fine asphalt mix. These may contain excess fines, which can create a dry friable mix if there is insufficient asphalt cement binder.

In order to evaluate these scenarios, laboratory testing has been performed to test for various properties utilizing a spectroscopic analysis of the HMAC and tests for organic contaminants at the blister interface. The asphalt sampling locations are illustrated on the Boring Location Sketch included within Appendix A. A schematic figure (Track Core Testing) depicting zones of analysis within the core samples is provided within Appendix A.

3.4.1 Test Results

The laboratory investigation has included Infrared Spectroscopy and Scanning Electron Microscopy to examine the blister interfaces in order to determine whether any contaminants were present which may have contributed to the blistering. This work was performed by KTA-Tator Inc. of Pittsburgh, PA. Their report and test data is included within Appendix C.

As shown, the conclusions of that report are as follows:

1. No contaminant was detected at the blister formed by the cohesive failure of the asphalt. This is the primary form of blistering at the site and this suggests that there may be a deficiency in the asphalt mixture used in the top lift. Further laboratory testing could be carried out to analyze the asphalt material.

2. Some contamination was detected at the track to asphalt interface where the surfacing had become debonded. This is not considered to be a concern. This form of blister is not typical and as shown in the Pull-Off Test, the bond of the surfacing to the asphalt base is considered to be sound.
In summary the I.R. spectroscopy and the SEM work has indicated that the blistering has not been caused by a contaminant on or within the asphalt. Further analysis of the asphalt core could be performed, however it is our opinion that this information would not provide information to render recommendations different than those provided in this report.

4.0 DISCUSSION AND RECOMMENDATIONS

The investigation has shown that the running track is still in a serviceable condition. Following is a summary of our findings.

1. Significant blistering has occurred in the asphalt pavement base, which has resulted in delamination of the track at many small locations. It appears that most of these have been repaired on the track surface.

2. Severe blistering is also evident in the “D” area. This has not been repaired to date.

3. The cause of the blistering is not clear however it is most likely the result of a paving problem and not related to the track surfacing. The laboratory test data suggests that it may be caused by trapped moisture in the top lift of hot mix asphalt concrete which was exacerbated by elements (silicon, magnesium, sulfur and calcium) found in the asphalt that have the ability to hold moisture. The moisture found in the top layer of asphalt appears to be coming from the micro pores that now exist in the track surface.

4.1 Remedial Options

There are two potential options for the remediation of the track:

1. To locate and repair the individual blisters and then re-apply a new topcoat of aliphatic urethane to resurface the track.
2. To remove the existing track surface, mill the asphalt to a depth of 1 inch and then reinstall a new lift of asphalt and new track surfacing.

It is important to note that Option 1 is not suitable for the high jump area. This area is so severely blistered that the top portion of the asphalt is damaged over most of its area. Here it is necessary to mill the top inch of the asphalt and to reinstall a new asphalt lift before installing new track surfacing.

Option 1 will provide a serviceable track for some years to come, however it should be noted that there is a continued risk of blistering at yet unidentified locations. It is our opinion that Option 2 is the best long term solution.
Estimates of probable construction costs for both options are provided within Appendix B.
APPENDIX B
## Wesleyan University

**Running Track Renovation**

**ESTIMATE OF PROBABLE COST: January 5, 2005**

Prepared By: 

<table>
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<th>REPAIR OPTION 1 - Repair Blisters, Mill &amp; Repair High Jump &amp; Resurface Track</th>
</tr>
</thead>
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<tr>
<td><strong>Track Area</strong></td>
</tr>
<tr>
<td>1.0 Repair existing Blisters - (4-)4sf each</td>
</tr>
<tr>
<td><strong>High Jump Area</strong></td>
</tr>
<tr>
<td>1.0 Bridging Over Exist track</td>
</tr>
<tr>
<td>1.0 Remove High Jump Surface to Minus 1-1/2&quot;</td>
</tr>
<tr>
<td>2.0 Install 1&quot; Asphalt Top Course</td>
</tr>
<tr>
<td>3.0 Install 1/2&quot; Full Pour Track Material</td>
</tr>
<tr>
<td>4.0 Resurface Existing Track (3 mm)</td>
</tr>
<tr>
<td>5.0 Restripe Track</td>
</tr>
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| Total Construction | $352,750 |
| **GENERAL CONDITIONS @ 10%** | $35,275 |
| 15% Construction Contingency | $52,913 |
| Soft Costs @ 10% | $35,257 |

### CONSTRUCTION

<table>
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<th>REPAIR OPTION 2 - Mill Entire Track, Install 1&quot; Asphalt &amp; 1/2&quot; Track Surface</th>
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<tr>
<td>1.0 Bridging Over Exist track</td>
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<tr>
<td>2.0 Mill &amp; Dispose of 1/2&quot; Track &amp; 1&quot; Asphalt</td>
</tr>
<tr>
<td>3.0 Install 1&quot; Asphalt Top Course</td>
</tr>
<tr>
<td>4.0 Install 1/2&quot; Full Pour Track Material</td>
</tr>
<tr>
<td>5.0 Restripe Track</td>
</tr>
</tbody>
</table>

| Total Construction | $648,000 |
| **GENERAL CONDITIONS @ 10%** | $64,800 |
| 15% Construction Contingency | $97,200 |
| Soft Costs @ 10% | $64,800 |
APPENDIX C
This report has been prepared and reviewed by the following qualified engineers employed by Clough Harbour & Associates LLP.

Report Prepared By:

[Signature]
Gary R. Dale
Geotechnical Engineer

Report Reviewed By:

[Signature]
Warren A. Harris, IV
Senior Geotechnical Engineer
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Table 1: Gradation Requirements for Structural Fill

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APPENDIX B: SOIL BORING LOGS
APPENDIX C: SITE PHOTOGRAPHS
1.0 INTRODUCTION

This report summarizes the results of the geotechnical investigation performed by Clough Harbour & Associates LLP (CHA) for the running track surface failures at Wesleyan University in Middletown, Connecticut. The project site is shown on the Site Location Map, Figure 1, included in Appendix A.

The objectives of the investigation were to evaluate the subsurface conditions beneath the existing running track to determine if the subsurface soils or groundwater contributed to the failure of the running track, and also to provide geotechnical recommendations regarding the design and construction of a proposed new running track.
2.0 PROJECT AND SITE DESCRIPTION

The existing 50,000 square foot track and field facility is located on the Wesleyan University campus in Middletown, Connecticut. The running track is situated to the south of the Freeman Athletic Center, and is bounded to the west by athletic fields, to the south by an athletic field and dense tree growth, and to the east by private dwellings. The ground surface slopes upward approximately seven feet on the east and 15 feet on the west of the running track, and is generally flat to the north and south of the running track.

We understand that the existing running track was constructed in 1991, and had cuts of about five feet at the east and west ends of the track, and fills of about five feet at the middle portion of the track. Based upon the geotechnical report written by Dr. C. Welti, P.E. in November 1987, the fill material most likely consisted of on-site cut materials (glacial deposits), and filled in a previous stream bed. The running track section consisted of a synthetic rubber surface bonded to a bituminous asphalt. The existing subsurface drainage apparently consists of fabric lined channels containing drainage pipe spaced approximately 50 feet apart across the track and field.

Approximately four to five years ago the track surface began to fail; the failure consisted of the synthetic surface bubbling due to an apparent loss of adhesion between the synthetic surface and/or the upper asphalt layer and the bituminous asphalt. The bubbling appears to be more prevalent when the outdoor temperature is above 85° F. Temporary repairs have been conducted to maintain the usability of the running track.

We understand that the University is interested in understanding the reason for the failure in the track surface, as well as obtaining recommendations and performance specifications to guide the contractor during construction of a new running track.
3.0 SUBSURFACE INVESTIGATION

A subsurface investigation for the running track investigation began on October 19, 2004 and was completed on October 20, 2004. Ten soil borings, identified as B-1 through B-10, were advanced around the running track, typically at locations where the bubbling was prominent. Asphalt cores were obtained in all the soil borings and continuous sampling of the subsurface soils was conducted to a depth of 10.5 feet in soil borings B-1 through B-8. The locations of the soil borings were determined in the field by a CHA geotechnical engineer using existing site features. The locations of the borings are shown on the Boring Location Plan, Figure 2, included in Appendix A.

New England Boring Contractors of Glastonbury, Connecticut was retained by CHA to advance the soil borings. The field investigation was observed by a CHA geotechnical engineer, who ensured proper drilling and sampling methods were utilized for the investigation, inspected and classified soil samples, and prepared field logs documenting the subsurface conditions.

Asphalt cores were taken at each soil boring and were submitted to KTA-Tator, Inc. for laboratory testing.

All the soil borings were advanced with a truck mounted drill rig using solid stem augers (SSA) with an outside flight diameter of 4.25 inches. Split spoon sampling and standard penetration tests were generally conducted continuously in the soil borings to 10.4 feet. The split spoon sampler was driven with a 140(±) pound hammer free falling 30(±) inches, in general accordance with American Society for Testing and Materials (ASTM) guidelines (D-1586). "Blow counts" are recorded on the soil boring logs, and indicate the penetration resistance for a six-inch advancement of the split spoon sampler. Initially, the sampler is driven six inches to seat the sampler in undisturbed material. The number of blows required to drive the sampler the next 12 inches is taken as the standard penetration resistance, or "N" value. This value is indicative of the soil's in-place compactness or consistency. The final six-inch increment that the sampler is driven is not included in the determination of "N". Refusal is defined as a resistance of greater than 50 blows per six inches of penetration.

Clough Harbour & Associates LLP

Wesleyan University Running Track
Forensic & Design Study
4.0 SUBSURFACE CONDITIONS

4.1 Regional Geology

According to the *Surficial Materials Map of Connecticut* (Stone, J.R., et al., 1992), the subsurface soils at the site are mapped as thin till (less than 15 feet thick), generally sandy and stony with fine grained till deposited subglacially, and derived of red Mesozoic sedimentary rocks of the central lowland of CT.

According to the *Bedrock Geological Map of Connecticut*, (Rodgers, J., 1985), the underlying bedrock at the site is mapped as Portland Arkose of lower Jurassic, and is mainly reddish-brown to maroon arkose and siltstone. The bedrock may also consist of red to black fissile silty shale.

4.2 Subsurface Stratigraphy

Subsurface conditions encountered in the soil borings are detailed and described on the subsurface logs included in Appendix B of this report. Soil borings B-9 and B-10 extended only to a depth of 0.4 feet, which included the rubber track surface and the bituminous asphalt. The subsurface conditions are generally described below, in order of increasing depth:

**Rubber Track Surface** – A synthetic rubber track surface approximately 0.4 inches thick was encountered in all soil borings.

**Bituminous Asphalt** – A bituminous asphalt layer was encountered in all soil borings, and was approximately 0.5 feet thick in B-1, 0.4 feet thick in B-2 through B-6, B-9 and B-10, and 0.3 feet thick in B-7 and B-8.

**Granular Subbase** – A gray to brown granular subbase, consisting of fine to coarse sand and fine to coarse gravel with trace amounts of silt, was encountered below the asphalt to approximate depths ranging from 0.7 feet to two feet in all soil borings except B-4. The granular subbase varied in
thickness from 0.3 feet to 1.6 feet. The granular subbase was visually classified as moist, and based on standard penetration tests the relative density was compact to very compact.

**Fill** – A brown, gray, white and black layer of fill was encountered below the asphalt or granular subbase in soil borings B-4, B-5 and B-7 to approximate depths ranging from 4.0 feet to 6.4 feet. The fill varied in thickness from three feet to six feet. The major components of the fill consisted of fine to coarse sand. The fill also contained variable amounts of fine to coarse gravel, silt and organics. The fill was visually classified as moist, and based on standard penetration tests the relative density was very loose to very compact.

**Silt** – A gray and brown silt was encountered below the sand or fill in soil borings B-3, B-4, B-5 and B-7. The silt varied in thickness from 1.3 feet to 3.2 feet. The silt contained varying amounts of fine sand and trace organics. The sand was visually classified as moist to wet with increasing depth, and based on standard penetration tests the consistency was soft to very stiff.

**Sand** – A brown, reddish brown and gray fine to medium sand was encountered in all soil borings. The sand layer occurred below the granular subbase in soil borings B-1, B-2, B-3, B-6 and B-8, as well as below the silt layer in B-4, B-5 and B-7, and typically extended to soil boring termination. The sand contained varying amounts of coarse sand, fine to coarse gravel, trace organics and trace silt, except in soil borings B-2 and B-8, which contained a layer with little to some silt below a depth of four feet below the ground surface. The sand was visually classified as moist to wet with increasing depth, and based on standard penetration tests the relative density was medium compact to very compact.

**Boulders or Cobble**s – Boulders or cobbles were encountered throughout soil borings B-1, B-2, B-3, B-6 and B-8.
4.3 Groundwater

Groundwater was encountered in all soil borings, except B-3, ranging in depth below the ground surface from 6.3 feet to 8.5 feet. Seasonal factors, for example temperature and precipitation, also affect groundwater levels; therefore, water levels may differ from those encountered in the soil borings.
5.0 RECOMMENDATIONS & CONCLUSIONS

5.1 Project Forensic Conclusions

Based upon the subsurface investigation, as well as an understanding of the history of the site and past performance of the running track, we conclude that bubbling of the rubber track surface is not caused by the subsurface soils or any near-surface groundwater. This conclusion is based upon the following points:

1. The existing subbase and subgrade soils are not frost susceptible.

2. The groundwater was not encountered any shallower than about six feet below the existing ground surface, and therefore would not contribute to potential excessive water vapor leaching upward through the asphalt, or any frost heave action immediately below the asphalt.

3. The immediate subbase and subgrade soils contain less than 10% fines, and thereby should allow any water infiltrating below the asphalt to drain freely to the subsurface drainage system.

4. The fill soils encountered are typically very compact below the track.

5. The trace organics encountered in some of the soil borings are minor and would not likely result in large settlements or depressions below the track.

6. Any distress in the running track, due either to frost heave or settlement of the subsurface soils, would have been visually evident by depressions or swells across the running track surface. Visual observation conducted and recorded (see the photographs included in Appendix C) during the subsurface investigation showed no depressions or swells.
5.2 Running Track Mitigation or Replacement

We understand that the existing running track section may be proposed for mitigation or replacement. The existing subgrade soils are typically compact, based on standard penetration tests, and are suitable to support a new running track section. In addition, the existing subgrade soils are free draining and should prevent water from accumulating in new subbase soils.

The proposed new subbase shall be underlain by a six ounce per square yard or heavier, non-woven geotextile with an apparent opening size (AOS) equal to or smaller than the U.S. Standard sieve size of 70 (such as Amoco 4506). The geotextile will provide a physical separation between the granular subbase and the sand subgrade, and prevent migration of the granular subbase material into the sand subgrade.

5.2.1 Site Preparation

The natural sand or fill subgrade soils below the proposed running track section should be compacted with a smooth drum roller with a weight of at least 10 tons while operating in the static mode. The roller should complete at least six passes at a speed not to exceed 3 feet per second. Areas that tend to “pump” or “weave” under the passing roller should be undercut by at least 12 inches and stabilized with structural fill. The subgrade shall be graded to match the final cross slope to be achieved at the running track surface elevation.

5.2.2 Structural Fill

Structural fill shall comprise of non-plastic, sound, durable, granular particles free of organic, frozen or other deleterious materials meeting the gradation requirements specified below as determined by a washed sieve analysis (ASTM D-422). Structural fill shall be placed in loose lifts not exceeding eight inches in thickness and shall be compacted using a vibratory compactor to at least 95% of the maximum laboratory dry density as determined by the standard Proctor test (ASTM D 698). Actual lift thickness shall be based upon the type of compaction equipment used.
Table 1: Gradation Requirements for Structural Fill

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
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<tbody>
<tr>
<td>4 inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 40</td>
<td>0 to 70</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 to 10</td>
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5.2.3 Control of Water

Groundwater was typically encountered in the soil borings at a depth below the running track surface of six feet or more. Although the proposed running track replacement should not extend any deeper than two to four feet below the existing surface elevation, project specifications should require that the contractor maintain groundwater at a minimum depth of two feet below excavation bottom at all times to maintain dry and stable conditions.

Dewatering methods suitable for this site include the use of sumps, diversion and drainage ditches, toe drains and other similar methods. Pumps should be of sufficient capacity to control the groundwater, and operated in a manner which will limit the withdrawal of fines. It is recommended that pumps be installed in sumps lined with a filter fabric and crushed stone. The filter fabric shall be a six ounce per square yard or heavier, non-woven filter fabric with an apparent opening size (AOS) equal to or smaller than the U.S. Standard sieve size of 70 (such as Amoco 4506). The crushed stone shall be similar to CTDOT No. 6 material.

Surface runoff should always be diverted away from excavations during construction.

Seasonal factors, for example temperature and precipitation, affect groundwater levels; therefore, water levels may differ from those described in this report.
6.0 EXCAVATIONS

All excavations should be performed in accordance with the Occupational Safety and Health Administration (OSHA) standards and applicable state and local codes. In areas where sufficient sloping of excavation cuts is not possible, the excavation should be shored, sheeted and braced. The design of a temporary excavation system shall be designed by a registered Professional Engineer in the State of Connecticut.
7.0 OBSERVATION DURING CONSTRUCTION

The final bearing surface for the running track section should be carefully inspected by a qualified geotechnical engineer to ascertain that the subgrade has been properly prepared. The inspection of the subgrade should include probing at select locations, specifically where the subgrade soils may have been disturbed.

The materials used as fill should be tested by a qualified soils laboratory to verify that they meet the specified gradations and to determine their maximum dry density for compaction. In-place density tests should be performed to verify that compaction methods and equipment used for compaction achieve the required densities.
8.0 CLOSURE

The geotechnical recommendations presented in this report are based, in part, on project and subsurface information available at the time this report was prepared, and in accordance with generally accepted soil engineering practices. No other warranty, expressed or implied, is made. Some variation of subsurface conditions may occur from the locations explored that may not become evident until construction. Depending on the nature and extent of the variations, it may be necessary to reevaluate the recommendations presented in this report.
APPENDIX A

FIGURES
APPENDIX B
SOIL BORING LOGS
Subsurface Logs present material classifications, test data, and observations from subsurface investigations at the subject site as reported by the inspecting geologist or engineer. In some cases, the classifications may be made based on laboratory test data when available. It should be noted that the investigation procedures only recover a small portion of the subsurface materials at the site. Therefore, actual conditions between borings and sampled intervals may differ from those presented on the Subsurface Logs. The information presented on the logs provides a basis for an evaluation of the subsurface conditions and may indicate the need for additional exploration. Any evaluation of the conditions reported on the logs must be performed by Professional Engineers or Geologists.

1. **SAMP/CORE NUMBERS** - Samples are numbered for identification on containers, laboratory reports or in test reports.
2. **SAMP ADVANCE/CORE** - Length of sampler advance or length of coring run measured in feet.
3. **RECOVERY** - Amount of sample actually recovered after withdrawing sampler or core barrel from bore hole measured in feet.
4. **SAMPLE BLOWS/FT** - Unless otherwise noted, blow counts represent values obtained by driving a 2.0" (OD), 1.5/8" (ID) split spoon sampler into the subsurface strata with a 140 pound weight falling 30" as per ASTM D 1586. After an initial penetration of 6" to seat the sampler into undisturbed material, the sampler is then driven on additional 2 or 3 six inch increments.
5. **"n" VALUE OR ROD % - **The sum of the second and third sample blow increments is generally termed the Standard Penetration Test (SPT) "n" value. CORE ROD - Core Rock Quality Designation, ROD, is defined as the summed length of all pieces of core equal to or larger than 4 inches divided by the total length of the coring run. Fresh, irregular breaks distinguishable as being caused by drilling or recovery operations are ignored and the pieces are counted as intact lengths. ROD values are valid only for cores obtained with NX size core barrels.
6. **SAMPLE** - Graphical presentation of sample type and advance or core length. See Table 1.
7. **DEPTH** - Depth as measured from the ground surface in feet.
8. **GRAPHICS** - Graphical presentation of subsurface materials. See Table 4. Dual soil classification and rock classification may vary and are not shown on Table 4.
9. **DESCRIPTION AND CLASSIFICATION** - Soil - Recovered samples are visually classified in the field by the supervising geologist or engineer unless otherwise noted. Particle size and plasticity classification is based on field observations and using the Unified Soil Classification System (USCS). See Table 4. USCS symbols are presented in parentheses following the soil description. Where necessary, dual symbols may be used for combinations of soil types. Relative proportions, by weight one/or plasticity, are described in general accordance with "Suggested Methods of Test for Identification of Soils" by D.M. Buurman, ASTM Special Publication 479, 6-1970. See Table 2. Soil density or consistency description is based on the penetration resistance. See Table 3. Soil moisture description is based on the observed wetness of the soil recovered being dry, moist, wet, or saturated. Water introduced into the bore during drilling may affect the moisture content of the materials. Other geologic terms may also be used to further describe the subsurface materials. ROCK - Rock core descriptions are based on the inspector’s observations and may be examined and described in greater detail by the project engineer or geologist. Terms used in the description of rock core are presented in Table 5.
10. **DIVISION LINES** - Division lines between deposits are based on field observations and changes in recovered material. Solid lines depict contacts between two deposits of different geologic depositional environment of known elevation. Dashed lines represent estimated elevation of contacts between two deposits of different geologic depositional environment. Dotted lines depict transitions of deposits within the same depositional environment, such as grain size or density.
11. **ELEVATION** - Elevation of strata changes in feet.
12. **REMARKS** - Miscellaneous observations.
13. **WATER LEVELS & WELL DATA** - Hollow water level symbol, if present, represents level at which first saturated sample or water level was encountered. Solid water level symbol, if present, depicts the most probable static water elevation at the time of drilling or as measured in an installed observation well at a later date. Subsurface water conditions are influenced by factors such as precipitation, strataligraphic composition, and drilling/coring methods. Conditions at other times may differ from those described on the logs. For graphical presentation of observation/monitoring well construction, see Table 6. Elevation of changes in construction are noted at the bottom of each section.
### Table 1: Typical Sample Types

<table>
<thead>
<tr>
<th>Sample Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split Spoon (1 3/8&quot; I.D.)</td>
</tr>
<tr>
<td>NX Size Rock Core</td>
</tr>
<tr>
<td>Shelby Tube &quot;Undisturbed&quot;</td>
</tr>
<tr>
<td>Auger Sample</td>
</tr>
</tbody>
</table>

### Table 2: Sample Material Proportions

<table>
<thead>
<tr>
<th>Adjective</th>
<th>Percentage of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;and&quot;</td>
<td>35% - 50%</td>
</tr>
<tr>
<td>&quot;some&quot;</td>
<td>20% - 35%</td>
</tr>
<tr>
<td>&quot;little&quot;</td>
<td>10% - 20%</td>
</tr>
<tr>
<td>&quot;trace&quot;</td>
<td>&lt; 10%</td>
</tr>
</tbody>
</table>

Standard split spoon samples may not recover particles with any dimension larger than 1 3/8". Therefore, reported gravel percentages may not reflect actual conditions.

### Table 3: Density/Consistency

<table>
<thead>
<tr>
<th>Granular Soils</th>
<th>Cohesive Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Consistency</td>
</tr>
<tr>
<td>&lt; 5</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>Very Loose</td>
<td>Very Soft</td>
</tr>
<tr>
<td>5-10</td>
<td>2-4</td>
</tr>
<tr>
<td>Loose</td>
<td>Soft</td>
</tr>
<tr>
<td>11-30</td>
<td>5-8</td>
</tr>
<tr>
<td>Med. Compact</td>
<td>Med. Stiff</td>
</tr>
<tr>
<td>31-50</td>
<td>9-15</td>
</tr>
<tr>
<td>Compact</td>
<td>Stiff</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>16-30</td>
</tr>
<tr>
<td>Very Compact</td>
<td>Very Stiff</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>Hard</td>
</tr>
</tbody>
</table>

### Table 4: USCS Classification, Particle Size, & Graphics

<table>
<thead>
<tr>
<th>Major Particle Size Division</th>
<th>USCS Symbol</th>
<th>Graphic Symbol</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Grained Soils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravel</td>
<td>GW</td>
<td></td>
<td>Well graded gravels, gravel &amp; sand mix.</td>
</tr>
<tr>
<td>Classification based on &gt; 50% being gravel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse: 3&quot; - 3/4&quot;</td>
<td>GP</td>
<td></td>
<td>Poorly graded gravels, gravel &amp; sand mix.</td>
</tr>
<tr>
<td>Fine: 3/4&quot; - #4</td>
<td>GM</td>
<td></td>
<td>Gravel, sand and silt mix.</td>
</tr>
<tr>
<td>Classification based on &gt; 50% being sand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>SW</td>
<td></td>
<td>Well graded sand, sand &amp; gravel mix.</td>
</tr>
<tr>
<td>Classification based on &gt; 50% being sand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse: #4 - #10</td>
<td>SP</td>
<td></td>
<td>Poorly graded sand, sand &amp; gravel mix.</td>
</tr>
<tr>
<td>Medium: #10 - #40</td>
<td>SM</td>
<td></td>
<td>Sand and silt mix.</td>
</tr>
<tr>
<td>Fine: #40 - #200</td>
<td>SC</td>
<td></td>
<td>Sand and clay mix.</td>
</tr>
<tr>
<td>Silts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification based on &gt; 50% passing #200 sieve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification based on &gt; 50% passing #200 sieve</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Organic Soils                |             |                |                     |
| Classification based on > 50% passing #200 sieve |

### Table 5: Rock Classification Terms

<table>
<thead>
<tr>
<th>Hardness</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft</td>
<td>Carves</td>
</tr>
<tr>
<td>Soft</td>
<td>Grooves with knife</td>
</tr>
<tr>
<td>Med. Hard</td>
<td>Scratched easily with knife</td>
</tr>
<tr>
<td>Hard</td>
<td>Scatched with difficulty</td>
</tr>
<tr>
<td>Very Hard</td>
<td>Cannot be scratched with knife</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weathering</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>Slight or no staining of fractures, little or no discoloration, few fractures.</td>
</tr>
<tr>
<td>Slightly</td>
<td>Fractures stained, discoloration may extend into rock 1&quot;, some soil in fractures.</td>
</tr>
<tr>
<td>Moderately</td>
<td>Significant portions of rock stained and discolored, soil in fractures, loss of strength.</td>
</tr>
<tr>
<td>Highly</td>
<td>Entire rock discolored and dull except quartz grains, severe loss of strength.</td>
</tr>
<tr>
<td>Complete</td>
<td>Weathered to a residual soil</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bedding</th>
<th>Fracture Spacing</th>
<th>RQD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massive</td>
<td>&gt; 40&quot;</td>
<td>Excellent &gt; 90%</td>
</tr>
<tr>
<td>Thick</td>
<td>12&quot; - 40&quot;</td>
<td>Good 76% - 90%</td>
</tr>
<tr>
<td>Medium</td>
<td>4&quot; - 12&quot;</td>
<td>Fair 51% - 75%</td>
</tr>
<tr>
<td>Thin</td>
<td>&lt; 4&quot;</td>
<td>Poor 25% - 50%</td>
</tr>
<tr>
<td>V. Thin/Close</td>
<td>2 1/2 - 8&quot;</td>
<td>V. Poor &lt; 25%</td>
</tr>
</tbody>
</table>

### Table 6: Well Construction

<table>
<thead>
<tr>
<th>Well Construction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid PVC Pipe</td>
<td></td>
</tr>
<tr>
<td>Screened PVC Pipe</td>
<td></td>
</tr>
<tr>
<td>Bentonite Plug</td>
<td></td>
</tr>
<tr>
<td>Stainess Steel</td>
<td></td>
</tr>
<tr>
<td>Air Entrained</td>
<td></td>
</tr>
<tr>
<td>Natural Soil/</td>
<td></td>
</tr>
<tr>
<td>Screened Pipe</td>
<td></td>
</tr>
<tr>
<td>Rock Fill</td>
<td></td>
</tr>
<tr>
<td>Bentonite/</td>
<td></td>
</tr>
<tr>
<td>Cement Grout</td>
<td></td>
</tr>
<tr>
<td>Washed Sand</td>
<td></td>
</tr>
</tbody>
</table>
Wesleyan University Running Track
SUBSURFACE LOG
HOLE NUMBER B-1

PROJECT NUMBER: 13722.2000.1502
LOCATION: Middletown, Connecticut
CLIENT: Wesleyan Univ. Office of Construction Services
CONTRACTOR: New England Boring Contractors
DRILLER: T. Roe
INSPECTOR: M. Bianchino
START DATE and TIME: 10/19/2004 9:30:00 AM
FINISH DATE and TIME: 10/19/2004 10:37:00 AM
SURFACE ELEV: 129.30 (ft; Estimated)
CHECKED BY: W. Harris

DRILL FLUID: None
DRILLING METHOD: 4.25" SSA

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>READING TYPE</th>
<th>WATER LEVEL OBSERVATIONS DURING DRILLING</th>
<th>WATER DEPTH (ft)</th>
<th>CASING BOTTOM (ft)</th>
<th>HOLE BOTTOM (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-19-04</td>
<td>10:22 AM</td>
<td>During Drilling</td>
<td>6.5</td>
<td>N/A</td>
<td>8.5</td>
<td></td>
</tr>
</tbody>
</table>

SAMP. CORE NUMBER (m), SAMP. ADV. (m), LENGTH (m), RECOVERY (m), Blows Per on Split Spoon Sampler, "N" Value or RQD, %, SAMPLE, DEPTH (Feet), GRAPHICS, DESCRIPTION AND CLASSIFICATION

C-1: 0.5, 0.5, Asphalt

S-1: 2, 1.3, 18-26-26-21, 52, f.m. SAND Some f.c. Gravel, brown, v. compact, moist (SP)

S-2: 2, 1.1, 23-25-29-30, 54, f.m. SAND Some f.c. Gravel, trace silt, brown/orange, v. compact, moist (SP)

S-3: 2, 1.7, 23-21-16-16, 37, f.m. SAND Some f.c. Gravel, trace silt, gray, compact, moist (SP)

S-4: 2, 1, 18-20-19-17, 39, f.m. SAND Some f.c. Gravel, trace silt, brown, m. compact, wet (SP)

S-5: 2, 1.5, 11-13-16-23, 29, End of Boring at 10.5 ft

Water used for asphalt track core at 0 to 0.5 feet.

Boulders and cobbles encountered throughout boring.

Groundwater level interpreted based on soil sample moisture content.

Remarks on Character of Drilling, Water Return, etc.

WATER LEVELS AND/OR WELL DATA
Wesleyan University Running Track
SUBSURFACE LOG
HOLE NUMBER B-2

DRILL FLUID: None
DRILLING METHOD: 4.25" SSA

DATE: 10-19-04
TIME: 11:15 AM
READING TYPE: During Drilling
WATER DEPTH (ft): 8.4
CASING BOTTOM (ft): N/A
HOLE BOTTOM (ft): 10.4

SURFACE ELEVATION: 129.30 (ft; Estimated)

<table>
<thead>
<tr>
<th>SAMPLE CORE NUMBER</th>
<th>BLOWS PER</th>
<th>&quot;N&quot; VALUE OR RODD%</th>
<th>&quot;N&quot; VALUE OR RODD%</th>
<th>GRAPHICS</th>
<th>DESCRIPTION AND CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-1</td>
<td>2</td>
<td>1.5</td>
<td>15-22-23-28</td>
<td>45</td>
<td>RUBBER TRACK SURFACE ASPHALT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>f.m.c. SAND Some f. Gravel, gray/brown, compact, moist (SUBBASE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>f.m.c. SAND little f.c. gravel, trace silt, brown, compact, moist (SP)</td>
</tr>
<tr>
<td>S-2</td>
<td>2</td>
<td>0.8</td>
<td>38-64-34-18</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>S-3</td>
<td>2</td>
<td>1.5</td>
<td>5-4-10-18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>S-4</td>
<td>2</td>
<td>1.4</td>
<td>15-9-14-14</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>S-5</td>
<td>2</td>
<td>1.6</td>
<td>13-15-16-19</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

Remarks on Character of Drilling, Water Return, etc.

- Water used for asphalt track core at 0 to 0.4 feet.
- Cobble wedged in spoon.
- Organic odor in sample S-3.
- Groundwater level interpreted based on soil sample moisture content.

End of Boring at 10.4 ft
Wesleyan University Running Track
SUBSURFACE LOG
HOLE NUMBER B-3

DATE: 10-19-04 12:10 PM
READING TYPE: During Drilling
WATER LEVEL OBSERVATIONS DURING DRILLING:

Drill Fluid: None
Drilling Method: 4.25" SSA
Water Level: 10.5 ft

Surface Elevation: 129.70 ft (Estimated)
Checked by: W. Harris

Sample Core Number | Sample Adv. (in) | Blows Per Core | Value or Rod% | Sample Depth (Feet) | Description and Classification
--- | --- | --- | --- | --- | ---
C-1 | 0.4 | 0.4 |  |  | Rubber Track Surface
S-1 | 2 | 1.5 | 21-23-26-29 | 49 | Asphalt
S-2 | 1 | 0.8 | 34-120/5 | R |
S-3 | 2 | 1.5 | 23-29-29-31 | 58 | F.m. Sand, little f. gravel, brown/grey, compact, moist (SP)
S-4 | 2 | 1.7 | 32-30-29-30 | 59 | F.m. Sand, little f. gravel, trace silt, brown, v. compact, moist (SP)
S-5 | 2 | 1.8 | 8-11-14-15 | 25 | Silts, little f. sand, brown, v. stuff, moist (ML)

End of Boring at 10.5 ft

Remarks on Character of Drilling, Water Return, etc.: Spoon refusal @ 3.4' and hard augering to 4.5' interpreted to be boulder or cobble.
Water used for asphalt track core at 0 to 0.4 feet.
Wesleyan University Running Track
SUBSURFACE LOG
HOLE NUMBER B-4

DRILL FLUID: None
DRILLING METHOD: 4.25" SSA

DATE | TIME | READING TYPE | WATER DEPTH (ft) | CASING BOTTOM (ft) | HOLE BOTTOM (ft)
--- | --- | --- | --- | --- | ---
10-19-04 | 1:45 PM | During Drilling | 6.4 | N/A | 8.4

WATER LEVEL OBSERVATIONS DURING DRILLING

SURFACE ELEV. 123.30 (ft, Estimated)
CHECKED BY: W. Harris

SUMMARY

SAMPLE NUMBER | SAMP. ADV. (ft) | LBM. CORE (ft) |blows per on split spoon sampler | ‘N’ Value or ROD % | SAMPL. DEPTH (ft) | GRAPHICS | DESCRIPTION AND CLASSIFICATION |
--- | --- | --- | --- | --- | --- | --- | ---
C-1 | 0.4 | 0.4 | | | | | RUBBER TRACK SURFACE ASPHALT |
S-1 | 2 | 1.6 | 19-20-34-47 | 54 | | | f.m.c. SAND little f.c. gravel, trace silt, brown/gray/white/black, v. compact, moist (FILL) |
S-2 | 2 | 1.2 | 33-30-21-25 | 51 | | | becomes v. loose (FILL) |
S-3 | 2 | 1.8 | 4-3-1-2 | 4 | | | SILT, little organics, trace f. gravel, brown/black/white/gray, soft, moist (FILL) |
S-4 | 2 | 1.7 | 4-3-3-3 | 6 | | | SILT, trace organics, gray/brown, m. stiff, moist/wet (ML) |
S-5 | 2 | 2 | 2-7-10-20 | 17 | | | f.m.c. SAND trace f. gravel, brown, m. compact, wet (SP) |

End of Boring at 10.4 ft

Remarks on Character of Drilling, Water Return, etc.

ELEVATION (ft)

128
126
124
122
120
118

1. Water used for asphalt track core at 0 to 0.4 feet.
3. Groundwater level interpreted based on soil sample moisture content.
## Wesleyan University Running Track Subsurface Log

**HOLE NUMBER B-5**

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>READING TYPE</th>
<th>WATER LEVEL OBSERVATIONS DURING DRILLING</th>
<th>WATER DEPTH (ft)</th>
<th>CASING BOTTOM (ft)</th>
<th>HOLE BOTTOM (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-19-04</td>
<td>2:30 PM</td>
<td>During Drilling</td>
<td>-</td>
<td>8.4</td>
<td>N/A</td>
<td>10.4</td>
</tr>
</tbody>
</table>

**Location:** Middletown, Connecticut  
**Client:** Wesleyan Univ. Office of Construction Services  
**Contractor:** New England Boring Contractors  
**Driller:** T. Roe  
**Inspector:** M. Blanchino  
**Start Date and Time:** 10/19/2004 2:05:00 PM  
**Finish Date and Time:** 10/19/2004 2:40:00 PM  
**Surface Elevation:** 129.70 (ft; Estimated)  
**Checked By:** W. Harris

<table>
<thead>
<tr>
<th>Sample Core Number</th>
<th>Sampling Advance Rate (%)</th>
<th>Blows Per on Split Spoon Sampler</th>
<th>% Value of Rod by Sample</th>
<th>Depth (Feet)</th>
<th>Description and Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
<td>RUBBER TRACK SURFACE ASPHALT</td>
</tr>
<tr>
<td>S-1</td>
<td>2</td>
<td>1.5</td>
<td>31-28-28-36</td>
<td>56</td>
<td>f.c. GRAVEL, gray, v. compact, moist</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SUBBASE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>f.m. SAND, Some f.c. Gravel, trace silt, brown/gray, v. compact, moist (FILL)</td>
</tr>
<tr>
<td>S-2</td>
<td>2</td>
<td>1.1</td>
<td>14-16-10-9</td>
<td>26</td>
<td>f.m. SAND, trace silt, trace f. gravel, brown/gray/black, m. compact, moist (FILL)</td>
</tr>
<tr>
<td>S-3</td>
<td>2</td>
<td>1.3</td>
<td>6-3-1-2</td>
<td>4</td>
<td>f.m. SAND, little silt, trace f.c. gravel, trace organics, brown/gray/black, v. loose, moist (FILL)</td>
</tr>
<tr>
<td>S-4</td>
<td>2</td>
<td>2.2</td>
<td>3-2-2-3</td>
<td>4</td>
<td>SILT, trace organics, trace f. sand, gray/brown, soft, moist (ML)</td>
</tr>
<tr>
<td>S-5</td>
<td>2</td>
<td>1.5</td>
<td>10-14-14-15</td>
<td>28</td>
<td>becomes wet (ML)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>f.m. SAND, trace f. gravel, brown, m. compact, wet (SP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>End of Boring at 10.4 ft</td>
</tr>
</tbody>
</table>

- **Remarks on Character of Drilling, Water Return, etc.:** Water used for asphalt track core at 0 to 0.4 feet.
- **Remarks on Soil Levels and/or Well Data:** Organic odor in sample S-3.
- **Remarks on Groundwater Level:** Groundwater level interpreted based on soil sample moisture content.
### SUBSURFACE LOG
#### HOLE NUMBER B-6

**Wesleyan University Running Track**

**PROJECT NUMBER:** 13722.2000.1502  
**LOCATION:** Middletown, Connecticut  
**CLIENT:** Wesleyan Univ. Office of Construction Services  
**CONTRACTOR:** New England Boring Contractors  
**DRILLER:** T. Roe  
**INSPECTOR:** M. Bianchino  
**START DATE and TIME:** 10/19/2004 2:45:00 PM  
**FINISH DATE and TIME:** 10/19/2004 4:00:00 PM  
**SURFACE ELEV.** 129.60 (ft; Estimated)  
**CHECKED BY:** W. Harris

<table>
<thead>
<tr>
<th>SAMPLE NUMBER</th>
<th>SAMPLING DEPTH (ft)</th>
<th>N' Value of Rod</th>
<th>Recovery</th>
<th>Blows Per on Split Spoon Sampler</th>
<th>GRAPHICS</th>
<th>DESCRIPTION AND CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td>RUBBER TRACK SURFACE ASAPHALT</td>
</tr>
<tr>
<td>S-1</td>
<td>2</td>
<td>1.5</td>
<td>23-23-21-32</td>
<td>44</td>
<td></td>
<td>t.c. GRAVEL, gray, compact, moist (SUBBASE)</td>
</tr>
<tr>
<td>S-2</td>
<td>2</td>
<td>1.4</td>
<td>27-24-44-24</td>
<td>68</td>
<td></td>
<td>b.c. SAND, little t.c. gravel, reddish brown, compact, moist (SP)</td>
</tr>
<tr>
<td>S-3</td>
<td>1.6</td>
<td>1</td>
<td>13-13-20-50/0.1</td>
<td>33</td>
<td></td>
<td>becomes compact (SP)</td>
</tr>
<tr>
<td>S-4</td>
<td>2</td>
<td>1</td>
<td>8-7-6-10</td>
<td>13</td>
<td></td>
<td>Spoon refusal @ 6' and hard augering to 6.5' interpreted to be boulder or cobble. Groundwater level interpreted based on soil sample moisture content.</td>
</tr>
<tr>
<td>S-5</td>
<td>2</td>
<td>2</td>
<td>7-8-9-10</td>
<td>17</td>
<td></td>
<td>End of Boring at 10.5 ft</td>
</tr>
</tbody>
</table>

**DRILL FLUID:** None  
**DRILLING METHOD:** 4.25" SSA  
**DRILLING OBSERVATIONS:**

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>READING TYPE</th>
<th>WATER DEPTH (ft)</th>
<th>CASING BOTTOM (ft)</th>
<th>HOLE BOTTOM (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-19-04</td>
<td>3:45 PM</td>
<td>During Drilling</td>
<td>6.5</td>
<td>N/A</td>
<td>8.4</td>
</tr>
</tbody>
</table>

**WATER LEVEL OBSERVATIONS DURING DRILLING:**

- 6.5 ft during drilling
- N/A after drilling
- 8.4 ft bottom of hole
### Subsurface Log

**Wesleyan University Running Track**
**Hole Number B-7**

**Drill Fluid:** None
**Drilling Method:** 4.25" SSA

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Reading Type</th>
<th>Water Depth (ft)</th>
<th>Casing Bottom (ft)</th>
<th>Hole Bottom (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20-04</td>
<td>8:45 PM</td>
<td>During Drilling</td>
<td>6.3</td>
<td>N/A</td>
<td>8.3</td>
</tr>
</tbody>
</table>

**Date and Time:**
- **Start:** 10/20/2004 8:15:00 AM
- **Finish:** 10/20/2004 9:00:00 AM

**Surface Elevation:** 129.40 (ft; Estimated)
**Checked By:** W. Harris

### Sampling Table

<table>
<thead>
<tr>
<th>Sample</th>
<th>Core</th>
<th>ADV. (IN)</th>
<th>Recovery (%)</th>
<th>Blows Per on Split Spoon Sampler</th>
<th>N Value</th>
<th>R Value</th>
<th>Sample Depth (Feet)</th>
<th>Description and Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rubber Track Surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asphalt</td>
</tr>
<tr>
<td>S-1</td>
<td>2</td>
<td>1.3</td>
<td></td>
<td>27-28-25-52</td>
<td>53</td>
<td></td>
<td></td>
<td>F.m.c. Sand some f. Gravel, brown/gray, v. compact, moist (Subbase)</td>
</tr>
<tr>
<td>S-2</td>
<td>2</td>
<td>0.8</td>
<td></td>
<td>37-22-20-12</td>
<td>42</td>
<td></td>
<td></td>
<td>F.m.c. Sand little f.c. gravel, reddish brown, v. compact, moist (Fill)</td>
</tr>
<tr>
<td>S-3</td>
<td>2</td>
<td>1.7</td>
<td></td>
<td>2-13-15</td>
<td>17</td>
<td></td>
<td></td>
<td>F.m.c. Sand little f.c. gravel, Trace silt, brown, gray, compact, moist (Fill)</td>
</tr>
<tr>
<td>S-4</td>
<td>2</td>
<td>1.6</td>
<td></td>
<td>13-15-15-18</td>
<td>30</td>
<td></td>
<td></td>
<td>F.m.c. Sand reddish brown, m. compact, moist (SP)</td>
</tr>
<tr>
<td>S-5</td>
<td>2</td>
<td>1.3</td>
<td></td>
<td>11-13-22-25</td>
<td>35</td>
<td></td>
<td></td>
<td>F.m.c. Sand trace silt, trace f. gravel, reddish brown, m. compact, moist/wet (SP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>End of Boring at 10.3 ft</td>
</tr>
</tbody>
</table>

**Remarks on Character of Drilling, Water Return, etc.:**
- Water used for asphalt track core at 0 to 0.3 feet.
- Organic odor in sample S-3.
- Groundwater level interpreted based on soil sample moisture content.

**Water Levels and/or Well Data:**

- Elevation (Feet): 128, 126, 124, 122, 120, 118
<table>
<thead>
<tr>
<th>SAMPLE NUMBER</th>
<th>SAMP. ADV. (ft)</th>
<th>LEN. CORE (ft)</th>
<th>Blows Per on Split Spoon Sampler</th>
<th>'% Value of ROD%'</th>
<th>SAMPLE DEPTH (Feet)</th>
<th>GRAPHICS</th>
<th>DESCRIPTION AND CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>RUBBER TRACK SURFACE</td>
<td>ASPHALT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>f.m.c. SAND Some f.c. Gravel, trace silt, red/brown/gray, v. compact, moist (SUBBASE)</td>
</tr>
<tr>
<td>S-1</td>
<td>2</td>
<td>1.5</td>
<td>18-24-35-34</td>
<td>59</td>
<td>2</td>
<td></td>
<td>f.m. SAND little f.c. gravel, brown, v. compact, moist (SP)</td>
</tr>
<tr>
<td>S-2</td>
<td>1.1</td>
<td>0.4</td>
<td>38-80-50/0.1</td>
<td>R</td>
<td>4</td>
<td></td>
<td>f.m. SAND Some f.c. Gravel, brown/gray, v. compact, moist (SP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Boulders/Cobbles</td>
</tr>
<tr>
<td>S-3</td>
<td>2</td>
<td>1.1</td>
<td>19-19-22-22</td>
<td>41</td>
<td>6</td>
<td>f.m. SAND trace silt, trace f.c. gravel, brown, compact, moist (SP)</td>
<td></td>
</tr>
<tr>
<td>S-4</td>
<td>2</td>
<td>1.5</td>
<td>13-19-24-28</td>
<td>43</td>
<td>8</td>
<td>f.SAND Some Silt, little f.c. gravel, brown, compact, moist/wet (SM)</td>
<td></td>
</tr>
<tr>
<td>S-5</td>
<td>2</td>
<td>1.6</td>
<td>11-17-22-28</td>
<td>39</td>
<td>10</td>
<td>f.m. SAND little f. gravel, trace silt, brown, compact, moist/wet (SP)</td>
<td></td>
</tr>
</tbody>
</table>

Water used for asphalt track core at 0 to 0.3 feet.

Spoon refusal @ 3.4' and hard augering to 4.3' interpreted to be boulder or cobbles.

Groundwater level interpreted based on soil sample moisture content.

End of Boring at 10.3 ft
Wesleyan University Running Track
SUBSURFACE LOG
HOLE NUMBER B-9

PROJECT NUMBER: 13722.2000.1502
LOCATION: Middletown, Connecticut
CLIENT: Wesleyan Univ. Office of Construction Services
CONTRACTOR: New England Boring Contractors
DRILLER: T. Roe
INSPECTOR: M. Bianchino
START DATE and TIME: 10/20/2004 9:20:00 AM
FINISH DATE and TIME: 10/20/2004 10:00:00 AM
SURFACE ELEV: 129.30 (ft; Estimated)

Drill Fluid: Water
Drilling Method: 4" Thin Wall

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>READING TYPE</th>
<th>WATER DEPTH (ft)</th>
<th>CASING BOTTOM (ft)</th>
<th>HOLE BOTTOM (ft)</th>
</tr>
</thead>
</table>

Water Level Observations During Drilling

SAMP. CORE NUMBER | SAMP. ADV. (ft) | LEN. CORE (ft) | Blows Per on Split Spoon Sampler | "N" Value or ROD% | SAMPLE DEPTH (Feet) |
------------------|----------------|----------------|---------------------------------|----------------|---------------------|
C-1               | 0.4            | 0.4            |                                 |                 |                     |

Description and Classification

- Rubber Track Surface
- Asphalt
  - End of Boring at 0.4 ft

Remarks on Character of Drilling, Water Return, etc.

Water used for asphalt track core at 0 to 0.4 feet.
**Wesleyan University Running Track**

**SUBSURFACE LOG**

**HOLE NUMBER B-10**

**DRILL FLUID:** Water  
**DRILLING METHOD:** 4" Thin Wall  

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>READING TYPE</th>
<th>WATER DEPTH (ft)</th>
<th>CASING BOTTOM (ft)</th>
<th>HOLE BOTTOM (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WATER LEVEL OBSERVATIONS DURING DRILLING**

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>READING TYPE</th>
<th>WATER DEPTH (ft)</th>
<th>CASING BOTTOM (ft)</th>
<th>HOLE BOTTOM (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SURFACE ELEV:** 129.50 (ft, Estimated)  
**CHECKED BY:** W. Harris

**SAMPLE NUMBER**

<table>
<thead>
<tr>
<th>SAMP. NUMBER</th>
<th>SAMP. ADV. (N) LEN. RECOVERY</th>
<th>Blows Per on Split Spoon Sampler</th>
<th>&quot;N&quot; Value or ROD% SAMPLE</th>
<th>DEPTH (Feet)</th>
<th>DESCRIPTION AND CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>0.4</td>
<td>0.4</td>
<td>1</td>
<td>128</td>
<td>RUBBER TRACK SURFACE ASPHALT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>126</td>
<td>End of Boring at 0.4 ft</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>124</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>122</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>118</td>
<td>Water used for asphalt track core at 0 to 0.4 feet.</td>
</tr>
</tbody>
</table>

**ELEVATION (Feet)**  
**Remarks on Character of Drilling, Water Return, etc.**  
**WATER LEVELS AND/OR WELL DATA**
APPENDIX C
SITE PHOTOGRAPHS
Orange cone at boring location B-2, looking southeast.
(October 20, 2004)

Orange cones at boring locations B-5 and B-4, left to right, looking east.
(October 20, 2004)
Set-up on boring location B-7, looking west.
Orange cone on far right is boring location B-6.
(October 20, 2004)

Set-up on boring location B-8, looking west;
(October 20, 2004)
Boring location B-9, looking northeast.
(October 20, 2004)

Approximate location of boring B-10 in the 'D', looking northeast.
(October 20, 2004)
Orange cone at boring location B-9, looking northeast.
(October 20, 2004)

Track and field, looking southwest.
(October 20, 2004)
Appendix D
Typical asphalt core.
(October 20, 2004)
Mr. David Savage  
Clough, Harbour & Associates, LLP  
III Winners Circle  
P.O. Box 5269  
Albany, NY 12205-0269

SUBJECT: Results of Determination of the Presence or Absence of Contamination;  
KTA Project No. 240889

Dear Mr. Savage:

In accordance with your request received on November 16, 2004, KTA-Tator, Inc. (KTA) has examined two (2) coated asphaltic core samples in order to determine the presence or absence of contamination between disbonded layers. This report describes the testing procedures employed and contains the results of the testing.

SAMPLES

The following samples were received from Clough, Harbour & Associates on November 16, 2004:

Sample KTA-1 – One 4” diameter asphaltic core with red aggregate/rubber topcoat, labeled “B8.”

Sample KTA-2 – One 4” diameter asphaltic core with red aggregate/rubber topcoat, labeled “B10.”

The following samples were received from Clough, Harbour & Associates on November 23, 2004:

Sample KTA-3 – One 4” diameter asphaltic core with disbonded red aggregate/rubber topcoat, labeled “B4.”

Sample KTA-4 – One 4” diameter asphaltic core with disbonded red aggregate/rubber topcoat with black asphaltic material, labeled “B9.”

It should be noted that at no time did KTA-Tator, Inc. personnel visit the job site or witness the taking of the above samples.
BACKGROUND

Sample KTA-3 ("B4") was reported by Clough, Harbour & Associates to have been taken from an area where liquid-filled blisters were observed at the site. Sample KTA-4 ("B9") was suspected by Clough, Harbour & Associates to have been contaminated with oil prior to disbondment of the topcoat and some adhered asphaltic material.

LABORATORY INVESTIGATION

The laboratory investigation consisted of infrared spectroscopic analysis and SEM-EDS of Sample KTA-3 ("B4") and infrared spectroscopy on Sample KTA-4 ("B9") for potential contamination of each. Samples KTA-1 and KTA-2 were not tested because they were not representative of the disbondment. After viewing these samples initially, new samples were requested. The results of the analyses are provided below. Four microphotographs are appended to this report at the client’s request to show magnification of the synthetic rubber layer and the asphaltic material.

Infrared Spectroscopy

Infrared spectroscopic analysis was performed with a Mattson Galaxy Model 3020 fourier transform infrared spectrometer. Sample scrapings were combined with potassium bromide powder and formed into pellets under high pressure. The pellets were then placed in the optical path of the spectrometer and spectra were obtained over the range of 4000 to 400 cm\(^{-1}\). Two spectra were obtained and are appended.

Briefly, the analysis revealed the following:

1. The spectrum obtained from an uncontaminated portion of the bituminous layer of Sample KTA-4 (Core B9) taken from 1/2" beneath the surface (Spectrum No. 1) was consistent with a hydrocarbon-based material. The presence of aliphatic hydrocarbons was evidenced by characteristic spectral bands near 2923, 1460, 1380, and 780 cm\(^{-1}\). The presence of silicates was evidenced by spectral bands in the 1100-1000 cm\(^{-1}\) region.

2. The spectrum obtained from the exposed disbondment surface of the bituminous layer of Sample KTA-4 (Spectrum No. 2) was nearly identical to Spectrum No. 1. No increase in hydrocarbon bands was observed to indicate oil contamination of the bituminous surface.

Scanning electron microscopy-energy dispersive x-ray spectroscopy (SEM-EDS)

SEM-EDS was performed on Sample KTA-3 ("B4") for potential contamination using a R. J. Lee scanning electron microscope equipped with an energy dispersive x-ray spectrometer. Sample preparation involved mounting a section of the specimen on a metallic stub. Four microphotographs were obtained and are appended.
Briefly, the analysis revealed the following:

1. The elemental spectrum (Spectrum No. 1) obtained from a portion of uncontaminated synthetic rubber material taken from a depth of 1/4" from beneath the surface of Sample KTA-3 ("B4") revealed the composition to be carbon, oxygen, silicon, and aluminum.

2. Three elemental spectra obtained from separate areas of the disbonded surface of the synthetic rubber material of Sample KTA-3 (arbitrarily labeled A, B, and C) were similar to Spectrum No. 1, with the exception of an increased amount of silicon and the presence of magnesium, sulfur, calcium, and iron. It is likely that the presence of these elements was due to environmental contamination of the surface of the asphaltic layer and inadequate removal prior to application of the synthetic rubber layer.

DISCUSSION

The submitted core sample B4 was found to have contamination on the delaminated surface that may have contributed to the reported blistering observed in the field. Core sample B9 was not found to contain evidence of suspected oil contamination. The laboratory investigation is relative to the samples received in the laboratory. The type of failure in the two submitted samples varied. Sample Core B9 exhibited a cohesive split within the bituminous layer while Sample B4 was an adhesive split between the bituminous substrate and the synthetic rubber coating. Since these samples varied as to the type of failure, it appears that additional information could be obtained from a field visit. A more conclusive cause for the blistering may be apparent with additional samples obtained during that field visit.

If you have any questions or comments regarding this report, please do not hesitate to contact this office.

Very truly yours,

KTA-TATOR, INC.

Carly M. Pravlik
Chemist

Cynthia L. O'Malley
Laboratory Manager

CMP/VDS/CLO/RAH:jas
JN240889 - (JAS04503)

NOTICE: This report represents the opinion of KTA-TATOR, INC. This report is issued in conformance with generally acceptable industry practices. While customary precautions were taken to insure that the information gathered and presented is accurate, complete, and technically correct, it is based on the information, data, time, materials, and/or samples afforded. This report should not be reproduced except in full.
INDEX OF INFRARED SPECTRA

Spectrum 1 – Sample KTA -4, uncontaminated bituminous layer, KBr pellet

Spectrum 2 – Sample KTA-4, delaminated surface (bottom), KBr pellet
Microphotograph No. 1
B4, cross-section of synthetic rubber, 8X

Microphotograph No. 2
B4, synthetic rubber layer, 20X
Microphotograph No. 3
B9, forcefully delaminated surface (bituminous layer), 8X

Microphotograph No. 4
B9, bottom half, previously delaminated surface (bituminous layer), 8X
SEM-EDS MICROPHOTOGRAPHIC APPENDIX

The following pictorial references contain three quadrants. The upper left quadrant contains the view of the sample. The right upper quadrant is the portion of the sample analyzed. The bottom quadrant contains the spectrographs of the elemental analysis.

SEM-EDS MICROPHOTOGRAHPH NO. 1
B4, good area (taken from 1/4" depth), 29X

SEM-EDS MICROPHOTOGRAHPH NO. 2
B4, delamination surface, 18X
SEM-EDS MICROPHOTOGRAPH NO. 3
B4, delamination surface, 16X

SEM-EDS MICROPHOTOGRAPH NO. 4
B4, delaminated surface, 17X