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Field Testing and Inspections

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To: Raymond Perkins
Richland County School District One
Stevenson Administration Building
1616 Richland Street
Columbia, SC 29201

From: ASET Services, Inc.
6598 E Canton S Boston Rd
Salem, IN 47167
USA

Mr Perkins,

Per our conversation last week during the inspection, I promised to deliver a letter about the safety and performance of the field at SC Flora as it relates to current standards.

The field was tested for Gmax per ASTM F1936. All values for Gmax were well below the 200 g limit. ASET also checked the depth of infill at SC Flora and found no unsafe conditions with regard to infill.

Currently, ASTM F1936 is the only safety standard that is mandatory for a synthetic turf field, and this field easily complies with F1936. The depth of infill varied by as much as 1/4" during the inspection but the field had been top-dressed minutes before we inspected it.

There are some depressions within the field that should be addressed but they do not exceed deviations that would be present in many natural turf fields, and there is no standard with regards to a uniformly flat surface that a synthetic turf must adhere to in North America.

I did not find any instance where the properties of the field exceeded required safety and performance standards and created a situation that was unfit for use.

Sincerely,

Paul W. Elliott, Ph.D., P.E.

Date: April 22, 2019



Field Test & Inspection Report

Issued To:
Richland County School District One
Stevenson Administration Building
1616 Richland Street
Columbia SC, 29201
USA

Project Scope:
SC-Flora Site – Inspection of turf for Gmax, infill depth, planarity and overall condition of turf
5 Additional Site Visits - Visual inspection of fields, record infill depth

Date Tested: April 17-18, 2019
Report Number: 1936-041719-01

Summary:

- These findings represent the conditions present during ASET's inspection. They are not a guarantee or even a predictor of future performance or safety. Events can happen on any given day to compromise the performance of a synthetic turf system.
- The statements and findings discuss safety, which is 'the reduction of injury risk to acceptable levels'. They should not be interpreted to mean a field is safe, or 'without any risk'.
- ASET can not issue a statement that the field or fields involved in this project are safe to play on. How the term 'safe' is interpreted varies widely. Additionally, there is an inherent risk involved in participating in a sport or fitness activity. ASET is able to report on the performance present at SC Flora and to compare how SC Flora compares to the other facilities.
- ASET is able to state that the Gmax at SC Flora is well below 200 G's, the level often considered mandatory within North America, and that the field is acceptable for play under the requirements outlined in ASTM F1936.

-continued-

Notes:

1 – Key construction details are highlighted in Section 1 (page 3) of this report. Specifications and installation instructions containing these key details have been supplied and reviewed. Necessary tools and methods to achieve proper anchoring have also been addressed in the specification and installation instructions.

2 – This document contains enhanced digital and duplication security features. More information can be found on our website: www.asetervices.com/blog.

3 – This report contains 14 pages, and may not be used for commercial purposes unless it is reproduced in its entirety.

Summary – Continued-

- The average infill depth at AC Flora was found to be 1 inch at the time of the inspection, and compares favorably to the other schools that were inspected. The infill depth at AC Flora was equal to or exceeded the levels found at 4 of the schools.
- The infill depth at AC Flora appears to be sufficient based on the inspections from the other 5 schools that were visited.
- The fibers at SC Flora, WJ Keenum and Lower Richmond appear to be laying over more than the fibers at Memorial and Eau Claire. It was not possible to document the cause as it could be related to the fibers, the manufacturing of the turf, maintenance or use practices. ASET did not find the condition of the fibers to create an increased hazard.
- ASET is able to state that the Gmax at SC Flora is well below the 165 G's presented in the Synthetic Turf Council's guidelines, and that the field is acceptable for play under the STC's published guidelines regarding Gmax.
- During checks of planarity, it was determined that the field has multiple points where the elevation of the field varies by more than 18 mm from the straightened. ASET considers this to be a significant deviation from the industry standard but it does not violate any known safety standards, therefore it does not constitute a reason to consider the field unfit for play. However, these areas should be addressed and the planarity of the field should be restored to the industry standard of ¼ inch deviation from a plane in 10 ft.



To: Richland County School District One
Stevenson Administration Building
1616 Richland Street
Columbia SC 29201
USA

Subject: Field Inspection and Testing Per ASTM F1936

ASET Services, Inc was commissioned by the Richland County School District to inspect an existing turf field at the SC Flora school. The project was expanded once on site to include visits to 5 other schools for visual inspections and to document infill depths. The field at SC Flora was also to be tested to determine its current Gmax ratings using ASTM F1936.

The date of the testing was April 17-18, 2019.

1 Project Summary

ASET Services was commissioned to test and inspect the field at SC Flora. The project expanded to include visual inspections and infill depth tests at 5 other synthetic turf fields in the district.

ASET's assignment was to test and inspect SC Flora's field and document any conditions that were present that would compromise the safety (or reduction in injury risk) with regard to the synthetic turf's performance. ASET was also assigned the task of visiting 5 other schools where the infill depth and fiber conditions of each field were measured and documented. The data from the additional fields was used as another way of evaluating the conditions at SC Flora.

2 Testing Method Overview

This section discusses the methods and equipment used during the testing and inspection of Richland One's synthetic turf fields.

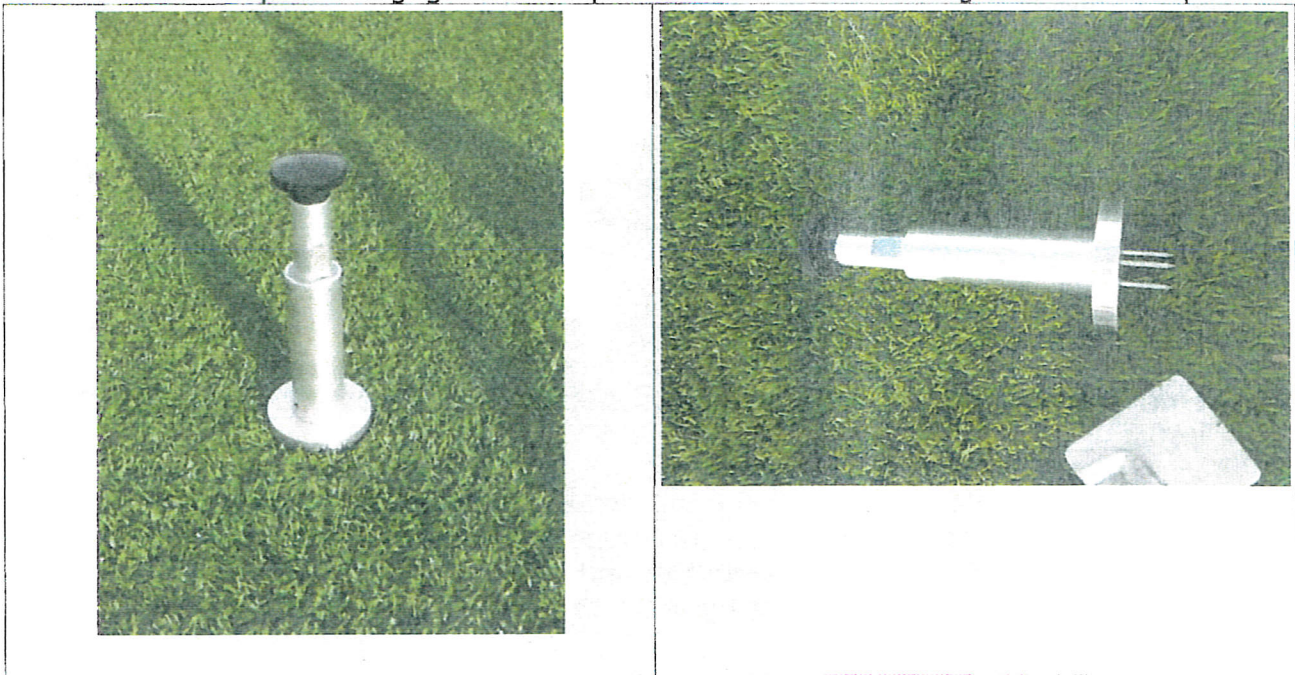
2.1Gmax:

ASET used a test device meeting the specifications of ASTM F1936. The device is shown in the following figure. During this test a 20 lb weight is dropped from a height of 24" above the playing field. The maximum force, or deceleration is measured, and presented in units of 'gravity' or 'g-forces'. A Gmax of 50 would mean that the weight experienced a deceleration of 50 times gravity, which would result in the 20 lbs mass exert a force of 1,000 lbs.



2.2 Infill Depth

ASET used a depth tool to determine the infill depth, which is shown below. The tool has thin shafts that are inserted into the infill until they reach the backing of the turf carpet. The gage has a depth scale for direct reading of the infill depth.



2.3 Planarity

ASET used a straight edge and a calibrated wedge block to determine the planarity of the surface. The straightedge is shown below. The system uses a 10 ft straightedge. The straight edge is placed on the turf and any gaps between the turf and the straight edge are measured with a calibrated wedge tool.



3 Field Test and Inspection Results

The following subsections contain the results from every field. Schematics are included when appropriate.

3.1 SC Flora

The ambient temperature was 85F, and the temperature of the infill was 105F during the inspection of SC Flora.

SC Flora was the most extensively tested, and inspected field during this engagement. The following tests were performed at SC Flora:

- Gmax Testing
- Infill Depth
- Planarity

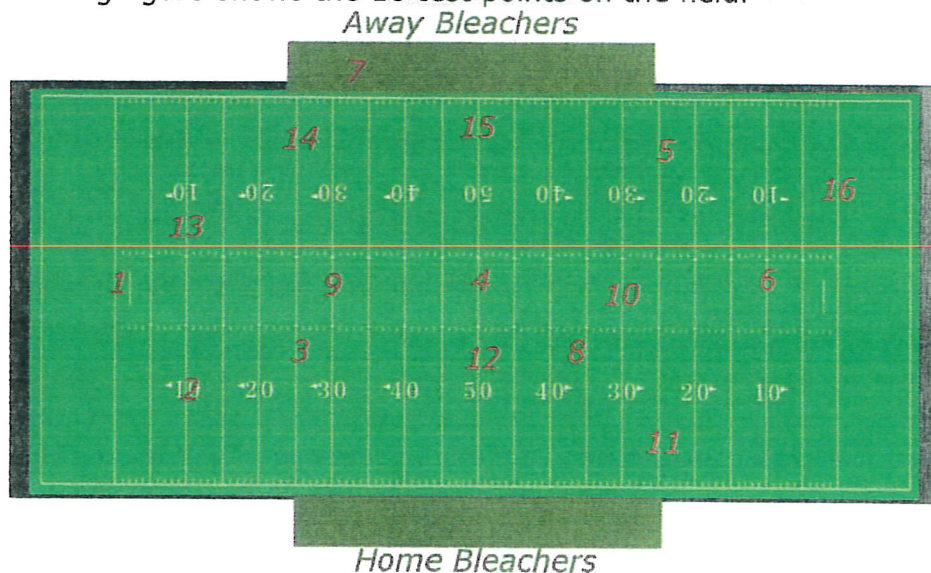
The field at SC Flora was also visually inspected for fiber condition (standing up or laying over).

The field as in the process of being top-dressed with additional infill at the time ASET arrived on site. This process was completed before testing or inspections were made. Such a recent top-dressing and grooming event could contribute to slight changes in the Gmax reading and infill depths readings as the new material settles over time.

The following is a schematic of the points where Gmax and Infill Depths were measured in the facility. The first 8 points are at locations mandated by ASTM F1936. Points 9 through 16 were selected by ASET Services to provide a more complete view of the fields performance.

Point	Description and Notes
1	Goal-Line Center of field
2	10 yard line ¼ distance from sideline to center of field
3	25 yard line 1/2 distance from sideline to center of field
4	Center of field
5	25 yard line ½ distance from sideline to center of field
6	12 yard line center of field
7	High use zone within play area
8	High use zone within play area
9	30 yard line center of field
10	30 yard line center of field
11	25 yard line ¼ distance from sideline to center of field
12	50 yard line ½ distance from sideline to center of field
13	10 yard line ½ distance from sideline to center of field
14	25 yard line ¼ distance from sideline to center of field
15	50 yard line ¼ distance from sideline to center of field
16	Goal line – in line with number markers

The following figure shows the 16 test points on the field.



The following table contains the Gmax and infill depth results at the 16 test points.

Point	Gmax	Infill Depth	Point	Gmax	Infill Depth
1	73	7/ 8	9	77	7/ 8
2	70	1 1/ 8	10	71	7/ 8
3	75	1 1/ 4	11	70	1
4	79	1 1/ 8	12	74	7/ 8
5	74	1 1/16	13	72	1
6	69	1 1/16	14	72	1
7	65	1 1/ 8	15	80	1
8	66	1 1/16	16	80	7/ 8
Overall Gmax Average			73		
Overall Infill Depth			1.01		

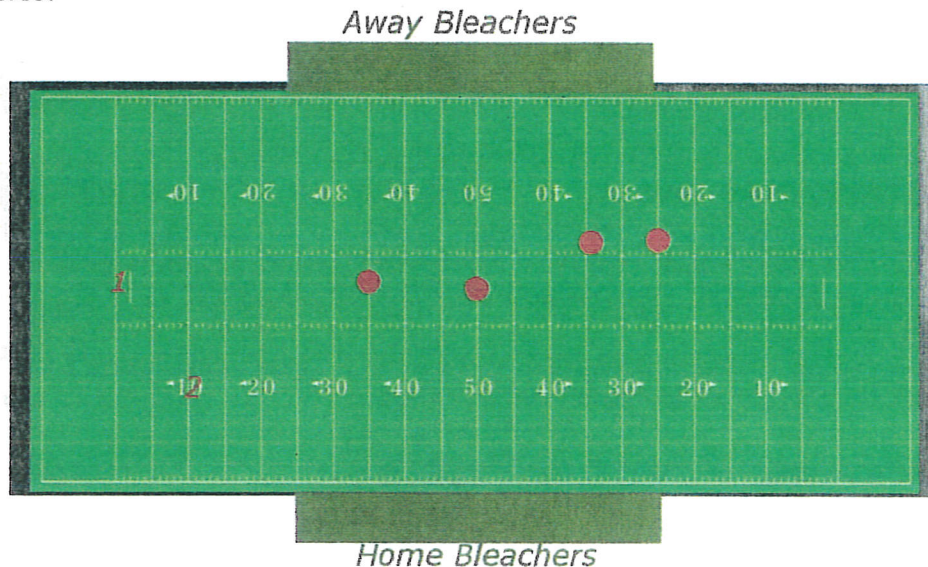
The field at SC Flora produced an average Gmax of 73, with a maximum value of 80 and a minimum value of 65. The average infill depth at SC Flora was 1.0 in with a maximum of 1-1/4" and a minimum of 7/8" .

ASTM F1936 establishes a maximum allowable level of 200 for the Gmax property of a turf field. This is the only mandatory requirement that ASET is aware of within North America. The Synthetic Turf Council® have published guidelines stating that synthetic turf fields not should exceed 165 during the life of the field. The guidelines from the Synthetic Turf Council are voluntary and are not mandatory within North America. While the project specification has not been reviewed, it is likely that the values for Gmax recorded during the testing are significantly lower than any that would be present in a specification.

There are no mandatory standard regarding infill depth in North America. It is possible that individual projects or products might include requirements in the specifications. At this time we have not found a specification posted on-line or been provided one by the school district to review. The Gmax values measured on this field conform to the mandatory requirements and also exceed the guideline published by the Synthetic Turf Council.

While the infill depth varied by approximately 3/8 inch, ASET is unaware of any decrease in safety or performance that would be associated with that level deviation. The system was found to have an average of 1" infill depth. Additionally, it is unknown what the difference will be once the field experiences some rain and athletic use to settle and compact the infill. FIFA which has very stringent rules regarding their systems requires infill to be within 15% of the specification. If the specification for these fields was 1" then the FIFA rules would allow a 0.3" range for infill depth, which is just slightly larger than measured during this inspection.

In addition to evaluating the surface for Gmax and Infill Depth, ASET also performed some random checks for the planarity of the surface. The figure below shows the locations of the 4 areas checked for planarity. The 4 locations are shown in circles.



One of the areas tested was at the center of the field where a hump was clearly visible. It was determined that this area produced an 8 mm change in elevation. The other three areas were where the field was clearly lower than nearby points, and each of the 3 test points produced an elevation change that was greater than 18 mm.

Most of the depressions were only 18 inches to 30 inches wide. We were unable to determine the cause of these localized depressions. The infill was checked in these four areas and in all cases it was found to be 1 inch to 1-1/8 inches. The depth of infill did not appear to be a significant cause for these dips. ASET was unable to determine the cause of the dips, but they are likely due to the planarity, or lack thereof, in the sub-base layers. It is impossible to know if these dips were present at the time of installation or if they have developed since the field was installed.

North American fields that are for football generally have a specification stating 'that the surface shall not vary from a true plane by more than 1/4" in 10 ft'. This would allow the surface to have a positive 1/4 inch mound and a negative 1/4 inch dip and still pass, and would create a spec that is equivalent to stating that the 'surface shall not deviate from the straightened by more than 12 mm.' There is no safety standard that specifies a maximum allowable deviation from planarity within

North America. This field has multiple points that exceed the industry standard of less than $\frac{1}{4}$ inch deviation from a true plane. Certainly there are natural turf fields that exceed the measurements reported here. While ASET does think that the elevation changes lead to a significant lack of planarity, there is no clear guidance provided by standards to indicate how non-uniform the surface can be before it becomes dangerous. ASET does not feel that the lack of planarity constitutes grounds for shutting down the field or deeming it unplayable, but ASET does advise that the school district work with the installer to improve the planarity of the playing surface at SC Flora.

3.2 Infill Depth Comparison

During the inspection ASET visited 5 other fields. One of the focuses during those inspections was determining the approximate infill depth at each field. The following table contains the identifying name of each school as well as the infill depth that was computed using the average of 3 readings obtained within the center circle of the soccer lines on each field.

School Name	Infill Depth		
	Max	Min	Avg
Memorial	1-1/4"	1-1/16"	1-5/32"
Eau Claire	1"	7/8"	7/8"
Columbia High School	1"	7/8"	7/8"
WJ Keenam	1"	7/8"	1"
Lower Richland	1-1/6"	1	1"
AC Flora (From table on pg 6)	1-1/4"	7/8"	1"

The infill depths at all fields were very similar with the exception of Memorial. Memorial had the deepest infill depth at 1-5/32". Memorial was found to be 5/32" (or 0.15") deeper than the AC Flora. The infill depth at Memorial measured 9/32" (0.28") more than Eau Claire and Columbia schools.

The average infill depth at AC Flora was found to be 1 inch at the time of the inspection, and compares favorably to the other schools that were inspected. This equaled or exceeded the infill depth at 4 of the other Richland One schools that were inspected, and only Memorial was found to have a deeper infill layer.

3.3 Fiber Inspection and General Comments

Another purpose of the visits to the other synthetic turf fields within Richland One's district was to see first hand the condition of the fibers. We have included some

photos from each facility in an attempt to document the fiber conditions present.



Memorial Field



Eau Claire

Columbia Photo Too Blurry to Use



WJ Keenam



Lower Richland



SC Flora

Mr Raymond Perkins of the Richland One District said that the school expressed concern that the fibers at SC Flora were laying over more than they were at other schools. During our inspections of the schools, each school had sections where the

fibers were standing straighter than other and sections where the fibers were laying over, or less vertical. The photo in the previous table are intended to represent some of what was present. One clear example was a comparison between the fibers at Eau Claire and the fibers at SC Flora. The fibers in the photo from SC Flora all tend to bend and point to the left of the photo, while the fibers in the photo from Eau Claire are more vertical, and random in their direction. The photos show that the fibers at three schools (SC Flora, Lower Richland, and WJ Keenam) had similar traits. The also show that the fibers at Memorial and Eau Claire tend to be more vertical.

The results are simply noted in this report. ASET does not find any of the differences in direction to be related to a safety issue. Also, the cause of the appearance differences is unknown. The field at SC Flora was brushed just minutes before ASET started the inspection there. The athletic use and maintenance that each field receives is unknown as well and that could have significant effects regarding the effect of the turf.

4) General Information

The following contains some general information regarding the lifespan of a synthetic turf field.

- Synthetic turf fields generally have a life span of 8-10 years under 'normal' use. Lightly used fields can sometimes last 12 years before needing to be replaced. Highly used fields can wear out within 4-5 years.
- Fields degrade over time due to use but they also degrade over time due to UV exposure.
- Maintenance practices can also cause a field to age or fail more quickly if they are not performed properly, or if they are performed too often.

Many of today's new turf systems are not doing a good job of retaining fibers during use and maintenance activities. ASET urges the Richland One School District to monitor the fibers removed during reconditioning and maintenance activities. If significant numbers of fibers being removed, then the grooming equipment, practices and frequency should be reconsidered in an attempt to retain fibers for as long as possible.



5 Conclusions

Testing and report generation was performed by Paul W. Elliott, PhD., P.E. of ASET Services, Inc. Dr Elliott maintains a PE in Indiana and Ohio. These services were rendered in South Carolina and are not presented as, and shall not be construed as performed by a professional engineer. The PE designation is used to reflect Dr Elliott's status and professionalism.

I hereby certify that the results presented in this report were obtained on the sample as described, on said date and are believed to be accurate representations of the performance of this sport surface system.

Paul W Elliott

Date: Oct 18, 2018

Paul W. Elliott, PhD, PE, CPSI

6 Limitations

The performance of an infilled system can change quickly. Therefore test reports are only an indication of what is present during our visit. They should not be used or viewed as predicting future performance.

Testing the field will be performed in a limited number of points (16). That is insufficient to characterize the entire playing surface/field. It is possible that points with significantly different performance will exist and will not be tested. While every attempt will be made to identify them, some times there are no visual cues.

ASET makes no warranties which extend beyond the results of the tests conducted by ASET. No statement by any employee, independent contractor or representative of ASET may be considered as a warranty or a statement of fitness of use of any sport surface system. In the event of an inspection, ASET will record the environmental conditions and the physical condition of the sports surface present at the time of the inspection. ASET will provide, upon request, a professional opinion on the status of the playing surface.

The standard of care for all engineering and related services performed or furnished by ASET under this Agreement will be the care and skill ordinarily used by members of the subject profession practicing under similar circumstances at the same time and in the same locality. ASET makes no warranties, expressed or implied, under this Agreement or otherwise, connection with ASET's services.

Paul Elliott, of ASET Services, is a licensed engineer in the States of Indiana and Ohio. The PE affixed to his name within this document is to indicate his general status. It does not imply that the work carried out during this field test will be done under his PE license, since he is not licensed in the State of Maryland.