Tifton Soil Testing Lab, LLC
689 Brighton Road
Tifton, Georgia 31794
(229) 382-7292
www.tiftonsoillab.com

ACCREDITED
TESTING CERT #1014.01

Date Received: March 18, 2026
Date Reported: March 26, 2026
Sample Number: L105B-26

Test Report For: Keiyo Country Club
802 Tabetacho, Wakaba Ward
Chiba 265-0066, Japan
Attn: Takayuki Takinami

RE: Aomori:Flattery Sand Mix Design

PHYSICAL ANALYSIS[1]

MIXES ANALYZED (% by Volume)			SATURATED HYDRAULIC CONDUCTIVITY in/hr	POROSITY (%)			BULK DENSITY g/cm³	WATER RETENTION AT FIELD CAPACITY %	CHEMICAL	
SAND Aomori	SAND Flattery	AMENDMENT		NON-CAPILLARY (air-filled)	CAPILLARY (water-filled)	TOTAL			pH[2]	EC mmhos/cm
100	0		50.2	32.2	12.3	44.5	1.47	8.4	6.6	
0	100		18.2	10.3	31.6	41.9	1.54	20.5	6.3	
80	20		40.1	28.1	14.9	43.0	1.51	9.9		
65	35		28.9	23.0	19.6	42.6	1.52	12.9		
50	50		26.4	19.0	23.3	42.3	1.53	15.2		
USGA Recommendations for Rootzone Mix:			≥ 6 in/hr.	15 - 30	15 - 25	35 - 55				

PARTICLE DENSITY[3] 2.65 g/cm³

PARTICLE SIZE ANALYSIS

SAMPLES	GRAVEL 2 mm %	SAND FRACTIONS (% Retained)[4]					SAND[5] 0.05-2 mm %	SILT[5] 0.002-0.05 mm %	CLAY[5] <0.002 mm %	ORGANIC MATTER[6] % by wt.
		VERY COARSE 1 mm	COARSE 0.5 mm	MEDIUM 0.25 mm	FINE 0.15 mm	VERY FINE 0.05 mm				
Aomori Sand	0.0	0.9	24.8	65.6	6.9	0.8	99.0	0.5	0.5	
Flattery Sand	0.0	0.0	1.9	40.8	49.1	8.2	100.0	0.0	0.0	
80:20 (by math)	0.0	0.7	20.2	60.6	15.3	2.3	99.2	0.4	0.4	
65:35 (by math)	0.0	0.6	16.8	56.9	21.7	3.4	99.4	0.3	0.3	
50:50 (by math)	0.0	0.5	13.4	53.2	28.0	4.5	99.5	0.3	0.3	
USGA Recommendations for a Rootzone Mix:	≤ 3% Gravel ≤ 10% Combined		≥ 60% Combined		≤ 20%	≤ 5%		≤ 5%	≤ 3%	

Note: Coarse Gravel (> 4 mm) should be 0%. Total fines (very fine sand, silt, and clay) should be ≤ 10% combined.

1. ASTM F1815 (Determined at 30 cm tension) 2. ASTM D4972 Method A (water) 3. ASTM D854 MOD 4. ASTM C136 5. Bouyoucos, 1962 6. ASTM F1647 Method A 7. F1632 Test Method 2 (Particle Shape)

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Attn: Takayuki Takinami

RE: Aomori:Flattery Sand Mix Design

Recommendation Form (Version 3) - Effective Date: 12/6/23

Recommendations:

The Aomori Sand was amended with the Flattery Sand on March 20, 2026, to develop a putting green rootzone mixture (greensmix) to develop a putting green rootzone mixture (greensmix) sand that meets USGA recommendations. The condition of the samples as received was normal.

The Aomori Sand is a medium sand (65.6% medium sand particles) that meets USGA particle size recommendations for a greensmix sand.

The Flattery Sand is a fine sand that has an excellent particle size for use as an amendment sand.

The Aomori Sand and the Flattery Sand have water permeability rates of 50.2 and 18.2 in/hr., respectively, when compacted by the USGA procedure ASTM F1815 to simulate a compacted golf green. Amending the Aomori Sand with 20, 35, and 50% Flattery Sand reduced the rate to 40.1, 28.9, and 26.4 in/hr., respectively. The USGA recommends a minimum water permeability rate of 6 in/hr.

The other physical properties of the 80:20 Mix do not meet all USGA recommendations because the capillary (water-filled) porosity is lower than the USGA recommended range.

By math, the 80:20 Mix is a medium sand (60.6% medium sand particles) that meets USGA particle size recommendations.

The 80:20 Mix has a Coefficient of Uniformity (CU) of 2.0, which is within the USGA recommended range of 2.0 - 3.5 for Pure Sand Rootzone Mixtures.

The 80:20 Mix has a soil water pH of 6.5 (5.6 $CaCl_2$), which is within the optimum pH range of 6.0 to 6.5 for turfgrass.

Conclusion: The 80:20 Aomori:Flattery Sand Mix is ready to mixed with peat to create a greensmix that meets all USGA recommendations. Since the goal is also to increase stability of this greensmix, we recommend using slightly more Flattery Sand. A mix design with peat will be performed using a 75:25 Aomori:Flattery Sand Mix.

Hope Mullis

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Attn: Takayuki Takinami

RE: Peat Mix Design

PHYSICAL ANALYSIS[1]

MIXES ANALYZED (% by Volume)			SATURATED HYDRAULIC CONDUCTIVITY in/hr	POROSITY (%)			BULK DENSITY g/cm³	WATER RETENTION AT FIELD CAPACITY %	CHEMICAL	
SOIL	SAND 75:25 A:F	AMENDMENT Peat		NON-CAPILLARY (air-filled)	CAPILLARY (water-filled)	TOTAL			pH[2]	EC mmhos/cm
	100	0	33.0	27.1	15.9	43.0	1.51	10.5	6.5	
	90	10	24.8	23.2	20.9	44.1	1.47	14.2	5.7	
	85	15	21.9	20.8	23.9	44.7	1.45	16.5		
	80	20	18.5	19.0	26.6	45.6	1.42	18.7		
USGA Recommendations for Rootzone Mix:			≥ 6 in/hr.	15 - 30	15 - 25	35 - 55				

PARTICLE DENSITY[3] 2.61-2.65 g/cm³

PARTICLE SIZE ANALYSIS

SAMPLES	GRAVEL 2 mm %	SAND FRACTIONS (% Retained)[4]					SAND[5] 0.05-2 mm %	SILT[5] 0.002-0.05 mm %	CLAY[5] <0.002 mm %	ORGANIC MATTER[6] % by wt.
		VERY COARSE 1 mm	COARSE 0.5 mm	MEDIUM 0.25 mm	FINE 0.15 mm	VERY FINE 0.05 mm				
90:10 Mix	0.0	0.7	19.1	59.1	17.3	2.9	99.0	0.5	0.5	0.78
USGA Recommendations for a Rootzone Mix:	≤ 3% Gravel ≤ 10% Combined		≥ 60% Combined		≤ 20%	≤ 5%		≤ 5%	≤ 3%	

Note: Coarse Gravel (> 4 mm) should be 0%. Total fines (very fine sand, silt, and clay) should be ≤ 10% combined.

1. ASTM F1815 (Determined at 30 cm tension) 2. ASTM D4972 Method A (water) 3. ASTM D854 MOD A 4. ASTM C136 5. Bouyoucos, 1962 6. ASTM F1647 Method A 7. F1632 Test Method 2 (Particle Shape)

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Attn: Takayuki Takinami

RE: Peat Mix Design

Recommendation Form (Version 3) - Effective Date: 12/6/23

Recommendations:

The 75:25 Aomori:Flattery Sand Mix was mixed with Peat on March 25, 2026, as requested by Keiyo Country Club, to develop a greensmix that meets USGA recommendations for a putting green rootzone mixture (greensmix). The condition of the sample as received was normal.

The Sand is a medium sand (59.1% medium sand particles) that meets USGA particle size recommendations.

The Sand is a silica sand with a soil water pH of 6.5 (5.6 $CaCl_2$).

The Sand has a water permeability rate of 33.0 in/hr. when compacted by the USGA procedure ASTM F1815 to simulate a compacted golf green. Amending this sand with 10, 15, and 20% loose Lambert Peat reduced the rate to 24.8, 21.9, and 18.1 in/hr., respectively. The USGA recommends a minimum water permeability rate of 6 in/hr. for a greensmix.

The other physical properties of the 90:10 and 85:15 Mixes meet all USGA recommendations for a greensmix.

The 90:10 Mix has 0.78% organic matter (peat) by weight as determined by the loss on ignition method (ASTM F1647). The 0.78% organic matter can serve as a reference to verify that 90:10 mixes made in the field using this same Sand and Peat have the same percent peat as the 90:10 Mix made in the lab.

The 90:10 Mix has a Coefficient of Uniformity (CU) of 2.1, which is within the USGA recommended range of 1.8 to 3.5 for Rootzone Mixtures with Peat.

The 90:10 Mix has a soil water pH of 5.7 (4.1 $CaCl_2$), which is lower than the optimum pH range of 6.0 to 6.5 for turfgrass. Lime application rate can be determined through chemical analysis.

Conclusion: The 90% 75:25 Aomori:Flattery Sand Mix and 10% Peat Mix meets all USGA recommendations for a greensmix.

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Gravel without Choker Form (Version 5) - Effective Date: 12/6/23
[1] ASTM C136

Gravel Recommendation When Intermediate (Choker) Layer is not Required

Rootzone Sieve Analysis[1] 90:10 Peat Mix	Particle Diameter (%)					
	2.0 mm	1.0 mm	0.50 mm	0.25 mm	0.15 mm	0.05 mm
% Retained (>D)	0.0	0.7	19.1	59.1	17.3	2.9
% Passing (<D)	100.0	99.3	80.2	21.1	3.8	0.9

From #L105-26 Report Gravel Sieve Analysis[1] Gravel	Particle Diameter (%)					
	6.3 mm	4.75 mm	3.35 mm	2.0 mm	1.0 mm	<1.0 mm
% Retained (>D)	0.4	1.8	34.5	58.4	3.1	1.8
% Passing (<D)	99.6	97.8	63.3	4.9	1.8	-

1. ***Bridging Factor:*** D_{15}(gravel)/D_{85}(rootzone) ≤ 8

4.16 mm ≤ 8

D_{15}(gravel) = 2.29 mm
D_{85}(rootzone) = 0.55 mm

The D_{15}(gravel) at 2.29 mm divided by D_{85}(rootzone) at 0.55 mm is 4.16 mm; which is less than or equal to (≤) 8. Therefore, bridging of the coarsest 15% rootzone particles should occur with the finest 15% gravel particles. This gravel is compatible with this sand.

Furthermore, the gravel should have 100% particles < 12 mm; ≤ 10% particles < 2 mm; and ≤ 5% particles < 1 mm.

2. ***Permeability Factor:*** D_{15}(gravel)/D_{15}(rootzone) ≥ 5

10.41 mm ≥ 5

D_{15}(gravel) = 2.29 mm
D_{15}(rootzone) = 0.22 mm

The D_{15}(gravel) at 2.29 mm divided by D_{15}(rootzone) at 0.22 mm is 10.41 mm; which is greater than or equal to (≥) 5. Therefore, adequate permeability should occur with this gravel and sand.

3. ***Uniformity Factor:*** D_{90}(gravel)/D_{15}(gravel) ≤ 3

1.89 ≤ 3

D_{90}(gravel) = 4.32 mm
D_{15}(gravel) = 2.29 mm

These results show that D_{90}/D_{15} is 1.89; which is less than 3.0.
Therefore, the Uniformity Coefficient of this gravel passes this criterion.

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Recommendation Form (Version 3) - Effective Date: 12/6/23

Recommendations:

The 90:10 Peat Mix and Gravel from the #L105-26 Report pass the three USGA criteria of bridging, permeability, and gravel uniformity coefficient for omitting the intermediate filter (choker) layer in USGA golf green construction. Therefore a choker layer is not required with this Greensmix and Gravel for USGA golf green construction.

These materials were tested for Keiyo Country Club on March 25, 2026, for USGA golf green construction without the intermediate (choker) layer.

Hope Mullis