April 7, 2021

Mr. Rick Blackburn
Blackburn Development Group, LLC
4709 Calmut Drive
Knoxville, TN 37919

ECS Project No. 26:4588-A

Reference: Seismic Site Classification Survey
Knoxville Head Start Western Heights - PSHA
Knoxville, Tennessee

Dear Mr. Blackburn:

As authorized by your acceptance of our proposal, ECS Southeast, LLP (ECS) has completed the probabilistic seismic hazard analysis (PSHA) for the proposed Head Start Building in Knoxville, Tennessee. This letter has been prepared to provide a summary of the results and conclusions with regard to this testing and analysis. This report should be included as an addendum to our original geotechnical report (ECS Report No. 26:4588) dated January 15, 2021

Probabilistic Seismic Hazard Analysis (PSHA):

The earthquake risk was estimated for a maximum considered earthquake ground motion having a 2-percent probability of exceedance within a 50-year period (2,475 year return period). The proprietary software program EZ-FRISK V7.62 was utilized to perform this analysis. This program incorporates earthquake return interval probability and peak ground and special accelerations on Site Class "B" conditions at a specific site location.

In the analysis, seismotectonic sources within the program are used for estimating site risk. EZ-FRISK includes a background seismotectonic source for the Central and Eastern United States (CEUS). This source is a variable seismicity source depending on location and is based on 2015 data from the United States Geological Survey (USGS). In addition to background seismicity, fault sources within the program are used to model areas historically known for large earthquakes. For the CEUS region of the United States, large historical earthquakes occurred in New Madrid, Missouri in 1812 (estimated magnitude of 7.8) and in Charleston, South Carolina in 1886 (estimated magnitude of 7.3). These areas are the most significant contributors to site risk within the region and are modeled within EZ-FRISK as fault sources. The combination of background seismicity and regional fault sources are the basis of the spectral parameters derived for this project site.

Earthquake motions generated by the seismotectonic sources were then attenuated to the site using attenuation relationships and methodology within EZ-FRISK. The attenuation relationships used in this analysis included Atkinson-Boore (1995), Campbell (2003), Somerville (2001), Toro (1997), and Abrahamson-Silva (1997), Boore-Joyner-Fumal (1997), Campbell-Bozorgnia (2003) and Sadigh (1997). These relationships were developed specifically to model earthquake

attenuation in the CEUS. The average of the appropriate spectral accelerations from these relationships was utilized in the determination of the design values.

The spectral accelerations determined by this PSHA are intended to be compared with those provided in ASCE 7-16. The ASCE 7-16 and PSHA spectral acceleration values for rock (Site Class "B") are provided in Table 1.

Table 1 - Summary of Parameters (Site Class "B")

Parameter	PSHA	IBC 2018
Spectral Accelerations at 0.2 sec S_s (g)	0.311	0.609
Spectral Acceleration at 1.0 sec S_1 (g)	0.079	0.132

The design values for structures at the ground surface must be calculated based on the appropriate site class determined from the characteristics of the subsurface profile. Based on the results of the Standard Penetration (SPT) borings conducted during our previous investigation, a seismic Site Class "D" is appropriate for this site. The IBC and the PSHA determined seismic parameters for a Site Class "D" are calculated in Table 2.

Table 2 - Summary of Seismic Parameters (Calculated for Site Class "D")

Parameter	PSHA	IBC 2018
F_a	1.55	1.313
F_v	2.4	2.335
S_{MS} (g) [S_s (g) x F_a]	0.482	0.800
S_{M1} (g) [S_1 (g) x F_v]	0.187	0.309

The IBC 2018 allows the use of site-specific procedures to determine the ground motion accelerations. When site-specific procedures (PSHA) are used to determine ground motions, the results are limited to 80% of the ground motions determined by the general spectral response acceleration determined by using IBC Code Section 1613. Table 3 summarizes the spectral parameters for the ground surface at the site based on the results in Table 3 for a seismic Site Class "D" and presents recommended values for design.

Table 3 - Parameters for Design (Site Class "D")

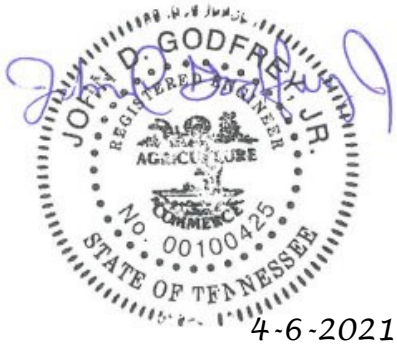
Parameter	PSHA	IBC 2018	PSHA/IBC	Recommended Design Values
S_{DS} (g) [S_{MS} (g) x 2/3]	0.321	0.533	60.3%	**0.427***
S_{D1} (g) [S_{M1} (g) x 2/3]	0.126	0.206	61.4%	**0.165***

*Design parameter limited to 80% of IBC value

Closing

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. ECS is not responsible for the conclusions, opinions, or recommendations made by others based on these data. No third party is given the right to rely on this report without express written permission. We appreciate this opportunity to be of service to you during the design phase of this project. If you have any questions with regard to the information and recommendations presented in this report, please do not hesitate to contact us.

Respectfully,
ECS SOUTHEAST, LLP



4-6-2021

Eric Gasiecki, P.E.
Geotechnical Department Manager

John D. Godfrey Jr., P.E.
Principal Engineer

Enclosed: PSHA Diagrams

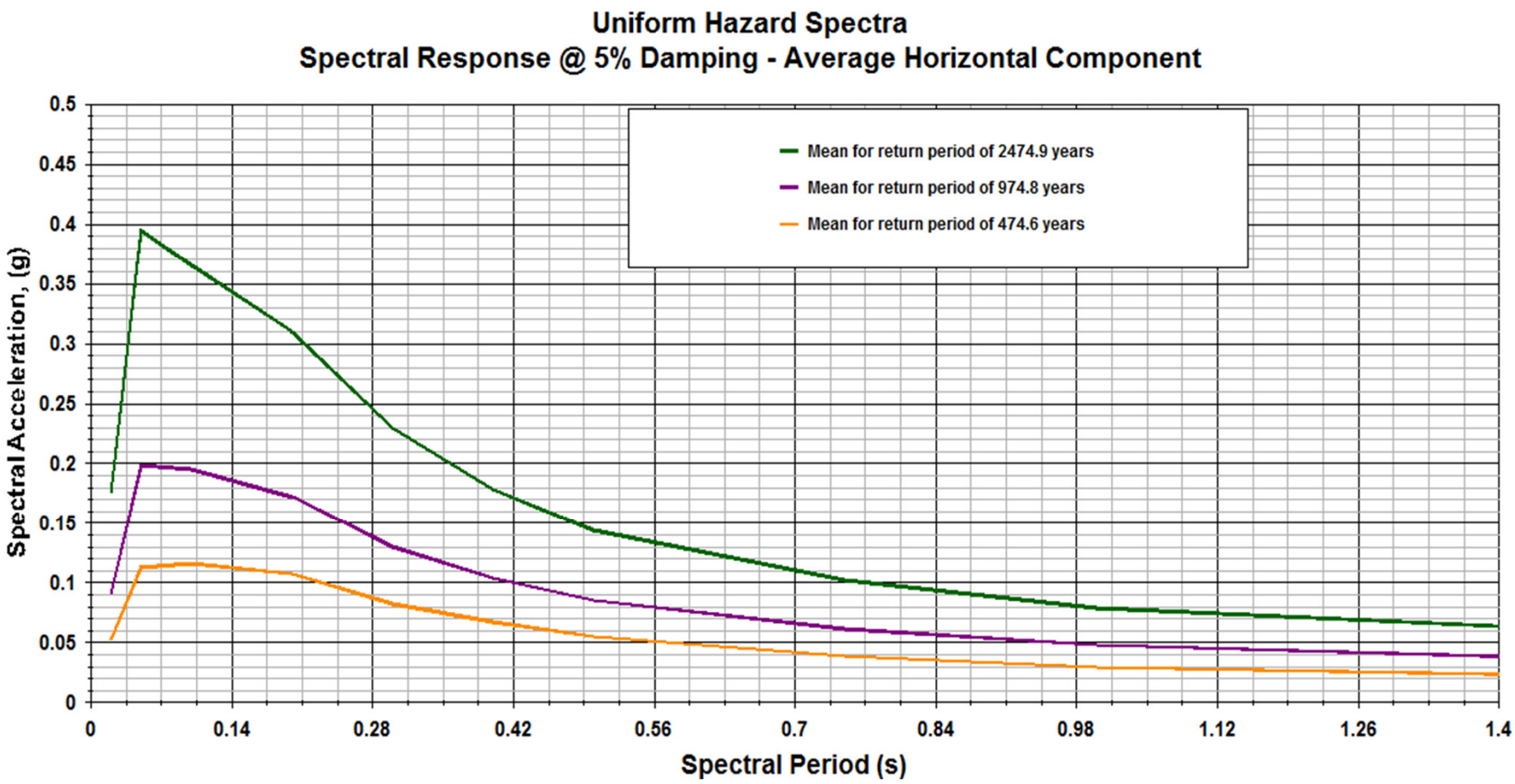


Figure 1 - Uniform Hazard Spectral Response

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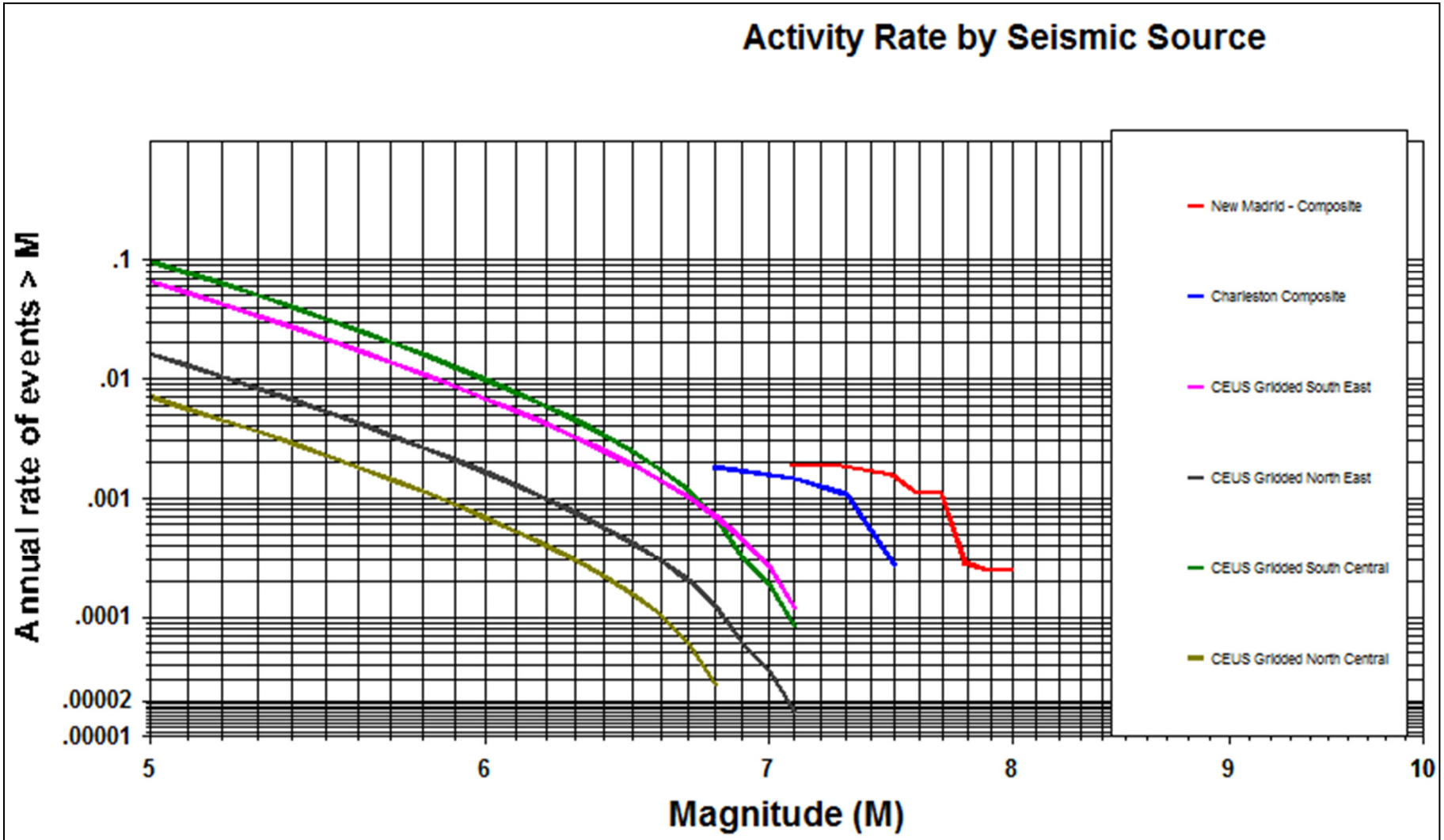

Figure 2 – Activity Rate by Source

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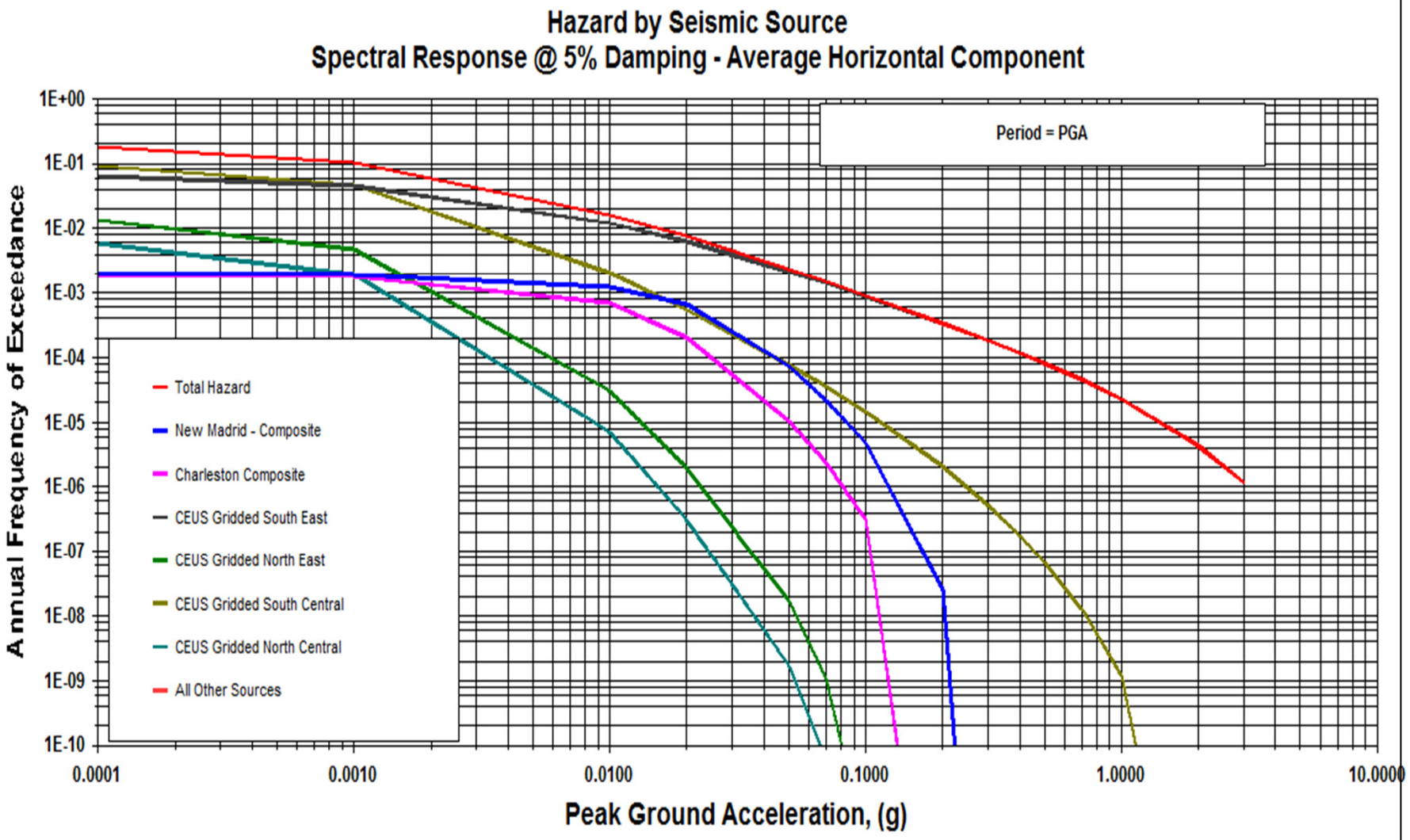

Figure 3 - Hazard by Seismic Source

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