TERRA ASSOCIATES, Inc.
Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

August 5, 2022
Project No. T-8264

Mr. Derek Cheshire
7615 East Mercer Way
Mercer Island, Washington 98040

Subject: Response to City of Mercer Island Comments
Cheshire Short Plat
7615 East Mercer Way
Mercer Island, Washington

References:
1. Geotechnical Report, Cheshire Short Plat, 7615 East Mercer Way, Mercer Island, Washington, Project No. T-8264, prepared by Terra Associates, Inc., dated May 12, 2020, revised August 5, 2022
2. Geotechnical Engineering Addendum, Cheshire Short Plat, 7615 East Mercer Way, Mercer Island, Washington, Project No. T-8264, prepared by Terra Associates, Inc., dated August 13, 2021
3. Geotechnical Peer Review Comments, prepared by City of Mercer Island, dated April 6, 2022

Dear Mr. Cheshire:

As requested, we have reviewed the referenced comments from the City of Mercer Island regarding the project site. The following is our response to the geotechnical comments.

**Page 1 – Comment #2**

*With the presence of groundwater and loose sand onsite provide calculations for review to verify there is sufficient Factor of Safety against liquefaction.*

**Response**

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of fine-grained sands underlying the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil's strength.

Soils do not offer a factor of safety against liquefaction. If the soils are going to liquefy during a seismic event then there is little that can be done to stop the soils from liquefying. What can be done is to complete an analysis to determine the potential impact should the soils liquefy.

We completed a liquefaction analysis using the computer program LiquefyPro published by CivilTech Corporation. The analysis was completed using a ground acceleration value of 0.62g, which is the ground acceleration for the maximum considered earthquake (MCE) for an earthquake with a 2,500 return-period. The value was determined using the U.S. Geological Survey (USGS) web-based Unified Hazard Tool.

The results of our analysis indicate soil liquefaction could occur during the design earthquake event, resulting in total settlements approaching approximately 2.8 inches, with one-half of that settlement likely being differential in nature. Results of the analysis are attached to this letter.

In our opinion, this amount of settlement would not structurally impact the building but would result in damage of a cosmetic nature. If the owner is not willing to accept the risk of cosmetic building damage requiring repair in the event of seismic-induced settlements occur, foundations would need to be supported on ground improved with stone columns or rammed aggregate piers. Based on our experience with similar sites and structures, structural design elements are also available to mitigate potential damage caused by the seismic-related soil settlements.

**Page 1 – Comment #3**

> *Given that the soil conditions presented in the geotechnical report are classified as landslide soils, use of shallow foundations to support the proposed structure would not be considered in conformance with geotechnical engineering standard of practice.*
>
> *Landslide soils are inherently variable to the point that use of an allowable soil bearing pressure is not appropriate since settlement will likely govern the performance of the foundation. Determining settlement on landslide soils is difficult, if not impossible given the lack of sufficient subsurface information or laboratory testing to support those calculations.*
>
> *Since excessive total or differential settlements of these landslide soils cannot be ruled out, an alternate foundation system should be considered.*

**Response**

We respectfully disagree with the reviewer's comment. The site soils are not classified as landslide soils, they are classified as silty SAND, SAND with gravel and SILT. All mineral materials with relatively densities predominantly in the medium dense to dense range. There was one sample in Test Boring B-1 that indicated some block zones that may be evidence of an ancient landslide, but this material was not observed in the other test boring and there is no evidence of widespread landslide deposits at the project site. Therefore, it is our opinion that the onsite soils are suitable for support of spread footing foundations and the typically engineering calculations used to determine potential settlement remain valid.

**Page 1 – Comment #4**

*The slope stability analyses for this site is based on one boring. One data point is not sufficient to construct a cross section. Please discuss how the cross section was determined as well as supporting data for the soil strengths used in the analyses. Specifically include discussion of how residual strengths were incorporated for soils characterized as landslide soil.*

**Response**

The slope stability has been revised and is based on two test borings completed in June 2022. As noted above there is no evidence of widespread landslide debris or evidence of a landslide plane. A slide plane would be needed to determine where to apply residual soil strengths. Therefore, using residual strengths for the stability analysis is overly conservative and is not based on onsite subsurface data.

**Page 1 – Comment #5**

*The geotechnical report indicates that there is not a landslide hazard as defined by MICC. Geologic (Troost and Wisher, 2006), groundwater conditions and soil boring information identify potential landslide conditions at this site.*

*The slope stability analyses may need to be revised following review of the soil strength information provided and results of liquefaction analyses.*

**Response**

While the geologic mapping may identify the potential for landslide conditions at the project site, typically the landslide potential is determined through onsite subsurface explorations along with site reconnaissance. The recent subsurface explorations identify a single sample in one test boring as blocky which is not necessarily an indication of a landslide. There was no other evidence of landslide debris in the test borings. As stated in the geotechnical report, there are no conditions onsite that meet the definition of a landslide hazard per the City of Mercer Island Code.

**Page 2 – Comment #1**

*There is also insufficient subsurface information for the location of proposed shoring along the west side of the structure. The type of shoring (ultrablock) requires an open cut. Will the open cut be stable to allow installation of the ultrablock without undermining utilities upslope? Is there enough space to install ultrablock? An alternate shoring system or temporary construction easement from the uphill property owner should be considered if these issues cannot be resolved.*

*If an open cut is proposed, slope stability analyses of the temporary cut will be required. Geotechnical engineer should include discussion on potential undermining or relocation of existing utilities upslope given the results of the stability analyses.*

**Response**

We respectfully disagree that there is insufficient subsurface information to analysis the use of Ultrablock Shoring for the proposed excavation. The referenced geotechnical engineering addendum outlines the assumptions used to determine the system is viable on a temporary basis. Yes, a temporary open cut is required to install the Ultrablock shoring, however, as noted on the wall details, the excavation for the wall should be completed so that exposed soils are completed covered at the end of the workday thus reducing the potential impact from an open and unsupported excavation.

**Page 2 – Comment #2**

> *Provide location and extent of proposed shoring including top and bottom shoring wall elevations. Provide detailed shoring design and calculations for review.*

**Response**

The location of the proposed shoring is shown on the design plans. The shoring design and calculations are in the referenced geotechnical engineering addendum.

**Page 2 – Comment #3**

> *There is subsurface information from the same geotechnical report (GeoTech Consultants, 4/5/2015) that the current soil boring information, B-5, was obtained. That boring, B-4 indicates artesian groundwater conditions.*
>
> *Provide assessment of the potential impacts of that artesian pressure on the design and construction of this development. If applicable, provide permanent dewatering design recommendations and calculations for review.*

**Response**

The geotechnical report has been revised and no longer relies on the information from the 2015 GeoTech report. While GeoTech boring B-4 may have indicated artesian groundwater conditions our test borings completed in June 2022 did not find any such conditions. Therefore, it is our opinion that an artesian groundwater condition is not present at the project site.

**Page 6 – Comment #1**

> *Geotechnical engineer to provide construction sequence recommendation so that excavation required for stormwater system does not undermine foundation support of adjacent proposed structures.*

**Response**

Provided the excavations are completed in accordance with the reference geotechnical report we see no potential impact to adjacent structures. The contractor should be cautious when installing various elements throughout the project so that any existing infrastructure is properly protected. We can assist with this during construction, if requested.

**Page 20 – Comment #1**

*The geotechnical report indicates Site Class E.*

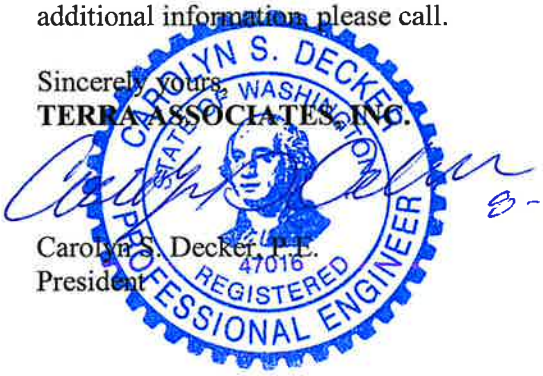
*Soil boring information does not support Site Class E classification. Geotechnical engineer to provide reasoning for Site Class E or revise Site Class.*

**Response**

Due to the site soils being subject to liquefaction, per the current International Building Code (IBC), the subsurface conditions would be assigned site class "F", which would require performing a site-specific seismic analysis to determine seismic forces for structural design. However, the current IBC allows for using code derived seismic values for the soil conditions indicated if the building's fundamental period is equal to or less than 0.5 seconds. We expect the single-family residence will fall into this category. In this case, based on soil conditions encountered and our knowledge of the area geology, site class "E" can be used to determine seismic design forces.

We trust the information presented is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
**TERRA ASSOCIATES, INC.**




8-5-22

Carolyn S. Decker, P.E.
President