Cobalt Geosciences, LLC
P.O. Box 1792
North Bend, WA 98045

August 9, 2023

RR Foundation Specialist
Attn: Alesha, Ty-Lynn, Jordan, or Amanda

RE: Limited Geotechnical Evaluation
Foundation Mitigation
4121 80th Avenue SE
Mercer Island, Washington

In accordance with your authorization, Cobalt Geosciences, LLC has prepared this letter to discuss the results of our limited geotechnical evaluation at the above-referenced location.

Site and Project Description

The site is located at 4121 80th Avenue SE in Mercer Island, Washington. The site consists of one rectangular shaped parcel (No. 3623500182) with a total area of about 11,500 square feet.

The south-western portion of the site is developed with a residence with a daylight basement, and a driveway. The remainder of the property is vegetated with grasses, shrubs, bushes, and sparse trees.

The southern half of the site slopes downward to the south at magnitudes of about 55 to 60 percent and relief of about 20 feet. This slope continues onto the properties to the west. The northern one-third of the site is mostly level and gradually slopes downward to the south with relief of less than 5 feet.

The site is bordered to the north, south, and west by residential properties, and to the east by 80th Avenue SE.

We understand that the residence has settled up to 2.5 inches over time, likely beginning after construction and potentially continuing today. The settlement is mostly present within the western and southwestern portions of the residence toward the downhill side.

The project includes installation of at least 9 helical anchors extending to refusal in relatively dense native soils below affected foundation elements. Anchors will be attached with steel brackets, C channel, and angle iron if necessary.

Lifting will be performed as feasible. New posts and a new beam will be installed under cantilever with concrete pile caps to help life and support cantilever.

Area Geology

The site lies within the Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances/retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and non-glacial sediments consisting of interbedded gravel, sand, silt, till, and peat lenses.

The Geologic Map of Mercer Island, indicates that the site is underlain by Pre-Olympia Non Glacial Deposits. These deposits include variable mixtures of silt, sand, clay and gravel that vary with location and depth. These deposits become denser with depth below a weathered zone.

Soil & Groundwater Conditions

As part of our evaluation, we excavated one hand boring to 8 feet below grade. The hand boring encountered approximately 6 inches of topsoil and vegetation underlain by loose to medium dense, silty-fine to fine grained sand trace gravel (Weathered Non Glacial Deposits) which continued to the termination depth. The soils became medium dense about 7.5 feet below grade.

Groundwater was not observed in the hand boring.

City of Mercer Island GIS Mapped Hazards

The City of Mercer Island GIS maps indicate that the site contains potential slide and erosion hazard areas. These designations are likely present due to a combination of soil deposit composition (possibly coarser grained) and presence of moderately steep to steep slopes.

The site is situated near the top of a ravine feature that slopes westerly. Overall, the site areas appear stable at this time with no evidence of recent or ongoing erosion or landslide activity. It is our opinion that the risk of landslide activity and erosion can be maintained at a low level with proper implementation of erosion control measures. We note that soil creep is likely occurring due to the presence of loose near-surface soils which are fine grained and in areas with magnitudes of about 30 percent or more.

The work includes minor excavations near the foundation system that are typically backfilled within a week. This work is very minor and will not have a net negative effect on critical areas provided erosion control measures are in place until completion.

Statement of Risk

Code information for the required Statement of Risk is as follows:

Per Section 19.07.160B3 of the Mercer Island City Code, development within geologic hazard areas require that a Geotechnical Engineer licensed within the State of Washington provide a statement of risk with supporting documentation indicating that one of the following conditions can be met:

3. Alteration of landslide hazard areas, seismic hazard areas and associated buffers may occur if the conditions listed in subsection (B)(3) of this section are satisfied and the geotechnical professional provides a statement of risk matching one of the following:

a. An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a landslide hazard area or seismic hazard area;

b. The landslide hazard area or seismic hazard area will be modified or the development has been designed so that the risk to the site and adjacent property is eliminated or mitigated such that the site is determined to be safe;

c. Construction practices are proposed for the alteration that would render the development as safe as if it were not located in a geologically hazardous area and do not adversely impact adjacent properties; or

d. The development is so minor as not to pose a threat to the public health, safety and welfare.

Based on our analysis, the site meets the criteria of item D. The underpinning is very minor and associated with the foundation elements only. This work will not affect geologic hazards if erosion control measures are in place until completion and there is proper geotechnical oversight.

Conclusions and Recommendation

Based on our observations, it appears likely that the settlement is likely the result of consolidation of weathered soils below the affected areas. This is common near slope faces as excavations often do not fully remove weathered soils that are at greater depths due to the topography changes (slopes downward).

It appears that the site was inadequately stripped of loose soils during construction. Contributing factors could be downspout leakage into the near surface soils, age of the foundation (1967), and inadequately designed foundations for the soil conditions.

The proposed mitigation utilizing helical anchors with steel connections appears suitable to reduce settlement and support the affected portions of the residence. Based on our observations, we anticipate that helical anchors may extend 7 to 15 feet (or more) below grade with an average of 12 feet.

Excavations required for pier placement will likely be 4 feet or less. There appears to be adequate space for these excavations from the adjacent property lines. We recommend a maximum temporary slope magnitude of 1H:1V (horizontal to vertical).

Helical Piers®

Helical Piers® may be used to support the foundation systems of the residence. The Helical Piers® could be installed using portable rotary tools, truck mounted rotary tools, backhoe mounted rotary tools, caisson drills, or skid-steer loaders. It is important that the torque output, rotational speed, down pressure capability, and angle control of the installation equipment is compatible with the required foundation system. The pile installation equipment should have adequate torque capacity to prevent refusal conditions at relatively shallower depths that are well above recommended bearing depths or layers.

A Helical Pier® consists of an anchor (lead section) with 1, 2, 3 or more helical flights on a shaft. The number and diameter of the helices on the anchor are dependent on the soil characteristics of the site and the design loads to be applied to the pier. Based on these parameters the anchor helix configuration is chosen to best fit the site conditions.

As the anchor is advanced into the soil extension sections (shaft) are placed on the lead section. The shaft configuration is based on the design loads and anticipated installation torque.

The static compression load capacity of a Helical Pier® is the sum of all individual helix capacities below liquefiable soils and in bearing layer. Individual helix static compression capacity is the result of the projected area of the helix, and its bearing pressure.

It is recommended that the piers penetrate into relatively dense native soils a minimum of 7 feet, or until refusal whichever is shallower. The bearing layer will be at variable depths below the existing ground surface due to previously natural slope conditions (anticipated to be 7 to 15 feet (estimated only)). Increased capacity can be obtained with increased penetration, and additional helical flights on the lead section.

Helical Pier® installation should be monitored to verify installation torque, and proper embedment into the presumed bearing layer. The Helical Pier® lengths may need to be modified during construction if it is determined that the depth to the bearing layer varies. Helical Pier® anchors are well suited to field adjustments as length can be varied by merely adding or deleting extension sections (shafts) during installation.

Monitoring installation torque in the field is used to estimate the anchor compression capacity, and also as a quality control during anchor installation, provided that the anchor is bearing in dense or hard soils. Dependent on the pile size and the equipment used to install the anchors, an empirical factor is multiplied by the average torque over the final 3 feet of installation to estimate ultimate capacity.

Allowable Helical Pier Compression Capacity Pa may be estimated from the following equation provided that the pier is in the recommended bearing soils:

Pa = Kt x T/FoS,

Where T is the applied torque, Kt is the empirical ratio factor. The following industry standards apply to shafts with blades spaced along the shaft at 2.5 to 3.5 times the average blade diameter on-center and meeting the manufacturer's specifications.

1.5" and 1.75" Square Shafts	-	Kt = 9 ft-1
2.875" O.D. Round Shafts	-	Kt = 9 ft-1
3.0" O.D. Round Shafts	-	Kt = 8 ft-1
3.5" O.D. Round Shafts	-	Kt = 7 ft-1

Proof testing of at least three percent of the helical piers in eight equal increments up to 200 percent of the design load, if required by the permitting authority. Each load increment up to the 200 percent of design load should be held for five (5) minutes and the vertical strain monitored. If the total strain between 1 and 5 minutes is less than 0.04 inches, the helical pier may be considered acceptable. If the recorded strain exceeds 0.04 inches, the helical pier should either be deepened and retested or abandoned and a new helical pier shall be installed and tested.

Closure

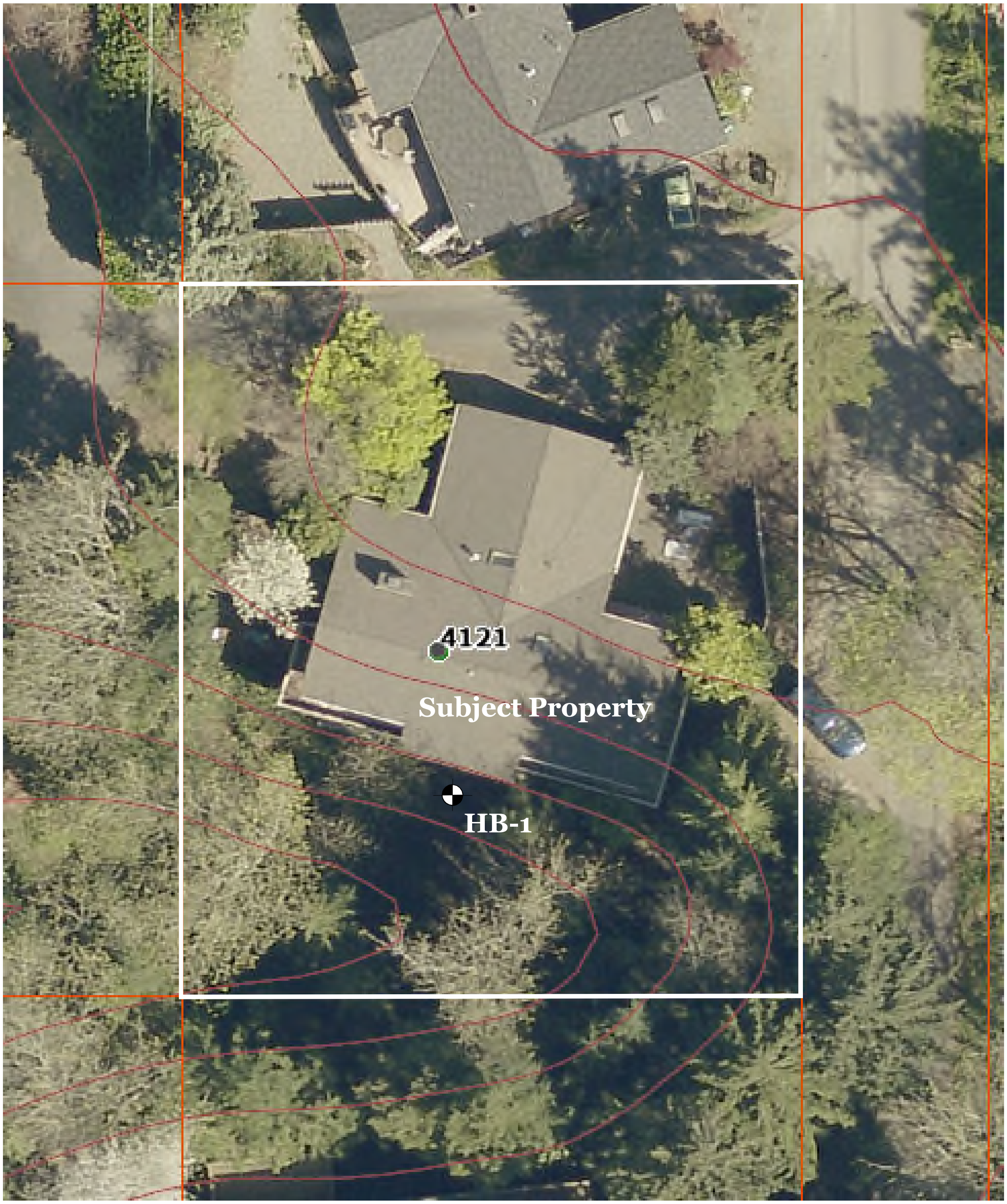
The information presented herein is based upon professional interpretation utilizing standard practices and a degree of conservatism deemed proper for this project. We emphasize that this report is valid for this project as outlined above and for the current site conditions and should not be used for any other site.

Sincerely,

Cobalt Geosciences, LLC

8/9/2023
Phil Haberman, PE, LG, LEG
Principal

Figure 1; Site Plan
Figure 2; Repair Plan
Figure 3; Hand Boring Log



HB-1 **Approximate Hand Boring Location**

King County imap Image

N

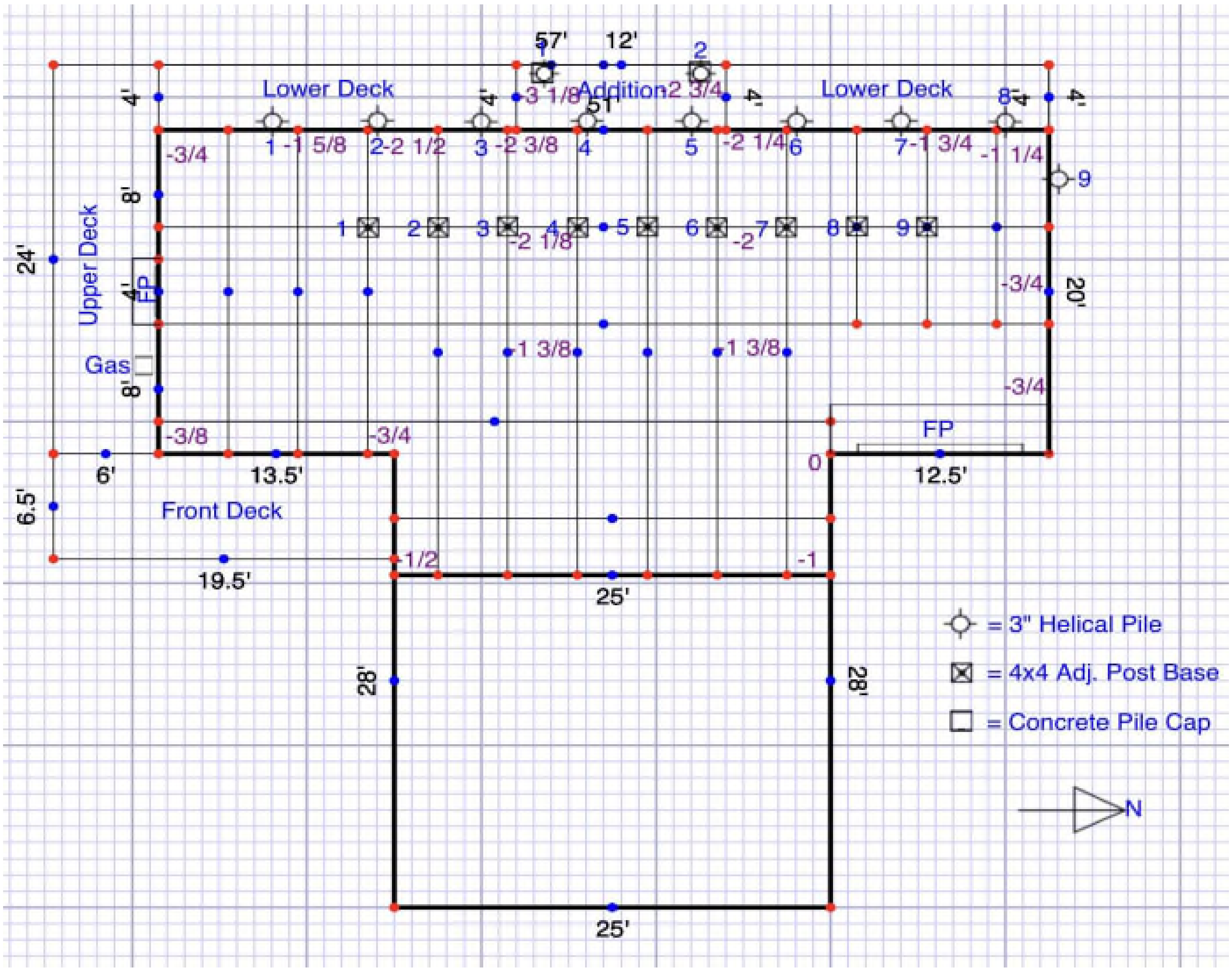
COBALT GEOSCIENCES

Foundation Mitigation
4121 80th Ave SE
Mercer Island, Washington

Site Image

Figure 1

Cobalt Geosciences, LLC
P.O. Box 82243
Kenmore, WA 98028
(206) 331-1097
www.cobaltgeo.com
cobaltgeo@gmail.com



COBALT GEOSCIENCES	Foundation Mitigation 4121 80th Ave SE Mercer Island, Washington	**Repair Plan** **Figure 2**	Cobalt Geosciences, LLC P.O. Box 82243 Kenmore, WA 98028 (206) 331-1097 www.cobaltgeo.com cobaltgeo@gmail.com

Unified Soil Classification System (USCS)

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS (more than 50% retained on No. 200 sieve)	Gravels (more than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with Fines (more than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (50% or more of coarse fraction passes the No. 4 sieve)	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sand, gravelly sands, little or no fines
		Sands with Fines (more than 12% fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (50% or more passes the No. 200 sieve)	Silts and Clays (liquid limit less than 50)	Inorganic	ML	Inorganic silts of low to medium plasticity, sandy silts, gravelly silts, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
		Organic	OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays (liquid limit 50 or more)	Inorganic	MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt
			CH	Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay
		Organic	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat, humus, swamp soils with high organic content (ASTM D4427)

Classification of Soil Constituents

MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).

Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).

Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).

Relative Density (Coarse Grained Soils)

N, SPT, Blows/FT	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
Over 50	Very dense

Consistency (Fine Grained Soils)

N, SPT, Blows/FT	Relative Consistency
Under 2	Very soft
2 - 4	Soft
4 - 8	Medium stiff
8 - 15	Stiff
15 - 30	Very stiff
Over 30	Hard

Grain Size Definitions

Description	Sieve Number and/or Size
Fines	<#200 (0.08 mm)
Sand	
-Fine	#200 to #40 (0.08 to 0.4 mm)
-Medium	#40 to #10 (0.4 to 2 mm)
-Coarse	#10 to #4 (2 to 5 mm)
Gravel	
-Fine	#4 to 3/4 inch (5 to 19 mm)
-Coarse	3/4 to 3 inches (19 to 76 mm)
Cobbles	3 to 12 inches (75 to 305 mm)
Boulders	>12 inches (305 mm)

Moisture Content Definitions

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

Log of Hand Boring HB-1

Date: June 2022	Depth: 8'	Initial Groundwater: None
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description	Groundwater	Moisture Content (%) Plastic Limit — Liquid Limit / SPT N-Value 0 10 20 30 40 50
						Vegetation/Topsoil		
1					ML	Loose to medium dense, silt with fine sand trace gravel, dark yellowish brown to mottled yellowish brown, moist. (Weathered Non Glacial Deposits?)		
2						Medium dense at 7.5'		
3								
4								
5								
6								
7								
8						End of Hand Boring 8'		
9								
10								

Cobalt Geosciences, LLC
P.O. Box 82243
Kenmore, WA 98028
(206) 331-1097
www.cobaltgeo.com
cobaltgeo@gmail.com

Foundation Mitigation
4121 80th Avenue SE
Mercer Island, Washington

Hand Boring Log