WESI Land Use Consultants
PLANNING • ENGINEERING • SURVEYING

1000 Cedar Avenue • Marysville WA 98270

425-356-2700 INFO@WESI.CO

June 19, 2025

RE: Permit No. 2505-049 Zhao Property

Dear Ruji,
Regarding the application for construction of a garage and a primary suite addition to the existing single family residential structure, located at 4433 86th Avenue SE.

We have been requested to prepare a letter response to address your concerns pertaining to the general seismic design criteria for the subject site.

The site falls in a relatively stable portion of Mercer Island on the upland plateau and not on or directly adjacent to a bluff that would be subject to hillside movement during a seismic event triggering a surficial shallow mudslide, if the quake occurred during the rainy season. Nor does it fall directly adjacent to the Island Crest Way easterly cut slope.

The site is gradually sloping with a daylight basement on the existing structure; no evidence of cracking or foundation impairment appears to have occurred at the residence subsequent to the 2001 Nisqually Earthquake. There are two minor topographic changes on the subject site a low wall/rockery exists to the east of the proposed garage no more than 30 inches in height and a small concrete wall along a driveway access to the north off 44th Place SE that serves two homes to the north at the east end of the parcel being built upon. (*addresses 8525 & 8541 SE 44th Place*)

Below are the general two seismic maps that the City of Mercer Island has posted to their Critical Areas Mapping System and their GIS system. While the one map does depict a small portion of the site designated in pink or subject to seismic hazard, we believe that this is mis-mapped on the Cities GIS map based on the relatively flat nature of the lower or east end of the site and the fact that this area is underlain by hardpan or consolidated till layer on this site. The published geologic mapping of the site confirms that as does the mapping on other parcels to the east at least to the main City Right of Way to the east and the slope above the Island Crest Way, the primary N/S arterial East of SE 44th Place.

Known Active Fault locations in the vicinity of Mercer Island, there is an inferred Vasa Park Fault to the north of Mercer Island as mapped by Thomas Brocher a little over 20 years ago in 2004, used small charges on the mainland like at Lincoln Park, Seattle for his Puget Sound seismic mapping and on Mercer Island and the shores of Lake Washington for his bathymetric and detailed evaluation and seismic mapping. This is an easterly/westerly trending fault.

The other defined fault mapped by UW Geology Professor Kathy Troost and Aaron P Wisher for Mercer Island is the more NW to SE trending fault orientation similar to the South Whidbey Island Fault, from the Admiral District in West Seattle to the southerly end of Harbor Island where sand boils erupted in the 2001 Nisqually Earthquake across to the Newcastle Hills. This inferred and labeled Newcastle Hills fault is shown on the Cities seismic map, however there is

no evidence in the Lidar imagery on Mercer Island of a surface rupture of the fault, like what was found on the South Whidbey Island fault by Professor Robert Yeats of Oregon State University and confirmed by Brian Sherrod of USGS and myself at Snohomish County during the permitting process for the Brightwater Treatment Plant within South Snohomish County adjacent to Highway 9.

In review of the Minimum Design Loads and Associated Criteria for Buildings and Other Structures ASCE 7-22, Chapter 11 addresses the General Seismic Design Criteria it appears that the proposed garage on the existing asphalt pad and proposed addition would normally meet the exemptions for one and two story wood frame structures being a single family dwelling and no more that is founded on weathered till satisfying the limitations of the International Residential Code, however since the Site Seismic Design Category is D2 and not A, B, or C it appears that the request for at least a cursory seismic review of the site is fully warranted by the Code. The following Earthquake Design Data is provided to assist the architect and structural engineer in assigning the appropriate seismic loads regardless of whether the wind load analysis at 98 mph lateral or uplift forces may govern.

Some of the following are provided for this particular site as the architect or structural engineer shall provide design comments on 7, 8 and 11.

1. Risk Category II and Occupancy Category U for private garage, R occupancy for building addition. Garage Passenger Vehicle Live Load 40psf, provided vehicular weights <10k #'s.
2. Seismic importance factor, I_e = 1.0 from Table 1.5-2 Importance Factors by Risk Category for Earthquake Loads. (see figure 1
3. Mapped spectral response acceleration parameters, $S_{s(g)}$= 1.56 and $S_{ms(g)}$ = 1.76 from Table C22-3, ASCE/SEI 7-22. These values are for default site conditions assuming not needing an in-depth geotechnical boring program and lab testing of hardpan/glacial till subsurface conditions at less than 3 feet. (see figure 2
4. Site Class- the shear wave velocity was not available for the site. Thus, the Site class assigned was C per C20.2, sections C20.2.2 through C20.25 on page 832
5. Design spectral response acceleration parameters, S_{DS} and S_{D1} Note: S_{DS} is to be taken at 90% of peak value of site-specific spectral response spectral acceleration and S_{DS} is assumed at 0.2 seconds for this site due to stiff soils and S_{D1} at 1 second.
6. Seismic design category is D2 from both City of Mercer Island table and NEHRP/USGS color map.
7. Basic seismic force-resisting systems(s) Light frame wood construction with 5/8 "plywood panel construction or equal with Simpson Strong Tie Hold Downs at the garage opening on both sides of the garage door opening. Detailing requirements for contractor are found at ASCE 7 section 14.5 and specified.
8. Design base shears(s) Architect/Structural Engineer to design based on Chapter 12, foundation connections and hold downs.

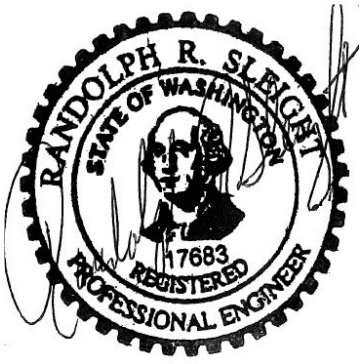
9. Seismic response coefficient(s), CS= FA = S_{MS}/S_S = 1.13 Site coefficient defined in Table 1613.2.3(1). From Table 1613.2.3(2) Site Class D, F_v =1.7, this times 1 sec = 1.7 for $S_{M1.}$ Therefore since 1.7 is greater than 1.13 use the 1.7 value. City of Mercer Island uses 1.86 times 90% = 1.67, still use the 1.7 value for $S_{M1.}$

   V = C_sW C_s=W/V w-effective seismic weight per 12.7.2; v-is seismic design base shear
10. Response modification coefficient(s), R=7 Light frame wood walls sheathed with wood structural panels rated for shear resistance, Omega = Overstrength factor 2.5, Deflection amplification factor C_d = 4.5
11. Analysis procedure used Architect/Structural Engineer to describe model used or method of calculation.

Also, the soils data and geologic mapping of the site is attached from Mercer Island GIS system with confirmed soils of till present as described. (see figure 4a)
Summary conclusion from a geotechnical engineering and earthquake engineering evaluation of lidar imagery, ASCE Standard review Chapters 7-02, 7-10 and 7-22, IBC and IRC 2021 Codes, that no portion of the subject site at 4433 86th Ave SE falls within an area of high potential of seismically induced ground motion that would cause significant cracks in the proposed or existing single-family home, assuming of course that the epicenter of an earthquake was not directly under the home. It is normally assumed movement and cracking of surficial features within the Seattle fault zone and along other faults in this region follow the fault lineaments or close to them.
If you have any questions regarding this seismic letter evaluation, please call

Sincerely

Randolph R Sleight PE, PLS, F. ASCE
425-356-2700x107
randys@wesi.co



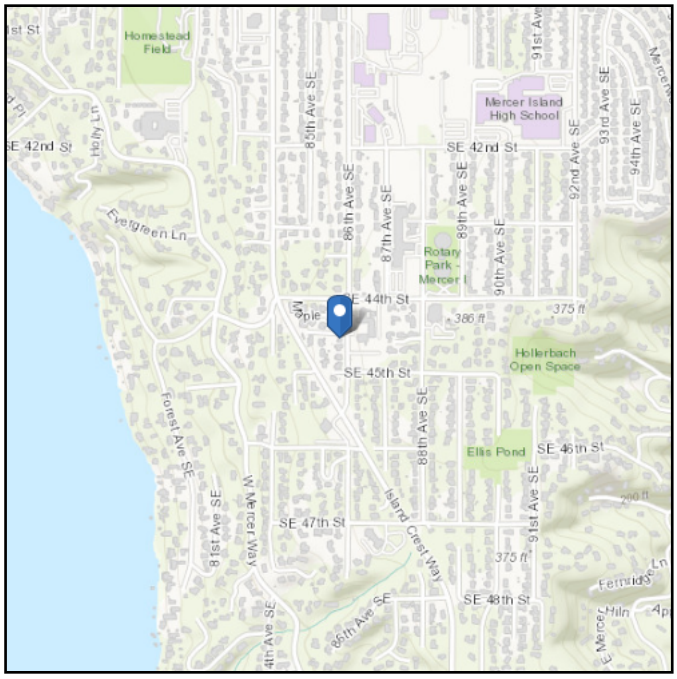
Enc. Figures 1, 2, 3, 3a, 4, 4a

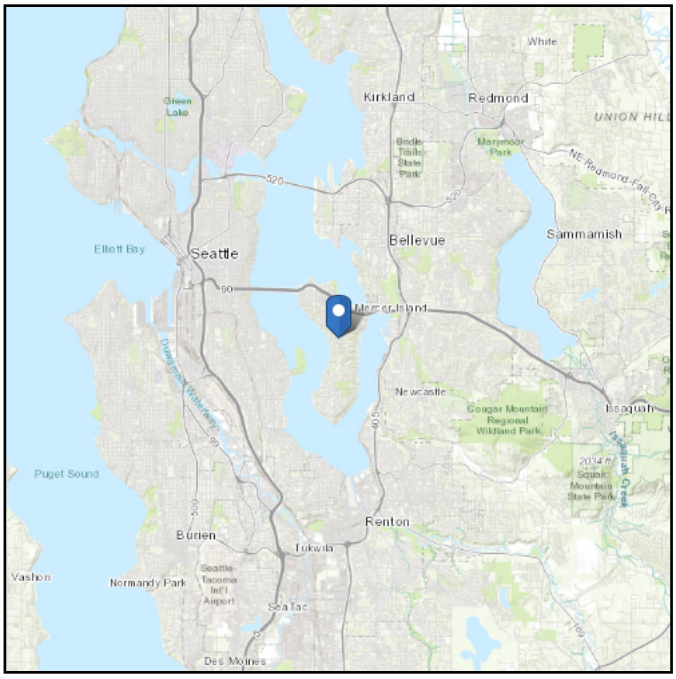
FIGURE 1

ASCE Hazards Report

Address:
4433 86th Ave SE
Mercer Island, Washington
98040

Standard:	ASCE/SEI 7-22	**Latitude:**	47.566341
Risk Category:	II	**Longitude:**	-122.224557
Soil Class:	Default	**Elevation:**	354.94395012789107 ft (NAVD 88)





Seismic

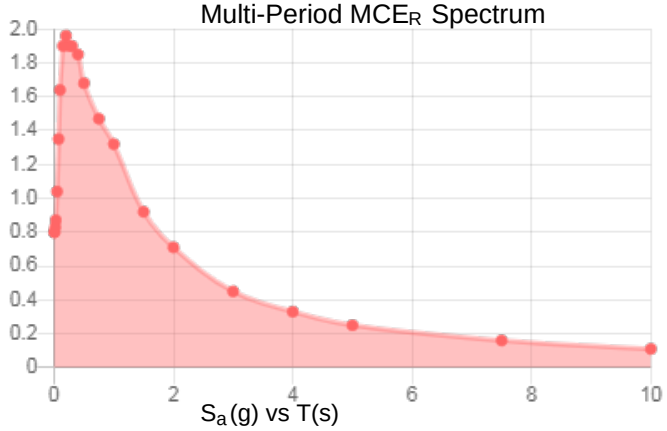
Site Soil Class: Default

Results:

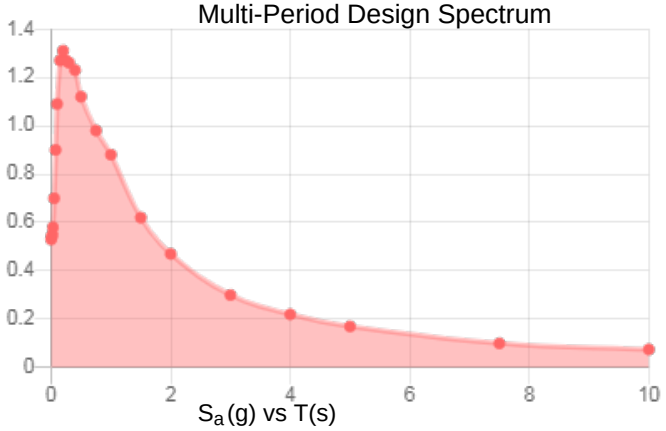
PGA_M :	0.73	T_L :	6
S_{MS} :	1.76	S_S :	1.59
S_{M1} :	1.32	S_1 :	0.63
S_{DS} :	1.18	V_{S30} :	260
S_{D1} :	0.88		

Seismic Design Category: D

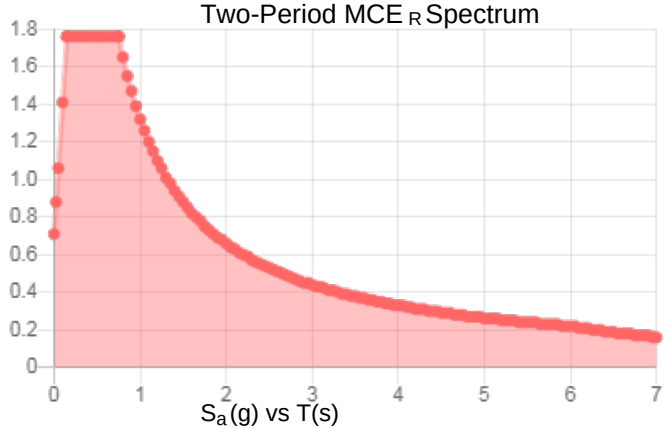
Multi-Period MCE_R Spectrum



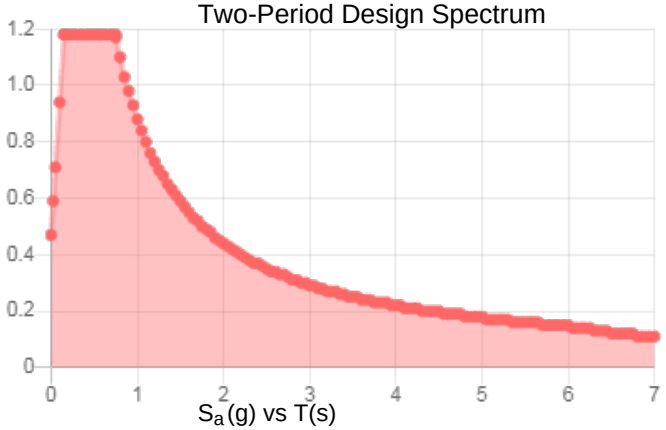
Multi-Period Design Spectrum



Two-Period MCE_R Spectrum



Two-Period Design Spectrum



MCE_R Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

REPORT SUMMARY

Site Information

Address:	*4433 86th Ave SE, Mercer Island, Washington, 98040*
Elevation:	354 ft (NAVD 88)
Lat:	47.566341
Long:	-122.224557
Standard:	ASCE/SEI 7-22
Risk Category:	II
Soil Class:	Default

Seismic Data

S_S	1.59
S_1	0.63
S_{MS}	1.76
S_{M1}	1.32
S_{DS}	1.18
S_{D1}	0.88
T_L	6
PGA_M	0.73
V_{S30}	260
Seismic Design Category	D
Note	Where values of the multi-period 5%-damped MCER response spectrum are not available from the USGS Seismic Design Geodatabase, the design response spectrum shall be permitted to be determined in accordance with Section 11.4.5.2

FIGURE 2

Seismic Design Category Maps for 2024 IRC (Color)

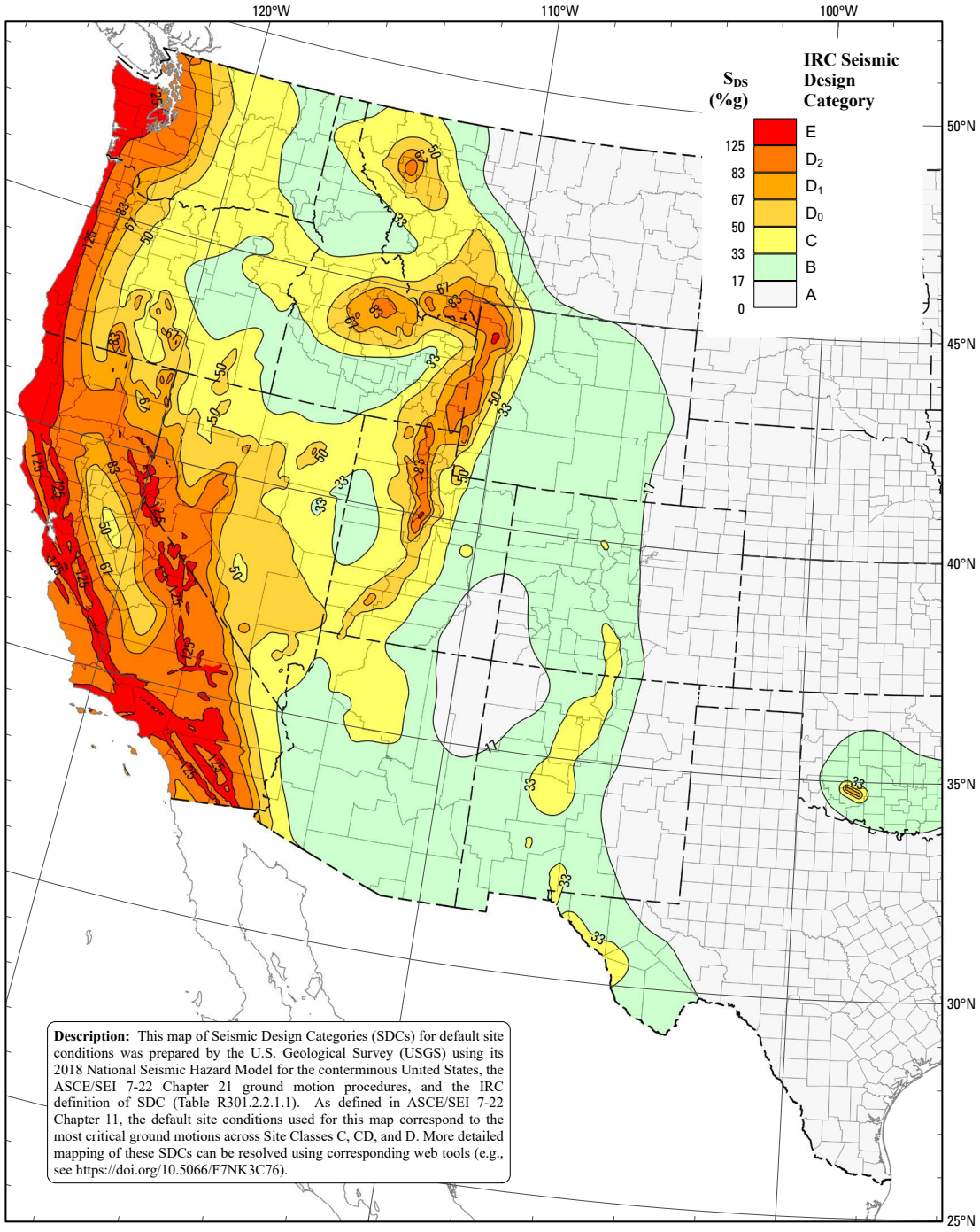


Figure 1. Seismic Design Category Map for 2024 IRC - Western U.S. (Color)

Mercer Island Seismic Hazard Assessment

by Kathy G. Troost & Aaron P. Wisher
April 2009

geomapnw.ess.washington.edu

0 0.5 1 Kilometers

1:12,000

0 0.5 1 Miles

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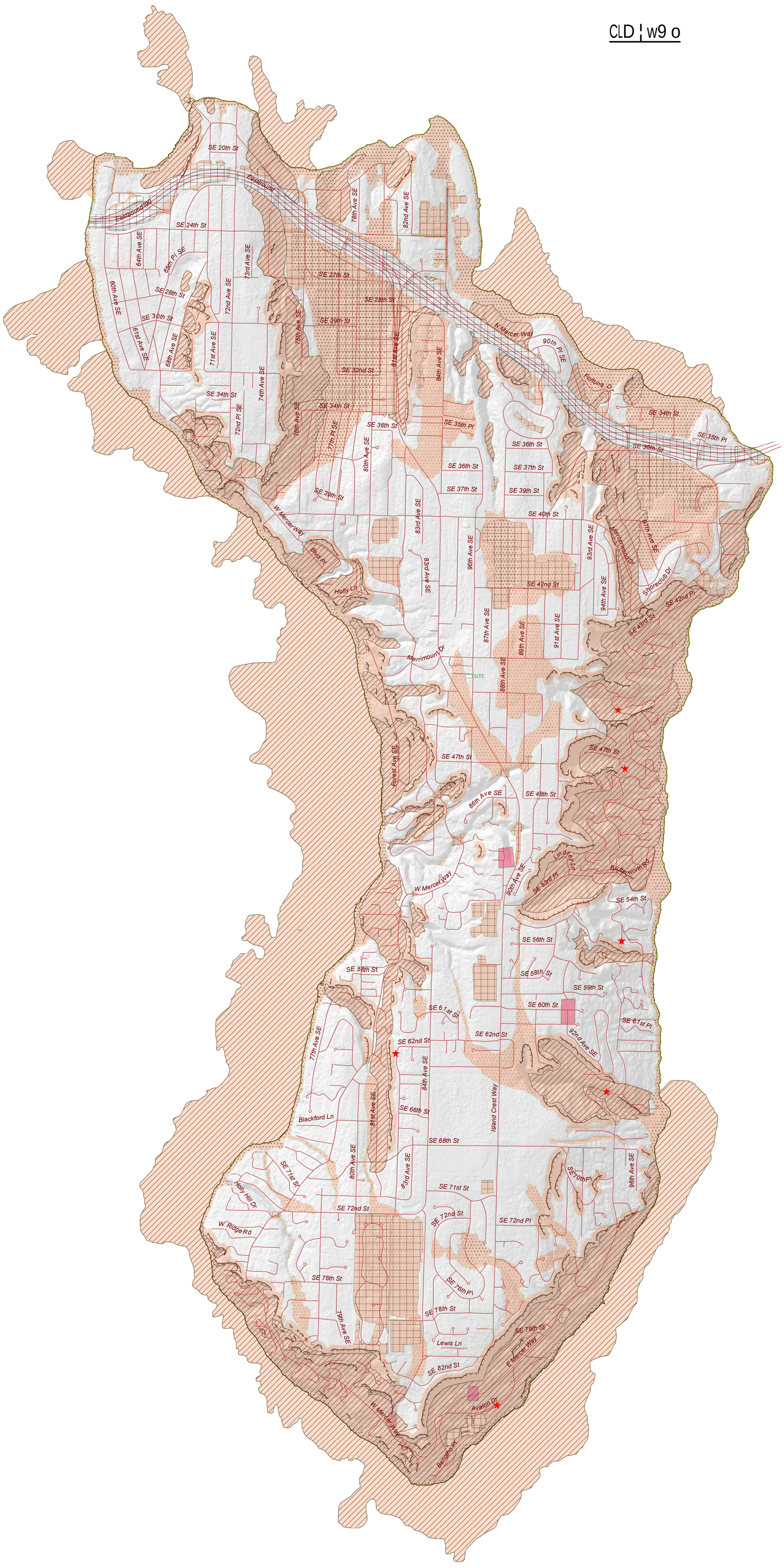


SEISMIC HAZARD AREAS (MICC 19.16.010)

Seismic Hazard areas are those areas subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction or surface faulting.

Seismic Hazard

- Seismic Hazard Area (Known or Suspect)

For all other areas risk is unknown or limited to ground shaking

Supplemental Data

Seismically Hazardous Areas

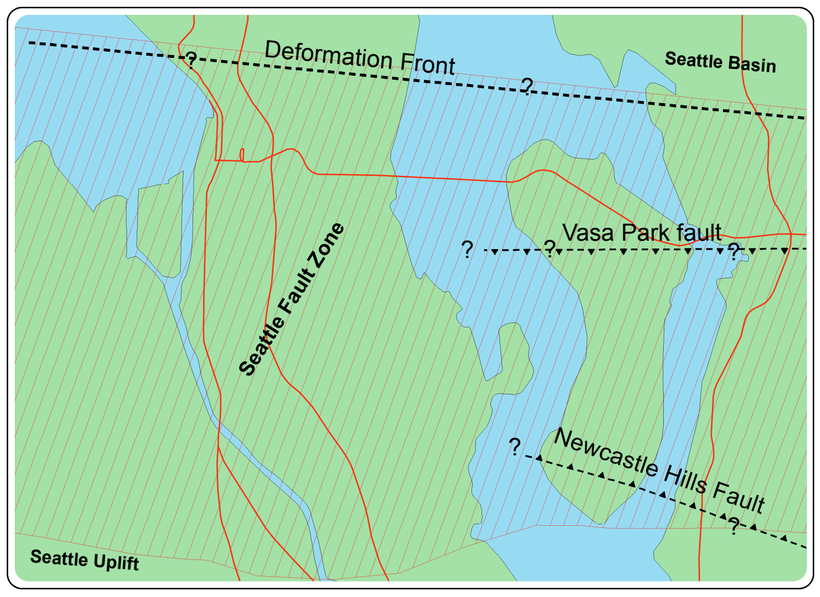
Potential for seismically induced ground failures including settlement, cracking, lateral spreading, liquefaction due to ground shaking.
Seismically hazardous areas include the following:

- High Potential for seismically induced ground failures (Poorly consolidated, see note below)
- Moderate Potential for seismically induced ground failures (Moderately consolidated, see note below)
- Scarp
- Landslide and Mass Wastage Deposits (subaerial & subaqueous)
- Modified land

Documented Earthquake Ground Effects

- Miscellaneous Ground Effects of the 2001 Nisqually Earthquake (Approx. Area)
- Ground Settlement from the 1965 Earthquake (Approx. Area)
- Miscellaneous Ground Effects of the 1949 Earthquake (Approx. Area)

ACTIVE FAULTS



Mercer Island falls within the Seattle fault zone and at least two stands of the Seattle fault cross the island. No direct evidence of surface fault rupture has yet been documented for Mercer Island (Troost and Wisher, 2006).

The Seattle Fault Zone is the area where several parallel strands of the Seattle fault have either broken the ground surface or caused deformation of geologic materials. Earthquakes of magnitude M7 or greater have occurred on some of these fault strands within the Holocene (last 10,000 years) and will likely occur again (Blakely, et al., 2002; Sherrod 2002, 2005). The Seattle Fault Zone is one of several active crustal faults zones in the Puget Lowland currently undergoing research.

On Mercer Island, evidence for movement along these fault strands consists of exposures of deformed sedimentary strata and geophysical images of folded and faulted strata (Troost and Wisher, 2006; Stephenson et al., 2007). Elsewhere in the Puget Sound lowland, evidence for movement on the fault strands consists of uplifted beach deposits, down-dropped tidal marshes, offset strata, fault scarps, and deformation such as sheared and tightly folded strata. Evidence of the Seattle fault zone in the subsurface consists of aeromagnetic, gravitational, and seismic reflection anomalies (Liberty and Pratt, 2008).

East of Mercer Island, the Vasa Park fault and Newcastle Hills fault each have surface expression in the form of fault scarps and subsurface expression in the form of magnetic and seismic linear anomalies (Liberty and Pratt, 2008; Sherrod, 2002). The magnetic and seismic anomalies may be continuous with similar features to the west of Lake Washington, but those continuities are not firmly established (Liberty and Pratt, 2008). The locations of these faults are not well defined on Mercer Island (Pratt, 2009, pers. comm.)

The Deformation Front is an east-west-trending, convex-upward fold in geologic strata, where those strata drape over the northern-most thrust fault in the Seattle Fault Zone. North of the Deformation Front is the Seattle Basin, where strata lie nearly flat; south of the Deformation Front the strata dip down toward the north beneath the Seattle Uplift (Pratt, 2009). The location of the Deformation Front was moved northward from previous interpretations (Brocher, et al, 2004) following detailed evaluation of seismic lines by Pratt (2009).

Notes: Degree of consolidation

Geologic materials were assessed then classified as either strongly, moderately, or poorly consolidated. Degree of consolidation is a direct translation of geologic unit based on geologic history and predominant lithology. Because considerable variability exists within each geologic unit, more detailed analysis is needed for site-specific evaluations or to evaluate the degree of consolidation at a larger scale than provided. Slope and degree of saturation also affect the degree of consolidation, but have not been factored into this map. This qualitative assessment should be used to evaluate and understand the character of the island as a whole. These data should not be used for purposes of site-specific land-use planning or site-specific geologic evaluations. The classification shown on the map does not account for the built environment and impervious surfaces.

GENERAL NOTES FOR GEOLOGICAL HAZARDS MAPS

This map is one of a suite of revised Geological Hazard Maps for the City of Mercer Island. This suite includes maps showing Seismic Hazards, Landslide Hazards, and Erosion Hazards.

Other geological and/or natural hazards may exist and geological events may occur on Mercer Island that are not specifically identified on these maps. Examples of geologic hazards and hazardous events that are not identified on these maps include, but are not limited to, tsunamis and seiches in Lake Washington.

These maps are for the sole use of the staff of the City of Mercer Island's Development Services Group (DSG) for the purposes of permit application evaluation. These maps provide DSG staff a general assessment of known or suspect geological hazard areas for which the City will require site and project-specific evaluation by a Washington State-licensed engineer, geologist or engineering geologist prior to issuing a permit for site development. All areas have not been specifically evaluated for geologic hazards and there may be locations that are not correctly represented on these maps. It is the responsibility of individual property owners and map users to evaluate the risk associated with their proposed development. No site-specific assessment of risk is implied or otherwise indicated by the City of Mercer Island by these maps.

The City of Mercer Island is using guidance provided by the State of Washington regarding the definition of geologically hazardous areas in accordance with WAC 365-190-080 and the Growth Management Act. "Geologically hazardous areas", by State definition, "include areas susceptible to erosion, sliding, earthquake, or other geological events. They pose a threat to the health and safety of citizens when incompatible commercial, residential, or industrial development is sited in areas of significant hazard."

This new set of maps represents an update of the 2002 Geologic Hazard Map Series and is based on a review of Best Available Science for the Seattle Fault and related events, a new Geological Map of Mercer Island by Troost and Wisher (2006), and a geologic database of Mercer Island compiled by GeoMapNW at the University of Washington. Information about data used for the maps, references, and data limitations are all described in an associated "Read Me" document. The digital version of these maps is accompanied by a meta data file containing pertinent information about map construction. These data and maps are all available on the City of Mercer Island website.

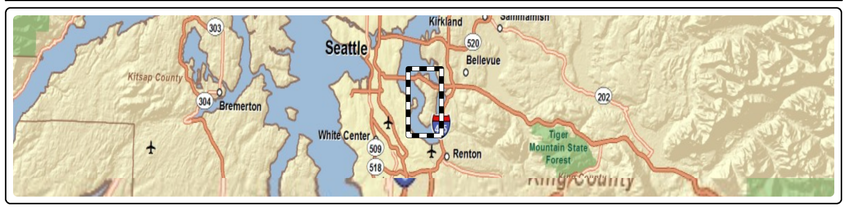


FIGURE 3a

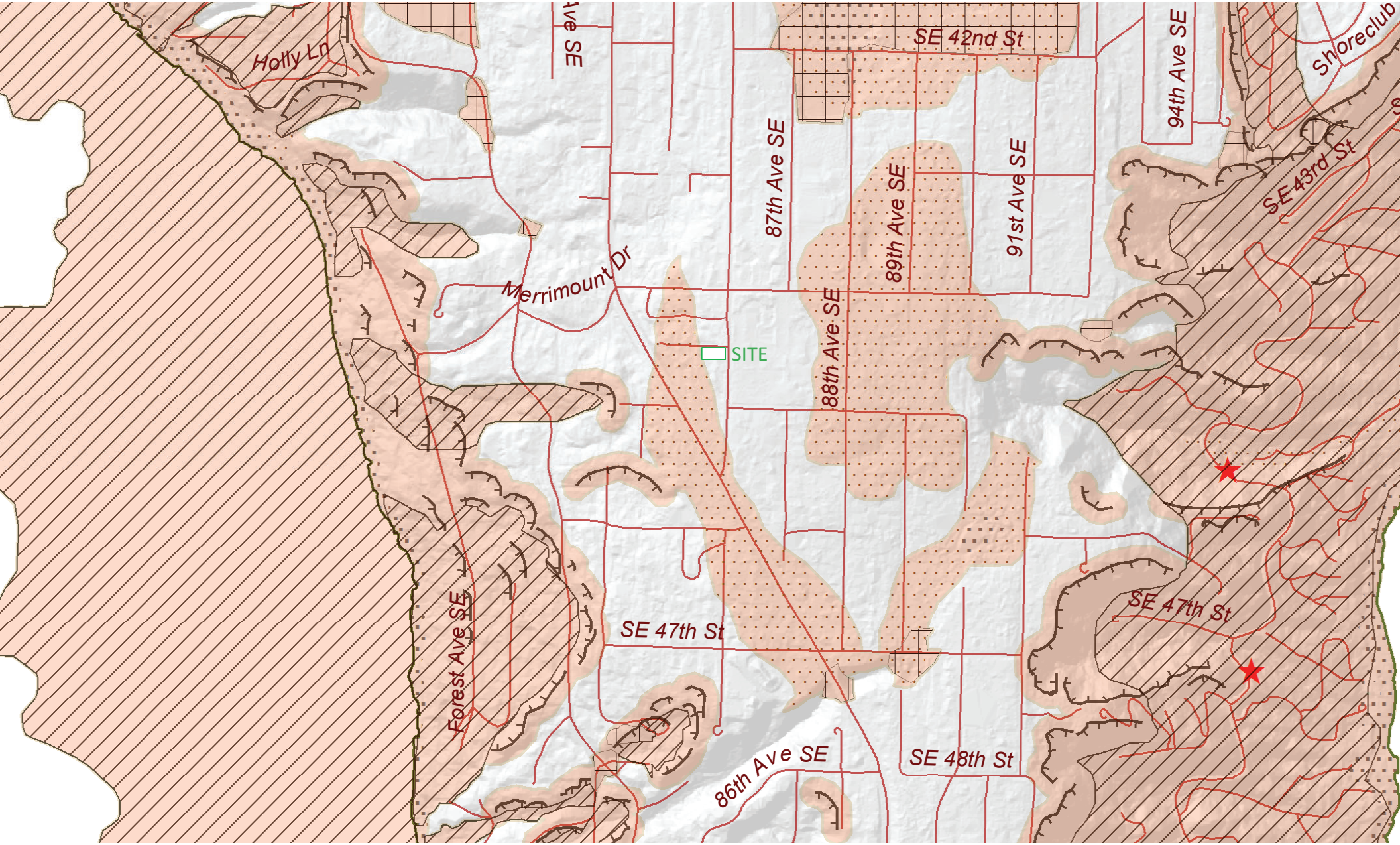

Holly Ln
SE 42nd St
94th Ave SE
Shoreclub
87th Ave SE
89th Ave SE
91st Ave SE
SE 43rd St
Merrimount Dr
SITE
88th Ave SE
SE 47th St
Forest Ave SE
SE 47th St
86th Ave SE
SE 48th St

FIGURE 4

Seattle Fault Zone

The **Seattle Fault Zone** represents the area where several parallel strands of the Seattle fault have either broken the ground surface or caused deformation of geologic materials. On Mercer Island, evidence for the Seattle fault consists of offset strata and deformation such as sheared, liquefied and folded strata.

The Seattle fault is one of several active crustal faults in the Puget Lowland undergoing further research. The location of the Seattle fault zone was derived from this geologic mapping and from Blakely and others (2002), and Brocher and others (2004).

Blakely, R.J., Wells, R.E., Weaver, C.S., and Johnson, S.Y., 2002, Location, structure, and seismicity of the Seattle fault zone, Washington: Evidence from aeromagnetic anomalies, geologic mapping, and seismic-reflection data: Geological Society of America Bulletin, v. 114, p. 169-177.

Brocher, T.M., Blakely, R.J., and Wells, R.E., 2004, Interpretation of the Seattle uplift, Washington, as a passive-roof duplex, Bulletin of the Seismological Society of America, August 2004, vol. 94, no. 4, p 1379-1401.

Geologic Units

Nonglacial Deposits (Holocene)

- Qp - Peat
- Ql - Lake deposits
- Qw
- Qf - Fan deposits
- Qal - Alluvium

Deposits of Fraser Glaciation (Pleistocene)

- Qvr - Vashon recessional outwash deposits
- Qvrl - Vashon recessional lacustrine deposits
- Qvrlc - Vashon recessional course-grained lacustrine deposits
- Qvi - Vashon ice-contact deposits
- Qvt - Vashon subglacial till
- Qva - Vashon advance outwash
- Qvlc - Lawton Clay

Older Glacial and Nonglacial Deposits (Pleistocene)

- Qpfn - Pre-Fraser nonglacial deposits
- Qob - Olympia beds
- Qpof - Pre-Olympia fine-grained deposits
- Qpoc - Pre-Olympia coarse-grained deposits
- Qpog - Pre-Olympia glacial deposits
- Qpogc - Pre-Olympia coarse-grained glacial deposits
- Qpogf - Pre-Olympia fine-grained glacial deposits
- Qpogt - Pre-Olympia glacial till
- Qpogd - Pre-Olympia glacial diamict
- Qpon - Pre-Olympia nonglacial deposits
- Qponc - Pre-Olympia coarse-grained nonglacial deposits
- Qponf - Pre-Olympia fine-grained nonglacial deposits

- Scarps
- Qmw - Mass wastage deposits
- Qls - Landslide deposits
- m - Modified land
- af - Artificial fill
- gr - Graded Land
- Seattle Fault Zone

Geologic Map of Mercer Island, Washington

by Kathy G. Troost & Aaron P. Wisher
October 2006

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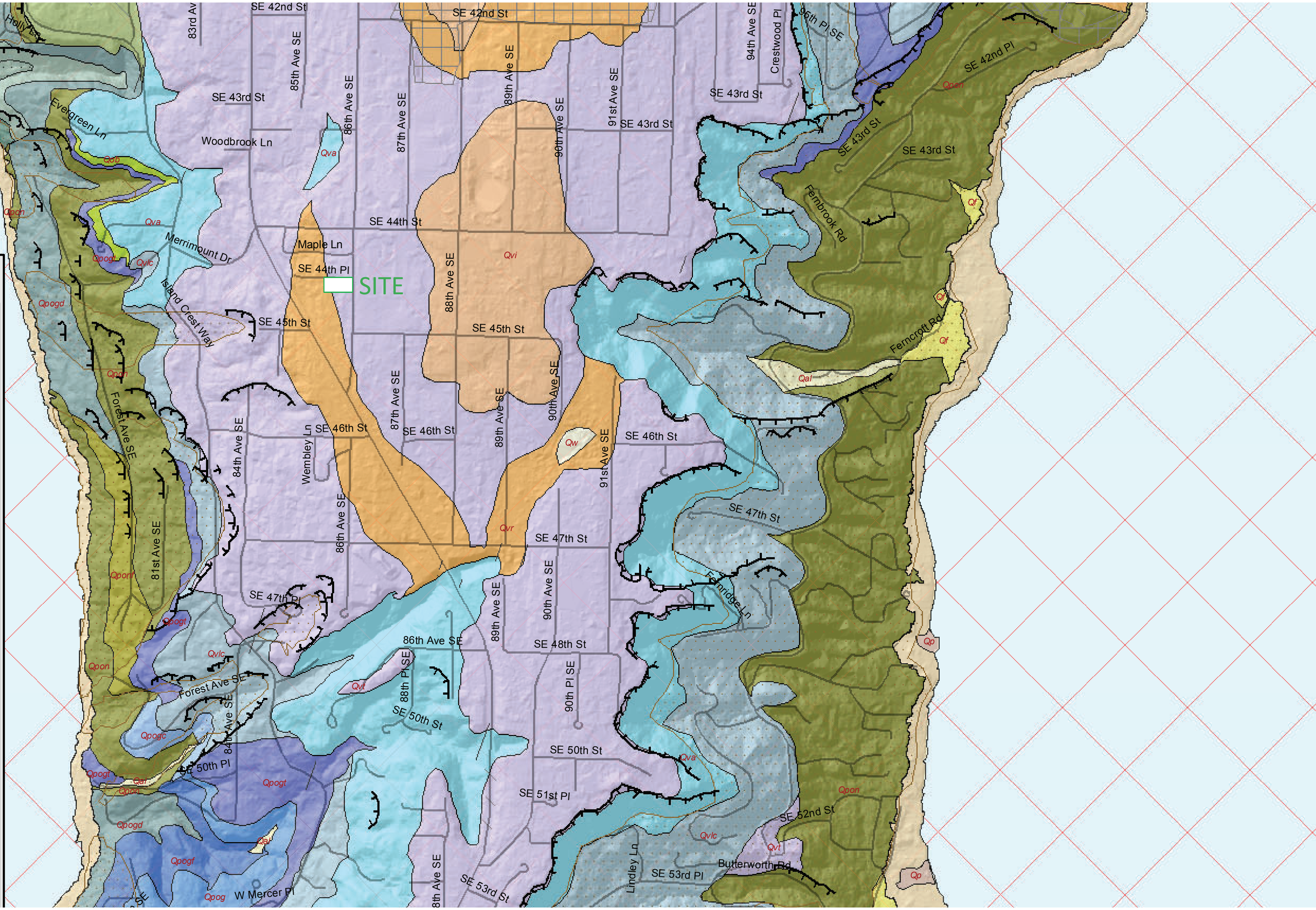
0 0.25 0.5 Miles

0 0.5 1 Kilometers

1:12,000

GeoMapNW
geomapnw.ess.washington.edu

FIGURE 4



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