Geology of Puget Lowland Bluffs and Ravines
The Maximum Extent of the last glaciation, approximately 15,000 years BCE.

Easterbrook, 1979
Puget Lobe, (Ice)

Advance Outwash

Pre-glacial Sediments

Glacial Till

North (Bellingham)

South (Olympia)

Direction of Glacial Advance
Typical Puget Sound Bluff Stratigraphy

- Glacial Till
- Advance Outwash
- Lake Sediments
- Pre-glacial Sediments
Transitional Beds in Tuck Creek
Exposure of Advance Sand from the west wall of the Snoqualmie Valley near the Tolt confluence
Close up of Advance Sand from the west wall of the Snoqualmie Valley near the Tolt confluence
Unmodified Glacial Upland
Troughs Scoured by Subglacial Meltwater Flow
Glacier Ice

Sub-Glacial meltwater Channel

Earth
Glaciated Upland
Puget Sound
Earth
Glaciated Upland

Puget Sound

Earth
Glaciated Upland
Puget Sound
Earth
Post-Glacial Ground Surface
Wave-cut Bench
Current Bluff
COASTAL BLUFF PROCESSES
# Measured rates of Bluff retreat in Puget Sound (After Finlayson 2006)

<table>
<thead>
<tr>
<th>Location</th>
<th>Rate (cm yr⁻¹)</th>
<th>Rate (ft/century)</th>
<th>Fetch (km)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maylor Point, Whidbey Is.</td>
<td>15</td>
<td>49</td>
<td>15</td>
<td>Keuler (1988)</td>
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<td>Penn Cove, Whidbey Is.</td>
<td>6.5</td>
<td>21</td>
<td>5</td>
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<td>Mutiny Bay, Whidbey Is.</td>
<td>11</td>
<td>36</td>
<td>10</td>
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<td>S. of Lake Handcock, Whidbey Is.</td>
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<td>13</td>
<td>20</td>
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<td>Rocky Point, Whidbey Is.</td>
<td>14</td>
<td>46</td>
<td>&gt; 50</td>
<td>Keuler (1988)</td>
</tr>
<tr>
<td>Camano Island, west side</td>
<td>3</td>
<td>10</td>
<td>10</td>
<td>Keuler (1988)</td>
</tr>
<tr>
<td>Smith Island</td>
<td>69</td>
<td>226</td>
<td>&gt; 50</td>
<td>Keuler (1988)</td>
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<tr>
<td>North Beach, Quimper Pen.</td>
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<td>20</td>
<td>&gt; 50</td>
<td>Keuler (1988)</td>
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<tr>
<td>Shannon Point, Fidalgo Is.</td>
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<td>66</td>
<td>10</td>
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<td>Skagit Co. (mean of 6 sites)</td>
<td>7.6±2.7</td>
<td>25</td>
<td>—</td>
<td>Keuler (1988)</td>
</tr>
<tr>
<td>Skagit Co. (mean of 26 sites)</td>
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<td>16</td>
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<td>Keuler (1988)</td>
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<tr>
<td>Port Williams</td>
<td>30</td>
<td>98</td>
<td>50</td>
<td>Eckler et al. (1979)</td>
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<tr>
<td>Sequim Bay</td>
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<td>20</td>
<td>&lt; 5</td>
<td>Eckler et al. (1979)</td>
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<tr>
<td>Port Angeles</td>
<td>90–150</td>
<td>394</td>
<td>&gt; 50</td>
<td>Galster and Schwartz (1989)</td>
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<tr>
<td>Port Grey, B.C.</td>
<td>30–50</td>
<td>131</td>
<td>&gt; 50</td>
<td>van Osch (1990)</td>
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<tr>
<td>Cowichan Head, B.C.</td>
<td>60</td>
<td>197</td>
<td>&gt; 50</td>
<td>van Osch (1990)</td>
</tr>
</tbody>
</table>
Erosion by Flowing Water
Woodway Landslide, 1997
Shallow Debris slides

Deep-Seated Landslides
Shallow Landslides
Video of a shallow debris slide

BNSF Railway
Everett to Seattle
Family of four killed by slide

BY LANA THOMSON

The family of four lost in the slide was identified as the Knox family. The slide occurred at the Knox residence on August 29, killing a mother and her three children. The family had recently moved into the area, and the slide caused significant damage to their home. The cause of the slide is under investigation, and the community is mourning the loss of the Knox family.
Video of deep-seated landslide

Beach Formation and Longshore Drift
Kulakala Point near Sequim

Photo by Hugh Shipman
Warm Beach

Photo by Hugh Shipman
Beach Sediment Composed of Lag from Bluff Erosion

Marrowstone Island, WA

Photo: Kris Symer
Figure 2-3
Seasonal Beach Profiles

Source: Downing, 1983.
QUESTIONS?
- Seattle Tide Gage
- 8 inches in 100 yrs
- From NOAA.gov
A graph showing the projected feet of sea level rise from 1900 to 2100. The uncertainty is highlighted by a green line that shows a significant increase in the late 20th century. The data projects a steady rise in sea levels from 1900 to 2000, with a sharp increase expected in the 21st century.