

Geologically Hazardous Areas¹

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Preface

This guide and checklist for Geologically Hazardous Areas was originally prepared in 1994 with an emphasis on Puget Sound shorelines for internal use by Shorelands Program, Department of Ecology staff, as well as local government planners. It received a general update in 1996, and minor updates in 2001 for the benefit of the Office of Community Development's Best Available Science program. Readers who would like to suggest improvements or updates are encouraged to communicate them to the author by e-mail at dcan461@ecy.wa.gov.

Introduction

Geologically hazardous areas, one of a number of "critical areas" identified by the Growth Management Act (GMA), are defined as:

areas that because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns. [RCW 36.70A.030 (9)]

The common shoreline geologic hazards addressed in this paper are: [1] wave erosion on marine beaches, [2] landsliding (instability) of marine bluffs and tall river banks, and [3] streambank erosion on rivers and other flowing waters; less frequently encountered shoreline geologic hazards include [4] earth-quake damage, and [5] mud flow inundation and other effects of volcanic eruptions. Other geologic hazards not addressed in this paper include tsunamis, earthquakes, and volcanic eruptions. Readers are encouraged to consult with the Washington Department of Natural Resources' Geology and Earth Resources Division with respect to earthquake and volcanic hazards.

The GMA requires that:

Each county and city shall adopt development regulations that protect critical areas that are required to be designated under RCW 36.70A.170. [RCW 36.70A.060 (2)]

¹ Washington Department of Ecology publication number 01-06-027.

Because geologically hazardous areas are not valued resources like wetlands or wildlife habitat, but rather are hazards to human health, safety, and welfare, the point is not to ‘protect’ geologically hazardous areas, but rather to protect the public from those geologic hazards:

Geologically hazardous areas 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. [WAC 365-190-080 (4)]

Because there are economically practical engineering, geotechnical, and bioengineering techniques available to mitigate hazards associated with wave erosion on marine beaches (Cox, Macdonald & Rigert, 1994.), landsliding of marine bluffs (Macdonald & Witek, 1994.), and streambank erosion on rivers and other flowing waters (Washington Department of Fish and Wildlife, in press) in low risk situations, it must be recognized that the legislature intended that prudence be exercised in development on or near low hazard sites, and extreme caution or avoidance be exercised in high risk areas. This is articulated in the GMA Guidelines:

Some geological hazards can be mitigated by engineering, design, or modified construction or mining practices so that risks to health and safety are acceptable. When technology cannot reduce risks to acceptable levels, building in geologically hazardous areas is best avoided. This distinction should be considered by counties and cities that do not now classify geological hazards as they develop their classification scheme. [WAC 365-190-080 (4)]

However, these risk-reduction techniques, especially shoreline armoring (bulkheading, revetments, etc.), can have cumulative adverse environmental effects which should be addressed (Macdonald, Simpson, Paulson, Cox & Gendron, 1994; Thom, Shreffler & Macdonald, 1994.). The adverse impacts of bioengineering techniques are usually less than those of engineering or geotechnical techniques. However, any measure which successfully halts or slows Puget Sound marine shoreline erosion will contribute to cumulative effects which will ultimately lead to diminished delivery of sediments to the beach, thus leading to beach lowering and coarsening (Canning & Shipman, 1995.).

One of the hazards of geologically hazardous areas is that they are not readily recognizable to the untrained eye. Many persons purchase property or residences only to later find that their investment or personal safety is threatened.

In reviewing local plans and development regulations, it would be good to keep in mind the words of George Mader (1974):

Where does the responsibility lie for protecting people and property? An often-heard argument is that if an individual wants to take the risk of building in a hazardous area, he should be allowed to do so. The argument goes on that only he will suffer in the event of a failure. In an isolated location, this position might be acceptable. But in urban and suburban settings, land failure on an individual property usually has intense repercussions on the surrounding area. Decreased property values, possible fire hazards, costly public assistance, and possible physical impact on adjacent land are frequent major results.

Similarly, a developer often says he is willing to accept the risk in an unstable area. In the end, of course, that risk is passed on to purchasers in the development and to the public agency that assumes responsibility for streets and other public improvements, for the developer is usually out of the picture by the time a failure occurs. Thus the burden is unfairly shifted to all the taxpayers in the community.

It becomes clear that geologic hazards are not private matters, but concern the public in general. It is therefore incumbent upon government to protect the public interest.

Mapping

While there is no specific requirement in the GMA that critical areas be mapped, the requirement to regulate critical areas logically requires that their location and characteristics be known. The difficulty in mapping critical areas is acknowledged by the GMA Guidelines:

For critical areas, performance standards are preferred, as any attempt to map wetlands, for example, will be too inexact for regulatory purposes. Standards will be applied upon land use application. Even so, mapping critical areas for information, but not regulatory purposes, is advisable. [WAC 365-190-040 (2) (d)]

Fortunately, some or all landslide sensitive areas are already mapped in many counties, and there is a generally accepted nomenclature for classifying the degree of landslide hazards (see Table 1). The marine shoreline landslide hazards are mapped in the Coastal Zone Atlas of Washington.² Landslide hazards mapping of broader regions is also available from the US Geological Survey and the Washington Department of Natural Resources map libraries.

Most Puget Sound beaches are erosional (except for rocky shores and accretional shoreforms such as sand spits) at an average rate of a few tenths of a foot per year but this has not been mapped. Information on the Southwest Washington Coastal Erosion Study is available on the Shorelands Program web site at <http://www.ecy.wa.gov/programs/sea/swce/index.html>.

To the extent that existing mapping is available, local governments can map landslide hazards, if only by reference to published maps and reports. A partial bibliography of geologic mapping and other documentation for the Puget Sound region can be found in Appendix A. For geologic mapping in other regions, readers should consult the Department of Natural Resources, Division of Geology and Earth Resources library.

Most landslide hazard mapping is generalized and useful only as a screening device. Site specific information is usually required for site-specific assessments. Therefore, while most landslide hazard mapping is inappropriate for site-specific regulatory purposes, it can be an excellent indicator of potential hazards and should be used by local governments as an adjunct to their critical area ordinance.

² The Coastal Zone Atlas is now out of print. Some libraries and local government planning offices have reference copies. Shorelands Program, Washington Department of Ecology is implementing a project to electronically scan the Atlas coastal slope stability mapping for electronic publishing on the Shorelands Program's web site at <http://www.ecy.wa.gov/programs/sea/shorelan.html>.

Table 1. Slope stability class definitions.³

CLASS 1; S, Stable Slopes: Believed to be stable. Slopes are generally less than 15%, but may be greater than 15% in local areas of low relief and low ground water concentration. Includes mostly rolling uplands underlain by very stable material, such as young glacial till, covered in places by a thin layer of sandy gravel or other permeable material; also included are flood plains, deltas, alluvial fans, and some beach deposits. Normal, proper engineering practices generally are adequate to ensure continued stability.

CLASS 2; I, Intermediate Slopes: Believed to be stable under natural conditions; may become unstable if disturbed. Slopes generally greater than 15%, but may be less than 15% in areas with less stable geologic materials. Includes areas underlain by: (1) well-drained sand and gravel, mostly in valley sides; (2) glacial till on slopes greater than 15%; and (3) bedrock. Destabilization may be caused by man's activities, over-steepening by erosion, or strong seismic shaking. Local minor modifications in slope for small buildings and narrow roads will probably result in little or no hazard unless proper engineering practices are ignored. Geologic engineering studies should precede significant development.

CLASS 3; U, Unstable Slopes: Inferred to be unstable. Slopes generally are greater than 15%, in areas underlain by weak, unstable materials in which old or recently active landslides have occurred. Includes areas of sand and gravel on top of impermeable till, silt, or clay, mostly along steep valley sides and Puget Sound shorelines. Most of these slides occur during periods of heavy rains. These slope failures include a few landslides of moderate size, but the most common occurrences are of slumping, slicing, and falling of relatively small amounts of earth materials. Thorough geologic engineering investigations imperative for safe development.

CLASS 4; Uos, Unstable Old Slides: Former landslide areas. Generally located within Class 3 areas. Includes relatively large slumps, flows, and slides of soil, rock, and debris that have occurred since the retreat of glaciers from the region. Present stability unknown, but sliding may be reactivated by excavations, slope modifications, or strong seismic shaking. These areas should be considered unstable land unless and until proven otherwise by thorough geologic engineering investigations.

CLASS 5; Urs, Unstable Recent Slides: Recent landslide areas. Known areas of recently active rapid downslope movement (probably within the past 50 years) generally within Class 2 and 3 areas. Includes relatively large- to moderate-sized landslides, but most commonly only slumping, sliding, and falling of relatively small amounts of earth material, usually occurring during periods of heavy rains. Presently stability considered very poor.

UNCLASSIFIED; M, Modified Slopes: Areas highly modified by human activities. Slope responses to a combination of natural processes and man's activities may be unpredictable. (Coastal Zone Atlas mapping only.)

³ As defined by the US Geological Survey and Washington Department of Natural Resources for Washington. Numerical classes are USGS and WDNR designations. Letter codes are Washington Department of Ecology Coastal Zone Atlas designations.

Growth Management Act Comprehensive Plan Review Suggestions

Priority Concerns

1. Do the geological hazard area policies address shoreline erosion and landsliding?
Geologically hazardous areas include areas susceptible to erosion, sliding, earth-quake, 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. [WAC 365-190-080 (4)]
2. Do the policies distinguish between high hazard zones where development should be severely limited, and low hazard zones where development is merely subject to extra precaution in design, construction, and occupancy?
Some geological hazards can be mitigated by engineering, design, or modified construction or mining practices so that risks to health and safety are acceptable. When technology cannot reduce risks to acceptable levels, building in geologically hazardous areas is best avoided. This distinction should be considered by counties and cities that do not now classify geological hazards as they develop their classification scheme. [WAC 365-190-080 (4)]

General Concerns

3. Do the policies include a preference for bioengineering techniques where appropriate, and require mitigation of adverse environmental effects of risk reduction techniques, including cumulative effects?

Growth Management Act Development Regulation Review Suggestions

Priority Concerns

- 1.1 Are landslide hazard areas mapped? The coastal landslide hazards, at least, should be mapped based upon the Coastal Zone Atlas.
- 2.1 Do the development regulations distinguish levels or degrees of landslide risk?
 - 2.1.1 Are “Uos” and “Urs” zones identified as landslide high hazard areas with corresponding limitations on development?
 - 2.1.2 Are “I” and “U” zones identified as landslide low hazard areas with corresponding requirements for special development and construction practices?
 - 2.1.3 Do the development regulations include provisions for professional geotechnical evaluation of landslide hazard areas?
- 2.2 Do the development regulations include or reference a clearing and grading regulation with special requirements for steep slopes and landslide hazard areas?
Clearing (vegetation removal) and grading (earthmoving) are the first steps toward destabilization of slopes. To prevent speculative land clearing and top soil mining, an

adequate clearing and grading regulation will provide for the issuance of a clearing and grading permit only in conjunction with a building permit.

2.3 Do the development regulations include or reference a requirement for special engineered plans for surface water drainage and ground water management as a condition of approval of development and construction on steep slopes and landslide hazard areas?

Most landslides occur during the winter following periods of heavy rainfall. Improper design of storm water disposal facilities and inadequate consideration of the role of ground water in slope stability will aggravate the likelihood of slope failure.

General Concerns

3.1 Do the development regulations include a preference for bioengineering techniques for risk reduction in geological critical areas?

Bioengineering is the practice of combining biological methods (e.g. vegetative erosion control) with engineered structures. Bioengineering is not universally applicable, but it can be appropriate for the stabilization of slopes, river banks, and coastal dunes.

In some circumstances, an effective bioengineering technique for beach erosion is beach nourishment in combination with beachgrass plantings on the artificially produced beach berm. Shorelands is not yet advocating this approach for general application. There are yet-to-be-resolved matters of [1] distinguishing between beach nourishment (for erosion protection), beach enhancement (for habitat enhancement), and beach fill (for land creation); [2] coordinating with the Department of Fish and Wildlife regarding the goals of the SMA and the Hydraulics Code; and [3] answering questions about habitat impacts and the determination of the proper sediment particle size mix for use in different wave and longshore drift regimes.

A comprehensive review of engineering, geotechnical, and bioengineering techniques for stabilization of Puget Sound bluffs is contained in Management Options for Unstable Bluffs in Puget Sound, Washington (Macdonald and Witek, 1994). The practical application of vegetative slope stabilization is described in a pair of companion booklets on slope stabilization (Myers, 1993) and vegetation management Menashe, 1993). The practical application of surface and groundwater drainage principals is described in a companion booklet (Myers, Lorilla & Myers, 1995).

Bibliography

- Brunengo, Matthew J. 1994. Geologic hazards and the Growth Management Act. *Washington Geology* 22(2): 4-10.
- Canning, Douglas J. and Hugh Shipman. 1995. *Coastal erosion management studies in Puget Sound, Washington: Executive summary. Coastal Erosion Management Studies, Volume 1.* Washington Department of Ecology, Olympia.
- Cox, Jack, Keith Macdonald, and Tom Rigert. 1994. *Engineering and geotechnical techniques for shoreline erosion management in Puget Sound. Coastal Erosion Management Studies, Volume 4.* Washington Department of Ecology, Olympia.

- Galster, Richard W. 1987. A survey of coastal engineering geology in the Pacific Northwest. *Association of Engineering Geologists Bulletin* 24(2): 161-197.
- Macdonald, Keith, David Simpson, Bradley Paulson, Jack Cox, and Jane Gendron. 1994. *Shoreline armoring effects on physical coastal processes in Puget Sound, Washington. Coastal Erosion Management Studies, Volume 5.* Washington Department of Ecology, Olympia.
- Macdonald, Keith B. and Bonnie Witek. 1994. *Management Options for Unstable Bluffs in Puget Sound, Washington. Coastal Erosion Management Studies Volume 8.* Shorelands and Coastal Zone Management Program, Washington Department of Ecology, Olympia.
- Mader, George G. 1974. Earthquakes, landslides and public policy. *Cry California* 9:16-22.
- Menashe, Elliott. 1993. *Vegetation management: A guide for Puget Sound bluff property owners.* Washington Department of Ecology Publication 93-31. An abbreviated version is available at <http://www.ecy.wa.gov/programs/sea/pubs/93-31/intro.html>.
- Mintz, D.W., R.S. Babcock, T.A. Terich. 1976. Potential land use problems of Puget Sound shore bluffs. pp 21-33 in: *Engineering geologic studies.* Washington Division of Geology and Earth Resources Information Circular 58.
- Myers, Rian D. 1993. *Slope stabilization and erosion control using vegetation.* Washington Department of Ecology Publication 93-30. An abbreviated version is available at <http://www.ecy.wa.gov/programs/sea/pubs/93-30/intro.html>.
- Myers, Rian D., Michele Lorilla & Jane N. Myers. 1995. *Surface water and groundwater on coastal bluffs: A guide for Puget Sound property owners.* Washington Department of Ecology Publication 95-107. An abbreviated version is available at <http://www.ecy.wa.gov/programs/sea/pubs/95-107/intro.html>.
- Terich, Thomas A. 1987. Living with the shore of Puget Sound and the Georgia Strait. *Duke University Press.*
- Thom, Ronald M., David K. Shreffler, and Keith Macdonald. 1994. *Shoreline armoring effects on coastal ecology and biological resources in Puget Sound, Washington. Coastal Erosion Management Studies, Volume 7.* Washington Department of Ecology, Olympia.
- Washington Department of Fish and Wildlife. In press. *Integrated Streambank Protection Guidelines.* Washington Department of Fish and Wildlife, Olympia. A draft version is available at <http://www.wa.gov/wdfw/hab/ahg/ispgdoc.htm>.

Appendix A: Geological Resource Materials⁴

General Resources

Galster, Richard W., 1987, A survey of coastal engineering geology in the Pacific Northwest: *Association of Engineering Geologists Bulletin*, v. 24, no. 2, p. 161-197.

Geographic: Puget Sound; Strait of Juan De Fuca; Pacific Coast

Subject: Shorelines; Engineering Geology; Geomorphology; Landslides and Slope Stability

Menashe, Elliott, 1993, *Vegetative management: A guide for Puget Sound bluff property owners*: Washington Department of Ecology, Publication 93-31, 46 p.

Geographic: Puget Lowland

Subject: Shorelines - Erosion; Landslides and Slope Stability - Vegetative Control

Mintz, D. W.; Babcock, R. S.; Terich, T. A., 1976, Potential land use problems of Puget Sound shore bluffs. in: Washington Division of Geology and Earth Resources, *Engineering geologic studies*: Washington Division of Geology and Earth Resources Information Circular 58, p. 21-33.

Geographic: Puget Lowland

Subject: Geologic Hazards - Landslides ; Shore-Lines; Coastal Zone Management; Land Use Planning

Myers Biodynamics, Inc., 1993, *Slope stabilization and erosion control using vegetation: A manual of practice for coastal property owners*: Washington Department of Ecology Publication 93-30, 42 p.

Geographic: PUGET LOWLAND

Subject: Shorelines - Erosion; Landslides and Slope Stability - Vegetative Control

Peck, Craig A., and Associates, 1976, *Draft environmental impact statement for Seacliff, residential development*: Whatcom County Planning Department, 1 v.

Geographic: Whatcom Co.; Point Roberts, Wash.

Subject: Environmental Impact Statements; Stratigraphy; Land-Slides and Slope Stability; Shorelines; Soil Mechanics

Terich, Thomas A., 1987, *Living with the shore of Puget Sound and the Georgia Strait*: Duke University Press, 165 p.

⁴ This bibliography of geologic reference materials was apparently generated by the Geology and Earth Resources Division, Washington Department of Natural Resources, in the mid-1990s. It addresses only western Washington in general, and Clallam, Island, Jefferson, King, Kitsap, Mason, Pierce, San Juan, Skagit, Snohomish, and Thurston counties in particular. Items listed in this bibliography should be available for viewing at the Geology and Earth Resources Library at the Natural Resources Building in Olympia. Items published by the US Geological Survey might be available from the USGS office in Tacoma.

Geographic: Puget Sound

Subject: Shorelines; Coastal Zone Management; Geologic Hazards - Coastal Landslides and Flooding; Land-Slides and Slope Stability; Flooding

Washington Department of Ecology, 1977, *Coastal zone atlas of Washington; volume 1, Whatcom County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Whatcom Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1978, *Coastal zone atlas of Washington; volume 2, Skagit County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Skagit Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1978, *Coastal zone atlas of Washington; volume 3, San Juan County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: San Juan Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 4, Island County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Island Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 5, Snohomish County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Snohomish Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 6, King County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: King CO.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 7, Pierce County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Pierce Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1980, *Coastal zone atlas of Washington; volume 8, Thurston County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Thurston Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1980, *Coastal zone atlas of Washington; volume 9, Mason County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Mason Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington-, volume 10, Kitsap County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Kitsap CO.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1978, *Coastal zone atlas of Washington; volume I 1, Jefferson County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Jefferson Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Washington Department of Ecology, 1978, *Coastal zone atlas of Washington; volume 12, Clallam County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Clallam Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Clallam County

Brown, R. D., Jr., 1970, *Geologic map of the north-central part of the Olympic Peninsula, Washington*: U.S. Geological Survey Open-File Report 70-43, 2 sheets, scale 1:62,500.

Geographic: Clallam Co.

Subject: Areal Geology; Maps - Geologic

Brown, Robert David, Jr.; Gower, Howard Dale; Snavelly, Parke Detwiler, Jr., 1960, *Geology of the Port Angeles-Lake Crescent area, Clallam County, Washington*: U.S. Geological Survey Oil and Gas Investigation Map OM-203, 1 sheet, scale 1:62,500.

Geographic: Clallam Co.; Port Angeles, Wash.; Lake Crescent

Subject: Areal Geology; Maps - Geologic

Frederick, J. E., 1979, *Map showing natural land slopes, Port Townsend quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I1198-A, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Clallam Co.; Jefferson Co.; Island Co.; Snohomish Co.; Skagit Co.; San Juan Co.

Subject: Topography; Geomorphology

Halloin, Louis J., 1987, *Soil survey of Clallam County area, Washington*: U.S. Soil Conservation Service, 213 p., 67 plates.

Geographic: Clallam Co.

Subject: Soil Surveys

Keuler, Ralph F., 1988, *Map showing coastal erosion, sediment supply, and longshore transport in the Port Townsend 30- by 60-minute quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-E, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Skagit Co.; Island Co.; Jefferson Co.; Clallam Co.

Subject: Shorelines; Littoral Drift; Erosion

Martin, Iury L.; Gilkeson, Raymond A., 1961, *State of Washington engineering soils manual: Soils of Clallam County*: Washington State Institute of Technology Division of Industrial Research Bulletin 253, 130 p.

Geographic: Clallam Co.

Subject: Soils; Engineering Geology

Miller, Robert D.; Pessl, Fred, Jr., compilers, 1986, *Map showing unconsolidated deposits grouped on the basis of texture, Port Townsend 30' x 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-D, 1 sheet.

Geographic: Port Townsend Quadrangle; Clallam Co.; Jefferson Co.; Island Co.; Skagit Co.; Snohomish Co.

Subject: Sedimentary Petrology; Soils

Miller, R. D.; Safioles, S. A.; Pessl, Fred, Jr., 1985, *Map showing relative slope stability in the Port Townsend 30' x 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-C, 1 sheet, scale 1:100,000.

Geographic: Puget Lowland; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.; Port Townsend Quadrangle

Subject: Landslides and Slope Stability

Noble, John Boardman, 1960, *A preliminary report on the geology and ground-water resources of the Sequim-Dungeness area, Clallam County, Washington*: Washington Division of Water Resources Water Supply Bulletin 11, 43 p., 3 plates.

Geographic: Clallam Co.; Sequim, Wash.; Dungeness, Wash.

Subject: Areal Geology; Hydrology - Ground Water; Maps - Geologic; Drilling Logs

Othberg, K. L.; Palmer, Pamela, 1979, *Preliminary surficial geologic map of part of the Gardiner quadrangle, Clallam County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 79-19, 3 p., 1 plate, scale 1:24,000.

Geographic: Clallam Co.; Gardiner Quadrangle

Subject: Areal Geology; Maps - Geologic

Othberg, K. L.; Palmer, Pamela, 1979, *Preliminary surficial geologic map of the Dungeness quadrangle, Clallam County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 79-17, 3 p., 1 plate, scale 1:24,000.

Geographic: Clallam Co.; Dungeness Quadrangle

Subject: Areal Geology; Maps - Geologic

Othberg, K. L.; Palmer, Pamela, 1979, *Preliminary surficial geologic map of the Sequim quadrangle, Clallam County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 79-18, 4 p., 1 plate, scale 1:24,000.

Geographic: Clallam Co.; Sequim Quadrangle

Subject: Areal Geology; Maps - Geologic

Othberg, K. L.; Palmer, Pamela, 1982, *Preliminary surficial geologic map of the Carlsborg quadrangle, Clallam County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 79-20, 1 sheet, scale 1:24,000.

Geographic: Clallam Co.; Carlsborg Quadrangle

Subject: Areal Geology; Maps - Geologic

Pessl, Fred, Jr.; Dethier, D. P.; Booth, D. B.; Minard, J. P., 1989, *Surficial geologic map of the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-F, 1 sheet, scale 1:100,000, with 13 p. text.

Geographic: Port Townsend Quadrangle; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic

Ritchie, A. M., 1958, Recognition and identification of landslides. In: Eckel, E. B., editor, 1958, *Landslides and engineering practice*: Highway Research Board Special Report 29, p. 48-68.

Geographic: King Co.; Clallam Co.

Subject: Landslides and Slope Stability; Landslide Bib; Engineering Geology

U.S. Army Corps of Engineers, 1972, Erosion control, Ediz Hook, Port Angeles, Washington. In: Schwartz, M. L., editor, 1972, *Spits and bars*: Dowden, Hutchinson and Ross Benchmark Papers in Geology, p. 401-438.

Geographic: Ediz Hook; Clallam Co.

Subject: Shorelines; Erosion; Coastal Zone Management

Washington Department of Ecology, 1978, *Coastal zone atlas of Washington; volume 12, Clallam County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Clallam Co.

Subject: Areal Geology; Naps - Geologic; Sand; Gravel; Land-Slides and Slope Stability ; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Whetten, J. T.; Carroll, P. I.; Gower, H. D.; Brown, E. H.; Pessl, Fred, Jr., 1988, *Bedrock geologic map of the Port Townsend 30- by 60-minute quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-G, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Skagit Co.; Snohomish Co.; Island Co.; Jefferson Co.; San Juan Co.; Clallam Co.; Puget Lowland

Subject: Areal Geology; Maps - Geologic

Island County

Anderson, H. W., Jr., 1968, *Ground-water resources of Island County, Washington*: Washington Department of Water Resources Water-Supply Bulletin 25, part 2, 317 p.

Geographic: Island Co.

Subject: Hydrology - Ground Water

Easterbrook, D. J., 1968, *Pleistocene stratigraphy of Island County*: Washington Department of Water Resources Water-Supply Bulletin 25, part 1, 34 p., - 1 plate (in 4 parts).

Geographic: Island Co.; Double Bluff Drift; Whidbey Formation; Possession Drift; Quadra Formation; Vashon Drift; Partridge Gravel; Everson Glaciomarine Drift

Subject: Quaternary - Pleistocene; Stratigraphy; Glacial Geology; Sedimentary Petrology

Frederick, J. E., 1979, *Map showing natural land slopes, Port Townsend quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-A, 1 sheet, scale 1: 100,000.

Geographic: Port Townsend Quadrangle; Clallam Co.; Jefferson Co.; Island Co.; Snohomish Co.; Skagit Co.; San Juan Co.

Subject: Topography; Geomorphology

Keuler, Ralph F., 1988, *Map showing coastal erosion, sediment supply, and longshore transport in the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S.

Geological Survey Miscellaneous Investigations Series Map I-1198-E, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Skagit Co.; Island Co.; Jefferson Co.; Clallam Co.

Subject: Shorelines; Littoral Drift; Erosion

Miller, Robert D.; Pessi, Fred, Jr., compilers, 1986, *Map showing unconsolidated deposits grouped on the basis of texture, Port Townsend 30' x 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-D, 1 sheet.

Geographic: Port Townsend Quadrangle; Clallam Co.; Jefferson Co.; Island Co.; Skagit Co.; Snohomish Co.

Subject: Sedimentary Petrology; Soils

Miller, R. D.; Safioles, S. A.; Pessl, Fred, Jr., 1985, *Map showing relative slope stability in the Port Townsend 30' x 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-C, 1 sheet, Miller, Robert D.; Pessl, Fred, Jr., compilers, 1986, *Map showing unconsolidated deposits grouped on the basis of texture, Port Townsend 1:100,000*.

Geographic: Puget Lowland; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.; Port Townsend Quadrangle

Subject: Landslides and Slope Stability

Minard, James P., 1982, *Distribution and description of geologic units in the Mukilteo quadrangle, Washington*: U.S. Geological Survey Miscellaneous Field Studies Map MF-1438, 1 sheet, scale 1:24,000.

Geographic: Island Co.; Mukilteo Quadrangle; Snohomish Co.

Subject: Areal Geology; Maps - Geologic

Minard, James P., 1985, *Geologic map of the Tulalip quadrangle, Snohomish County, Washington*: U.S. Geological Survey Miscellaneous Field Studies Map MF- 1744, 1 sheet, scale 1:24,000.

Geographic: Snohomish Co.; Island Co.; Tulalip Quadrangle

Subject: Areal Geology; Maps - Geologic

Ness, A. O.; Richins, C. G., 1958, *Soil survey of Island County, Washington*: U.S. Soil Conservation Service Series 1949, no. 6, 58 p., 16 plates.

Geographic: Island Co.

Subject: Soils

Pessl, Fred, Jr.; Dethier, D. P.; Booth, D. B.; Minard, J. P., 1989, *Surficial geologic map of the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-F, 1 sheet, scale 1:100,000, with 13 p. text.

Geographic: Port Townsend Quadrangle; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 4, Island County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Island Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Jefferson County

Birdseye, R. U., 1976, *Geologic map of east-central Jefferson County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-26, 1 sheet, scale 1:24,000.

Geographic: Jefferson Co.

Subject: Areal Geology; Maps - Geologic

Birdseye, R. U., 1976, *Relative slope stability in east-central Jefferson County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-27, 1 sheet, scale 1:24,000,

Geographic: Jefferson Co.

Subject: Landslides and Slope Stability

Carson, R. J., 1976, *Relative slope stability of the Brinnon area, Jefferson County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-15, 1 sheet, scale 1:24,000.

Geographic: Jefferson Co.; Brinnon Area.

Subject: Landslides and Slope Stability

Frederick, J. E., 1979, *Map showing natural land slopes, Port Townsend quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-A, 1 sheet, scale 1: 100,000.

Geographic: Port Townsend Quadrangle; Clallam Co.; Jefferson Co.; Island Co.; Snohomish Co.; Skagit Co.; San Juan Co.

Subject: Topography; Geomorphology

Galster, Richard W.; Ekman, Mark, 1977, Field trip 5: Coastal engineering geology, Northern Olympic Peninsula. In: *Association of Engineering Geologists, Guidebook to field trips; 1977 National Meeting, Seattle, Washington*: Association of Engineering Geologists, p. 115-133.

Geographic: Jefferson Co.; Clallam Co.; Dungeness Spit; Ediz Hook.

Subject: Guidebooks; Shorelines; Littoral Drift; Engineering Geology

Gayer, M. J., 1976, *Slope stability map of northeastern Jefferson County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-22, 1 sheet, scale 1:24,000.

Geographic: Jefferson Co.

Subject: Landslides and Slope Stability

Grimstad, Peder; Carson, Robert J., 1981, *Geology and ground-water resources of eastern Jefferson County, Washington*: Washington Department of Ecology Water-Supply Bulletin 54, 125 p., 3 plates.

Geographic: Jefferson Co.

Subject: Areal Geology; Maps - Geologic; Hydrology - Ground Water

Hanson, K. L., 1976, *Geologic map of the Uncas-Port Ludlow area, Jefferson County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-20, 1 sheet, scale 1:24,000.

Geographic: Jefferson Co.; Uncas-Port Ludlow Area.

Subject: Areal Geology; Maps - Geologic

Hanson, K. L., 1976, *Slope stability map of the Uncas-Port Ludlow area, Jefferson County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-18, 1 sheet, scale 1:24,000.

Geographic: Jefferson Co.; Uncas-Port Ludlow Area.

Subject: Land-Slides and Slope Stability

Keuler, Ralph F., 1988, *Map showing coastal erosion, sediment supply, and longshore transport in the Port Townsend 30' by 60' quadrangle, Puget Sound region Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-E, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Skagit Co.; Island Co.; Jefferson Co.; Clallam Co.

Subject: Shorelines; Littoral Drift; Erosion

McCreary, F. R., 1975, *Soil survey of Jefferson County area, Washington*: U.S. Soil Conservation Service, 100 p., 70 plates.

Geographic: Jefferson Co.

Subject: Soils

Miller, R. D.; Safioles, S. A.; Pessi, Fred, Jr., 1985, *Map showing relative slope stability in the Port Townsend 30' x 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I- 1198- C, 1 sheet, scale 1: 100,000.

Geographic: Puget Lowland; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.; Port Townsend Quadrangle.

Subject: Landslides and Slope Stability

Pessl, Fred, Jr.; Dethier, D. P.; Booth, D. B.; Minard, J. P., 1989, *Surficial geologic map of the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-F, 1 sheet, scale 1:100,000, with 13 p. text.

Geographic: Port Townsend Quadrangle; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic

Washington Department of Ecology, 1978, *Coastal zone atlas of Washington; volume 11, Jefferson County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Jefferson Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Yount, J. C.; Minard, J. P.; Dembroff, G. R., 1993, *Geologic map of surficial deposits in the Seattle 30' x 60' quadrangle, Washington*: U.S. Geological Survey Open-File Report 93-233, 2 sheets, scale 1:100,000.

Geographic: King Co.; Kitsap Co.; Snohomish Co.; Seattle Quadrangle; Island Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic; Stratigraphy

King County

King County Parks, Planning, and Resources Department, 1990, *Sensitive areas map folio: King County, December 1990*: King County Parks, Planning, and Resources Department, 1 v.

Geographic: King Co.

Subject: Geologic Hazards; Land Use Planning ; Wetlands ; Floods ; Erosion; Landslides and Slope Stability ; Earthquakes and Seismology; Coal Mine Subsidence

Woodward, D. G., 1992, Evaluation of the ground-water resources of southwestern King County. In: Wayenberg, J. A.; Renslow, V. F., compilers, *Summary of water-resources activities of the U.S. Geological Survey in Washington: Fiscal year 1991*: U.S. Geological Survey Open-File Report 92-92, p. 27.

Geographic: King Co.

Subject: Hydrology - Ground Water

Yount, J. C.; Minard, J. P.; Dembroff, G. R., 1993, *Geologic map of surficial deposits in the Seattle 30' x 60' quadrangle, Washington*: U.S. Geological Survey Open-File Report 93-233, 2 sheets, scale 1:100,000.

Geographic: King Co.; Kitsap Co.; Snohomish Co.; Seattle Quadrangle; Island Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic; Stratigraphy

Booth, D. B., 1991, *Geologic map of Vashon and Maury Islands, King County, Washington*: U.S. Geological Survey Miscellaneous Field Studies Map MF-2161, 1 sheet, scale 1:24,000, with 6 p. text.

Geographic: King Co.; Vashon Island; Maury Island

Subject: Areal Geology; Maps - Geologic

Friedman-Thomas, Rachel; Minton, Gary, 1988, Erosion control: What is the state of the art? In: *Washington State Puget Sound Water Quality Authority, Proceedings: First annual meeting on Puget Sound research*: Puget Sound Water Quality Authority, v. 2, p. 718-722.

Geographic: King Co.

Subject: Engineering Geology - Erosion; Soil Erosion Caused By Development

Galster, R. W.; Laprade, W. T., 1991, Geology of Seattle, Washington, United States of America: *Association of Engineering Geologists Bulletin*, v. 28, no. 3, p. 235-302, 1 plate.

Geographic: Seattle, Wash.; King Co.

Subject: Earth-Quakes and Seismology; Glacial Geology

Grant, W. P.; Perkins, W. J.; Youd, T. L., 1992, *Evaluation of liquefaction potential, Seattle, Washington*: U.S. Geological Survey Open-File Report 91-441-T, 44 p., 1 plate.

Geographic: Seattle, Wash.; King Co.

Subject: Earthquake-Induced Liquefaction; Areal Geology; Maps - Geologic; Engineering Geology - Soil Mechanics

King County Department of Community and Environmental Development, 1975, *Vashon-Maury Island: Physical characteristics and shoreline inventory*: King County Department of Community and Environmental Development, 63 p.

Geographic: King Co.; Vashon Island; Maury Island

Subject: Shore-Lines; Land Use Planning

King County Parks, Planning, and Resources Department, 1990, *Sensitive areas map folio: King County, December 1990*: King County Parks, Planning, and Resources Department, 1 v.

Geographic: King Co.

Subject: Geologic Hazards; Land Use Planning ; Wetlands ; Floods ; Erosion ; Landslides and Slope Stability; Earthquakes and Seismology; Coal Mine Subsidence

Liesch, B. A.; Price, C. E.; Walters, K. L., 1963, *Geology and ground-water resources of northwestern King County, Washington*: Washington Division of Water Resources Water-Supply Bulletin 20, 241 p., 3 plates.

Geographic: King Co.

Subject: Areal Geology; Maps - Geologic; Hydrology - Ground Water

Livingston, V. E., Jr., 1971, *Geology and mineral resources of King County, Washington*: Washington Division of Mines and Geology Bulletin 63, 200 p., 8 plates.

Geographic: King Co.

Subject: Areal Geology; Mineral Resources; Maps - Geologic

McGavock, Edwin H., 1990, Evaluation of ground-water resources in southwest King County. In: Wayenberg, J. A., editor, *Summary of water-resources activities of the U.S. Geological Survey in Washington: Fiscal year 1989*: U.S. Geological Survey Open-File Report 90-180, p. 43.

Geographic: King Co.

Subject: Hydrology - Ground Water

Miller, R. D., 1973, *Map showing relative slope stability in part of west-central King County, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-852-A, 1 sheet, scale 1:48,000.

Geographic: King Co.

Subject: Landslides and Slope Stability

Minard, James P., 1982, *Landslides mapped in Seattle, Washington [abstract]*: U.S. Geological Survey Professional Paper 1275, p. 222-223.

Geographic: Seattle, Wash.; King Co.

Subject: Landslides and Slope Stability

Minard, James P., 1983, *Geologic map of the Edmonds East and part of the Edmonds West quadrangles, Washington*: U.S. Geological Survey Miscellaneous Field Studies Map MF-1541, 1 sheet, scale 1:24,000.

Geographic: King Co.; Snohomish Co.; Edmonds East Quadrangle; Edmonds West Quadrangle

Subject: Areal Geology; Maps - Geologic

Yount, J. C.; Minard, J. P.; Dembroff, G. R., 1993, *Geologic map of surficial deposits in the Seattle 30' x 60' quadrangle, Washington*: U.S. Geological Survey Open-File Report 93-233, 2 sheets, scale 1:100,000.

Geographic: King Co.; Kitsap Co.; Snohomish Co.; Seattle Quadrangle; Island Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic; Stratigraphy

Reichert, W. H., 1978, *Annotated guide to sources of information on the geology, minerals, and ground-water resources of the Puget Sound region, Washington, King County section; with supplemental references by D. D. Dethier*: Washington Division of Geology and Earth Resources Information Circular 61, 63 p.

Geographic: King Co.

Subject: Areal Geology; Mineral Resources; Hydrology - Ground Water; Bibliography

Ritchie, A. M., 1958, Recognition and identification of landslides. In: Eckel, E. B., editor, 1958, *Landslides and engineering practice*: Highway Research Board Special Report 29, p. 48-68.

Geographic: King Co.; Clallam Co.

Subject: Landslides and Slope Stability; Landslide Bib; Engineering Geology

Smith, Mackey, 1975, *Preliminary surficial geologic map of the Edmonds East and Edmonds West quadrangles, Snohomish and King Counties, Washington*: Washington Division of Geology and Earth Resources Geologic Map GM-14, I sheet, scale 1:24,000.

Geographic: Snohomish Co.; King Co.; Edmonds East Quadrangle; Edmonds West Quadrangle

Subject: Areal Geology; Maps - Geologic

Snyder, D. E.; Gale, P. S.; Pringle, R. F., 1973, *Soil survey of King County area, Washington*: U.S. Soil Conservation Service, 100 p., 22 plates.

Geographic: King Co.

Subject: Soils

Tubbs, D. W., 1974, *Landslides and associated damage during early 1972 in part of west-central King County, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map 1-852-B, 1 sheet, scale 1:48,000.

Geographic: King Co.

Subject: Landslides and Slope Stability; Geologic Hazards - Landslides

Tubbs, D. W., 1974, *Landslides in Seattle*: Washington Division of Geology and Earth Resources Information Circular 52, 15 p.

Geographic: King Co.; Seattle, Wash.

Subject: Landslides and Slope Stability

Tubbs, D. W.; Dunne, Thomas, 1977, *Geologic hazards in Seattle: A field guide for the Geological Society of America Annual Meeting, 1977*: Geological Society of America, 37 p.

Geographic: Seattle, Wash.; King Co.

Subject: Geologic Hazards; Landslides And Slope Stability

Waldron, H. H., 1961, *Geology of the Poverty Bay quadrangle, Washington*: U.S. Geological Survey Open-File Report 61-167, 2 sheets. (Published as USGS map GQ- 158.)

Geographic: King Co.; Pierce Co.; Poverty Bay Quadrangle

Subject: Areal Geology; Maps - Geologic

Waldron, H. H., 1967, *Geologic map of the Duwamish Head quadrangle, King and Kitsap Counties, Washington*: U.S. Geological Survey Geologic Quadrangle Map GQ- 706, 1 sheet, scale 1:24,000.

Geographic: Duwamish Head Quadrangle; King Co.; Kitsap Co.

Subject: Areal Geology; Maps - Geologic

Waldron, H. H.; Leisch, B. A.; Mullineaux, D. R.; Crandell, D. R., 1961, *Preliminary geologic map of Seattle and vicinity*: U.S. Geological Survey Open- File Report 61-168, 3 sheets. (Published as USGS map 1-354.)

Geographic: King Co.; Seattle, Wash.

Subject: Areal Geology; Maps - Geologic

Walsh, Timothy J., 1987, *Geologic map of the south half of the Tacoma quadrangle, Washington*: Washington Division of Geology and Earth Resources Open-File Report 87-3, 10 p., 1 plate, scale 1:100,000.

Geographic: Tacoma Quadrangle; Thurston Co.; Pierce Co.; King Co.; Mason Co.

Subject: Areal Geology; Maps - Geologic

Walsh, Timothy J.; Korosec, Michael A.; Phillips, William M.; Logan, Robert L.; Schasse, Henry W., 1987, *Geologic map of Washington: Southwest quadrant*: Washington Division of Geology and Earth Resources Geologic Map GM-34, 2 sheets, scale 1:250,000, with 28 p. text.

Geographic: Southwestern Washington; Grays Harbor Co.; Mason Co.; Thurston Co.; Pierce Co.; King Co.; Kittitas Co.; Pacific Co.; Lewis Co.; Yakima Co.; Klickitat Co.; Skamania Co.; Clark Co.; Cowlitz Co.; Wahkiakum Co.

Subject: Areal Geology; Maps - Geologic

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 6, King County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: King Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shorelines; Land Use Planning; Coastal Zone Management

Washington Surveying and Rating Bureau, 1966, Seattle and vicinity, *Washington earthquake map, showing general areas of filled or unstable ground*: Washington Surveying and Rating Bureau, 1 sheet, scale 1:48,000, with 1 p. text.

Geographic: Seattle, Wash.; King Co.

Subject: Earthquakes and Building; Soil Mechanics

Yount, J. C., 1982, Earthquake hazards Puget Sound, Washington. In: Jacobson, M. L.; Rodriguez, T. R.; Saiders, W. H., compilers, *Summaries of technical reports, Volume XIV*: U.S. Geological Survey Open-File Report 82-840, p. 70-71.

Geographic: Puget Lowland; Seattle, Wash.; King Co.

Subject: Earthquake Induced Landslides; Geologic Hazards; Areal Geology; Seismology; Landslides and Slope Stability; Earthquakes

Yount, James C., 1983, Geologic units that likely control seismic ground shaking in the greater Seattle area. In: Yount, J. C.; Crosson, R. S., editors, *Proceedings of workshop XIV*,

Earthquake hazards of the Puget Sound region, Washington: U.S. Geological Survey Open-File Report 83-19, p. 268-279.

Geographic: King Co.; Seattle, Wash.

Subject: Seismology; Areal Geology

Kitsap County

Garring, M. E.; Molenaar, Dee; and others, 1965, *Water resources and geology of the Kitsap Peninsula and certain adjacent islands*: Washington Division of Water Resources Water-Supply Bulletin 18, 309 p., 5 plates.

Geographic: Kitsap Co.; Mason Co.; Pierce Co.; Puget Lowland; Kitsap Peninsula

Subject: Areal Geology; Maps - Geologic; Hydrology - Ground Water

Hansen, A. J., Jr.; Bolke, E. L., 1980, *Ground-water availability on the Kitsap Peninsula, Washington*: U.S. Geological Survey Open-File Report 80-1186, 70 p.

Geographic: Kitsap Peninsula; Kitsap Co.; Pierce Co.

Subject: Hydrology - Ground Water

McMurphy, C. J., 1980, *Soil survey of Kitsap County area, Washington*: U.S. Soil Conservation Service, 127 p., 31 plates.

Geographic: Kitsap Co.

Subject: Soils

Othberg, K. L., 1975, *Geologic interpretive map showing areas of unstable slopes, Kitsap County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 75-7, 11 sheets, scale 1:24,000.

Geographic: Kitsap Co.

Subject: Landslides and Slope Stability; Maps - Geologic

Sceva, Jack E., 1956, *Geology and ground-water resources of Kitsap County, Washington: Annotated Bibliography of Economic Geology 1954*, v. 27, no. 2, p. 289.

Geographic: Kitsap Co.

Subject: Hydrology - Ground Water

Sceva, Jack Edward, 1957, *Geology and ground-water resources of Kitsap County, Washington*: U.S. Geological Survey Water-Supply Paper 1413, 178 p., 3 plates.

Geographic: Kitsap Co.

Subject: Areal Geology; Hydrology - Ground Water; Maps - Geologic

Smith, Mackey, 1974, Poulsbo slide: *Washington Geologic Newsletter*, v. 2, no. 3, p. 7.

Geographic: Kitsap Co.; Poulsbo, Wash.

Subject: Landslides and Slope Stability

Smith, Mackey; Carson, R. J., 1977, *Relative slope stability of the southern Hood Canal area, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-853-F, 1 sheet, scale 1:62,500.

Geographic: Mason Co.; Kitsap Co.; Hood Canal

Subject: Landslides and Slope Stability

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 10, Kitsap County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Kitsap Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Yount, J. C.; Minard, J. P.; Dembroff, G. R., 1993, *Geologic map of surficial deposits in the Seattle 30' x 60' quadrangle, Washington*: U.S. Geological Survey Open-File Report 93-233, 2 sheets, scale 1:100,000.

Geographic: King Co.; Kitsap Co.; Snohomish Co.; Seattle Quadrangle; Island Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic; stratigraphy

Mason County

Carson, R. J., 1975, *Slope stability map of north-central Mason County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 75-4, 1 sheet, scale 1:62,500.

Geographic: Mason Co.

Subject: Landslides and Slope Stability

Carson, R. J., 1976, *Geologic map of north-central Mason County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-2, 1 sheet, scale 1:62,500.

Geographic: Mason Co.

Subject: Areal Geology; Maps - Geologic

Garling, M. E.; Molenaar, Dee; and others, 1965, *Water resources and geology of the Kitsap Peninsula and certain adjacent islands*: Washington Division of Water Resources Water-Supply Bulletin 18, 309 p., 5 plates.

Geographic: Kitsap Co.; Mason Co.; Pierce Co.; Puget Lowland; Kitsap Peninsula

Subject: Areal Geology; Maps - Geologic; Hydrology - Ground Water

Molenaar, Dee; Noble, J. B., 1970, *Geology and related ground-water occurrence, southeastern Mason County, Washington*: Washington Department of Water Resources Water-Supply Bulletin 29, 145 p., 2 plates.

Geographic: Mason Co.

Subject: Hydrology - Ground Water; Areal Geology; Maps - Geologic

Ness, A. O.; Fowler, R. H., 1960, *Soil survey of Mason County, Washington*: U.S. Soil Conservation Service Series 1951, no. 9, 76 p., 24 plates.

Geographic: Mason Co.

Subject: Soils

Smith, Mackey; Carson, R. J., 1977, *Relative slope stability of the southern Hood Canal area, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-853-F, 1 sheet, scale 1:62,500.

Geographic: Mason Co.; Kitsap Co.; Hood Canal

Subject: Landslides and Slope Stability

Walsh, Timothy J., 1987, *Geologic map of the south half of the Tacoma quadrangle, Washington*: Washington Division of Geology and Earth Resources Open-File Report 87-3, 10 p., 1 plate, scale 1:100,000.

Geographic: Tacoma Quadrangle; Thurston Co.; Pierce Co.; King Co.; Mason Co.

Subject: Areal Geology; Maps - Geologic

Walsh, Timothy J.; Korosec, Michael A.; Phillips, William M.; Logan, Robert L.; Schasse, Henry W., 1987, *Geologic map of Washington: Southwest quadrant*: Washington Division of Geology and Earth Resources Geologic Map GM-34, 2 sheets, scale 1:250,000, with 28 p. text.

Geographic: Southwestern Washington; Grays Harbor Co.; Mason Co.; Thurston Co.; Pierce Co.; King Co.; Kittitas Co.; Pacific Co.; Lewis Co.; Yakima Co.; Klickitat Co.; Skamania Co.; Clark Co.; Cowlitz Co. Wahkiakum Co.

Subject: Areal Geology; Maps - Geologic

Washington Department of Ecology, 1980, *Coastal zone atlas of Washington; volume 9, Mason County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Mason Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Pierce County

Anderson, W. W.; Ness, A. O.; Anderson, A. C., 1955, *Soil survey of Pierce County, Washington*: U.S. Soil Conservation Service Soil Survey Series 1939, no. 27, 88 p.

Geographic: Pierce Co.

Subject: Soil Surveys

Garring, M. E.; Molenaar, Dee; and others, 1965, *Water resources and geology of the Kitsap Peninsula and certain adjacent islands*: Washington Division of Water Resources Water-Supply Bulletin 18, 309 p., 5 plates.

Geographic: Kitsap Co.; Mason Co.; Pierce Co.; Puget Lowland; Kitsap Peninsula

Subject: Areal Geology; Maps - Geo-Logic; Hydrology - Ground Water

Smith, Mackey, 1976, *Relative slope stability of Gig Harbor Peninsula, Pierce County, Washington*: Washington Division of Geology and Earth Resources Geologic Map GM-18, 1 sheet, scale 1:31,680.

Geographic: Pierce Co.; Gig Harbor Peninsula

Subject: Landslides and Slope Stability

Smith, Mackey, 1976, *Surficial geology of northeast Tacoma, Pierce County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-9, 1 sheet, scale 1:24,000.

Geographic: Tacoma, Wash.; Pierce Co.

Subject: Areal Geology; Maps - Geologic

Smith, Mackey, 1977, *Geologic map of the city of Tacoma, Pierce County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 77-9, 1 sheet, scale 1:24,000.

Geographic: Pierce Co.; Tacoma, Wash.

Subject: Areal Geology; Maps - Geologic

Waldron, H. H., 1961, *Geology of the Poverty Bay quadrangle, Washington*: U.S. Geological Survey Open-File Report 61-167, 2 sheets. (Published as USGS map GQ- 158.)

Geographic: King Co.; Pierce Co.; Poverty Bay Quadrangle

Subject: Areal Geology; Maps - Geologic

Waldron, Howard Hamilton, 1961, *Geology of the Poverty Bay quadrangle, Washington*: U.S. Geological Survey Geologic Quadrangle Map GQ-158, 1 sheet, scale 1:24,000.

Geographic: Poverty Bay Quadrangle; King Co.; Pierce Co.

Subject: Areal Geology; Maps - Geologic

Walsh, Timothy J., 1987, *Geologic map of the south half of the Tacoma quadrangle, Washington*: Washington Division of Geology and Earth Resources Open-File Report 87-3, 10 p., 1 plate, scale 1:100,000.

Geographic: Tacoma Quadrangle; Thurston Co.; Pierce Co.; King Co.; Mason Co.

Subject: Areal Geology; Maps - Geologic

Walsh, Timothy J.; Korosec, Michael A.; Phillips, William M.; Logan, Robert L.; Schasse, Henry W., 1987, *Geologic map of Washington: Southwest quadrant*: Washington Division of Geology and Earth Resources Geologic Map GM-34, 2 sheets, scale 1:250,000, with 28 p. text.

Geographic: Southwestern Washington; Grays Harbor Co.; Mason Co.; Thurston Co.; Pierce Co.; King Co.; Kittitas Co.; Pacific Co.; Lewis Co.; Yakima Co.; Klickitat Co.; Skamania Co.; Clark Co.; Cowlitz Co.; Wahkiakum Co.

Subject: Areal Geology; Maps - Geologic

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 7, Pierce County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Pierce Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Zulauf, A. S., 1979, *Soil survey of Pierce County area, Washington*: U.S. Soil Conservation Service, 131 p.

Geographic: Pierce Co.

Subject: Soils

San Juan County

Cowan, D. S.; Whetten, J. T.; Brown, E. H., 1977, Geology of the southern San Juan Islands. In: Brown, E. H.; Ellis, R. C., editors, *Geological excursions in the Pacific Northwest; Geological Society of America annual meeting, 1977*: Western Washington University, p. 309-338.

Geographic: San Juan Islands; Fidalgo Formation; San Juan Co.

Subject: Areal Geology; Guidebooks

Danner, Wilbert Roosevelt, 1962, *Guidebook for geological field trips, San Juan Island, Washington State*: University of British Columbia Department of Geology Report 1, 25 p., 2 plates.

Geographic: San Juan Island; San Juan Co.

Subject: Guidebooks; Areal Geology

Dietrich, W. E., 1975, Surface water resources of San Juan County. In: Russell, R. H., editor, *Geology and water resources of the San Juan Islands, San Juan County, Washington*: Washington Department of Ecology Water-Supply Bulletin 46, p. 59-125.

Geographic: San Juan Co.; San Juan Islands

Subject: Hydrology

Eddy, P. A., 1975, Quaternary geology and ground-water resources of San Juan County, Washington. In: Russell, R. H., editor, *Geology and water resources of the San Juan Islands, San Juan County, Washington*: Washington Department of Ecology Water-Supply Bulletin 46, p. 21-39.

Geographic: San Juan Co.; San Juan Islands

Subject: Areal Geology; Quaternary; Hydrology - Ground Water

Frederick, J. E., 1979, *Map showing natural land slopes, Port Townsend quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-A, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Clallam Co.; Jefferson Co.; Island Co.; Snohomish Co.; Skagit Co.; San Juan Co.

Subject: Topography; Geomorphology

Miller, R. D.; Safioles, S. A.; Pessl, Fred, Jr., 1985, *Map showing relative slope stability in the Port Townsend 30' x 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-C, 1 sheet, scale 1:100,000.

Geographic: Puget Lowland; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.; Port Townsend Quadrangle

Subject: Landslides and Slope Stability

Pessi, Fred, Jr.; Dethier, D. P.; Booth, D. B.; Minard, J. P., 1989, *Surficial geologic map of the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I- 1198-F, 1 sheet, scale 1:100,000, with 13 p. text.

Geographic: Port Townsend Quadrangle; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic

Russell, R. H., editor, 1975, *Geology and water resources of the San Juan Islands, San Juan County, Washington*: Washington Department of Ecology Water-Supply Bulletin 46, 171 p., 3 plates.

Geographic: San Juan Co.; San Juan Islands

Subject: Areal Geology; Hydrology; Maps - Geologic

Schlots, Fred E.; Ness, Arnold O.; Rasmussen, Jack J.; McMurphy, Carl J.; Main, Lauren L.; Richards, Ralph J.; Starr, Warren A.; Krashevski, Stephen H., 1962, *Soil survey of San Juan County, Washington*: U.S. Soil Conservation Service Series 1957, no. 15, 73 p., 36 plates.

Geographic: San Juan Co.

Subject: Soils

Washington Department of Ecology, 1978, *Coastal zone atlas of Washington; volume 3, San Juan County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: San Juan Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Skagit County

Artim, E. R.; Wunder, J. M., 1976, *Preliminary geologic map of the La Conner quadrangle in Skagit County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-1, 1 sheet, scale 1:24,000.

Geographic: Skagit Co.; La Conner Quadrangle

Subject: Areal Geology; Maps - Geologic

Dethier, David P.; Whetten, John T., 1981, *Preliminary geologic map of the Mount Vernon 7 1/2 minute quadrangle, Skagit County, Washington*: U.S. Geological Survey Open-File Report 81-105, 9 p., 1 sheet, scale 1:24,000.

Geographic: Skagit Co.; Mount Vernon Quadrangle

Subject: Maps - Geologic; Areal Geology

Frederick, J. E., 1979, *Map showing natural land slopes, Port Townsend quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-A, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Clallam Co.; Jefferson Co.; Island Co.; Snohomish Co.; Skagit Co.; San Juan Co.

Subject: Topography; Geomorphology

Heller, P. L., 1979, *Map showing landslides and relative slope stability of Quaternary deposits of the lower Skagit and Baker Valleys, north Cascades, Washington*: US Geological Survey Open-File Report 79-963, 30 p., 2 plates, scale 1:62,500.

Geographic: Skagit Valley; Baker Valley; Skagit Co.

Subject: Land-Slides and Slope Stability; Quaternary

Heller, P. L., 1979, *Map showing surficial geology of parts of the lower Skagit and Baker Valleys, north Cascades, Washington*: U.S. Geological Survey Open-File Report 79-964, 16 p., 1 plate, scale 1:62,500.

Geographic: Skagit Co.; Skagit Valley; Baker Valley

Subject: Areal Geology; Maps - Geologic; Quaternary

Heller, Paul L., 1981, Small landslide types and controls in glacial deposits: Lower Skagit River drainage, northern Cascade Range, Washington: *Environmental Geology*, v. 3, no. 4, p. 221-228.

Geographic: Skagit Co.; Skagit River Basin; Baker River Basin

Subject: Landslides and Slope Stability; Glacial Geology

Heller, Paul L.; Dethier, David P., 1981, Surficial and environmental geology of the lower Baker valley, Skagit County, Washington: *Northwest Science*, v. 55, no. 2, p. 145-155.

Geographic: Skagit Co.; Baker Valley; Baker River Basin

Subject: Areal Geology; Landslides and Slope Stability

Keuler, Ralph F., 1988, *Map showing coastal erosion, sediment supply, and longshore transport in the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey - Miscellaneous Investigations Series Map I- 1198-E, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Skagit Co.; Island Co.; Jefferson Co.; Clallam Co.

Subject: Shorelines; Littoral Drift; Erosion

Miller, R. D.; Safioles, S. A.; Pessl, Fred, Jr., 1985, *Map showing relative slope stability in the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-C, 1 sheet, scale 1:100,000.

Geographic: Puget Lowland; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.; Port Townsend Quadrangle

Subject: Landslides and Slope Stability

Ness, A. O.; Buchanan, D. E.; Richins, C. G., 1960, *Soil survey of Skagit County, Washington*: U.S. Soil Conservation Service Series 1951, no. 6, 91 p., 40 plates.

Geographic: Skagit Co.

Subject: Soils

Pessl, Fred, Jr.; Dethier, D. P.; Booth, D. B.; Minard, J. P., 1989, *Surficial geologic map of the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I- 1198-F, 1 sheet, scale 1:100,000, with 13 p. text.

Geographic: Port Townsend Quadrangle; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic

Washington Department of Ecology, 1978; *Coastal zone atlas of Washington; volume 2, Skagit County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Skagit Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Wunder, J. M., 1976, *Preliminary geologic map of the Utsalady quadrangle, Skagit and Snohomish Counties, Washington*: Washington Division of Geology, and Earth Resources Open-File Report 76-10, 1 sheet, scale 1:24,000.

Geographic: Skagit Co.; Snohomish Co.; Utsalady Quadrangle

Subject: Areal Geology; Maps - Geologic

Snohomish County

Capps, Gerald; Simmons, J. D.; Videgar, F. D., 1973, *Preliminary report on the geology of southern Snohomish County, Washington*: Washington Division of Geology and Earth Resources Open-File Report 73-1, 11 p., 2 plates.

Geographic: Snohomish Co.

Subject: Areal Geology; Maps - Geologic

Debose, Alfonso; Klungland, Michael W., 1983, *Soil survey of Snohomish County area, Washington*: U.S. Government Printing Office, 197 p., 59 plates.

Geographic: Snohomish Co.

Subject: Soils

Frederick, J. E., 1979, *Map showing natural land slopes, Port Townsend quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-A, 1 sheet, scale 1:100,000.

Geographic: Port Townsend Quadrangle; Clallam Co.; Jefferson Co.; Island Co.; Snohomish Co.; Skagit Co.; San Juan Co.

Subject: Topography; Geomorphology

Miller, R. D.; Safioles, S. A.; Pessl, Fred, Jr., 1985, *Map showing relative slope stability in the Port Townsend 30' x 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-C, 1 sheet, scale 1:100,000.

Geographic: Puget Lowland; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.; Port Townsend Quadrangle

Subject: Landslides and Slope Stability

Minard, J. P., 1980, *Distribution and description of the geologic units in the Stanwood quadrangle, Washington*: U.S. Geological Survey Open-File Report 80-464, 6 p., 1 plate, scale 1:24,000.

Geographic: Stanwood Quadrangle; Snohomish Co.

Subject: Areal Geology; Maps - Geologic

Minard, J. P., 1980, *Distribution and description of the geologic units in the Tulalip quadrangle, Washington*: U.S. Geological Survey Open-File Report 80-465, 6 p., 1 sheet, scale 1:24,000.

Geographic: Tulalip Quadrangle; Snohomish Co.

Subject: Areal Geology; Maps - Geologic

Minard, James P., 1981, *Distribution and description of the geologic units in the Everett quadrangle, Washington*: U.S. Geological Survey Open-File Report 81-248, 5 p., 1 sheet, scale 1:24,000.

Geographic: Snohomish Co.; Everett Quadrangle

Subject: Areal Geology; Maps - Geologic

Minard, James P., 1982, *Distribution and description of geologic units in the Mukilteo quadrangle, Washington*: U.S. Geological Survey Miscellaneous Field Studies Map MF-1438, 1 sheet, scale 1:24,000.

Geographic: Island Co.; Mukilteo Quadrangle; Snohomish Co.

Subject: Areal Geology; Maps - Geologic

Minard, James P., 1985, *Geologic map of the Stanwood quadrangle, Snohomish County, Washington*: U.S. Geological Survey Miscellaneous Field Studies Map MF-1741, 1 sheet, scale 1:24,000.

Geographic: Snohomish Co.; Stanwood Quadrangle

Subject: Areal Geology; Maps - Geologic

Minard, James P., 1985, *Geologic map of the Tulalip quadrangle, Snohomish County, Washington*: U.S. Geological Survey Miscellaneous Field Studies Map MF- 1744, 1 sheet, scale 1:24,000.

Geographic: Snohomish Co.; Island Co. Tulalip Quadrangle

Subject: Areal Geology; Maps - Geologic

Newcomb, Reuben C., 1952, *Ground-water resources of Snohomish County, Washington*: U.S. Geological Survey Water-Supply Paper 1135, 133 p.

Geographic: Snohomish Co.

Subject: Hydrology - Ground Water; Areal Geology; Maps -Geologic

Pessl, Fred, Jr.; Dethier, D. P.; Booth, D. B.; Minard, J. P., 1989, *Surficial geologic map of the Port Townsend 30' by 60' quadrangle, Puget Sound region, Washington*: U.S. Geological Survey Miscellaneous Investigations Series Map I-1198-F, 1 sheet, scale 1:100,000, with 13 p. text.

Geographic: Port Townsend Quadrangle; Skagit Co.; Snohomish Co.; Island Co.; San Juan Co.; Clallam Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic

Smith, Mackey, 1975, *Preliminary surficial geologic map of the Edmonds East and Edmonds West quadrangles, Snohomish and King Counties, Washington*: Washington Division of Geology and Earth Resources Geologic Map GM-14, 1 sheet, scale 1:24,000.

Geographic: Snohomish Co.; King Co.; Edmonds East Quadrangle; Edmonds West Quadrangle

Subject: Areal Geology; Maps - Geologic

Smith, Mackey, 1976, *Preliminary surficial geologic map of the Mukilteo and Everett quadrangles, Snohomish County, Washington*: Washington Division of Geology and Earth Resources Geologic Map GM-20, 1 sheet, scale 1:24,000.

Geographic: Snohomish Co.; Mukilteo Quadrangle; Everett Quadrangle

Subject: Areal Geology; Maps - Geologic

Washington Department of Ecology, 1979, *Coastal zone atlas of Washington; volume 5, Snohomish County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Snohomish Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management

Weber, Paul R., 1977, Landslides in Puget Sound glacial sediments. In: *Canadian Geotechnical Society, 30th Canadian geotechnical conference (proceedings); Geotechnical aspects of glacial deposits*: Canadian Geotechnical Society, p. VIII-26 - VIII-46.

Geographic: King Co.; Snohomish Co.

Subject: Quaternary; Glacial Geology; Landslides and Slope Stability; Sediments
Wunder, J. M., 1976, *Preliminary geologic map of the Utsalady quadrangle, Skagit and Snohomish Counties, Washington*: Washington Division of Geology and Earth Resources Open-File Report 76-10, 1 sheet, scale 1:24,000.

Geographic: Skagit Co.; Snohomish Co. Utsalady Quadrangle

Subject: Areal Geology; Maps - Geologic

Yount, J. C.; Minard, J. P.; Dembroff, G. R., 1993, *Geologic map of surficial deposits in the Seattle 30' x 60' quadrangle, Washington*: U.S. Geological Survey Open-File Report 93-233, 2 sheets, scale 1:100,000.

Geographic: King Co.; Kitsap Co.; Snohomish Co.; Seattle Quadrangle; Island Co.; Jefferson Co.

Subject: Areal Geology; Maps - Geologic; Stratigraphy

Thurston County

Artim, E. R., 1976, *Slope stability map of Thurston County, Washington*: Washington Division of Geology and Earth Resources Geologic Map GM-15, 1 sheet, scale 1:125,000.

Geographic: Thurston Co.

Subject: Landslides and Slope Stability

Noble, J. B.; Wallace, E. F., 1966, *Geology and ground-water resources of Thurston County, Washington; Volume 2*: Washington Division of Water Resources Water-Supply Bulletin 10, v. 2, 141 p., 5 plates.

Geographic: Thurston Co.

Subject: Areal Geology; Maps - Geologic; Hydrology - Ground Water

Pringle, Russell F., 1990, *Soil survey of Thurston County, Washington*: U.S. Soil Conservation Service, 283 p., 49 plates.

Geographic: Thurston Co.

Subject: Soil Surveys

Wallace, Eugene Francis; Molenaar, Dee, 1961, *Geology and ground-water resources of Thurston County, Washington, volume 1*: Washington Division of Water Resources Water Supply Bulletin 10, v. 1, 254 p., 2 plates.

Geographic: Thurston Co.

Subject: Areal Geology; Hydrology - Ground Water; Drilling Logs

Walsh, Timothy J., 1987, *Geologic map of the south half of the Tacoma quadrangle, Washington*: Washington Division of Geology and Earth Resources Open-File Report 87-3, 10 p., 1 plate, scale 1:100,000.

Geographic: Tacoma Quadrangle; Thurston Co.; Pierce Co.; King Co.; Mason Co.

Subject: Areal Geology; Maps - Geologic

Walsh, Timothy J.; Korosec, Michael A.; Phillips, William M.; Logan, Robert L.; Schasse, Henry W., 1987, *Geologic map of Washington: Southwest quadrant*: Washington Division of Geology and Earth Resources Geologic Map GM-34, 2 sheets, scale 1:250,000, with 28 p. text.

Geographic: Southwestern Washington; Grays Harbor Co.; Mason Co.; Thurston Co.; Pierce Co.; King Co.; Kittitas Co.; Pacific Co.; Lewis Co.; Yakima Co.; Klickitat Co.; Skamania Co.; Clark Co.; Cowlitz Co.; Wahkiakum Co.

Subject: Areal Geology; Maps - Geologic

Washington Department of Ecology, 1980, *Coastal zone atlas of Washington; volume 8, Thurston County*: Washington Department of Ecology, 1 v., maps, scale 1:24,000.

Geographic: Thurston Co.

Subject: Areal Geology; Maps - Geologic; Sand; Gravel; Land-Slides and Slope Stability; Littoral Drift; Shore-Lines; Land Use Planning; Coastal Zone Management