STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
DONALD A. HULL, STATE GEOLOGIST

Liquefaction Susceptibility Map of the Salem East and Salem West Quadrangles, Marion and Polk Counties, Oregon

1996

ISSN 0270-952X

GMS-105

Relative Earthquake Hazard Maps of the Salem East and Salem West Quadrangles, Marion and Polk Counties, Oregon

By Y. Wang and W.J. Leonard

Funded in part by the City of Salem, and
Oregon State Lottery funds appropriated to
the Oregon Department of Geology and Mineral Industries

Plate 1

Explanation

Category 5	>24 feet estimated thickness of liquefiable material
Category 4	≥18-24 feet estimated thickness of liquefiable material
Category 3	≥12-18 feet estimated thickness of liquefiable material
Category 2	≥6-12 feet estimated thickness of liquefiable material
Category 1	<6 feet estimated thickness of liquefiable material
Category 0	No susceptibility, with possible exceptions in small, localized areas

This liquefaction susceptibility map depicts six categories identifying levels of susceptibility to earthquake-induced liquefaction. Refer to the companion text, which explains details of the liquefaction hazards associated with this map and of the different categories. In category 0, no susceptibility is expected--with possible exceptions in small, localized areas. For categories 1-5, susceptibility is based on estimated available thickness of liquefiable material.

Liquefaction, the loss of soil strength due to increases in pore pressures, is often compared to "quicksand". Loose, water saturated, sandy soils can liquefy from earthquake shaking and can produce extensive damage. Hazards often involve structural and foundation failures due to differential movement in the vertical direction between the structure and the ground and lateral spreading, that is, horizontal movement of surface soil layers down gentle slopes or towards free faces (such as river banks). Ruptured pipelines, displaced bridge abutments, damaged buildings and other structures, and flotation of buoyant underground structures are potential hazards associated with liquefaction.

This liquefaction susceptibility map may be used to gain an understanding of liquefaction hazards, so that steps may be taken to reduce the risk to life and property through planning policy and other mitigation measures. User groups include but are not limited to local jurisdictions, building officials, land use planners, emergency preparedness and response planners, engineering and geology consultants, lifeline managers, developers, realtors, insurers, and private citizens.

This map was developed to serve as a regional planning tool and does not have site-specific accuracy. All areas shown on the map are susceptible to earthquake shaking, regardless of the assigned hazard zone.

Please note:
Information provided in this publication should NOT be used in place of site-specific studies. The relative hazard zones are not intended to replace site-specific evaluations, such as for engineering analysis and design. Site-specific earthquake hazards should be assessed through geotechnical or engineering geology investigation by qualified practitioners.

Hazard analysis by Yumei Wang and William J. Leonard,
Oregon Department of Geology and Mineral Industries

Cartography by Paul E. Staub

The geologic hazard information on this map is available in digital formats

Base map by U.S. Geological Survey
Control by USGS, USC&GS, and State of Oregon
Polyconic projection. 1927 North American datum
10,000-foot grid based on Oregon coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks,
zone 10, shown in blue

NORTH

SCALE 1:24 000

.5 0 1 2 KILOMETERS
1000 0 7000 FEET
.5 0 1 MILE

CONTOUR INTERVAL 10 FEET

OREGON
QUADRANGLE LOCATION

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
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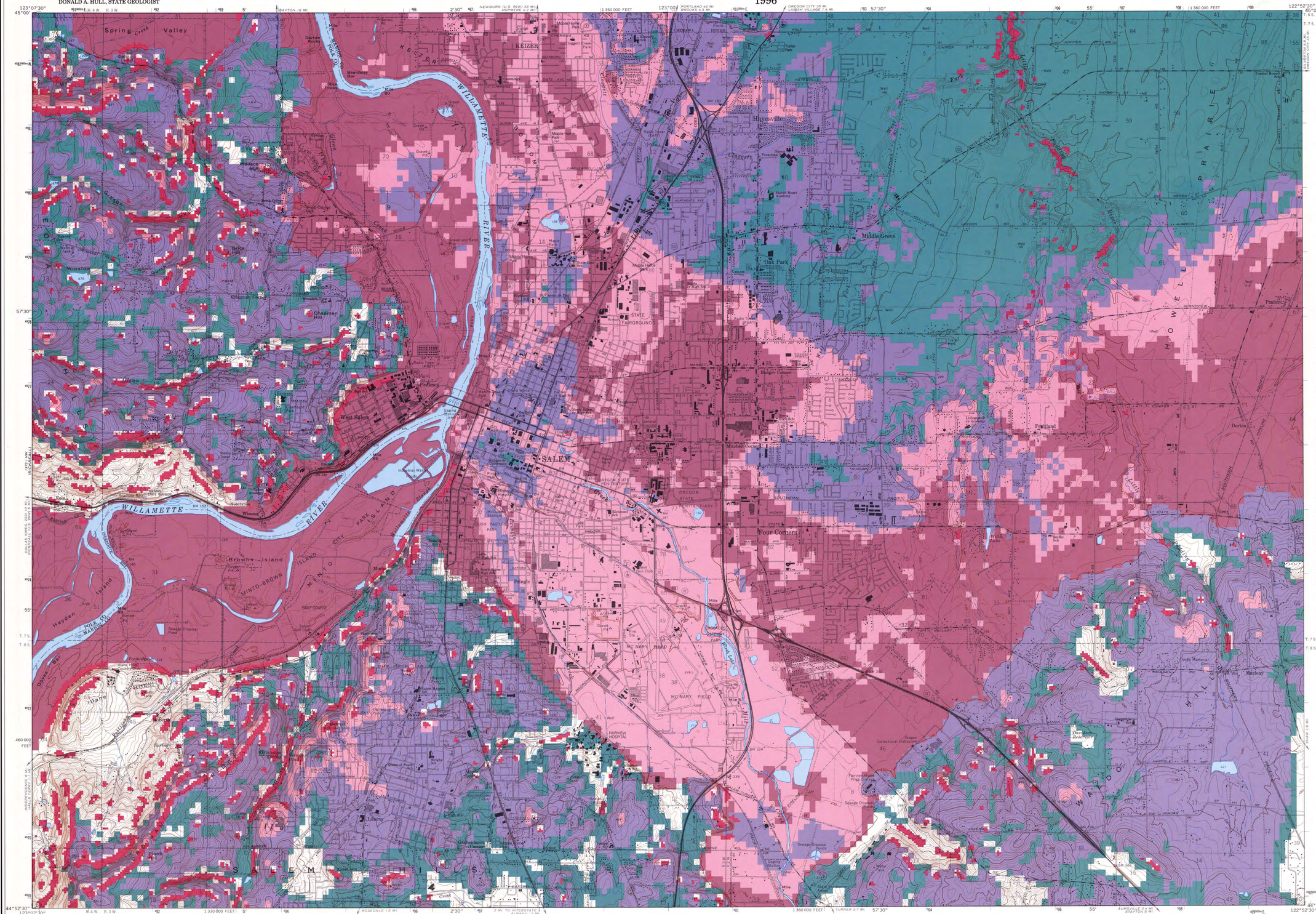
Amplification Susceptibility Map of the Salem East and Salem West Quadrangles, Marion and Polk Counties, Oregon

1996



Base map by U.S. Geological Survey
Control by USGS, USC&GS, and State of Oregon
Polyconic projection. 1927 North American datum
10,000-foot grid based on Oregon coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks,
zone 10, shown in blue

NORTH

SCALE 1:24 000

.5 0 1 2 KILOMETERS
1000 0 7000 FEET
.5 0 1 MILE

CONTOUR INTERVAL 10 FEET

OREGON
QUADRANGLE LOCATION

Hazard analysis by Yumei Wang and William J. Leonard, Oregon Department of Geology and Mineral Industries

Cartography by Paul E. Staub

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Plate 2

Explanation

Category 5	Possible high susceptibility to amplification in areas of abrupt topographic changes
Category 4	>1.6 amplification factor for peak rock accelerations
Category 3	>1.4-1.6 amplification factor for peak rock accelerations
Category 2	>1.2-1.4 amplification factor for peak rock accelerations
Category 1	>1.2 amplification factor for peak rock accelerations
Category 0	No susceptibility (stable bedrock at or near the surface), with possible exceptions in small, localized areas

This amplification susceptibility map depicts six categories identifying levels of susceptibility to amplification of peak rock accelerations associated with earthquake shaking. Refer to the companion text, which explains details of the amplification hazards associated with this map and of the different categories. The six categories of susceptibility to amplification range from category 0, where no susceptibility is expected because of stable bedrock at or near the surface–with possible exceptions in small, localized areas--to category 5 with possible high but unquantified susceptibility to amplification in areas of abrupt topographic changes. For categories 1-4, susceptibility is based on calculated amplification factors for peak rock accelerations.

Amplification of peak rock accelerations from earthquake motions can produce severe damage to the built environment, such as to buildings and lifelines (e.g. water, wastewater, electricity, gas, communication, and road systems). Amplification generally occurs in unconsolidated, younger soils as opposed to harder, older bedrock. Amplification, however, may occur in bedrock areas with abrupt topographic changes, such as in ridges and swales. Amplification can greatly increase the danger of building damage and nonstructural damage, such as broken windows, fallen ducts, or overturned bookcases.

This amplification susceptibility map may be used to gain an understanding of the ground shaking amplification hazards in the higher frequency (or shorter period) response domain and is especially useful for structures with short periods. It provides a basis for steps to be taken to reduce the risk to life and property through planning policy and other mitigation measures. User groups include but are not limited to local jurisdictions, building officials, land use planners, emergency preparedness and response planners, engineering and geology consultants, lifeline managers, developers, realtors, insurers, and private citizens.

This map was developed to serve as a regional planning tool and does not have site-specific accuracy. All areas shown on the map are susceptible to earthquake shaking, regardless of the assigned hazard zone.

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Landslide Susceptibility Map of the Salem East and Salem West Quadrangles, Marion and Polk Counties, Oregon

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Plate 3

Explanation

Category 5		High susceptibility to landsliding in areas with existing landslides
Category 4		>22 degrees of slope angle
Category 3		≥14-22 degrees of slope angle
Category 2		≥6-14 degrees of slope angle
Category 1		<6 degrees of slope angle in hills
Category 0		<6 degrees of slope angle in valley

This landslide susceptibility map depicts six categories identifying levels of susceptibility to landsliding associated with earthquake shaking. Refer to the companion text, which explains details of the landsliding hazards associated with this map and of the different categories. The six categories of susceptibility to landsliding range from category 0, where no susceptibility is expected (flat ground in the valley)--with possible exceptions in small localized areas--to category 5 with high but unquantified susceptibility to landsliding because of existing landslides. For categories 0-4, susceptibility is based on calculated slope angles.

Landslides, which generally occur on steep slopes composed of weak rock or soil, can be triggered by earthquake motions. Earthquakes can reactivate former landslide areas or generate new slides. Landslide activities can bury extensive areas, damage structures, and destroy or block roads. Landslides may also occur without the influence of earthquakes, simply because of unusually heavy or prolonged rainfall and oversteepening of slopes by natural processes or human influence. Areas affected by human activities, such as roadcuts and mine excavations, have not been specifically addressed herein.

This landslide susceptibility map may be used to gain an understanding of landslide hazards, so that steps can be taken to reduce the risk to life and property through planning policy and other mitigation measures. User groups include but are not limited to local jurisdictions, building officials, land use planners, emergency preparedness and response planners, engineering and geology consultants, lifeline managers, developers, realtors, insurers, and private citizens. The zones can be used for purposes involving potential landsliding hazards not associated with earthquake shaking.

This map was developed to serve as a regional planning tool and does not have site-specific accuracy. All areas shown on the map are susceptible to earthquake shaking, regardless of the assigned zone.

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Hazard analysis by Yumei Wang and William J. Leonard,
Oregon Department of Geology and Mineral Industries

Cartography by Paul E. Staub

The geologic hazard information on this map is available in digital formats

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1000-meter Universal Transverse Mercator grid ticks,
zone 10, shown in blue

SCALE 1:24 000

2 KILOMETERS
7000 FEET
1 MILE

CONTOUR INTERVAL 10 FEET

OREGON
QUADRANGLE LOCATION

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Plate 4

Explanation

Zone A	Highest hazard
Zone B	Intermediate to high hazard
Zone C	Low to intermediate hazard
Zone D	Lowest hazard

This relative earthquake hazard map depicts four zones of greater or lesser earthquake hazard, relative to one another. Refer to the companion text, which explains details of the earthquake hazards associated with this map and their differentiation. Areas within the highest earthquake hazard zone (A) are likely to suffer the most intense damage related to ground response; those in the lowest (D) are likely to suffer the least.

Three earthquake hazards that are associated with local geology (liquefaction, amplification, and landsliding) were individually evaluated and then combined to develop the relative earthquake hazard map. Individual hazard assessments are shown on the companion maps (Plates 1-3).

This composite map allows technical and nontechnical users to gain an understanding of earthquake hazards, so that steps can be taken to reduce the risk to life and property through planning policy and other mitigation measures. User groups include but are not limited to local jurisdictions, building officials, land use planners, emergency preparedness and response planners, engineering and geology consultants, lifeline managers, developers, realtors, insurers, and private citizens.

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SCALE 1:24 000

CONTOUR INTERVAL 10 FEET

Earthquake hazard analysis by Yumei Wang and William J. Leonard,
Oregon Department of Geology and Mineral Industries

Cartography by Paul E. Staub

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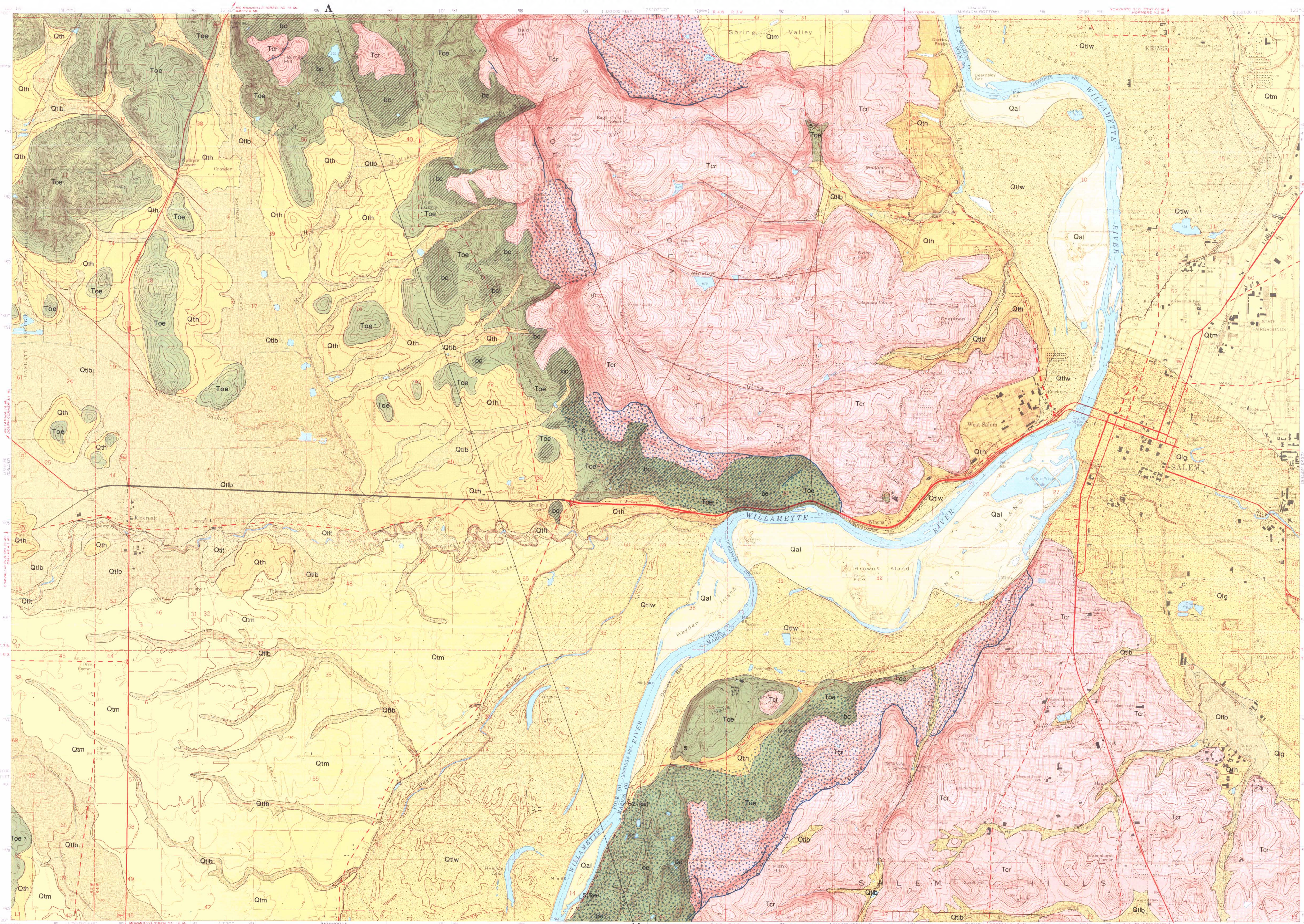
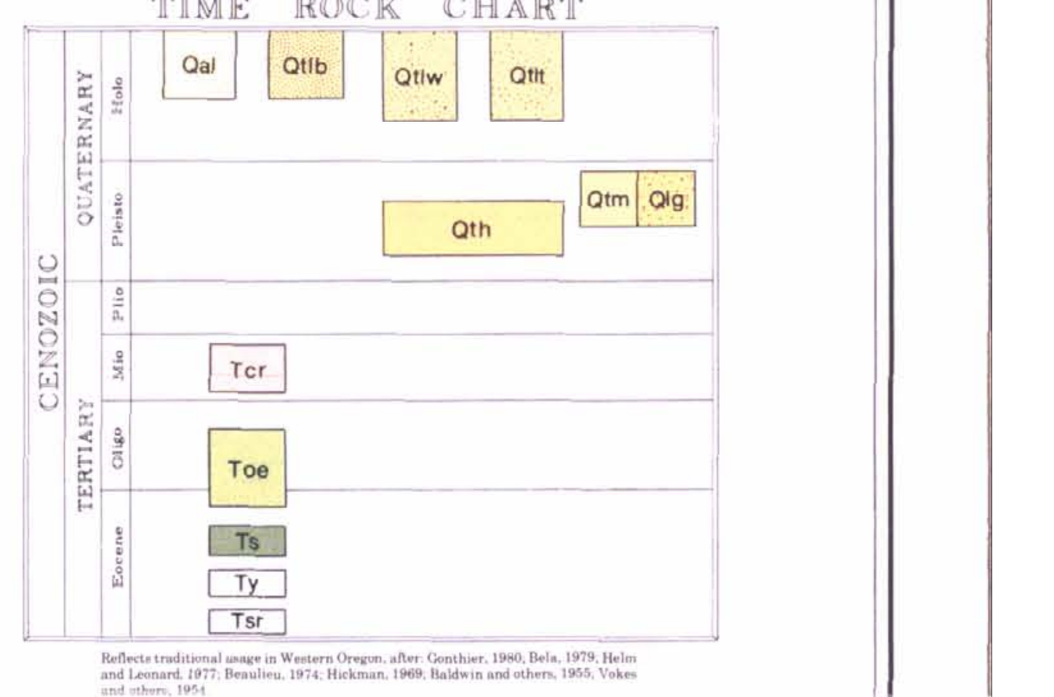
Geologic Map of the Rickreall and Salem West Quadrangles, Oregon



TIME ROCK CHART



EXPLANATION

SURFICIAL GEOLOGIC UNITS

Qal

Qtlw

Qtlt

Qtlb

Qtm

Qlg

Qth

BEDROCK GEOLOGIC UNITS

Tcr

Toe

Ts

Ty

Tsr

OTHER SYMBOLS

bc

Base Map by U. S. Geological Survey

Control by USGS, USC&GS, and State of Oregon

Topography by photogrammetric methods from aerial photographs taken 1967. Field checked 1970

Polyconic projection. 1927 North American datum
10,000-foot grid based on Oregon coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks, zone 10, shown in blue

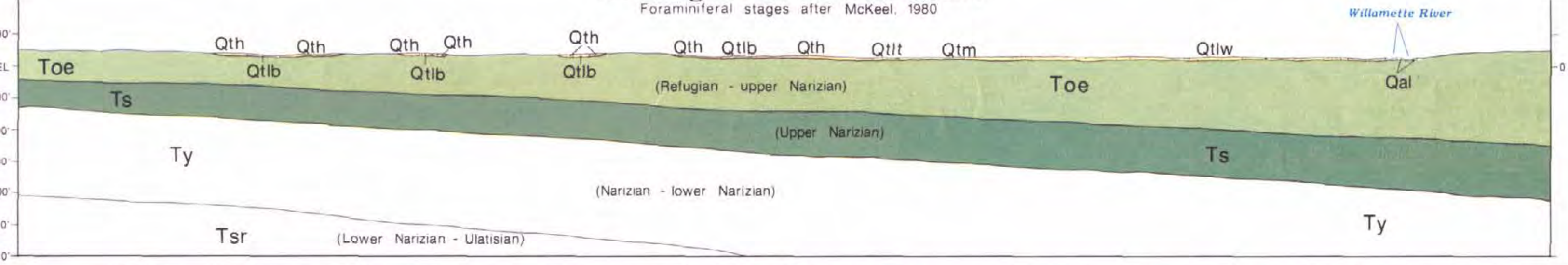
Fine red dashed lines indicate selected fence lines

Map prepared by
STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

CARTOGRAPHY by Paul E. Staub

Geologic Cross Section

Foraminiferal stages after McKeel 1980



SCALE OF CROSS SECTION IS 1:48,000

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS

UTM GRID AND 1969 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Geology by James L. Bela, 1981

GMS18b

GEOLOGIC SYMBOLS

Contact

Strike and dip of beds

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