Drainage Problems of the Middle Willamette Valley

by

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TITLE

DRAINAGE PROBLEMS

OF THE MIDDLE WILLAMETTE VALLEY

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PREFACE

It is fairly well known that drainage data are lacking in quality and quantity for most of the United States. There are many agencies which collect and maintain precise data for irrigation or flood control but none that keeps an accurate accounting of drainage activities or attempts to survey, in any detail, the problems of drainage. That this situation exists, in spite of the fact that more land possibly could benefit from drainage than from irrigation, indicates a gap in information relating to land use and agriculture that should be closed.

The Willamette Valley has been considered, in many cases, an ideal farming area. But there are agricultural problems of some magnitude which occur because of the nature of the precipitation regime, the topography, and the soils. Aside from the economic factors which affect every farming community, these physical factors set some limitations upon the agriculture. Summer rainfall is inadequate for the growth of high value crops except where irrigation is practiced. Irrigation is therefore on the increase. In some areas excess water in spring and fall preclude the possibility of good crop yields due to drainage difficulties. Agricultural problems of a physical nature relate to the matter of distribution of water temporally. Drainage represents a part of the effort being made to modify the physical conditions of too much water in spring and fall and too little in summer. It also represents an important feature of the agriculture and an integral part of the economic picture of the Willamette

Valley. It is hoped that this study of drainage will help to provide information on this aspect of the Willamette Valley and therefore be of use in a better understanding of this region.

The purpose of this work is, very simply, to study the drainage problems as they exist in the Willamette Valley, Oregon. Of interest in this regard is the amount of land suffering from a drainage problem and the extent and nature of the poor drainage conditions on this land. An attempt has been made to delineate the distribution of such land and to determine how much of such land has had at least some drainage facility constructed upon it. Also pertinent is the nature of land use as it pertains to the drainage problem--this consideration has also been attempted. Of less immediate import but of considerable interest, at least to the writer, are the historical developments--how did drainage conditions influence early settlement, how did wet land affect farming, and how did drainage work develop? Under the broad plan of these considerations, the following study has been developed.

The study has been limited to the central part of the valley: the entire Willamette Valley was considered too large an area to cover. Moreover, the northern part of the valley is considerably urbanized and broken up by ridges and hills, and the southern part of the valley is farmed much less intensively than the central area. The central part of the valley represents a median between the agriculturally less important southern section of the valley and the urbanized, specialty farming type of landscape in the northern valley.

Four counties bracketing the river in the central valley were selected--including Marion County, one of the principal income producing counties in Oregon. Counties were selected as units because of the

relative availability of data. More than one county was chosen since a single county could not supply a broad enough base on which to form ideas of the nature of Willamette Valley drainage problems.

A search was made in Federal, state, and county agency offices for data relevant to drainage. Library sources were utilized and a synthesis of this material attempted. Then a field examination of the drainage problems was made through several summers, and a reconnaissance of the entire area was made. Next, from aerial photographs, one hundred farms were selected, twenty-five in each county. These one hundred farms were spaced equidistantly over the area of less than one per cent slope. No farms were chosen from the lands of higher slope as these areas possess a different type of agriculture and soils. The one hundred farms were visited, mapped, and the operators questioned as to land use, drainage, and the tenure of the operator or owner. On the basis of the data collected, thirty-six of these farms were eliminated because of insufficient information about the farm, because they were atypical, and some to permit the remaining sixty-four farms to be again spaced equidistantly on the valley floor.

The sample farms data were used to provide an evaluation of land use as it relates to drainage conditions and to provide, with the field reconnaissance, data for the evaluation of information from other sources.

The writer wishes to acknowledge the help given by many people. Dr. Leslie Hewes gave suggestions and guidance during the entire preparation of the thesis. The various county Agricultural Stabilization Committee offices made available data otherwise unobtainable and gave permission to use their large scale aerial photos. The willing and patient explanation of Agricultural Stabilization Committee procedure by Earl

Johnson of the Marion County office was very much appreciated. David Duniway, Oregon State Archivist, made available material without which Figures 14, 15, and 16 could not have been drawn, and Mr. Ganony of the Bureau of Land Management was kind enough to permit access to the original surveyors plats. Appreciation is extended to Mrs. E. V. Elkins for making material of the Geneological Forum of Portland quickly available to me. Acknowledgment is also extended to the many other people in various county, state, and federal agencies who contributed directly or indirectly to this study. Particularly, acknowledgment must be given to the farmers who, after being plagued by multitudes of field investigators, still have the patience and wisdom to impart much knowledge of the land to those who care to listen. I am grateful, also, to my wife, Marjorie, who typed and proofread this manuscript through its many transitions.

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INTRODUCTION AND GENERAL OVERVIEW

Location and Delineation of the Study Area

The Willamette Valley lies in western Oregon between the Coast Range and the Cascade Mountains. It is aligned roughly north-south with the axis of the valley approximately straddling the 123rd meridian and extending from a few miles south of Eugene to the junction of the Willamette River with the Columbia River at Portland. The Willamette Valley is divided into three sections by ranges of low hills which constrict the valley just south of Oregon City and by the Eola Hills and Salem Hills which again constrict it near Salem.

This study is concerned with the central part of the valley containing the four counties; Benton, Linn, Marion and Polk (Plates I and II). Marion and Linn counties extend eastward from the Willamette River to the crest of the Cascade Mountains, whereas Benton and Polk counties extend westward from the Willamette River to the crest of the Coast Range. These counties contain much land outside the valley which is not, except for a few isolated farms, agricultural land. The non-agricultural land has been excluded by restricting the study to a belt of land eight townships wide across the valley. The eight township wide belt contains almost all of the land of gentle slope, almost all of the agricultural land, and all of the area of alluvial valley fill in the four counties.

Since this study pertains to drainage of agricultural lands, the

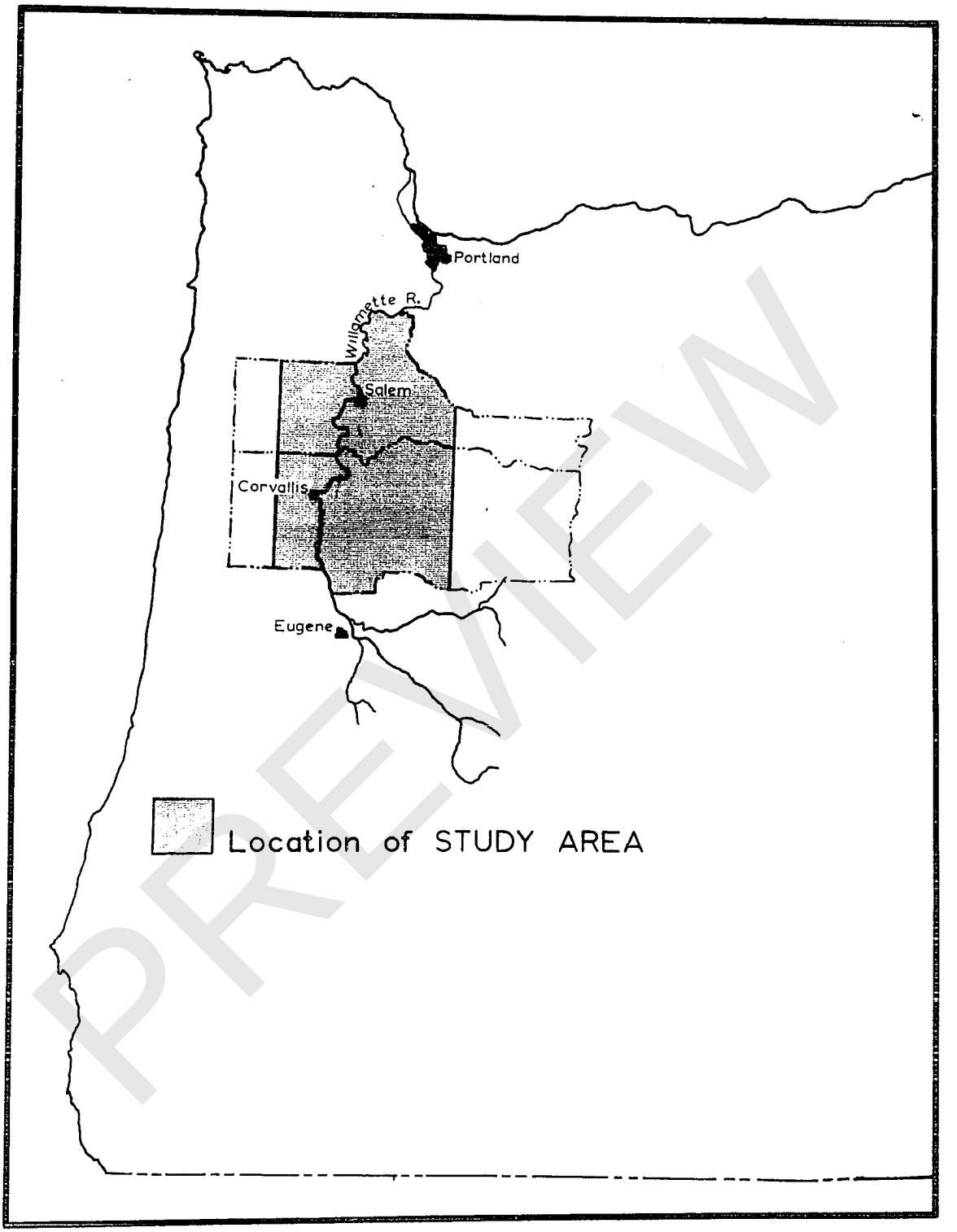


Plate I

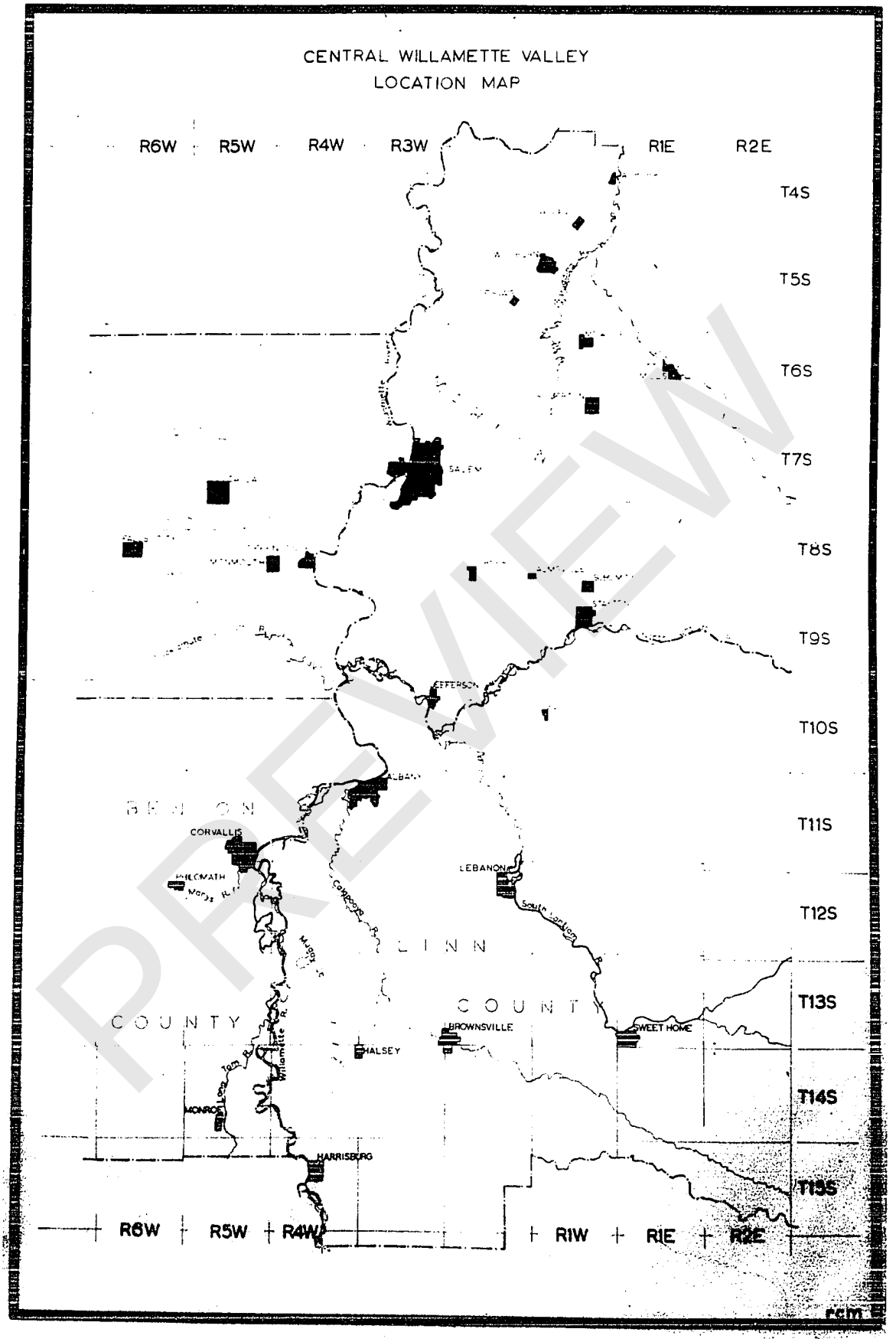


PLATE II

parts of the four counties lying outside the eight township wide belt are not considered pertinent to the results. The area under consideration extends from about twenty miles north of Eugene northward to the constriction of the valley by hills south of Oregon City. This area, about seventy miles in a north-south direction, contains over half of the cropland of the Willamette Valley. The Willamette River flows through the area from south to north, and is joined from the east by the major tributaries of the North and South Santiam rivers, the Calapooya River, Muddy Creek, and the Pudding River and its tributary, Butte Creek. Major tributaries coming from the Coast Range to the west are the Long Tom River, Marys River, and the Luckiamute River. Most of these major tributaries curve northward in the valley before joining the Willamette River and sometimes run parallel to the Willamette for a considerable distance.

General Overview of the Study Area

Climate

In the major climatic classifications, the climate of the Willamette Valley is variously described. In the Koppen climatic classification, the area becomes a cool summer Mediterranean (Csb). In the Trewartha classification the area becomes a cool summer marine climate with precipitation concentrated in winter (Cbs). On a map showing Thornthwaite's classification[1], the area appears as BC's or a humid microthermal climate with a summer precipitation deficiency. In general, the area does not fit well in any of the above categories and is often described as being a "modified" west coast marine, or a "modified"

[1] C. Warren Thornthwaite, "The Climates of the Earth," Geographical Review, XXIII (1933), 433-440.

Mediterranean climate.

The outstanding characteristics of the climate are the cool wet winter and the warm dry summer. The climate is much affected by moist maritime air from the Pacific Ocean moving eastward over the Coast Range into the valley, after dropping much of its moisture as it is lifted the two to three thousand feet over the mountains. There is some evidence that this air moves into the Willamette Valley through certain topographic breaks in the Coast Range, notably those in the vicinity of Grande Ronde and between Toledo and Corvallis. The movement of air downslope into the valley accounts for the decrease in annual precipitation from over eighty inches in the Coast Range to about thirty-five to forty-five inches for the valley bottom. The least annual precipitation occurs roughly along the axis of the valley and increases both east and west of this line.

Over eighty per cent of the precipitation occurs in the six month period from October through March, with the maximum coming usually in December or January (see Plate III). The months of July and August are driest; it is common during this period to have at least thirty days without a trace of precipitation. Very little precipitation occurs as snow. Snow depth in winter seldom exceeds a few inches with snow cover rarely lasting over a day or two.

Precipitation is of the cyclonic type, modified to some extent by orographic control. Most of the storms entering the area are occluded fronts, but some are associated with waves from stationary fronts. Storm winds enter the valley from the southwest, so that southerly or southwesterly winds in winter are associated with clouds and rainfall. Conversely, northerly winds usually indicate clearing. The prevailing wind is from the southwest in winter and in summer from the north or northwest.

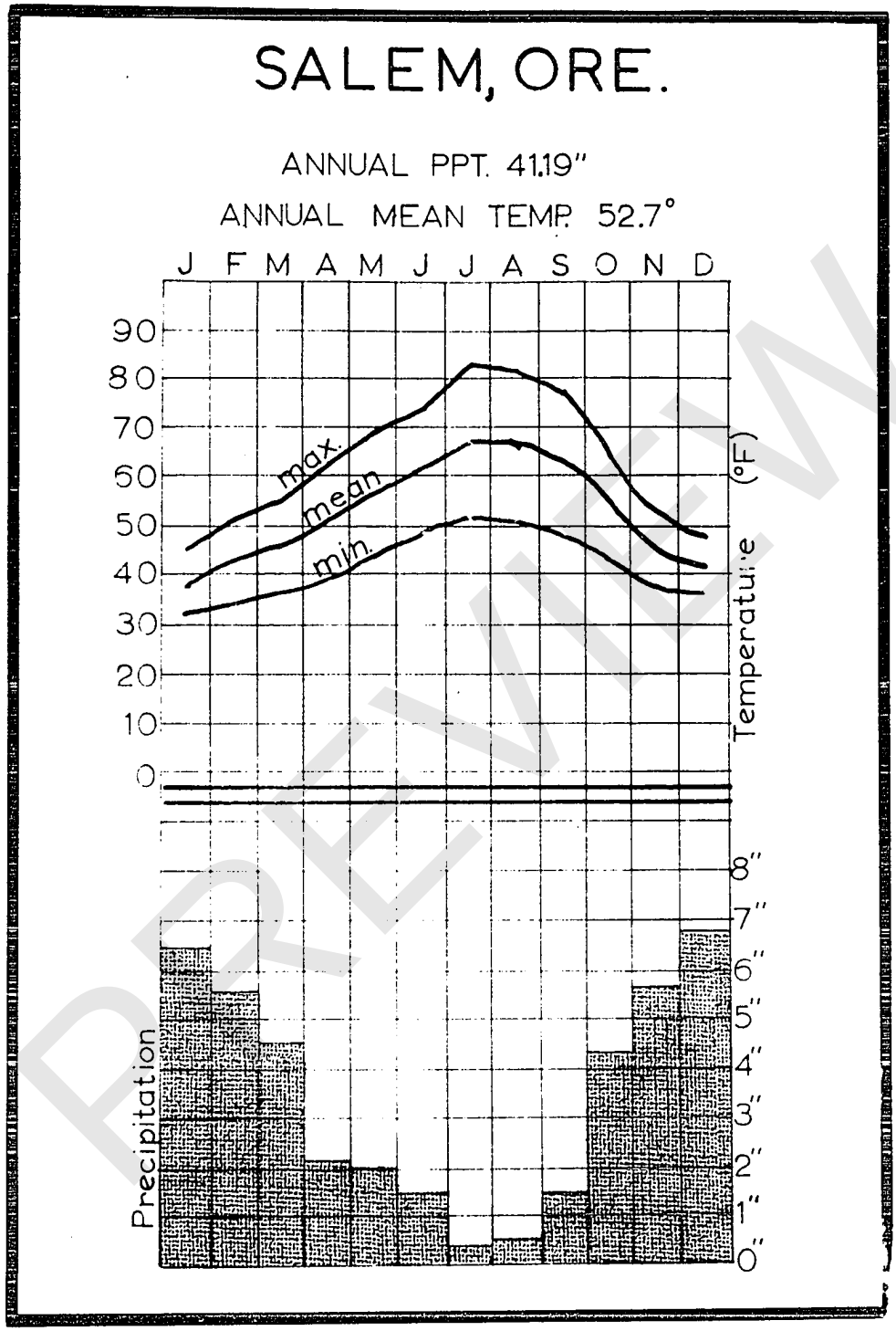


PLATE III

Few convectional storms occur in the valley. Those which do occur in spring are relatively mild and not of the severity associated with mid-western thunderstorms. Although the precipitation in the valley is only thirty-five to forty-five inches, the number of cloudy days approaches two hundred a year. This is an indication of the fact that precipitation is gentle, usually a mild drizzle, and spaced throughout the cool months. Fog is common from September through February.

Temperatures are moderate, with averages of from thirty-five to forty degrees for January and sixty-five to seventy degrees for July. Rarely do minimum temperatures fall below zero and seldom do maxima exceed one hundred degrees. The high summer daytime maxima are offset somewhat by rapid night cooling.

Length of growing season varies between 180 and 210 days in various parts of the valley, depending on elevation and latitude.

Physiography

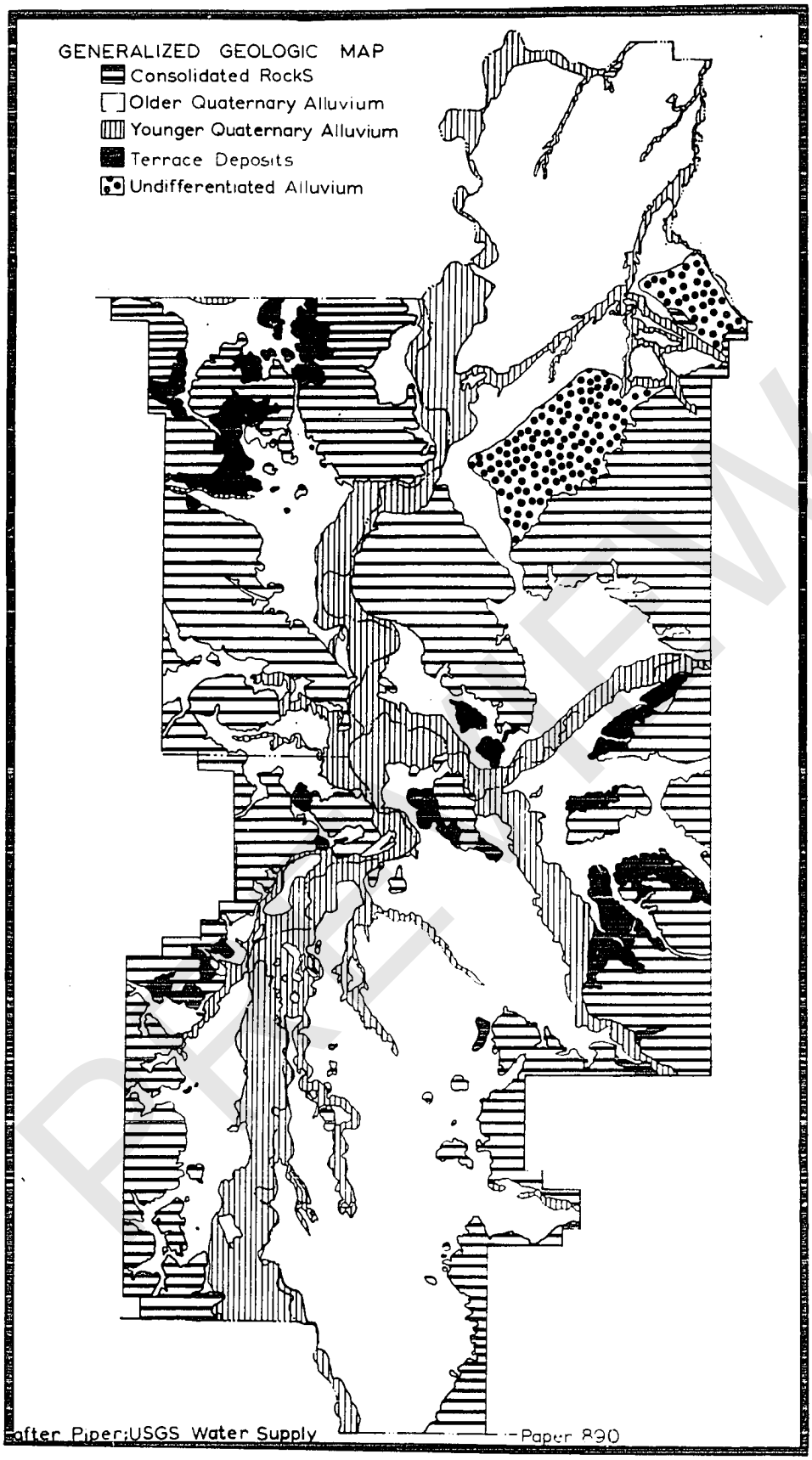
The Willamette Valley is a broad depression through which the Willamette River flows in an erratic course slightly west of center of the valley, the deepest part of the valley lying near the course of the river.

Geologically, the valley is a trough which owes its origin to faulting and the lifting of the Coast Range. The rocks of the Coast Range consist of Eocene to Miocene sedimentary rocks with associated basaltic flows, sills, and dikes and occasional pyroclastics. The bedrock of the valley is similar to that of the Coast Range and dips gently north and northeast. Areas of bedrock outcrop in the valley are few. Generally, bedrock occurs at the surface only in the elevated portions of the valley, notably in the Salem, Eola, and Amity Hills and in the occasional buttes. Elsewhere, the

older bedrock is deeply covered.

The valley is floored with a series of Pleistocene gravels and alluvium and recent alluvial material (Plate IV). The Pleistocene deposits have not been studied in detail but, generally speaking, there are terrace gravels occupying the bench lands along the margins of the valley and along some of the valleys cutting back into the hills. These gravels are poorly sorted and range in size from cobbles down to pea-size gravel. Other of the Pleistocene alluvial deposits are not well differentiated. They consist of gravels and silts and sands, normally interfingered in complex fashion. In some places, a thick sequence of lacustrine silt can be detected. This silt, together with the many erratics that are scattered along the margins of the valley, is evidence of a fresh water lake that occupied the valley sometime during the latter part of the Pleistocene. Although the full explanation of this lake has not been determined, it is believed to have resulted when the outlet of the Columbia River was blocked by glaciers near St. Helen, Oregon. All of the Pleistocene deposits are overlain near streams with recent alluvium.

Within the study area, the floor of the valley proper is relatively flat, but does slope gently up away from the Willamette River (Plate V). Except for the terraces (where present), the slope is generally less than one per cent. The three ranges of hills, the Salem, Eola, and Amity, rise above the valley floor eight hundred to one thousand feet and constrict the valley floor to less than a mile at Salem from its normal width of about fifteen to twenty miles. Elsewhere, only isolated buttes rise above the valley floor. Most of these buttes are erosional remnants and are composed either of sandstone or volcanic ash capped by a layer of basalt. A few of the buttes appear to represent erosional



IV

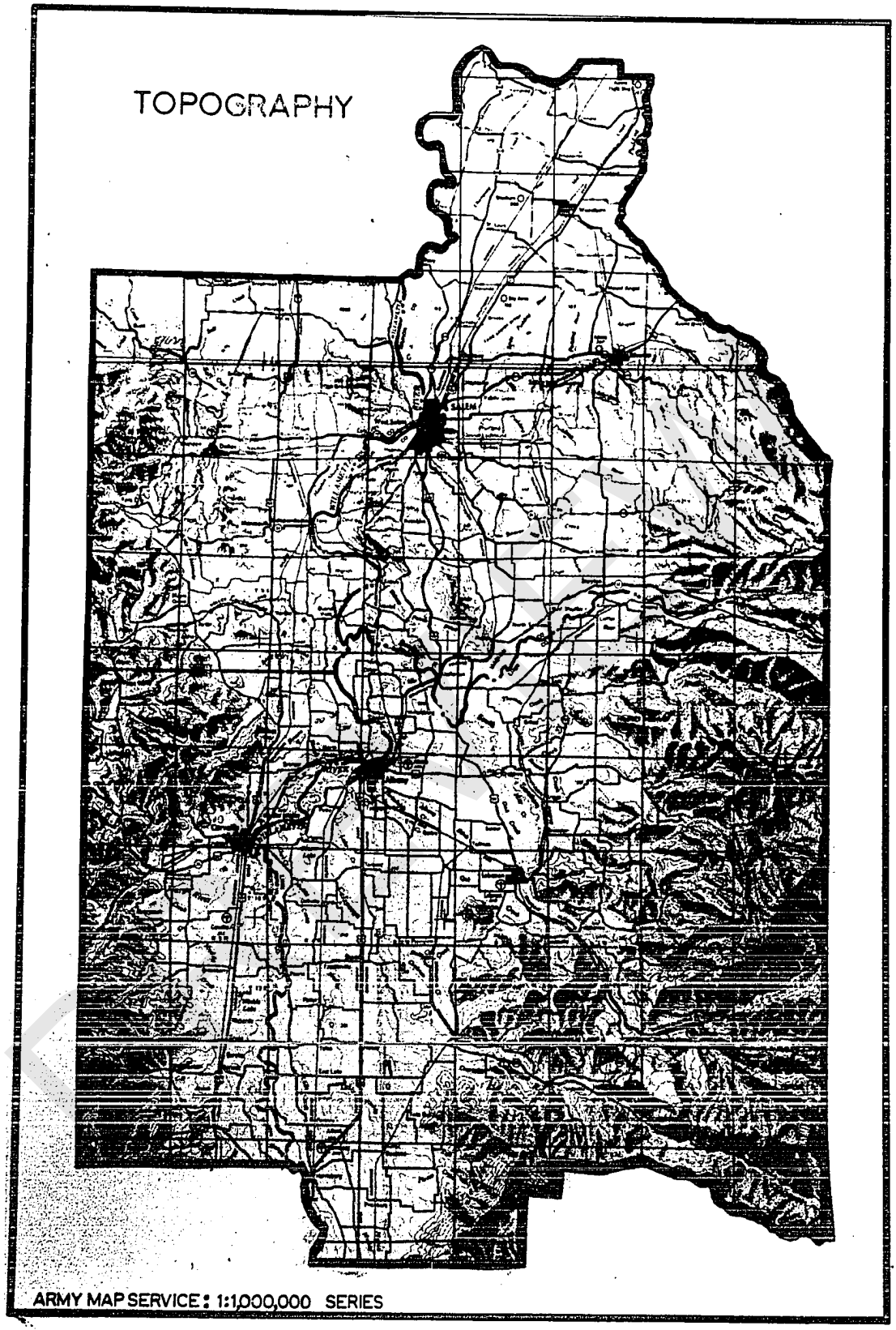


PLATE V

remains of old volcanoes and are composed entirely of basalt and coarse volcanic ejectamenta. The buttes range in size from a few which are twenty acres in extent to several with an area of over a mile.[1]

The Willamette River is at an elevation of approximately one hundred feet at the northern end of the study area and of about two hundred fifty feet at the southern end. The floor of the valley lies between one hundred fifty feet and two hundred fifty feet elevation with the Salem Hills and other hills rising to one thousand to twelve hundred feet. On the east and west margins of the valley, stringers of the bordering mountains rise quickly to elevations of eighteen hundred to two thousand feet.

There is little erosion by streams on the valley floor. The major streams rise in the mountain areas adjacent to the valley and are actively downcutting in these hill lands because of their high gradient. They carry considerable sediment during flood peaks and undoubtedly carried tremendous loads during Pleistocene glacier melt periods, as evidenced by the thick valley fill. As these major streams reach the valley floor, their gradient is checked, and they have a tendency to choke their channel with sediment, become braided and meandering, and change their course over a relatively wide area. These tendencies have scarred the valley floor with sloughs, oxbow lakes, and meander scars. The latter features are visible on USGS topographic quadrangles. Even streams originating in the hill lands directly adjacent to the valley floor exhibit these tendencies. In contrast, the minor tributaries originating on the floor of the valley are chiefly ephemeral, flowing during winter and spring but becoming dry in summer and fall. The ephemeral nature of these small streams is due to the precipitation

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[1]Ewart Baldwin, Geology of Oregon, (Ann Arbor, Michigan: Edwards Bros., Inc., 1959), 37-50.