to 54° F., and the length of the frost-free season is 190 to 200 days. The vegetation is mainly grass, poison-oak, rose, oak, and scattered Douglas-firs. Witzel soils are associated with Nekia and Jory soils.

In a typical profile, the surface layer is dark-brown very stony silt loam about 4 inches thick. The subsoil is about 15 inches thick, and it consists of dark-brown very stony silty clay loam in the upper part and of dark reddish-brown very stony silty clay loam in the lower part. Partly fractured basalt bedrock is at a depth of about 19 inches.

The Witzel soils are used mainly for pasture and as woodland.

Witzel very stony silt loam, 3 to 40 percent slopes (ME).-This is the only soil of the Witzel series mapped in the survey area. It is on slope breaks and in red foothills. The dominant slopes are less than 12 percent.

Representative profile (NE1/4SE1/4 sec. 8, T. 8 S., R. 2W.):

A1--0 to 4 inches, dark-brown (7.5YR 3/2) very stony silt loam, brown (7.5YR 5/4) when dry; moderate, fine, granular structure; friable, hard, slightly sticky and slightly plastic; 60 percent roots; many, very fine and fine, interstitial pores; many coarse fragments; medium acid (pH 6.0); clear, smooth boundary. (2 to 6 inches thick.)

B21-4 to 9 inches, dark-brown (7.5YR 3/2) very stony silty clay loam, brown (7.5YR 5/4) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky and plastic; many roots; common, very fine, tubular pores; 60 percent coarse fragments; medium acid (pH 6.0); gradual, wavy boundary. (3 to 10 inches thick.)

B22-9 to 19 inches, dark reddish-brown (5YR 3/4) very stony silty clay loam, reddish brown (5YR 5/4) when dry; weak, medium, subangular blocky structure; friable, hard, sticky and plastic; many roots; common, very fine, tubular pores; 60 percent coarse fragments; medium acid (pH 6.0); clear, smooth boundary, (2 to 6 inches thick.)

IIR-19 inches, partly fractured basalt bedrock.

The A horizon ranges from silt loam to silty clay loam or clay loam in texture, and in places the B horizon is clay loam. Color of the B horizon ranges from dark brown to dark reddish brown. Thickness of the solum over basalt bedrock ranges from 12 to 20 inches. The content of coarse fragments of rock in the soil mass ranges from 50 to 75 percent.

Included with this soil in mapping were some areas in which bedrock is as deep as 30 inches.

The available water capacity is 1 to 3 inches. Permeability is moderately slow, and fertility is low. Roots can penetrate to a depth of 12 to 20 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is not used for cultivated crops, but it is used mainly for native pasture and as woodland. The high content of stones, low available water capacity, and hazard of erosion make this soil poorly suited to use for pasture. (Capability unit VIs-1; not placed in a woodland suitability group)

Woodburn Series

The Woodburn series consists of moderately well drained soils that have formed in silty alluvium and loess of mixed mineralogy. These soils are on broad valley terraces. They have slopes of 0 to 20 percent. Elevations range from 150 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly grass and Douglas-fir. Woodburn soils are associated with Willamette soils.

In a typical profile, the surface layer is about 17 inches thick and is very dark brown silt loam in the upper part and dark-brown silt loam in the lower part. The subsoil is about 37 inches thick. It is dark yellowish-brown silty clay loam in the upper part; mottled dark-brown silty clay loam in the middle part; and mottled, dark-brown silt loam in the lower part. The substratum is dark-brown silt loam that extends to a depth of 68 inches or more.

The Woodburn soils are used mainly for small grains, pasture, hay, orchards, berries, and vegetables.

Woodburn silt loam, 0 to 3 percent slopes (WuA).-This soil is on broad terraces of Willamette silts.

Representative profile about 200 feet west of the paved road to Champoeg (SW1/4SE1/4SE1/4 sec. 2, T. 4 S., R. 2 W.; profile No. 5 in table 9 in the section "Laboratory Data.") .

Ap-0 to 9 inches, very dark brown (10YR 2/2) silt loam, brown (10YR 5/3) when dry; cloddy and has very weak, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; many, fine and very fine, tubular pores; few, fine, interstitial pores; common, medium and fine, reddish-brown and black concretions; medium acid (pH 5.9); abrupt, smooth boundary. (6 to 10 inches thick.)

A1-9 to 17 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate, medium, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; common clean silt and sand grains on ped surfaces; many roots; many, very fine, tubular pores; few, thin, darker (10YR 2/2) coatings on ped surfaces; few reddish-brown and black concretions; slightly acid (pH 6.2), smooth boundary. (3 to 8 inches thick.)

B21t-17 to 25 inches, dark yellowish-brown (10YR 3/4) silty clay loam, brown (7.5YR 5/4) when dry; moderate, coarse and medium, subangular blocky structure; friable, hard, sticky and plastic; common roots; many, very fine, tubular pores; few thin clay films on peds; few reddish-brown and black concretions; few black stains on ped surfaces; medium acid (pH 6.0); clear, smooth boundary. (7 to 9 inches thick.)

B22t-25 to 32 inches, dark-brown silty clay loam, brown (10YR 5/3) when dry; few, fine and medium, distinct, dark-gray (10YR 4/1) mottles, light brownish gray (10YR 6/2) when dry; moderate, medium and coarse, subangular blocky structure; friable, hard, brittle, sticky and plastic; common roots; many, very fine, tubular pores; continuous, moderately thick clay films on ped surfaces and in pores; few, fine, black concretions and stains on ped surfaces; medium acid (pH 5.8); abrupt, smooth boundary. (6 to 10 inches thick.)

B31t-32 to 39 inches, dark-brown (10YR 4/3) silt loam, brown (10YR 5/3) when dry; distinct, dark grayish-brown (10YR 4/2) mottles in a few root channels; thin, dark grayish-brown (10YR 4/2) coatings on plane surfaces, light gray (10YR 7/2) when dry; nearly massive; some planes of weakness that are indistinct; vertical planes are more distinct than horizontal planes; very firm, very hard, brittle, slightly sticky and slightly plastic; few roots; many, fine and very fine, tubular pores; continuous, moderately thick clay films on plane surfaces and in some root channels and pores; few, fine and medium, black concretions and few, black coatings on plane surfaces; medium acid (pH 5.7); gradual, smooth boundary. (7 to 10 inches thick.)

B32t-39 to 54 inches, dark-brown (10YR 4/3) silt loam, pale brown (10YR 6/3) when dry; nearly massive, and has some indistinct vertical planes of weakness; very firm, very hard, brittle, slightly sticky and slightly plastic;

no roots; many, fine and very fine, and few, medium, tubular pores; continuous, thin clay films in pores and in old root channels; few black concretions, and some patchy, black coatings on plane surfaces; medium acid (pH 5.9); gradual, wavy boundary. (11 to 17 inches thick.)

C-54 to 68 inches, dark-brown (10YR 4/3) silt loam, pale brown (10YR 6/3) when dry; massive; very firm, very hard, brittle, slightly sticky and slightly plastic; no roots; many, very fine, tubular pores; common moderately thick clay films in larger pores and in old root channels or worm channels; few black coatings in pores and in channels; medium acid (pH 5.9); gradual, wavy boundary. (14 to 16 inches thick.)

When the soil is moist, color of the A horizon ranges from dark grayish brown to very dark brown or dark brown, and color of the B2 horizon ranges from very dark grayish brown or dark brown to dark yellowish brown or strong brown. In all areas the A horizon is thicker than 10 inches. The B2 horizon ranges from heavy silt loam to silty clay loam in texture. Structure of the B2 horizon ranges from weak to moderate, medium or coarse, prismatic to moderate, fine to coarse, subangular blocky. Distinct mottling occurs at a depth above 30 inches. In some places the B3 horizon has weak to moderate subangular blocky or prismatic structure. In others it is massive and has vertical planes of weakness. Consistence of the B3 horizon is firm or very firm when the soil is moist. The substratum is stratified. It ranges from silty clay loam or silt loam to very fine sandy loam or fine sandy loam in texture.

Included with this soil in mapping were small areas of Amity and Willamette soils, and small areas of a somewhat poorly drained soil. The areas of Amity soils occupy less than 5 percent of the acreage in this mapping unit. The areas of Willamette soils occupy as much as 10 percent.

The available water capacity is 11 to 13 inches. Permeability is moderate in the upper part of the subsoil, and it is slow in the lower part. Fertility is high. Depth to which roots can penetrate is restricted by a seasonal perched water table and as the result of the type of structure. Runoff is slow, and no apparent erosion has taken place.

This soil is used mainly for small grains, field corn, orchards, pasture, hay, caneberries, and vegetables. Areas that are drained are used for all the crops commonly grown in the survey area. Because of the perched water table, drainage is needed for crops that cannot tolerate excessive moisture. (Capability unit IIw-1; not placed in a woodland suitability group)

Woodburn silt loam, 3 to 12 percent slopes (WuC).-This soil has slopes of 3 to 5 percent in about 60 percent of the acreage. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included with this soil in mapping were small areas that have a thin surface layer and that have distinct mottling within 12 inches of the surface.

This Woodburn soil is used for about the same crops as Woodburn silt loam, 0 to 3 percent slopes. It is less suitable for vegetables and berries, however, because of the difficulty of cultivating those crops so that erosion is controlled without damaging the crop. Mechanical harvesting of vegetables and berries is difficult where slopes are steeper than 5 percent. (Capability unit IIe-1; not placed in a woodland suitability group)

Woodburn silt loam, 12 to 20 percent slopes (WuD).-Where this soil occurs along creeks, intermittent drainageways, and terrace fronts, its slopes are short and abrupt. Runoff is rapid, and the hazard of erosion is moderate.

Included with this soil in mapping were small areas that hve a thin surface layer and that have distinct mottling within 12 inches of the surface.

This Woodburn soil is used mainly for pasture, hay, and small grains, although some small areas are used for row crops and orchards. This soil is poorly suited to row crops; for the slopes are too short and steep for mechanical harvesting of vegetables, berries, and other row crops to be feasible. Tilling row crops so that excessive soil losses are avoided is also difficult. (Capability unit IIIe-1; not placed in a woodland suitability group)

Formation and Classification of Soils

Soils of the Marion County Area differ in fertility, in physical and chemical properties, and in productivity. These differences are the result of differences in parent material and of local differences in the environment under which the soils have formed. This section describes some factors in the environment, and major processes that have affected the formation of soils of the Marion County Area. It also defines the current system, for classifying soils and shows the classification of the soils by series and by higher categories.

Formation of Soils

Soil is a natural body on the surface of the earth. It consists of mixtures of rocks and minerals that have been subjected to various degrees of weathering and that contain greatly varying amounts of organic matter, water, and air. Soils have more or less distinct horizons that have developed under the influence of local factors in the environment. The soil-forming processes that produce different kinds of soils are parent material, which affects the physical and chemical composition of the soils; climate, principally precipitation and temperature; biological forces., or the plant and animal life in and on the soil; relief, or topography; and the time in which the soil-forming processes have acted on the parent material. These five factors, in many different combinations and intensities, produce soils that differ from place to place. The influence of each soil-forming factor on the soils of the Marion County Area is described in the following paragraphs.

Parent material

Soils in the survey area have formed in eight major kinds of parent material. These are (1) recent alluvium, (2) gravelly alluvium, (3) young, silty terrace alluvium, (4) weakly consolidated, old gravelly alluvium, (5) basic colluvium from basalt and massive tuffs, (6) sedimentary alluvium and colluvium derived from tuffaceous sandstone and shale, (7) glacial till, and (8) deposits of organic material. The soils in about 80 percent of the survey area have formed in recent alluvium (Willamette silts); in basic igneous material (basic colluvium derived from basalt and massive tuffs); or in glacial till. Figure 10 shows the approximate distribution of the different kinds of parent materials in the survey area. This figure is based only partly on the results of geologic studies, and therefore it cannot be called a geologic map. The distribution shown is the result of combining information obtained