



Natural Resources Conservation Service
1080 SW Baseline, Suite B2
Hillsboro, OR 97123

Phone: (503) 648-3174, x113
FAX: (503) 681-9772
dean.moberg@or.usda.gov

To: Kathryn Higgs
Oregon Department of Agriculture
635 Capitol St NE
Salem, OR 97301-2532

Date: June 13, 2007

RE: George Marsh
CAFO plan (enclosed)

From: Dean Moberg
Certified Crop Advisor
District Conservationist

Cc: George Marsh

Kathryn:

Enclosed is the updated CAFO plan for George Marsh, owner/operator of the Marsh Homestead Inc. dairy farm in Washington County. George asked me to send this plan to you for approval.

Please let me know if we need to make any corrections to the plan.

Thanks.

RECEIVED

JUN 15 2007

NATURAL RESOURCES
DIVISION

MA# 63609
AWMP# 07104
Due Date: 7/30/2007

Approved 7/5/07 KA.



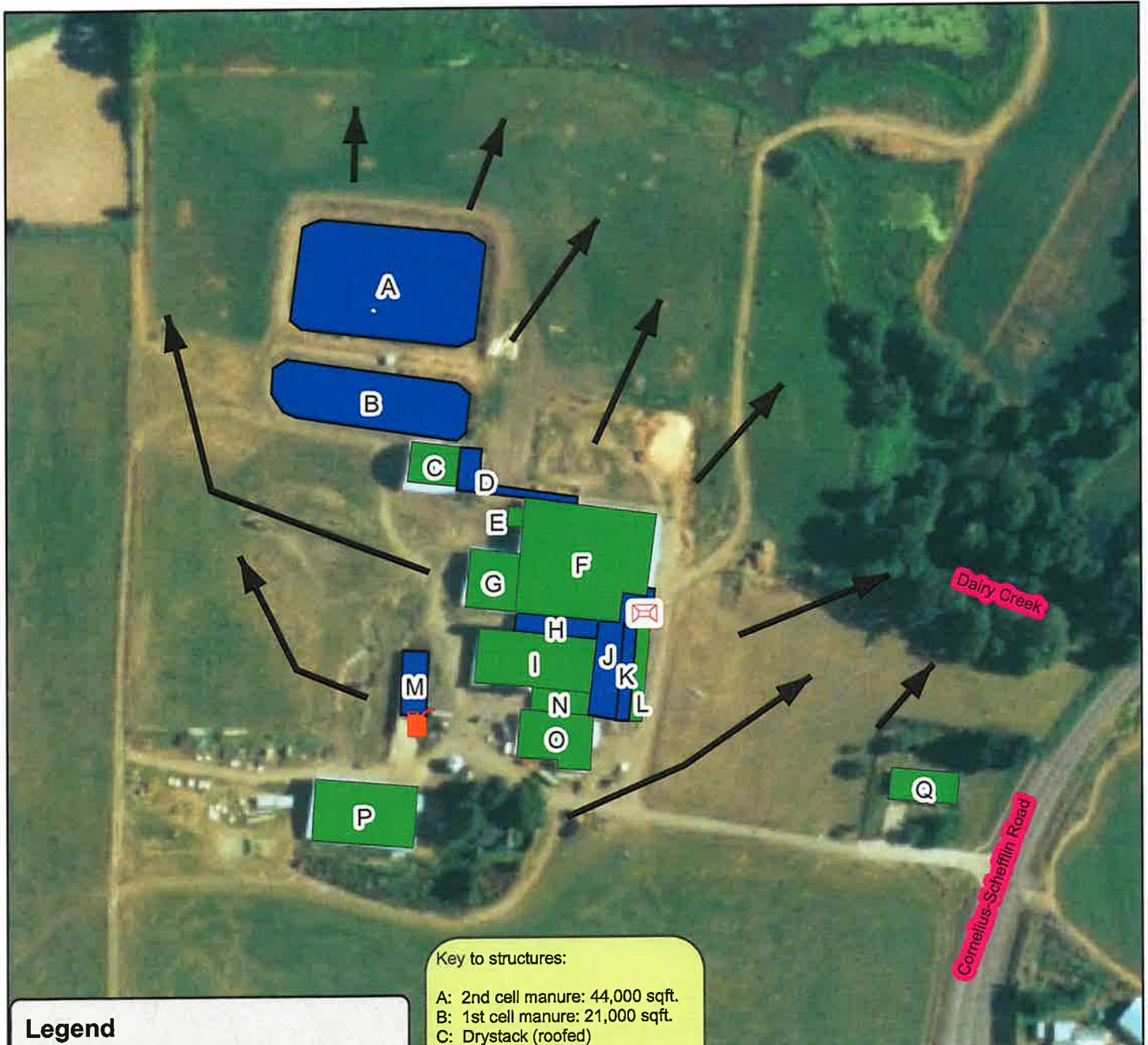


Marsh Homestead, Inc. HQ Map



T1N, R3W, S33
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007
503/648-3174, x113



Legend

HQ buildings

- Drains away
- Drains to pond

HQ points

- Fuel tanks
- Reception pit for liquid runoff
- HQ drainage

Key to structures:

- A: 2nd cell manure: 44,000 sqft.
- B: 1st cell manure: 21,000 sqft.
- C: Drystack (roofed)
- D: Slab: 3,400 sqft.
- E: Milking cow barn
- F: Milking cow barn
- G: Milking cow barn
- H: Milking cow barn: 2,800 sqft.
- I: Heifer barn
- J: Concrete slab: 6,000 sqft.
- K: West half new barn: 2,400 sqft.
- L: East half new barn
- M: Bunker silo: 2,900 sqft.
- N: Milkhouse:
- O: Shop
- P: Residence
- Q: Residence

0 100 200 300 400
Feet

Image: 2005



Marsh Homestead, Inc.
HQ Map - Main Farm



T1N, R3W, S20&21
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Legend

HQ

-  Waste pond
-  Drystack
-  Bunker silo
-  Slab (drains to waste pond)
-  Barn
-  Residence

Areas (sq. ft.):

Unpaved lot draining to waste pond:
Concrete slab draining to waste pond:
Silo draining to waste pond: 2900
Roof draining to waste pond:
Roof not draining to waste pond:
Pond surface (total both cells): 65,000

Image: 2005



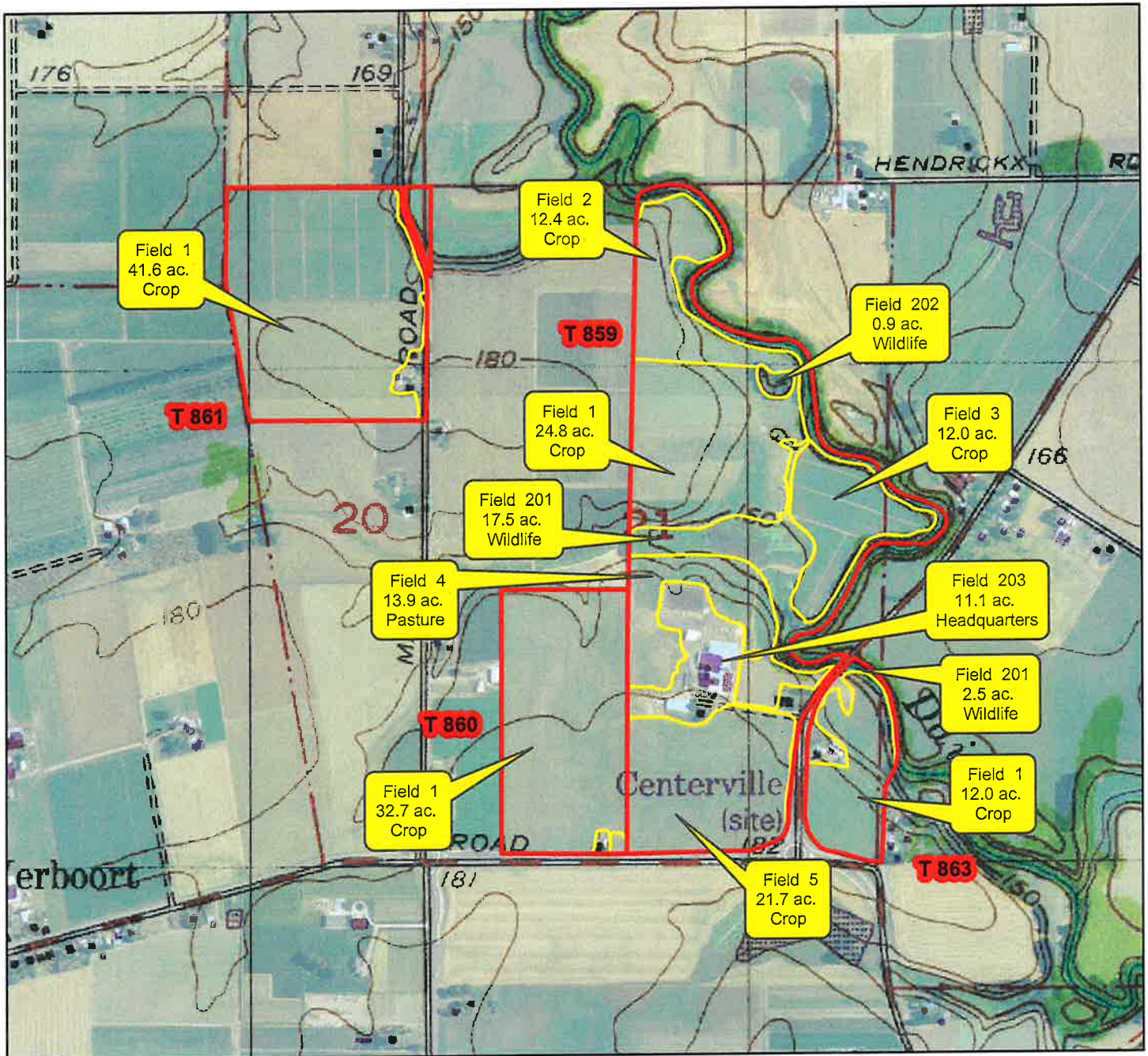


Marsh Homestead, Inc. Plan Map - Main Farm



T1N, R3W, S20&21
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Legend

-  Tract Boundaries
-  CNMP fields

500 0 500 1,000 Feet



Marsh Homestead, Inc.
Site Plan Map - South Farm



T1N, R3W, S33
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007

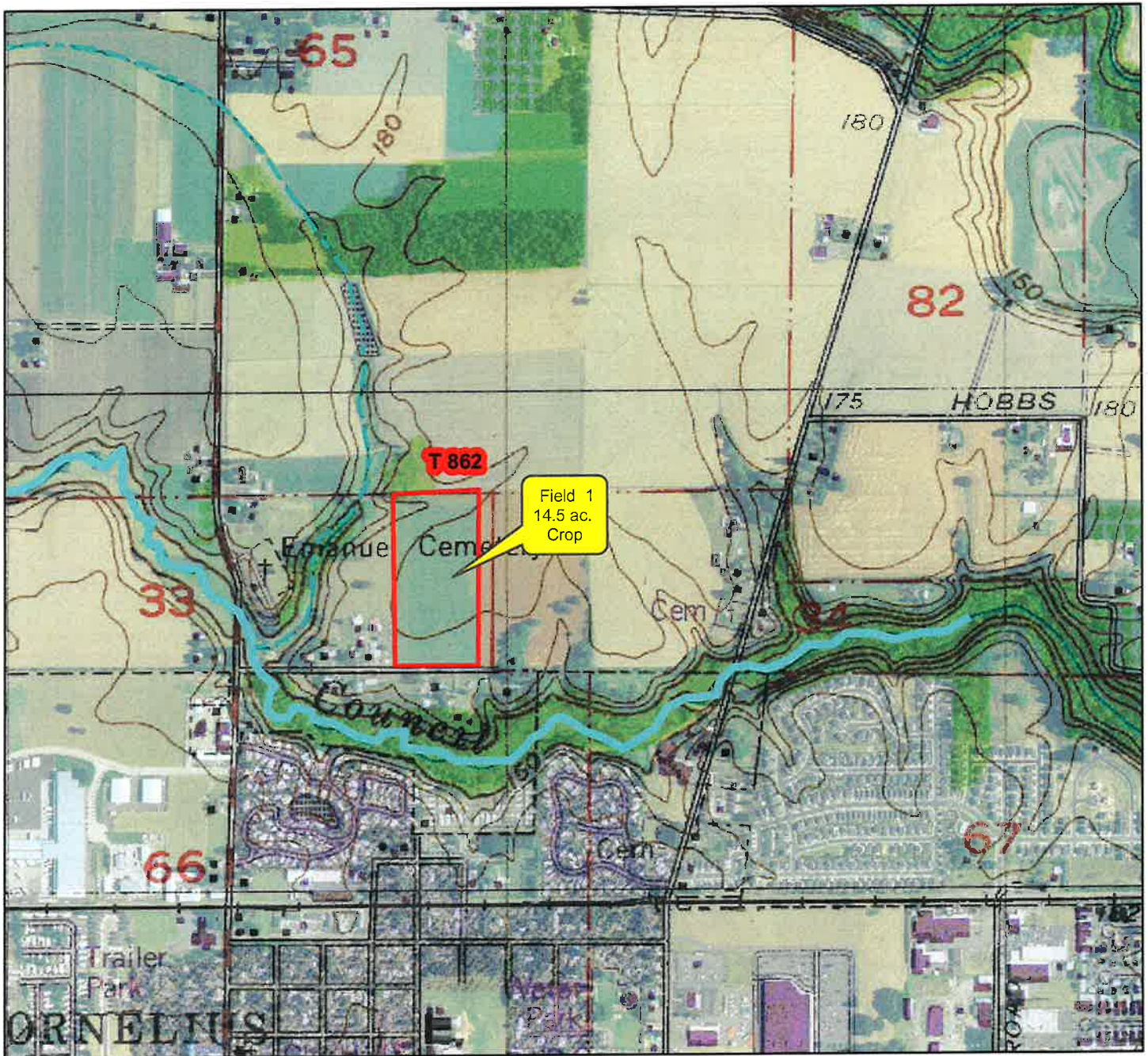


Image: 2005

Legend

- Tract Boundaries
- CNMP

Water features

- Council Creek
- Un-named intermittent creek

500 0 500
Feet



Marsh Homestead, Inc. Soils Map - Main Farm



T1N, R3W, S20&21
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007

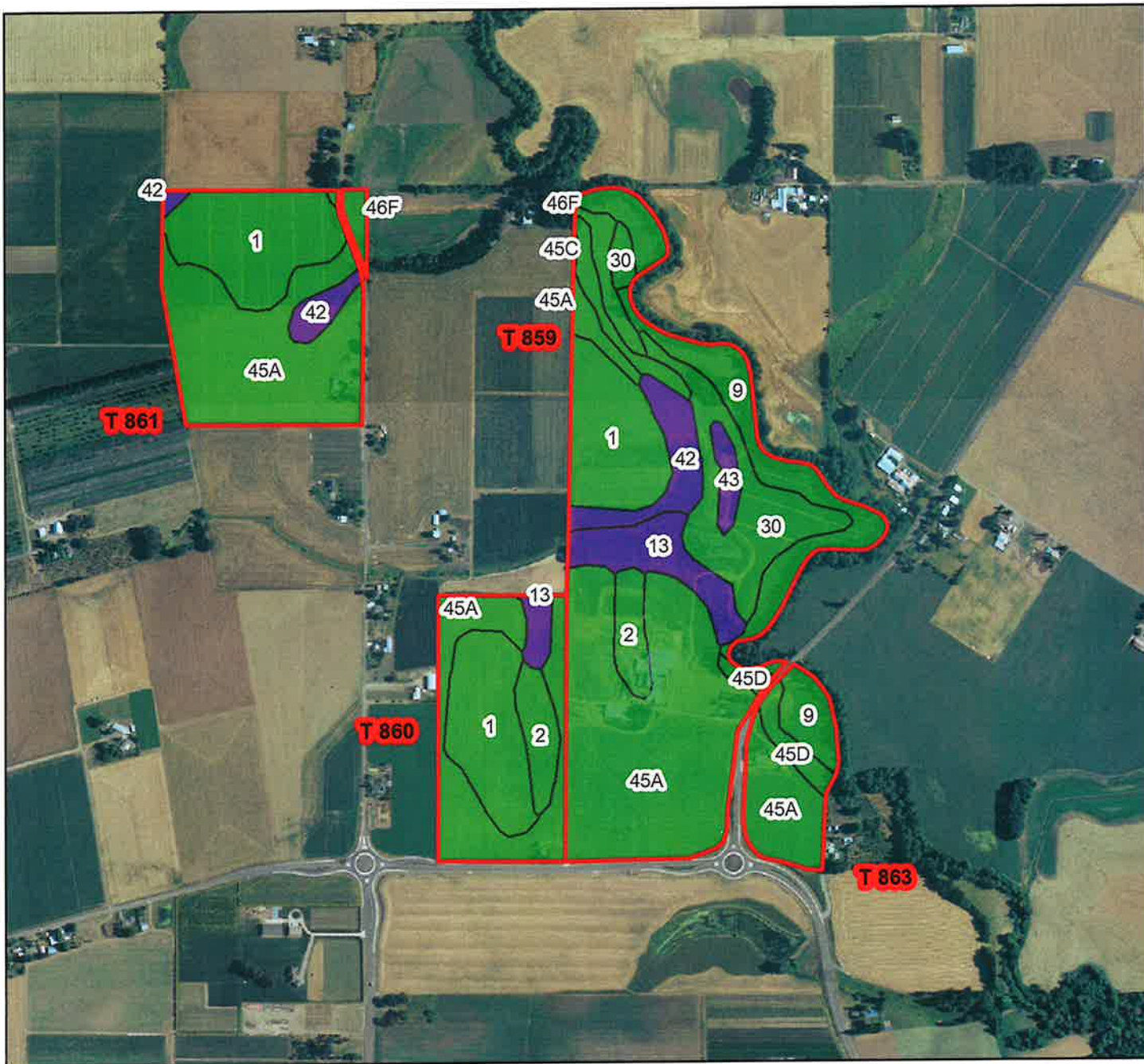


Image: 2005

Legend

- Tract Boundaries
- Map Unit Hydric Rating**
- All Hydric
- Partially Hydric
- Not Hydric

Hydric soils are present on this farm.
Contact NRCS for a certified wetland
determination before beginning any drainage,
filling, dredging, ditch-cleaning or stump
removal project.



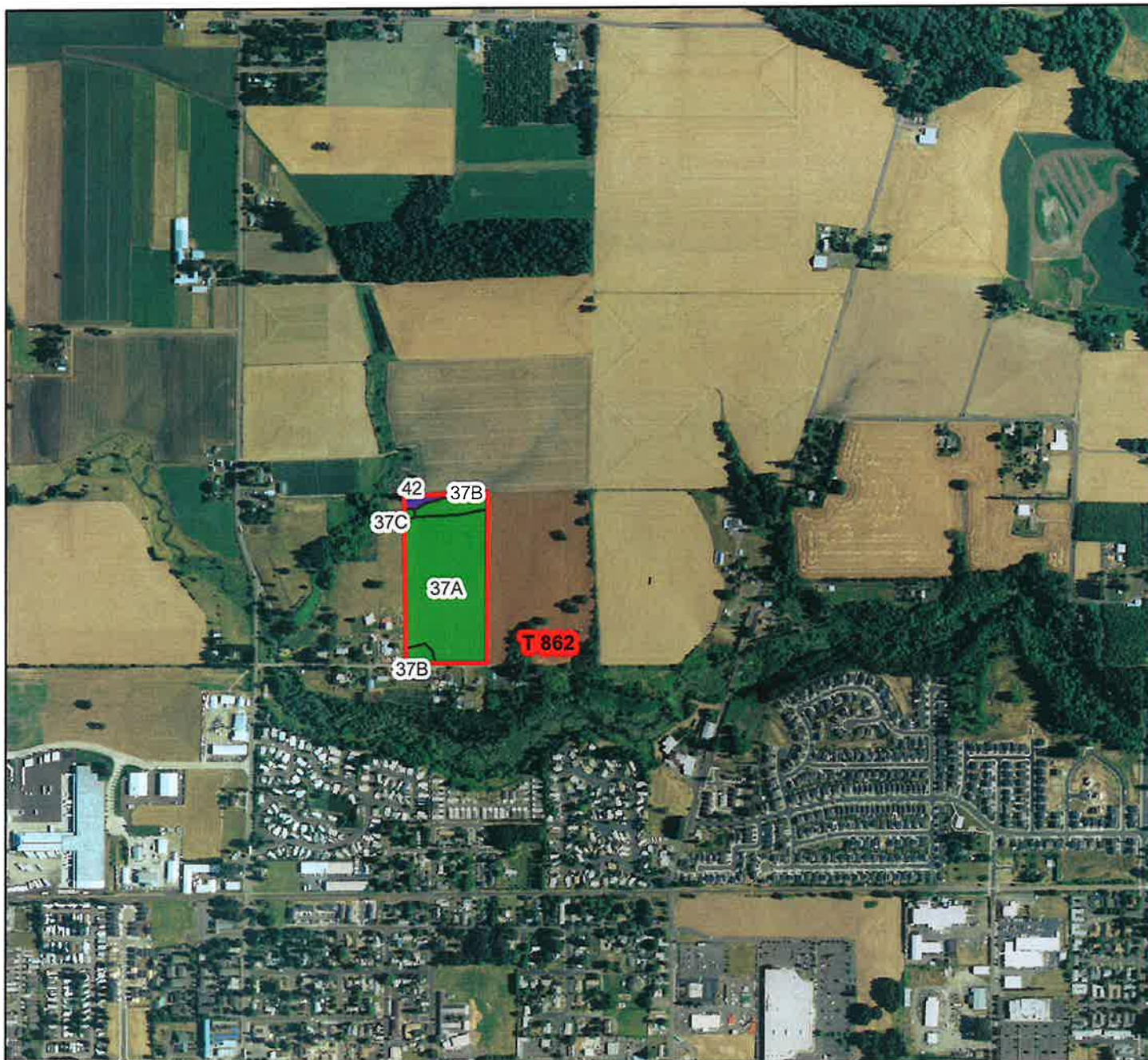


Marsh Homestead, Inc. Soils Map - South Farm



T1N, R3W, S33
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Legend

-  Tract Boundaries
- Map Unit Hydric Rating**
-  All Hydric
-  Partially Hydric
-  Not Hydric

Hydric soils are present on this farm.
Contact NRCS for a certified wetland
determination before beginning any drainage,
filling, dredging, ditch-cleaning or stump
removal project.

Image: 2005

500 0 500
Feet

Hembre soils are well drained. They have a surface layer of dark reddish-brown silt loam and a subsoil of dark reddish-brown, reddish-brown, and yellowish-red silty clay loam over basalt bedrock. Effective rooting depth is 40 to 50 inches.

Klickitat soils are well drained. They have a surface layer of dark reddish-brown cobbly loam and a subsoil of dark-brown and reddish-brown cobbly and very cobbly loam over basalt bedrock. Effective rooting depth is 40 to 50 inches.

These soils are used for timber production, recreation, and wildlife habitat. Availability of food, cover, and water controls movement and number of birds and animals.

Runoff is mainly from areas where the plant cover has been removed. Sedimentation from runoff is high. Maintaining maximum cover and using water control practices on roads and logged areas minimize soil loss.

These soils provide good sites for most recreational uses. As a result of the heavy precipitation, these soils are a major source of water supply. These soils provide good habitat for game animals and some birds.

Descriptions of the soils

This section describes the soil series and mapping units in Washington County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is noted otherwise, what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile. That is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils.

Color terms are for moist soil unless otherwise stated. The profile described in the series is representative for one of the mapping units in that series. If the profile of a soil in a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit or they are differences that are apparent in the name of the mapping unit, or both.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Udifluvents, nearly level, for example, do not belong to a soil series, but nevertheless, are listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a number, or number and letter, which identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, wildlife group, and woodland group in which the mapping unit has been placed. The page for the description of each capability unit and a listing of the wildlife group and woodland group can be found by referring to

the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (11).

Aloha series (1)

The Aloha series consists of somewhat poorly drained soils that formed in alluvium or lacustrine silt on broad valley terraces. Slope is 0 to 3 percent. Elevation is 150 to 200 feet. Where these soils are not cultivated, the vegetation is mainly Douglas-fir and some Oregon white oak, shrubs, forbs, and grasses. Average annual precipitation is 40 to 50 inches, average annual air temperature is 52° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is dark-brown silt loam about 8 inches thick. The subsoil is a dark-brown and dark yellowish-brown, mottled silt loam about 38 inches thick. The substratum is dark yellowish-brown, mottled silt loam and very fine sandy loam about 19 inches thick. The profile is medium acid throughout.

Permeability is moderately slow. Available water capacity is 11 to 13 inches. Water-supplying capacity is 18 to 20 inches. Effective rooting depth is 40 inches to more than 60 inches.

These soils are used mainly for orchards, irrigated vegetable crops, irrigated berries, small grain, hay, pasture, and legume seed production. Other uses include wildlife habitat, recreation, and homesites.

Representative profile of Aloha silt loam, 0 to 3 percent slopes, located 200 feet south and 40 feet east of the end of the county road in the NW1/4SW1/4NW1/4 section 16, T. 1 S., R. 2 W.:

Ap-0 to 8 inches, dark-brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate, fine, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common very fine roots; common, fine, irregular pores; common fine shot; medium acid (pH 6.0); abrupt, smooth boundary. 6 to 9 inches thick.

B1-8 to 15 inches, dark-brown (10YR 4/3) silt loam, light yellowish-brown (10YR 6/4) dry; common, medium, faint, dark grayish-brown, brown, and dark-brown (10YR 4/2, 5/3 and 7.5YR 3/2) mottles; moderate, fine, subangular blocky structure, slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many, fine and very fine, tubular pores; medium acid (pH 5.8); clear, wavy boundary. 0 to 9 inches thick.

B21-15 to 22 inches, dark yellowish-brown (10YR 4/4) silt loam, pale brown (10YR 6/3) dry; common, fine, faint,

¹ Italic numbers in parentheses refer to References.

In the original manuscript, there was a table in this space.
All tables have been updated and are available as a separate document.

- dark grayish-brown, brown, and dark-brown (10YR 4/2, 5/3 and 7.5YR 3/2) mottles; moderate, fine, subangular blocky structure; firm hard, slightly sticky and slightly plastic; common, very fine roots; many, medium, fine and very fine, tubular pores; few thin clay films in pores; few black coatings on peds; few medium shot; medium acid (pH 5.8) ; clear, wavy boundary. 5 to 9 inches thick.
- B22-22 to 31 inches, dark yellowish-brown (10YR 4/4) heavy silt loam, pale brown (10YR 6/3) dry; many, medium, distinct, dark brown, dark-gray, and dark yellowish-brown (7.5YR 4/2, 10YR 4/1 and 3/4) moist mottles; weak, medium, subangular blocky structure parting to moderate, fine, subangular blocky; firm, hard, slightly sticky and slightly plastic; slightly brittle; few very fine roots; many very fine pores and few, fine, tubular pores; few, thin, dark-colored coatings or cutans on vertical surfaces of peds and in pores; common fine shot; medium acid (pH 5.8) ; gradual, wavy boundary. 6 to 13 inches thick.
- B3-31 to 46 inches, variegated brown and dark-brown (10YR 5/3 and 4/3) silt loam, pale brown (10YR 6/3) dry; many, medium and fine, faint and distinct, dark grayish-brown and reddish-brown (10YR 4/2, 5YR 4/4) moist mottles; weak, coarse, subangular blocky structure, hard, firm, slightly sticky and slightly plastic; brittle; few fine roots; many very fine pores and few, fine, tubular pores; common, medium, black coatings; common fine shot, common micaceous fragments; few, thin coatings or cutans on vertical surfaces of peds; over 60 percent of the horizon exhibits gray, clean sand and silt particles in a patchy pattern along surfaces of peds and in the larger pores; medium acid (pH 6.0) ; gradual, wavy boundary. 0 to 18 inches thick.
- C1-46 to 60 inches, dark yellowish-brown (10YR 3/4) silt loam, pale brown (10YR 6/3) and yellowish-brown (10YR 5/4) dry; common, coarse, dark grayish-brown (10YR 4/2) mottles and streaks; few black coatings; massive; firm, slightly sticky, slightly plastic; slightly brittle; few, coarse, tubular pores and many, fine and very fine, tubular pores; micaceous; medium acid

(pH 6.0) ; gradual irregular boundary.
12 to 16 inches thick.

C2-60 to 65 inches, dark yellowish-brown (10YR 4/4) very fine sandy loam, light yellowish-brown (10YR 6/4) dry; massive, slightly hard, friable; nonsticky and nonplastic; common or many firm nodules; very fine tubular pores.

The solum ranges from 30 to 60 inches in thickness. Depth to bedrock more than 60 inches. The A horizon is silt loam or loam. The B horizon is a silt loam or loam that is 18 to 27 percent clay and less than 15 percent rock fragments coarser than very fine sand. The lower part of the B horizon ranges from slightly brittle to strongly brittle. The C horizon is silt loam, loam, or very fine sandy loam.

1-Aloha silt loam. This nearly level soil is on smooth terraces. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Amity, Cornelius variant, Woodburn, Quatama, and Huberly soils which make up as much as 10 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIw-1; wildlife group 2.

Amity series (2)

The Amity series consists of somewhat poorly drained soils that formed in old alluvium on valley terraces. Slope is 0 to 3 percent. Elevation is 150 to 240 feet. Where these soils are not cultivated, the vegetation is grasses, low shrubs, and scattered Oregon white oak. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is very dark brown over very dark grayish-brown silt loam about 12 inches thick and very dark gray silty clay loam 4 inches thick. The subsurface layer is dark gray, faintly mottled silty clay loam about 4 inches thick. The subsoil is dark grayish-brown and grayish-brown, distinctly mottled silty clay loam about 20 inches thick. The profile is medium acid in the surface and subsurface layers and slightly acid in the subsoil and substratum.

Permeability is moderately slow. Available water capacity is 9 to 12 inches. Water-supplying capacity is 18 to 20 inches. Effecti

These soils are used for irrigated vegetable crops, irrigated strawberries, small grain, grass and legume seed production, hay, pasture, recreation, and wildlife habitat.

Representative profile of Amity silt loam, located about 150 feet east of the road in SW1/4NE1/4 section 20, T. 1 N., R. 3 W.:

Ap-0 to 6 inches, very dark-brown (10YR 2/2) silt loam, grayish-brown (10YR 5/2) dry; weak, fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; many, very fine, irregular pores; medium acid (pH 5.6); abrupt, smooth boundary. 5 to 8 inches thick.

A12-6 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish-brown (10YR 5/2) dry; weak, medium, subangular blocky structure breaking to moderate, fine and very fine, subangular blocky; hard, friable, nonsticky and slightly plastic; many very fine roots; common, fine and medium, tubular pores; medium acid (pH 5.6) ; clear, smooth boundary. 5 to 10 inches thick.

A13-12 to 16 inches, very dark gray (10YR 3/1) light silty clay loam, grayish-brown (10YR 5/2) dry; moderate, fine and very fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; common, fine, tubular pores; medium acid (pH 5.8) ; clear, smooth boundary. 0 to 7 inches thick.

A2-16 to 20 inches dark-gray (10YR 4/1) light silty clay loam, light gray (5YR 7/1) dry; few, faint, dark-brown (7.5YR 3/2) mottles; weak, medium and fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine roots; many, fine and very fine, tubular pores; medium acid (pH 5.8) ; clear, smooth boundary. 5 to 7 inches thick.

B21t-20 to 28 inches, dark grayish-brown (10YR 4/2) silty clay loam, pale brown (10YR 6/3) dry; common, fine and medium, distinct, dark reddish-brown (5YR 3/3) mottles; moderate, fine and very fine, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common, fine, tubular pores; slightly acid (pH 6.4) ; clear, smooth boundary. 6 to 9 inches thick.

B22t-28 to 33 inches, dark grayish-brown (2.5Y 4/2) silty clay loam, pale brown (10YR 6/3) dry; common, distinct, dark-brown (7.5YR 3/2) mottles; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; many, fine, tubular pores; common, black coatings on peds; thin continuous clay films on peds and in pores; slightly acid (pH 6.4) ; clear, smooth boundary. 4 to 8 inches thick.

B3t-33 to 40 inches, grayish-brown (2.5Y 5/2) silty clay loam, pale brown (10YR 6/3) dry; many, medium, distinct, darkbrown (7.5YR 3/2) mottles; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common, fine, tubular pores; many, medium, black coatings on peds and in pores; few, thin, clay films on peds and in pores; slightly acid (pH 6.4) ; abrupt, smooth boundary. 0 to 10 inches thick.

C-40 to 60 inches, light olive brown (2.5Y 5/4) silt loam, very pale brown (10YR 7/4) dry; few, fine, faint mottles; massive;

hard, firm, nonsticky and nonplastic; common, fine, tubular pores; slightly acid (pH 6.4)

The B2t horizon has weak to moderate structure in the upper part and is brittle in the lower part. Faint and distinct mottles of high chroma occur in the upper 10 inches of the Bt and A2 horizons, and mottles of chroma of 2 or less occur within 30 inches of the surface.

2-Amity silt loam. This nearly level soil is on smooth terraces. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Aloha, Woodburn, and Dayton soils, which make up as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIw-2; wildlife group 2.

Astoria series

The Astoria series consists of well drained soils that formed in colluvium or residuum from sedimentary rock on uplands. Slope is 5 to 60 percent. Elevation is 300 to 2,000 feet. Vegetation is Douglas-fir, western hemlock, vine maple, red alder, shrubs, and forbs. Average annual precipitation is 80 to 110 inches, average annual air temperature is 48° to 49° F, and the frost-free period is 145 to 200 days.

In a representative profile the surface layer is dark-brown silt loam and silty clay loam about 12 inches thick. The upper part of the subsoil is dark-brown and brown silty clay loam and silty clay about 30 inches thick. The lower part of the subsoil is strong brown silty clay about 8 inches thick. Fractured weathered siltstone is at a depth of 50 inches. The profile is strongly acid and very strongly acid in the surface layer and very strongly acid in the subsoil.

Permeability is moderate. Available water capacity is 11 to 15 inches. Water-supplying capacity is 20 to 26 inches. Effective rooting depth is 40 to more than 60 inches.

These soils are used mainly for timber. Other uses include recreation, wildlife habitat, and water supply.

Representative profile of Astoria silt loam, 5 to 30 percent slopes, located 50 feet south of the road NW1/4SW1/4SE1/4 section 20, T. 1 S., R. 6 W.:

O1-1/4 inch to 0, moss, fir needles, twigs, and leaves.

A11-0 to 5 inches, dark-brown (7.5YR 3/2) silt loam, brown (7.5YR 4/2) dry; strong, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many, very fine, irregular pores; many fine concretions; 5 percent fine pebbles; strongly acid (pH 5.2); clear, smooth boundary. 5 to 10 inches thick.

A12-5 to 12 inches, dark-brown (7.5YR 3/2) light silty clay loam, brown (7.5YR 4/3) dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many, very fine, tubular pores; few fine concretions; 5 per-

cent fine pebbles; few, fine, weathered siltstone fragments; very strongly acid (pH 5.0); clear, smooth boundary. 5 to 12 inches thick.

B1-12 to 20 inches, dark-brown (2.5YR 3/4) silty clay loam, brown (7.5YR 5/4) dry; moderate, fine subangular, blocky structure; hard, friable, sticky and plastic; many fine roots; many, very fine, tubular pores; 5 percent fine weathered siltstone pebbles; very strongly acid (pH 5.0); clear, smooth boundary. 0 to 12 inches thick.

B21-20 to 31 inches, brown (7.5YR 4/4) silty clay, reddish-yellow (7.5YR 6/6) dry; moderate, fine, subangular blocky structure; hard, friable, sticky and plastic; common medium roots; many, very fine, tubular pores; 5 percent fine weathered siltstone pebbles; very strongly acid (pH 4.8); clear, smooth boundary. 9 to 13 inches thick.

B22-31 to 42 inches, brown (7.5YR 5/4) silty clay; moderate, fine subangular blocky structure; hard, friable, sticky and plastic; few fine roots; many, very fine, tubular pores; 5 percent fine weathered siltstone pebbles; very strongly acid (pH 4.8); gradual, smooth boundary. 11 to 21 inches thick.

B3-42 to 50 inches, strong brown (7.5YR 5/6) silty clay, weak, fine, subangular blocky structure; hard, friable, sticky and plastic; few fine roots; many, very fine, tubular pores; 5 percent fine weathered siltstone pebbles; very strongly acid (pH 4.8); clear, wavy boundary. 4 to 8 inches thick.

Cr-50 to 60 inches, fractured weathered siltstone.

The A horizon is very dark brown, very dark grayish brown, or dark brown when moist. Structure is moderate or strong granular or fine to very fine subangular blocky. The A horizon is silt loam in the upper part and ranges to silty clay loam in the lower part. Fine concretions are commonly present in the A horizon. The B2 horizon ranges from silty clay to clay. In places a few weathered sedimentary rock fragments are in the upper part of the solum, and they increase in abundance with depth.

3E-Astoria silt loam, 5 to 30 percent slopes. This soil is on ridgetops and side slopes in the Coast Range. The soil has the profile described as representative of the series.

Included with this soil in mapping were areas of Hembre, Klickitat, Tolke, and more steeply sloping Astoria soils. Areas of gravelly or cobbly soils and soils less than 40 inches deep are included. These included areas make up as much as 20 percent of this mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Capability unit VIe; woodland suitability group 2o1; wildlife group 4.

3F-Astoria silt loam, 30 to 60 percent slopes. This

are subject to higher precipitation. Included soils make up as much as 20 percent of this mapping unit.

Runoff is rapid, and the hazard of erosion is severe. This soil is used mainly for timber, wildlife habitat, and homesites. Capability unit VIe; woodland suitability group 3w1; wildlife group 3.

Chehalem series

The Chehalem series consists of somewhat poorly drained soils that formed in deep, fine textured, mixed alluvium on alluvial fans. Slope is 3 to 12 percent. Elevation is 150 to 300 feet. Where these soils are not cultivated, the vegetation is grasses, low shrubs, and Oregon white oak. Average annual precipitation is 40 to 50 inches, average annual air temperature is 51° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is very dark brown silty clay loam about 20 inches thick. The subsoil is very dark brown, mottled silty clay loam and silty clay about 16 inches thick. The substratum is brown, mottled silty clay about 14 inches thick. Reaction is medium acid throughout the profile.

Permeability is slow. Available water capacity is 10 to 11 inches. Water-supplying capacity is 20 to 24 inches. Effective rooting depth is 40 inches to more than 60 inches.

These soils are used for small grain, hay, irrigated pasture, irrigated berries, legume seed, recreation, and wildlife habitat.

Representative profile of Chehalem silty clay loam, 3 to 12 percent slopes, located in NE1/4SE1/4SW1/4 section 19, T. 1 S., R. 4 W.:

- Ap-0 to 9 inches, very dark brown (10YR 3/2) silty clay loam, dark gray (10YR 5/2) dry; moderate, very fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many very fine roots; many, very fine, irregular pores; slightly acid (pH 6.2); abrupt, smooth boundary. 6 to 9 inches thick.
- A12-9 to 15 inches, very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate, fine and very fine, subangular blocky structure; hard, firm, slightly sticky and plastic; many fine roots; many, very fine, tubular pores; 5 percent weathered siltstone pebbles; medium acid (pH 6.0); clear, smooth boundary. 6 to 13 inches thick.
- A3-15 to 20 inches, very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; few, faint mottles; moderate, very fine, subangular blocky structure; hard, firm, sticky and plastic; many fine roots; many, fine and very fine, tubular pores; 5 percent weathered siltstone pebbles; medium acid (pH 6.0); clear, smooth boundary. 0 to 12 inches thick.
- B21-20 to 27 inches, very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; few, fine, yellowish-brown (10YR 6/6) and reddish-brown (5YR 5/4) mottles; moderate, fine, sub-

angular blocky structure; hard, firm, sticky and plastic; few fine roots; many, fine, tubular pores; few thin clay films and dark-colored coatings on vertical ped surfaces and in pores; 10 percent weathered siltstone pebbles; medium acid (pH 5.8); clear, smooth boundary. 7 to 15 inches thick.

B22-27 to 36 inches, very dark brown (10YR 3/2) silty clay, light brownish gray (10YR 6/2) dry; many, fine, yellowish-brown (10YR 5/6) and reddish-brown (5YR 5/4) mottles; weak, fine, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common, fine, tubular pores; few thin clay films and coatings on vertical ped faces; 15 percent weathered siltstone pebbles; medium acid (pH 5.6); clear, smooth boundary. 6 to 15 inches thick.

C-36 to 50 inches, brown (10YR 4/3) silty clay; common, fine, yellowish-brown (10YR 5/6) and gray (10YR 5/1) mottles; massive; hard, firm, sticky and plastic; 30 percent weathered siltstone pebbles.

The solum ranges from 30 to 60 inches in thickness. The A horizon is silt loam, clay loam, or silty clay loam. It has hue of 10YR to 7.5YR and moist value of 2 to 3. The B horizon is silty clay, clay, or silty clay loam and averages 35 to 45 percent clay. It has hue of 10YR or 2.5Y; moist value generally is 2 or 3, but it ranges to 4 below a depth of 24 inches. Mottles in the B horizon range from faint to prominent and are distinct or prominent in the lower part of the mollic epipedon or below a depth of 20 inches.

8C-Chehalem silty clay loam, 3 to 12 percent slopes.

This gently sloping to moderately steep soil is on alluvial fans at the mouth of side draws. This soil has the profile described as representative of the series.

Included with this soil in mapping were areas of Canton, Melbourne, and Cove soils, which make up as much as 10 percent of this mapping unit.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Capability unit IIIe-6; wildlife group 1.

Chehalis series (9)

The Chehalis series consists of well-drained soils that formed in recent alluvium on bottom lands. Slope is 0 to 3 percent. Elevation is 150 to 300 feet. Where these soils are not cultivated, the vegetation is ash, cottonwood, and willow. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown and dark-brown silty clay loam about 16 inches thick. The subsoil is dark-brown silty clay loam about 29 inches thick. The substratum is dark yellowish-brown silt loam about 15 inches thick. The profile is slightly acid in the surface layer and medium acid in the subsoil and substratum.

Permeability is moderate. Available water capacity is 11 to 13 inches. Water-supplying capacity is 20 to

26 inches. Effective rooting depth is more than 60 inches.

These soils are used for irrigated vegetable crops, orchards, small grain, irrigated berries, irrigated hay, irrigated pasture, wildlife habitat, and recreation.

Representative profile of Chehalis silty clay loam, located southeast of bridge over the Tualatin River in the SW1/4SE1/4NE1/4 section 9, R. 1 S., R. 3 W.:

Ap-0 to 8 inches, very dark grayish-brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many fine roots; many, very fine, tubular pores; slightly acid (pH 6.2); abrupt, smooth boundary. 4 to 10 inches thick.

A12-8 to 16 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many fine roots; many, very fine, tubular pores; slightly acid (pH 6.2); clear, smooth boundary. 2 to 10 inches thick.

B21-16 to 38 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, fine, subangular blocky structure; slightly hard, firm, sticky and plastic; moderate fine roots; common, fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary. 10 to 22 inches thick.

B22-38 to 45 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, medium, subangular blocky structure; slightly hard, firm, sticky and plastic; few fine roots; common, fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary. 7 to 30 inches thick.

C-45 to 60 inches, dark yellowish-brown (10YR 3/4) silt loam, brown (10YR 5/3) dry; massive; hard, firm, slightly sticky and slightly plastic; few, very fine and fine roots; few, very fine, tubular pores; medium acid (pH 6.0).

The A horizon has moist colors of very dark grayish brown or dark brown to a depth of 20 inches or more. The dry colors are brown, grayish brown, or dark grayish brown. Texture is silt loam to silty clay loam. Texture of the B horizon is silty clay loam, but thin, stratified layers of silt loam occur in places. In some places silt loam horizons are at a depth of more than 40 inches.

9-Chehalis silty clay loam, occasional overflow. This nearly level soil is on smooth flood plains. This soil has the profile described as representative of the series.

Included with this soil in mapping were areas of Chehalis silt loam, McBee soils, and Wapato soils, which make up as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. The hazard of streambank erosion is severe (fig. 4). Capability unit IIw-3; wildlife group 1.

10-Chehalis silt loam, occasional overflow. This

nearly level soil is on smooth flood plains. It has a profile similar to the one described as representative of the series, but it has a silt loam surface layer and a heavy silt loam subsoil.

Included with this soil in mapping were areas of Chehalis silty clay loam, McBee soils, and Wapato soils, which make up as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. The hazard of streambank erosion is severe. Capability unit IIw-3; wildlife group 1.

Cornelius series

The Cornelius series consists of moderately well drained soils that formed in loesslike material over fine-silty, old alluvium of mixed origin on uplands. Slope is 2 to 60 percent. Elevation is 350 to 800 feet. Where these soils are riot cultivated, vegetation is Douglas-fir, bigleaf maple, shrubs, and grasses. Average annual precipitation is 40 to 60 inches. Average annual air temperature is 52° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is dark-brown silt loam about 6 inches thick. The upper part of the subsoil is brown silt loam about 32 inches thick, and the lower part is a brown, mottled silt loam fragipan about 20 inches thick. The profile is medium acid in the surface layer, medium to strongly acid in the upper part of the subsoil, and strongly acid in the fragipan.

Permeability is slow. Available water capacity is 8 to 10 inches. Water-supplying capacity is 18 to 20 inches. Effective rooting depth is 30 to 40 inches.

These soils are used for irrigated berries, irrigated vegetable crops, orchards, small grain, legume and grass seed, irrigated hay, irrigated pasture, timber, recreation, and wildlife habitat.

Representative profile of Cornelius silt loam in an area of Cornelius and Kinton silt loams, 2 to 7 percent slopes, located about 2,000 feet east and 300 feet south of Midway-Vandeschuere Road junction in the NW1/4NE1/4SE1/4 section 17, T. 2 S., R. 2 W.:

Ap-0 to 6 inches, dark-brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common, fine, and few, medium roots; many, very fine, tubular pores; many fine concretions; medium acid (pH 5.6); abrupt, smooth boundary. 5 to 6 inches thick.

B11-6 to 11 inches, brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; common fine roots and few medium roots; many, very fine, tubular pores; thin silt coatings on some pedis; 2 percent fine hard concretions; medium acid (pH 5.9); clear, smooth boundary. 4 to 6 inches thick.

B12-11 to 17 inches, brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; moderate, fine and medium, suban-

slightly hard, friable, slightly sticky and slightly plastic; common black manganese stains on peds; common, fine reddish-brown (5YR 4/4) mottles; few very fine roots; many, very fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary. 6 to 13 inches thick.

B21t-23 to 32 inches, brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; many, thick, grayish-brown (10YR 5/2) coatings on peds; weak, medium, subangular blocky structure; hard, firm, slightly brittle, sticky and plastic; many, fine and medium, distinct, dark reddishbrown (5YR 3/4) and dark-brown (7.5YR 4/4) mottles; few fine roots; many, very fine, tubular pores; common clay films on pores and few on peds; common black manganese stains in peds; slightly acid (pH 6.2); clear, smooth boundary. 8 to 15 inches thick.

B22t-32 to 39 inches, brown (10YR 4/3) light silty clay loam, pale brown (10YR 6/3) dry; many, thick, grayish-brown (10YR 5/2) coatings on peds; many, fine and medium, distinct, light brownish-gray (10YR 6/2) and dark-brown (7.5YR 4/4) mottles; weak, coarse, subangular blocky structure; hard, very firm, brittle, sticky and plastic; common, moderately thick clay films in pores and on peds; very few fine roots; many, very fine, and fine, tubular pores; slightly acid (pH 6.4); clear, smooth boundary. 5 to 10 inches thick.

C1x-39 to 50 inches, brown (10YR 4/3) light silty clay loam; grayish-brown (10YR 5/2) coatings; many, fine and medium, distinct, light brownish-gray (10YR 6/2) and dark-brown (7.5YR 4/4) mottles; massive; very firm, brittle, slightly sticky and plastic; very few fine roots; many, very fine, tubular pores; many, thick, continuous clay films in pores and on fractures; slightly acid (pH 6.4); clear, smooth boundary. 10 to 20 inches thick.

C2x-50 to 60 inches, brown (10YR 4/3) light silty clay loam; grayish-brown (10YR 5/2) coatings; many, fine and medium, distinct, light brownish-gray (10YR 6/2) and dark-brown (7.5YR 4/4) mottles; massive; very firm, brittle, slightly sticky and plastic; many, very fine, irregular pores; common medium clay films in pores and on fractures; slightly acid (pH 6.4).

The solum ranges from 30 to 50 inches in thickness. Depth to bedrock is more than 60 inches. The A horizon is a silt loam with 0 to 5 percent fine hard concretions. The B horizon is a silty clay loam or silt loam. Depth to a weak fragipan is 30 to 40 inches.

12A-Cornelius Variant silt loam, 0 to 3 percent slopes. This nearly level soil is on smooth terraces. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Aloha, Cornelius, Helvetia, and more steeply sloping Cornelius Variant soils, which make up as much as 10 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIIw-1; wildlife group 2.

12B-Cornelius Variant silt loam, 3 to 7 percent slopes. This gently sloping soil is on smooth terraces.

Included with this soil in mapping were areas of Aloha, Cornelius, Helvetia, and other Cornelius Variant soils, which make up as much as 10 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIIw-1; wildlife group 2.

12C-Cornelius Variant silt loam, 7 to 12 percent slopes. This moderately sloping soil is on smooth terraces.

Included with this soil in mapping were areas of Aloha, Cornelius, Helvetia, and less steeply sloping Cornelius Variant soils, which make up as much as 10 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe-4; wildlife group 2.

Cove series (13)

The Cove series consists of poorly drained soils that formed in recent clayey alluvium on flood plains (fig. 5). Slope is 0 to 2 percent. Elevation is 150 to 300 feet. Where these soils are not cultivated, the vegetation is mainly ash and willow, with some sedges, cattails, and grasses. Average annual precipitation is 40 to 60 inches, average annual air temperature is 52° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is very dark gray, mottled silty clay loam about 8 inches thick. The subsoil is very dark gray, gleyed and mottled clay about 32 inches thick. The substratum is very dark gray clay that extends to a depth of 60 inches or more. The soil reaction is medium acid in the surface layer to slightly acid in the subsoil.

Permeability is very slow. Available water capacity is 4 to 4.5 inches. Water-supplying capacity is 20 to 26 inches. Effective rooting depth is less than 20 inches because of the seasonally high water table.

These soils are used for pasture and wildlife habitat.

Representative profile of Cove silty clay loam, 0 to 2 percent slopes, located 200 feet north of road, NE1/4SW1/4SW1/4 section 19, T. 1 S., R. 2 S.:

Ap-0 to 8 inches, very dark-gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few, fine, yellowish-brown and red mottles; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many fine roots; common, fine, tubular pores; medium acid (pH 6.0); abrupt, smooth boundary. 7 to 16 inches thick.

B21g-8 to 18 inches, very dark gray (N 3/) clay, dark gray (N 4/) dry; many, fine, dark yellowish-brown and dark reddish-brown mottles; moderate, coarse, prismatic structure; very hard, very firm, very sticky and very plastic;



Figure 5.-An area of Cove silty clay loam, 0 to 2 percent slopes, (in the foreground) surrounded by Quatama loam and Aloha silt loam soils (in the background). Cove soils typically are in long, narrow areas along drainageways.

few fine roots; common, fine, tubular pores; few slickensides on some peds; slightly acid (pH 6.2); clear, smooth boundary. 8 to 12 inches thick.

B22g-18 to 40 inches, very dark-gray (N 3/) clay, gray (N 5/) dry; weak, coarse, prismatic structure, very hard, very firm, very sticky and very plastic; common, fine, tubular pores; few slickensides on some peds; few, fine, dark yellowish-brown mottles; slightly acid (pH 6.2); clear, smooth boundary. 15 to 26 inches thick.

Cg-40 to 60 inches, very dark gray (N 3/) clay, gray (N 5/) dry; massive; very hard, very firm, very sticky and very plastic; common, fine, tubular pores; few slickensides on some peds; few, fine, dark yellowish-brown mottles; slightly acid (pH 6.2).

The solum ranges from 35 to 45 inches in thickness. Texture of the A horizon is silty clay loam, silty clay, or clay. Mottles are distinct or prominent within a depth of 20 inches. A few fine rock fragments occur in places.

13-Cove silty clay loam. This nearly level soil is on flood plains. It occurs in slightly concave areas along large and small streams. The soil has the profile described as representative of the series.

Included with this soil in mapping were areas of Cove clay, Labish soils, and clayey soils that have peat below a depth of 30 inches. Included areas make up less than 10 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IVw-1; wildlife group 1.

14-Cove clay. This nearly level soil is on flood plains. It occurs in slightly concave areas along large and small streams. It has a profile similar to the one described as representative of the series, but it has a clay surface texture.

Included with this soil in mapping were areas of Labish soils and Cove silty clay loams, which make up as much as 10 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IVw-1; wildlife group 1.

Dayton series

The Dayton series consists of poorly drained soils that formed in old alluvium on old terraces. Slope is 0 to 3 percent. Elevation is 150 to 400 feet. Where these soils are not cultivated, the vegetation is grasses, sedges, low shrubs, and scattered ash trees. Average annual precipitation is 40 to 50 inches, average annual air temperature is 50° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is dark grayish-brown and dark gray silt loam about 10 inches thick. The subsurface layer is gray silt loam 6 inches thick. The subsoil is dark-gray and olive-gray, mottled clay and silty clay about 23 inches thick. The substratum is grayish-brown silty clay loam about 11 inches thick. The profile is medium acid in the surface layer and subsoil and slightly acid in the substratum.

Permeability is very slow. Available water capacity

able to firm and is brittle. The C horizon is silty clay or clay with 3 to 25 percent fine, weathered igneous rock fragments.

28B-Laurelwood silt loam, 3 to 7 percent slopes.

This gently sloping soil is on long, convex side slopes on uplands. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Kinton, Helvetia, Saum, Melbourne, and Jory soils, which make up as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIe-3; woodland suitability group 2o2; wildlife group 3.

28C-Laurelwood silt loam, 7 to 12 percent slopes.

This moderately sloping soil is on uplands.

Included with this soil in mapping were areas of Kinton, Helvetia, Saum, Melbourne, and Jory soils, which make up as much as 15 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe-3; woodland suitability group 2o2; wildlife group 3.

28D-Laurelwood silt loam, 12 to 20 percent slopes.

This moderately steep soil is on uplands.

Included with this soil in mapping were areas of Kinton, Helvetia, Saum, Melbourne, and Jory soils, which make up as much as 15 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe-2; woodland suitability group 2o2; wildlife group 3.

28E-Laurelwood silt loam, 20 to 30 percent slopes.

This steep soil is on uplands.

Included with this soil in mapping were areas of Kinton, Helvetia, Melbourne, Saum, and Jory soils, which make up as much as 15 percent of this mapping unit.

Runoff is rapid, and the hazard of erosion is severe. Capability unit IVe-2; woodland suitability group 2o2; wildlife group 3.

29E-Laurelwood silt loam, 3 to 30 percent slopes. This gently sloping to steep soil is on uplands.

Included with this soil in mapping were areas of Jory, Kinton, Melbourne, and Saum soils, which make up as much as 20 percent of this mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Most of this soil is used for timber. The soil is suitable for cropland. Capability unit IVe-2; woodland suitability group 2o2; wildlife group 3.

29F-Laurelwood silt loam, 30 to 60 percent slopes.

This steep to very steep soil is on uplands.

Included with this soil in mapping were areas of Jory, Kinton, Melbourne, and Saum soils, which make up as much as 20 percent of this mapping unit.

Runoff is rapid, and the hazard of erosion is severe. Capability unit VIe; woodland suitability group 2r2; wildlife group 3.

McBee series (30)

The McBee series consists of moderately well drained soils that formed in alluvium on flood plains. Slope is 0 to 3 percent. Elevation is 100 to 300 feet.

Where these soils are not cultivated, the vegetation is ash, cottonwood, and willow. Average annual precipitation is 40 to 60 inches, average annual air temperature is 50° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is dark-brown silty clay loam about 11 inches thick. The subsoil is silty clay loam about 34 inches thick. It is dark brown and has common to many, fine, dark yellowish-brown, gray, and dark grayish-brown mottles. The substratum is dark-gray clay loam about 20 inches thick. The profile is medium acid in the surface layer and slightly acid in the subsoil and substratum.

Permeability is moderate. Available water capacity is 10 to 12 inches. Effective rooting depth is more than 60 inches.

These soils are used for irrigated vegetable crops, small grain, irrigated hay, irrigated pasture, recreation, and wildlife habitat.

Representative profile of McBee silty clay loam, located about 40 feet south of the road, NW1/4NE1/4SW1/4 section 36, T. 1 S., R. 4 W.:

Ap-0 to 7 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine roots; many, very fine, irregular pores; medium acid (pH 6.0); abrupt, smooth boundary. 6 to 9 inches thick.

A12-7 to 11 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; few, fine, faint mottles of dark yellowish brown (10YR 4/4); weak, fine, subangular blocky structure; slightly hard, firm, slightly sticky and plastic; many fine roots; common, fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary. 0 to 5 inches thick.

B1-11 to 24 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; common, fine, faint mottles of dark yellowish brown (10YR 4/4); moderate, fine subangular blocky structure; slightly hard, firm, slightly sticky and plastic; common fine roots; common, fine, tubular pores; slightly acid (pH 6.2); clear, smooth boundary. 0 to 16 inches thick.

B2-24 to 38 inches, fine variegated dark-brown, gray, and dark yellowish-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, fine, subangular blocky structure; slightly hard, firm, sticky and plastic; common fine roots; common, fine, tubular pores; slightly acid (pH 6.4); gradual, smooth boundary. 8 to 16 inches thick.

B3-38 to 45 inches, many, fine, distinct mottles of dark grayish brown, gray, and dark yellowish brown (10YR 4/2 5/1, 4/4) silty clay loam, brown (10YR 6/3) dry; moderate parting to weak, medium, subangular blocky structure; slightly hard,

firm, sticky and plastic; very few fine roots; many, very fine, tubular pores and few, fine, tubular pores; slightly acid (pH 6.4) ; gradual, smooth boundary. 4 to 11 inches thick.

C-45 to 65 inches, dark-gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; many, medium and fine, distinct mottles of very dark brown and dark brown (10YR 2/2 and 3/3) ; massive; many, very fine, tubular pores; slightly acid (pH 6.4).

The solum is 30 to 48 inches thick. The A horizon is dark colored to a depth of more than 20 inches. Coarse fragments are commonly absent in the control section, but their content ranges to 20 percent below a depth of 35 inches and to 50 percent below a depth of 40 inches. The B horizon is silty clay loam or clay loam. The C horizon is clay loam to clay.

30-McBee silty clay loam. This nearly level soil is in areas along larger streams (fig. 9).

Included with this soil in mapping were areas of Chehalis, Cove, and Wapato soils, which make up as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Flooding is frequent, and the hazard of streambank erosion is high. Capability unit IIw-4; wildlife group 1.

Melbourne series

The Melbourne series consists of well-drained soils that formed in residuum and colluvium weathered from sedimentary rock on uplands. Slope is 2 to 60 percent. Elevation is 300 to 800 feet. Vegetation is Douglas-fir, Oregon white oak, poison-oak, wild rose, shrubs, and forbs. Average annual precipitation is 40 to 60 inches, average annual air temperature is 51° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is dark-brown and dark yellowish-brown silty clay loam about 10 inches thick. The upper part of the subsoil is dark yellowish-brown silty clay loam about 8 inches thick, and the lower part is brown silty clay about 32 inches thick. The substratum is yellowish-brown silty clay about 16 inches thick. The profile is slightly acid and medium acid in the surface layer, medium acid in the upper part of the subsoil, and strongly acid in the lower part of the subsoil and in the substratum.

Permeability is moderately slow. Available water capacity is 3.5 to 6 inches. Water-supplying capacity is 17 to 24 inches. Effective rooting depth is more than 60 inches.

These soils are used for timber, irrigated berries, hay, pasture, wildlife habitat, recreation, and water supply.



Figure 9.-McBee silty clay loam on nearly level flood plain. Laurelwood soils on moderately steep uplands in background.

C-55 to 60 inches, yellowish-red (5YR 5/8) silty clay loam with streaks of yellowish-brown (10YR 5/6), strong brown (7.5YR 5/8) dry; massive; slightly hard, friable, sticky and plastic; few fine roots; many, very fine, irregular pores; few moderately thick clay films on rock fragments and in pores; 50 percent weathered siltstone fragments; strongly acid (pH 5.4).

Depth to fractured, partially consolidated siltstone and shale is 40 to 60 inches or more. The Bt horizon is silty clay loam to silty clay and averages 35 to 50 percent clay. The C horizon consists of partially weathered, fractured siltstone or shale, with moderately fine textured material filling the fractures.

36C-Pervina silty clay loam, 7 to 12 percent slopes. This strongly sloping soil is on uplands. It has a profile similar to the one described as representative of the series.

Included with this soil in mapping were areas of Melby, Melbourne, Olyic, and Tolke soils, gently sloping Pervina soils, and steeper Pervina soils. Included soils make up as much as 15 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for pasture, timber, water supply, recreation, and wildlife habitat. Capability unit IIIe-7; woodland suitability group 2o1; wildlife group 4.

36D-Pervina silty clay loam, 12 to 20 percent slopes. This moderately steep soil is on uplands.

Included with this soil in mapping were areas of Melby, Melbourne, Olyic, and Tolke soils. Also included were areas of Pervina soils that are steeper or less sloping than this Pervina soil. Included soils make up as much as 15 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for pasture, timber, water supply, recreation, and wildlife habitat. Capability unit IIIe-7; woodland suitability group 2o1; wildlife group 4.

36E-Pervina silty clay loam, 20 to 30 percent slopes. This steep soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Melby, Melbourne, Olyic, and Tolke soils. Also included were areas of Pervina soils that are steeper or less sloping than this Pervina soil. Included soils make up as much as 15 percent of this mapping unit.

Runoff is rapid, and the hazard of erosion is severe. This soil is used for pasture, timber, water supply, recreation, and wildlife habitat. Capability unit IVe-3; woodland suitability group 2o1; wildlife group 4.

36F-Pervina silty clay loam, 30 to 60 percent slopes. This very steep soil is on uplands.

Included with this soil in mapping were areas of Melby, Melbourne, Olyic, and Tolke soils. Also included are areas of Pervina soils that are less sloping than this Pervina soil. Included soils make up as much as 20 percent of this mapping unit.

Runoff is rapid, and the hazard of erosion is very severe. This soil is used mainly for timber. Other uses include water supply, recreation, and wildlife habitat.

Capability unit VIe; woodland suitability group 2r1; wildlife group 4.

Quatama series (37)

The Quatama series consists of moderately well drained soils that formed in mixed, loamy alluvium on old terraces. Slope is 0 to 20 percent. Elevation is 140 to 200 feet. Where these soils are not cultivated, the vegetation is Douglas-fir, western redcedar, Oregon white oak, ash, Oregon-grape, grasses, and forbs. Average annual precipitation is 40 to 50 inches, average annual air temperature is 52° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is dark-brown loam about 9 inches thick. The subsoil is dark yellowish-brown loam and clay loam about 34 inches thick. The substratum is dark yellowish-brown loam about 19 inches thick. The profile is medium acid throughout.

Permeability is moderately slow. Available water capacity is 8 to 10 inches. Water-supplying capacity is 18 to 20 inches. Effective rooting depth is over 60 inches.

These soils are used for irrigated berries, irrigated vegetable crops, orchards, small grain, irrigated hay, irrigated pasture, homesites, recreation, and wildlife habitat.

Representative profile of Quatama loam, 0 to 3 percent slopes, located about 100 feet east of the road in the southeast corner of the SW1/4NW1/4NE1/4 section 9, T. 2 S., R. 2 W.:

Ap-0 to 9 inches, dark-brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate, fine and very fine, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common fine roots; many, fine and very fine, irregular pores; medium acid (pH 5.6); abrupt, smooth boundary. 7 to 9 inches thick.

B1-9 to 15 inches, dark yellowish-brown (10YR 3/4) loam, pale brown (10YR 6/3) dry; weak, coarse, subangular blocky structure; hard, firm, nonsticky and plastic; very few fine roots; many, medium and fine, tubular pores; thin, continuous clay films in root channels and pores; medium and fine, tubular pores; thin, continuous clay films in root channels and pores; medium acid (pH 5.8); clear, smooth boundary. 0 to 7 inches thick.

B21t-15 to 21 inches, dark yellowish-brown (10YR 3/4) clay loam, pale brown (10YR 6/3) dry; moderate, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; few very fine roots; many, fine, tubular pores; thin, continuous clay films in pores and few, thin clay films on pedis; medium acid (pH 5.8); clear, smooth boundary. 5 to 10 inches thick.

B22t-21 to 30 inches, dark yellowish-brown (10YR 3/4) clay loam, pale brown (10YR 6/3) dry; few, fine, distinct, light brownish-gray (10YR 6/2) and

reddish-brown (5YR 4/3) mottles; weak, hard, firm, slightly sticky and plastic; very few roots; many, coarse, medium, and fine, tubular pores; continuous clay films in pores and on peds; common manganese stains; medium acid (pH 5.9); gradual irregular boundary. 6 to 18 inches thick.

B3t-30 to 43 inches, dark yellowish-brown (10YR 3/4) loam, pale brown (10YR 6/3) dry; common, fine, dark grayish-brown (10YR 4/2) mottles; massive in places parting to weak, coarse, subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; common, large and medium, tubular pores; thin continuous clay films on peds and in pores; medium acid (pH 6.0); gradual, irregular boundary. 10 to 20 inches thick.

C-43 to 62 inches, dark yellowish-brown (10YR 3/4) loam, yellowish brown (10YR 5/4) dry; common grayish-brown (10YR 6/2 & 5/8) mottles; massive; hard, firm, slightly sticky and slightly plastic; common, fine, tubular pores; medium acid (pH 6.0).

The thickness of the solum ranges from 40 to 60 inches. Texture of the A horizon is silt loam to loam. The Bt horizon ranges in texture from loam to clay loam. Structure in the Bt horizon ranges from moderate, coarse to fine, subangular blocky in the upper part and from nearly massive to weak, coarse, subangular blocky in the lower part. Clay films are thin to moderately thick, and they are in channels, in pores, and on vertical and horizontal ped faces. Stratified layers of sandy loam to loamy sand occur below a depth of 40 inches in places.

37A-Quatama loam, 0 to 3 percent slopes. This nearly level soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Aloha, Hillsboro, and Huberly soils, which make up as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIw-1; wildlife group 2.

37B-Quatama loam, 3 to 7 percent slopes. This gently sloping soil is on terraces.

Included with this soil in mapping were areas of Aloha, Hillsboro, and Huberly soils, which make up as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIe-2; wildlife group 2.

37C-Quatama loam, 7 to 12 percent slopes. This moderately sloping soil is on terraces.

Included with this soil in mapping were areas of Aloha, Hillsboro, and Huberly soils, which make up as much as 15 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe-2; wildlife group 2.

37D-Quatama loam, 12 to 20 percent slopes. This moderately steep soil is on dissected terraces.

Included with this soil in mapping were areas of Aloha, Hillsboro, and Huberly soils, which make up as much as 15 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe-5; wildlife group 2.

Saum series

The Saum series consists of well-drained soils that formed in mixed eolian material, old alluvium, and residuum from basalt on uplands. Slope is 2 to 60 percent. Elevation is 250 to 1,200 feet. Where these soils are not cultivated, the vegetation is Douglas-fir, Oregon white oak, hazelbrush, poison-oak, grasses, and forbs. Average annual precipitation is 40 to 50 inches, average annual air temperature is 51° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is dark reddish-brown silt loam and silty clay loam about 14 inches thick. The subsoil is dark reddish-brown and reddish-brown silty clay loam about 18 inches thick. The substratum is yellowish-red silty clay loam about 18 inches thick. Basalt bedrock is at a depth of 50 inches. The profile is medium acid throughout.

Permeability is moderately slow. Available water capacity is 8 to 10.5 inches. Water-supplying capacity is 16 to 22 inches. Effective rooting depth is 20 to 40 inches.

These soils are used for irrigated strawberries, orchards, small grain, hay, pasture, timber, homesites, recreation, and wildlife habitat.

Representative profile of Saum silt loam, 2 to 7 percent slopes, located about 25 feet north of the road in the SW1/4SE1/4SW1/4 section 7, T. 3 S., R. 1 W.:

Ap-0 to 8 inches, dark reddish-brown (5YR 3/2) silt loam, reddish brown (5YR 5/3) dry; moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many, very fine, irregular pores; 5 percent fine concretions; medium acid (pH 6.0); abrupt, smooth boundary. 5 to 8 inches thick.

A12-8 to 14 inches, dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 5/4) dry; moderate, medium, subangular blocky structure; hard, firm, slightly sticky and plastic; many fine roots; many, fine, tubular pores; 5 percent fine concretions; medium acid (pH 5.8); clear, smooth boundary. 5 to 8 inches thick.

B2-14 to 23 inches, dark reddish-brown (5YR 3/4) silty clay loam, reddish brown (5YR 5/4) dry; moderate, medium and fine, subangular blocky structure; hard, firm, slightly sticky and plastic; many fine roots; many, fine, tubular pores; few pebbles; medium acid (pH 5.8); clear, smooth boundary. 8 to 15 inches thick.

IIB3-23 to 32 inches, reddish-brown (5YR 4/4) silty clay loam, yellowish red (5YR 5/6) dry; weak, medium and fine, subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; many, fine, tubular pores; 20 percent weathered pebbles and 10 percent stones; few,

6/6) dry; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine roots; many, very fine, tubular pores; very strongly acid (pH 4.8); clear, smooth boundary. 10 to 19 inches thick.

B3-45 to 61 inches, strong-brown (7.5YR 4/6) silty clay loam, reddish yellow (5YR 6/6) dry; weak, coarse, subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; many, very fine, tubular pores; common, moderately thick clay films in pores and on peds; very strongly acid (pH 4.6).

Depth to bedrock is more than 60 inches. The A horizon is a silt loam to loam. The B horizon has weak or moderate, very fine to medium, subangular blocky structure. The bedrock is siltstone or basalt.

39E-Tolke silt loam, 5 to 30 percent slopes. This gently sloping to steep soil is on ridgetops and side slopes in the Coast Range. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Olyic, Melby, Goble, and Hembre soils, which make up as much as 20 percent of this mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Capability unit VIe; woodland suitability group 2o1; wildlife group 4.

39F-Tolke silt loam, 30 to 60 percent slopes. This steep soil is on side slopes of canyons in the Coast Range.

Included with this soil in mapping were areas of Olyic, Melby, Goble, and Hembre soils, which make up as much as 30 percent of this mapping unit.

Runoff is rapid, and the hazard of erosion is severe. Capability unit VIe; woodland suitability group 2r1; wildlife group 4.

Udifuvents, nearly level

40-Udifuvents, nearly level, are in small, narrow, irregularly shaped areas along stream channels and concave alluvial fans. They consist of a heterogeneous mixture of silt loams, loams, sandy loams, and silty clay loams. A typical area is in the NW1/4NE1/4 section 17, T. 3 S., R. 5 W.

These soils formed in long, narrow bands of mixed alluvium along streams and on concave alluvial fans. Slope is 0 to 3 percent. Elevation is 300 to 2,000 feet. Vegetation includes red alder, spruce, western redcedar, Douglas-fir, and low shrubs and forbs. Average annual precipitation is 60 to 100 inches, average annual air temperature is 45° to 50° F, and the frost-free period is 145 to 200 days.

The surface layer is commonly dark colored. The subsoil is yellowish-brown to strong-brown gravelly loam to silty clay loam. The surface layer is strongly acid. Water-rounded pebbles or cobbles commonly form thin stone lines or layers in the lower part of the subsoil.

These soils are well drained. Permeability is moderate to moderately slow. Available water capacity is variable. Effective rooting depth is 40 inches to more than 60 inches.

Runoff is slow, and the hazard of erosion is slight.

The soils are subject to overflow, and in places they are ponded during the months of high precipitation. They are subject to deposition of new sediment during periods of overflow.

Udifuvents, nearly level, are used for wildlife habitat, recreation, and water supply. Capability unit VIw; wildlife group 1.

Urban Land

41-Urban Land consists of areas that have been altered or obscured by urban works and structures. The areas are so greatly modified that identification of the soils is not feasible.

Soil properties such as drainage, permeability, and degree of compaction vary from place to place. All types of fill material are included.

Urban land is used for residential or commercial sites.

Verboort series (42)

The Verboort series consists of poorly drained soils that formed in stratified, moderately fine textured and fine textured alluvium on bottom lands. Slope is 0 to 3 percent. Elevation is 150 to 300 feet. Where these soils are not cultivated, the vegetation is ash, willow, shrubs, sedges, rushes, and grasses. Average annual precipitation is 40 to 50 inches, average annual air temperature is 50° to 54° F, and the frost-free period is 200 to 210 days.

In a representative profile the surface layer is very dark brown silty clay loam about 12 inches thick. The subsurface layer is very dark gray, mottled silty clay loam about 7 inches thick. The subsoil is very dark gray and dark grayish-brown light clay and silty clay about 14 inches thick. The substratum is dark grayish-brown silty clay loam about 17 inches thick. The profile is medium acid in the surface and subsurface layers and neutral in the subsoil and substratum.

Permeability is very slow. Available water capacity is 3 to 5 inches. Effective rooting depth is 20 to 36 inches.

These soils are used mainly for grain, hay, irrigated pasture, and wildlife habitat.

Representative profile of Verboort silty clay loam, 0 to 3 percent slopes, located about 20 feet west of Helvetia road, in the SE1/4NE1/4NW1/4 section 10, T. 1 N., R. 2 W.:

Ap-0 to 8 inches, very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; strong, fine, subangular blocky structure; hard, friable, sticky and plastic; many fine roots; many, very fine, tubular pores; medium acid (pH 5.8); abrupt, smooth boundary. 7 to 8 inches thick.

A12-8 to 12 inches, very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/1) dry; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many fine roots; common, fine, tubular pores; medium acid (pH 5.8); clear, smooth boundary. 4 to 7 inches thick.

A2-12 to 19 inches, very dark gray (10YR 3/1) silty clay loam, gray (10YR 6/1) dry; many, fine, dark reddish-brown (10YR 3/1) mottles; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common, fine, tubular pores; medium acid (pH 6.0); abrupt, smooth boundary. 6 to 9 inches thick.

IIB2t-19 to 28 inches, very dark-gray (N 3/) light clay, grayish brown (2.5Y 5/2) dry; weak, medium, prismatic structure parting to moderate, medium, angular blocky; very hard, very firm, very sticky and very plastic; common fine roots along vertical ped faces, and few fine roots within peds; few, fine, tubular pores; many pressure faces on peds; neutral (pH 6.6); gradual, smooth boundary. 6 to 9 inches thick.

IIB3t-28 to 33 inches, dark grayish-brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; weak, fine, prismatic structure parting to moderate, fine, angular blocky; very hard, very firm, sticky and very plastic; few fine roots between peds; common, very fine, tubular pores; many pressure faces on peds; neutral (pH 6.6); gradual, smooth boundary. 6 to 9 inches thick.

IIIC-33 to 50 inches, dark grayish-brown (2.5Y 4/2) silty clay loam, light gray (2.5Y 7/2) dry; many, medium, distinct, dark-brown (7.5YR 4/2) mottles; massive; hard, firm, sticky and plastic; few fine roots; few, fine and medium, tubular pores with very dark gray (N 3/) clay films; neutral (pH 6.6).

Mottles in the A horizon are faint to distinct. The IIB2t horizon ranges in texture from clay to silty clay. The texture of the IIB3t horizon ranges from silty clay to silty clay loam. The IIIC horizon is silty clay loam to silt loam in texture and ranges from neutral to mildly alkaline in reaction.

42-Verboort silty clay loam. This nearly level soil is in narrow, irregularly shaped, concave areas along drainageways. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Dayton, Wapato, Labish, and Cove soils, which make up as much as 10 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. This soil is subject to flooding, and the hazard of streambank erosion is severe. Capability unit IIIw-2; wildlife group 1.

Wapato series (43)

The Wapato series consists of poorly drained soils that formed in recent alluvium on flood plains. Slope is 0 to 3 percent. Elevation is 100 to 300 feet. Where these soils are not cultivated, the vegetation is ash, willow, rushes, and grass. Average annual precipitation is 40 to 60 inches, average annual air temperature

is 52° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown silty clay loam about 14 inches thick. The subsoil is dark grayish-brown silty clay loam about 28 inches thick. The profile is slightly acid in the surface layer and slightly acid to medium acid in the subsoil.

Permeability is moderately slow. Available water capacity is 10 to 12 inches. Effective rooting depth in places is limited by a seasonal water table to less than 30 inches. The soils are saturated with water during winter unless artificially drained.

These soils are used mainly for pasture, wildlife habitat, and recreation. Other uses are small grain, hay, and late-planted irrigated vegetable crops.

Representative profile of Wapato silty clay loam, located southwest of farmstead in NW1/4SW1/4SW1/4 section 34, T. 1 S., R. 4 W.:

Ap-0 to 7 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark brown (10YR 4/3) dry; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many fine roots; many, very fine, irregular pores; slightly acid (pH 6.2); abrupt, smooth boundary. 6 to 9 inches thick.

A12-7 to 14 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/3) dry; many, fine, distinct, dark-brown (7.5YR 3/2) mottles; few, fine, black manganese stains; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many fine roots; many, fine tubular pores; slightly acid (pH 6.2); clear, smooth boundary. 4 to 10 inches thick.

B21g-14 to 28 inches, dark grayish-brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; many, fine, distinct, dark-brown (7.5YR 3/2) and gray (10YR 5/1) mottles; few, fine, black manganese stains; weak, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; common, fine, tubular pores; slightly acid (pH 6.2); clear, smooth boundary. 5 to 17 inches thick.

B22g-28 to 42 inches, dark grayish-brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; many, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, fine, subangular blocky structure; hard, firm, sticky and plastic; common, fine, black stains; medium acid (pH 6.0).

The A horizon is slightly acid to neutral. The B2 horizon is dominantly silty clay loam, but in places it ranges to silty clay below a depth of 30 inches. It is slightly acid to medium acid. The B3 and C horizons, which are below a depth of 30 inches, are commonly silty clay. In some pedons a few water-worn pebbles are embedded in the solum below a depth of 40 inches.

43-Wapato silty clay loam. This soil is on bottom

lands along small streams and in low-lying areas adjacent to larger streams. It has smooth topography and is subject to short periods of overflow and ponding (fig. 10).

Included with this soil in mapping were areas of Chehalis, Cove, Labish, and McBee soils and of gravelly soils. Included soils make up as much as 15 percent of this mapping unit.

Runoff is slow, and water ponds for short periods during winter. The hazard of erosion is slight. Capability unit IIIw-2; wildlife group 1.

Willamette series

The Willamette series consists of well-drained soils that formed in old alluvium on low, broad valley terraces. Slope is 0 to 20 percent. Elevation is 150 to 450 feet. Where these soils are not cultivated, the vegetation is hazelbrush, wild blackberry, grasses, Oregon white oak, and Douglas-fir. Average annual precipitation is 40 to 50 inches, average annual air temperature is 50° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown silt loam about 15 inches thick. The subsoil is very dark grayish brown, dark-brown, and brown silt loam and silty clay loam about 28

inches thick. The substratum is brown silty clay loam about 17 inches thick. The profile is medium acid in the surface layer and medium acid to slightly acid in the subsoil and substratum.

Permeability is moderate. Available water capacity is 10 to 12 inches. Water-supplying capacity is 15 to 20 inches. Effective rooting depth is more than 60 inches.

These soils are used for irrigated vegetable crops, irrigated berries, orchards, small grain, hay, irrigated pasture, homesites, recreation, and wildlife habitat.

Representative profile of Willamette silt loam, 0 to 3 percent slopes, located in the NE1/4SW1/4NE1/4 section 16, T. 1 N., R. 2 W.:

Ap-0 to 8 inches, very dark-brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate, fine, granular structure; slightly hard, friable, nonsticky and slightly plastic; many fine roots; many, fine, irregular pores; medium acid (pH 5.8); abrupt, smooth boundary. 5 to 8 inches thick.

A12-8 to 15 inches, very dark grayish-brown (10YR 3/2) silt loam grayish brown (10YR 5/2) dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plas-



Figure 10.-Flooded area of Wapato silty clay loam surrounded by Woodburn soils.

tic; many fine roots; many, fine, tubular pores; medium acid (pH 5.6); clear, smooth boundary. 6 to 10 inches thick.

B1-15 to 23 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many, medium, tubular pores; medium acid (pH 6.0); clear, wavy boundary. 7 to 11 inches thick.

B21t-23 to 32 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, fine and very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many, medium and fine, tubular pores; few, thin, patchy clay films; medium acid (pH 6.0); clear, wavy boundary. 0 to 13 inches thick.

B22t-32 to 43 inches, brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak, coarse, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many fine roots; many, medium, tubular pores; many moderately thick clay films in pores, and few thin clay films on peds; slightly acid (pH 6.2); gradual, wavy boundary. 0 to 16 inches thick.

C-43 to 60 inches, brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; massive; slightly hard, firm, slightly sticky and plastic; few fine roots; many, medium, tubular pores; many moderately thick clay films in pores; slightly acid (pH 6.2).

The A horizon ranges from very dark brown, to dark brown and very dark grayish brown, when moist. The Bt horizon ranges in texture from silty clay loam to heavy silt loam, and it is 25 to 35 percent clay. In places the structure of the B horizon is moderate or weak, prismatic breaking to moderate, subangular blocky. The C horizon is medium textured to moderately fine textured and commonly has contrasting strata below a depth of 40 inches.

44A-Willamette silt loam, 0 to 3 percent slopes.

This nearly level soil is on broad valley terraces. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Amity, Dayton, and Woodburn soils, which make up as much as 10 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit I-1; wildlife group 2.

44B-Willamette silt loam, 3 to 7 percent slopes. This gently sloping soil is on broad valley terraces.

Included with this soil in mapping were areas of Amity, Dayton, and Woodburn soils, which make up as much as 10 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIe-1; wildlife group 2.

44C-Willamette silt loam, 7 to 12 percent slopes.

This moderately sloping soil is on broad valley terraces.

It has a profile similar to the one described as representative of the series.

Included with this soil in mapping were areas of Amity, Dayton, and Woodburn soils, which make up as much as 10 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe-1; wildlife group 2.

44D-Willamette silt loam, 12 to 20 percent slopes.

This moderately steep soil is on side slopes of terrace escarpments.

Included with this soil in mapping were areas of Amity, Dayton, and Woodburn soils, which make up as much as 10 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe-1; wildlife group 2.

Woodburn series (45)

The Woodburn series consists of moderately well-drained soils that formed in old alluvium on low, broad valley terraces. Slope is 0 to 20 percent. Elevation is 150 to 250 feet. Where these soils are not cultivated, the vegetation is Douglas-fir, Oregon white oak, grasses, and shrubs. Average annual precipitation is 40 to 50 inches, average annual air temperature is 50° to 54° F, and the frost-free period is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown silt loam about 11 inches thick. The subsoil is dark-brown and dark grayish-brown silt loam and silty clay loam about 30 inches thick. The substratum is dark grayish-brown silt loam about 19 inches thick. The profile is medium acid throughout.

Permeability is slow. Available water capacity is 11 to 13 inches. Water-supplying capacity is 15 to 20 inches. Effective rooting depth is more than 60 inches.

These soils are used for irrigated vegetable crops, irrigated berries, orchards, small grain, hay, irrigated pasture, recreation, homesites, and wildlife habitat.

Representative profile of Woodburn silt loam, 0 to 3 percent slopes, located in the SW1/4NE1/4 section 20, T. 1 N., R. 3 W.

Ap-0 to 5 inches, very dark grayish-brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; common, medium, irregular pores; medium acid (pH 5.8); abrupt, smooth boundary. 6 to 10 inches thick.

A12-5 to 11 inches, very dark grayish-brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; many, very fine, tubular pores; medium acid (pH 5.6); clear, smooth boundary. 0 to 8 inches thick.

B1t-11 to 16 inches, dark-brown (10YR 3/3) silt loam, yellowish brown (10YR 5/4) dry; moderate, fine and very fine, subangular blocky structure; slightly hard, plastic; many fine roots; many, fine, tubular pores; thick clay films in pores;

medium acid (pH 5.6) ; gradual, smooth boundary. 0 to 7 inches thick.

B21t-16 to 26 inches, dark-brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) dry; moderate, fine, and very fine, subangular blocky structure; hard, firm, slightly sticky and plastic; many fine roots; many, very fine, tubular pores; thick clay films on peds and in pores; medium acid (pH 5.8) ; clear, smooth boundary. 7 to 10 inches thick.

B22t-26 to 31 inches, dark-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common fine, distinct, dark grayish-brown (10YR 4/2) and grayish-brown (2.5YR 5/2) mottles; weak, medium, and fine, subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; many, fine and very fine, tubular pores; common thick clay films in pores and on peds; few, fine, black manganese stains; medium acid (pH 6.0) ; gradual, smooth boundary. 4 to 10 inches thick.

B3-31 to 41 inches, dark grayish-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common, fine, distinct, dark grayish-brown (10YR 4/2) and grayish-brown (2.5YR 5/2) mottles; weak, medium and fine, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine and medium roots; common, fine and very fine, tubular pores; few thick clay films in larger pores; medium acid (pH 6.0) ; gradual, smooth boundary. 0 to 12 inches thick.

C-41 to 60 inches, dark grayish-brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; many, distinct, grayish-brown (2.5YR 5/2), dark grayish-brown (10YR 4/3) , and dark yellowish-brown (10YR 4/4) mottles; massive; hard, firm, slightly sticky and slightly plastic; few fine roots; very few, fine, tubular pores; medium acid (pH 6.0).

The A horizon has moist value of 2 or 3, chroma of 2 or 3, and hue of 10YR. Dry value is 4 or 5, and chroma is 2 or 3. Between depths of 10 and 20 inches, moist value and chroma range to 4. Distinct mottles are within a depth of 30 inches. The B2 horizon ranges from heavy silt loam to silty clay loam. Horizons below a depth of 30 inches are firm to very firm and are brittle. The solum is slightly acid to medium acid.

45A-Woodburn silt loam, 0 to 3 percent slopes.

This nearly level soil has the profile described as representative of the series.

Included with this soil in mapping were areas of Aloha, Amity, Willamette, Helvetia, and Dayton soils, which occupy as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIw-1; wildlife group 2.

45B-Woodburn silt loam, 3 to 7 percent slopes.

This soil is gently sloping.

Included with this soil in mapping were areas of

Aloha, Amity, Willamette, Helvetia, and Dayton soils, which occupy as much as 15 percent of this mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIe-2; wildlife group 2.

45C-Woodburn silt loam, 7 to 12 percent slopes.

This soil is moderately sloping.

Included with this soil in mapping were areas of Aloha, Amity, Willamette, Helvetia, and Dayton soils, which occupy as much as 15 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe-2; wildlife group 2.

45D-Woodburn silt loam, 12 to 20 percent slopes.

This moderately steep soil is along terrace escarpments.

Included with this soil in mapping were areas of Aloha, Amity, Willamette, Helvetia, and Dayton soils, which occupy as much as 15 percent of this mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe-5; wildlife group 2.

Xerochrepts and Haploxerolls, very steep (4b)

46F-Xerochrepts and Haploxerolls, very steep. This undifferentiated group is about 45 percent Xerochrepts and about 45 percent Haploxerolls. It occurs as steep to very steep escarpments along the small streams that have cut deeply into the valley terraces and where the terraces meet the bottom lands and flood plains along major streams and rivers. These soils are well drained. They formed in a mixture of silt, sand, and an accumulation of material that has moved downslope. The short slopes range from 20 to 60 percent. Elevation is 50 to 450 feet. Vegetation is Douglas-fir, Oregon white oak, shrubs, forbs, and grasses. The average annual precipitation is 40 to 60 inches, average annual air temperature is 50° to 54° F, and the frost-free period is 165 to 210 days.

Included in mapping were areas of Hillsboro, Quatama, Willamette, and Woodburn soils, which make up as much as 15 percent of this mapping unit. Small seep spots and wet-season springs are also included.

Permeability is moderate to moderately slow. Available water capacity is 10 to 12 inches. Water-supplying capacity is 22 to 26 inches. Effective rooting depth is more than 60 inches.

Runoff is rapid, and the hazard of erosion is severe.

These soils are used for pasture, recreation, homesites, and wildlife habitat. Capability unit VIe; wildlife group 2.

Xerochrepts-Rock outcrop complex

47D-Xerochrepts-Rock outcrop complex. This complex is about 50 percent Xerochrepts and 30 percent Rock outcrop. It occurs in irregularly shaped areas southeast of Sherwood and is composed of shallow and very shallow soils and barren exposures of basalt bedrock. Slope is 5 to 30 percent. The Xerochrepts formed in a mixture of silt and sand too variable to map. Vegetation is low shrubs, Oregon white oak, Douglas-fir, grasses, and forbs. The average annual precipitation is

40 to 60 inches, average annual air temperature is 50° to 54° F, and the frost-free period is 165 to 210 days.

Included with this complex in mapping were areas of Saum soils and moderately deep very cobbly loams, which make up as much as 20 percent of this mapping unit.

Permeability is variable. Available water capacity and water-supplying capacity are variable. Xerochrepts are well drained.

These soils are used for wildlife, recreation, homesites, and wildlife habitat. Capability unit VII; wildlife group 2.

Use and management of the soils

This section describes use and management of the soils of Washington County for crops and pasture. It also discusses woodland, wildlife, and engineering uses of the soils and use of the soils for recreation.

Crops and pasture'

Among the dryland crops commonly grown in the survey area are winter wheat, alfalfa, filberts, and red clover for seed. Irrigated crops commonly grown are strawberries, bush beans, and pasture. In the following pages, practices suitable for soils used for these main crops are described. First, the system of capability classification is explained and management suitable for the soils of each capability unit is discussed. Then, predicted average yields per acre of the principal crops are given for a high level of management. Finally, specific management practices are described for each of the crops for which predicted yields are given.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. This classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering purposes.

In the capability system, all kinds of soils are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial plants.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-3 or IIIe-2. The capability unit is identified in the description of each mapping unit in the section "Descriptions of the soils."

Management by capability units

In the following pages, the capability units in Washington County are described and suggestions for use and management of the soils of each unit are given. The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. The names of all soils in any given capability unit can be found in the "Guide to Mapping Units" at the back of this survey.

Capability unit I-1

This unit consists of very deep, well drained Hills-

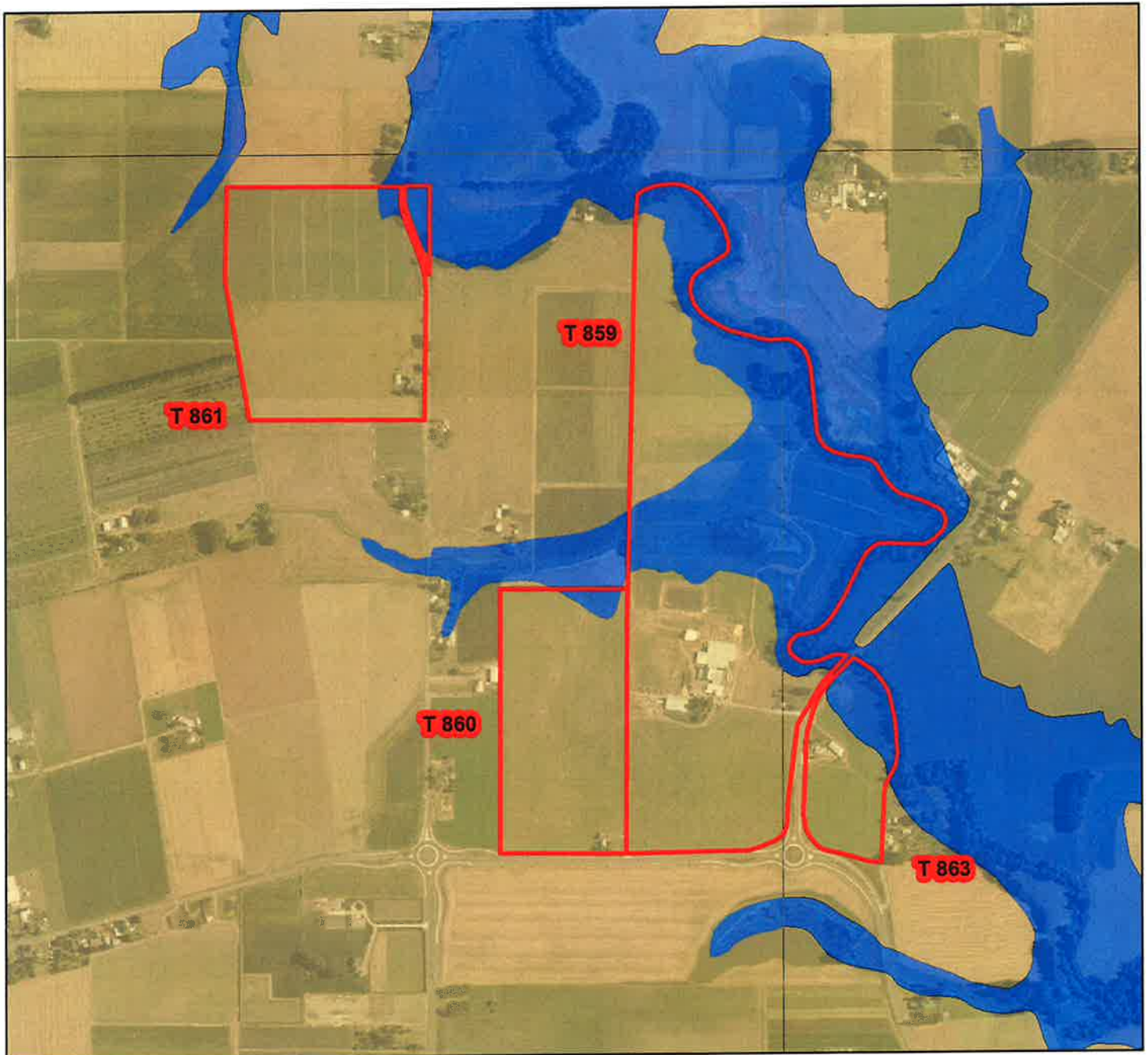


Marsh Homestead, Inc.
FEMA Floodplain Map - Main Farm



T1N, R3W, S20&21
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Legend

-  Tract Boundaries
- FEMA floodplains**
-  100 year
-  500 year
-  Not in floodplain

500 0 500 1,000
Feet

Image: 2005

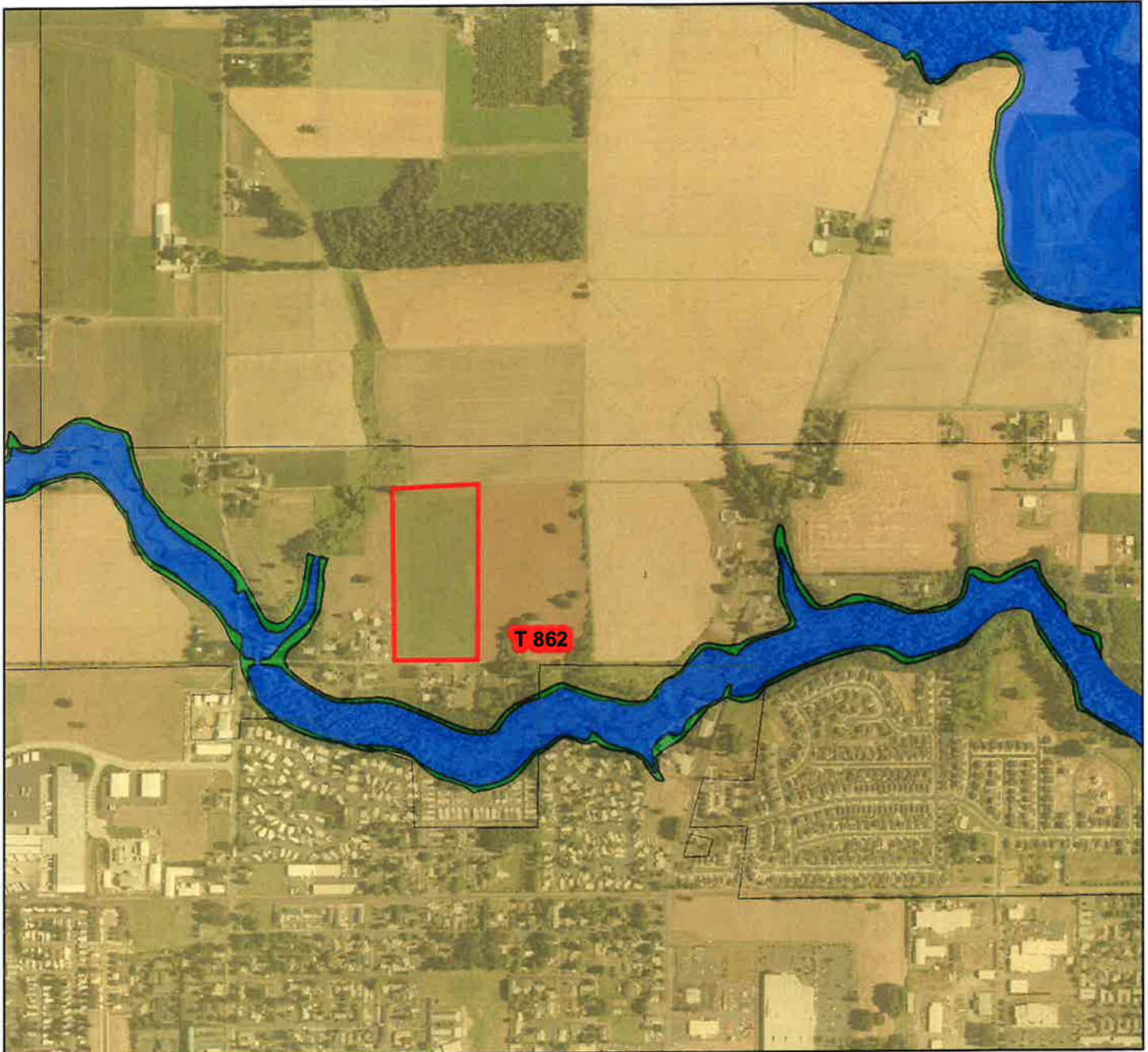


Marsh Homestead, Inc.
FEMA Floodplain Map - South Farm



T1N, R3W, S33
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Legend

-  Tract Boundaries
- FEMA floodplains**
-  100 year
-  500 year
-  Not in floodplain

Image: 2005

500 0 500
Feet

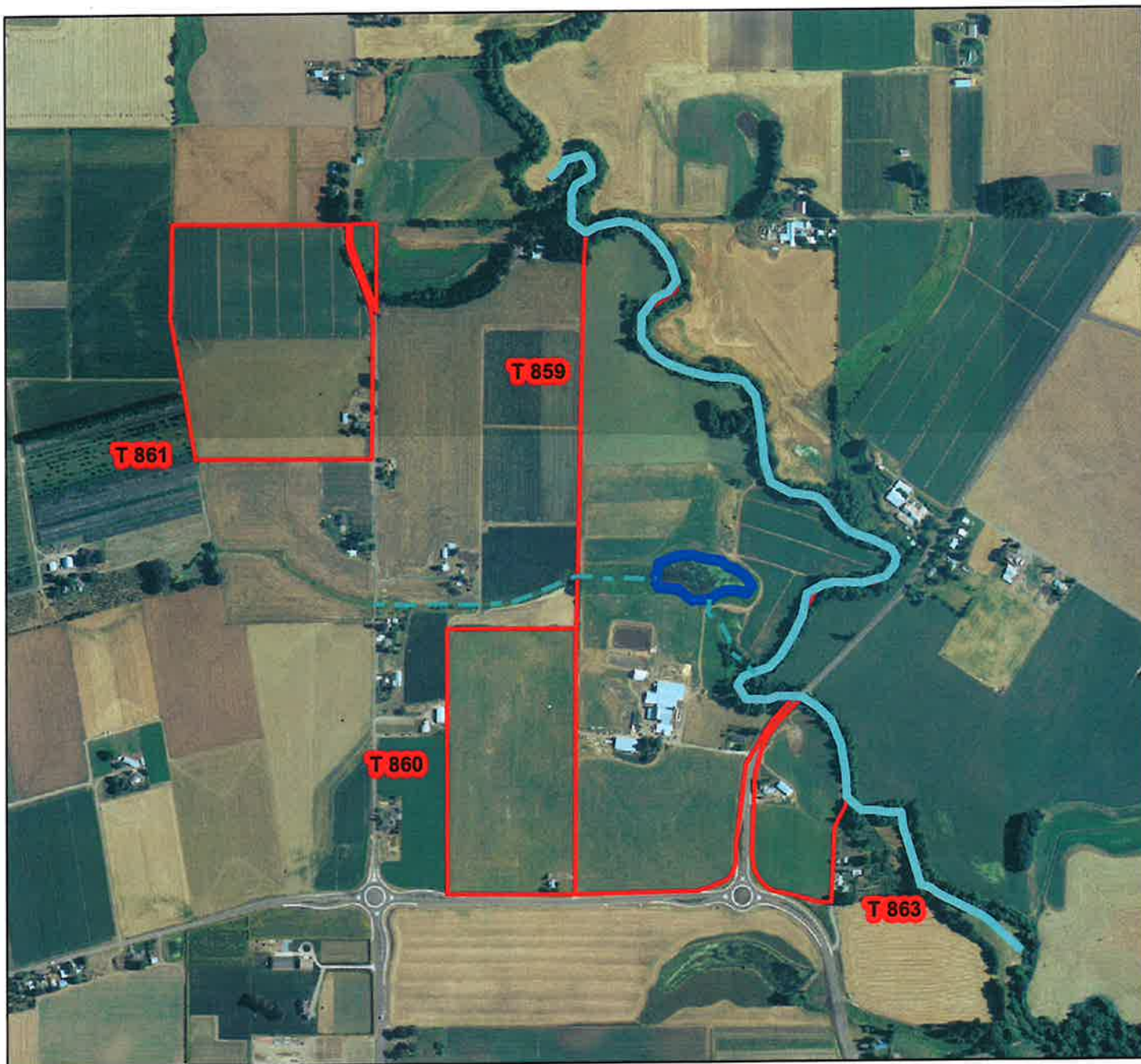


Marsh Homestead, Inc.
Water Features Map - Main Farm



T1N, R3W, S20&21
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Legend

 Tract Boundaries

Water features

 Dairy Creek

 Un-named intermittent creek

 Freshwater pond

500 0 500 1,000
 Feet

Image: 2005

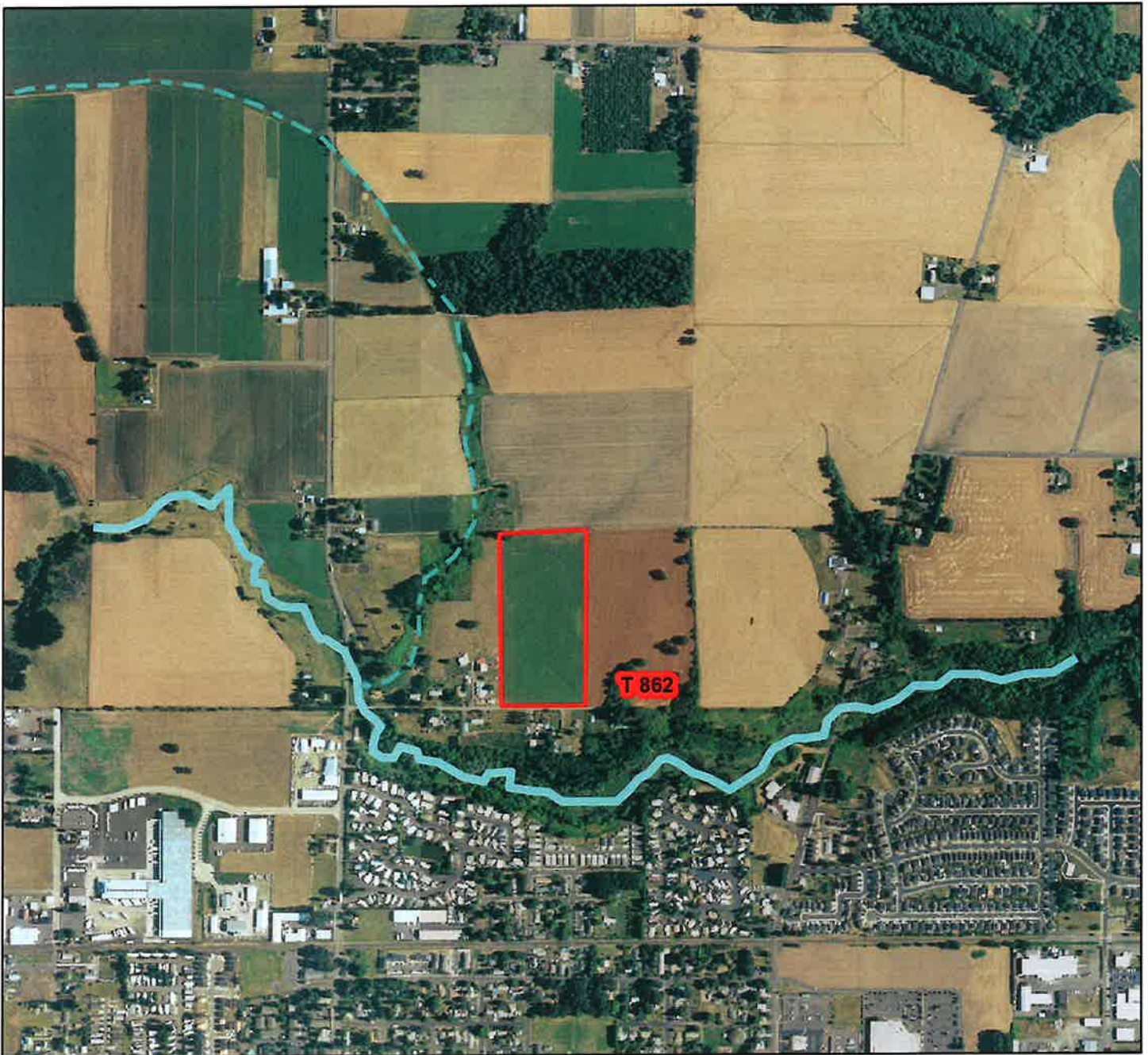


Marsh Homestead, Inc.
Water Features Map - South Farm



T1N, R3W, S33
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Legend

- Tract Boundaries
- Water features**
- Council Creek
- Un-named intermittent creek

Image: 2005

500 0 500
Feet

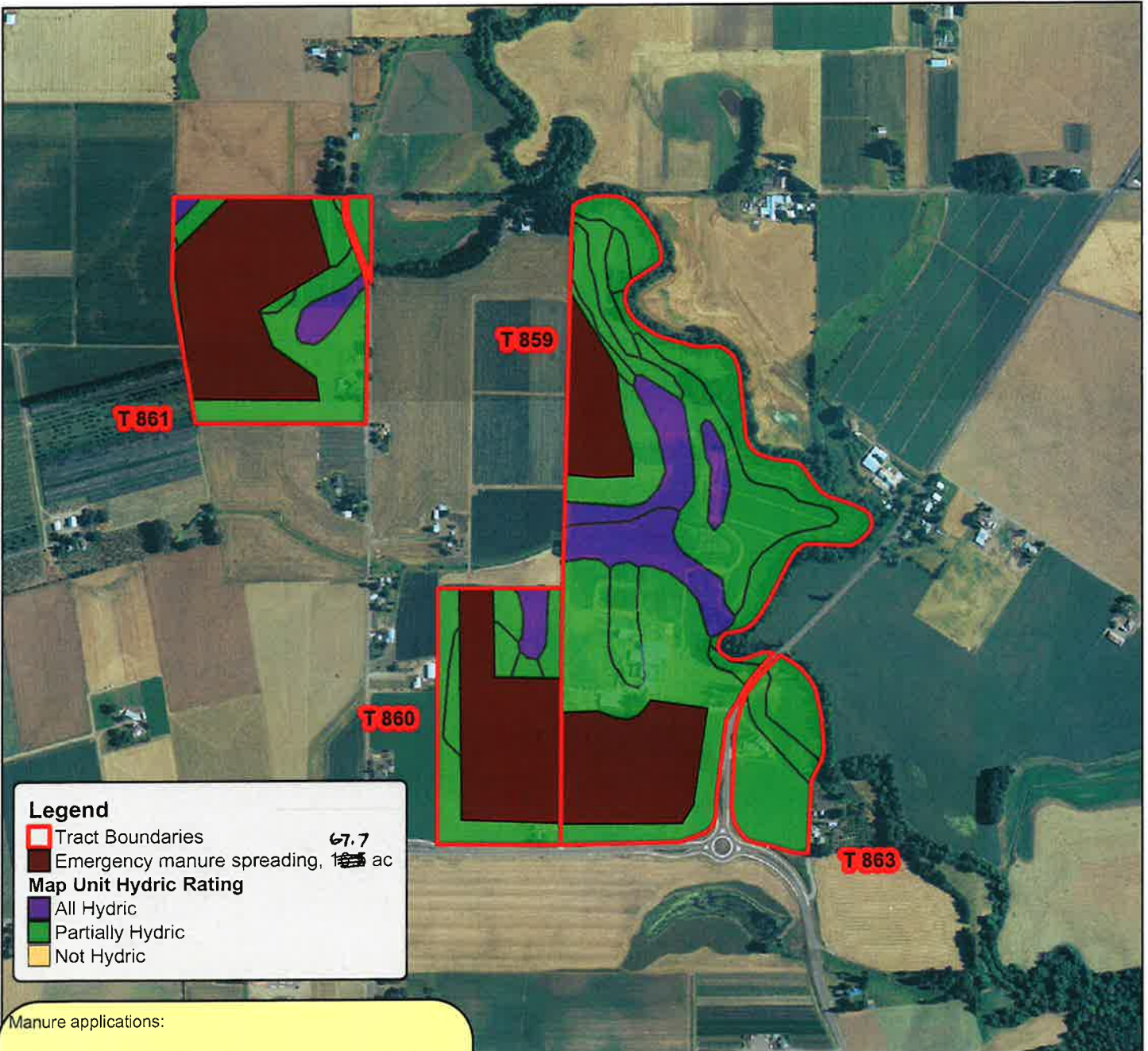


Marsh Homestead, Inc.
Emergency Winter Manure Spreading Map - Main Farm



T1N, R3W, S20&21
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Legend

- Tract Boundaries
- Emergency manure spreading, 67.7 ac
- Map Unit Hydric Rating**
- All Hydric
- Partially Hydric
- Not Hydric

Manure applications:

Sept 1- Oct 15: Limit liquid and solid manure applications as much as possible. Only apply manure to fields that will have a growing crop during the winter. Do not apply manure to filter strips.

Oct 16 - Feb 15: Only apply manure when storage facilities are at risk for overflowing. Then only apply manure to fields with established perennial grass in the emergency areas shown on this map in dark brown. Do not apply within 100 feet of roads, hydric soil (shown in purple on this map) or the floodplain. Do not apply manure to filter strips.

Feb 16- Aug 30: Apply most manure during this time. Do not apply manure to filter strips.

Image: 2005

500 0 500 1,000
Feet

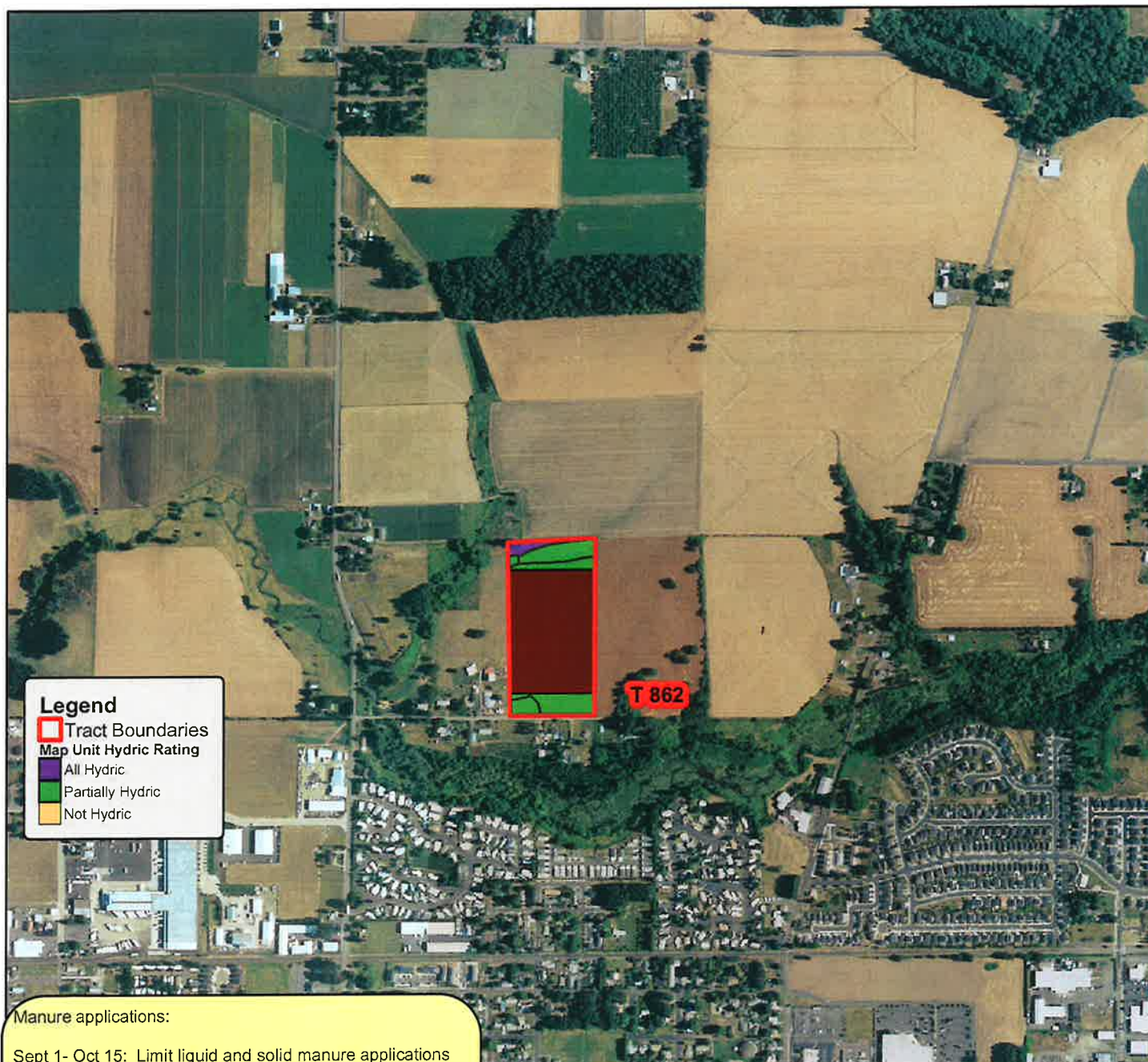


Marsh Homestead, Inc.
Emergency Manure Spreading Map - South Farm



T1N, R3W, S33
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007



Nutrients, Organics & Pathogens - Livestock Yard Management Worksheet

Ground & Surface Water Contaminants – Nutrients, Organics & Pathogens - Livestock Yard Management					
Farm:					
Rating Item	Low Risk 4 Points	Low-Moderate Risk 3 Points	Mod-High Risk 2 Points	High Risk 1 Point	Score
1. Location	More than 200 feet from well and more than 500 feet from stream, pond, or drainageway	Between 100-200 feet of well and between 250-500 feet from stream, pond, or drainageway	Between 50-100 feet of well and between 100-250 feet from stream, pond, or drainageway	Less than 50 feet of well and less than 100 feet from stream, pond, or drainageway	3
2. Livestock water source	Stock water in troughs, with overflow diverted to wastewater system	Stock water in troughs with overflow diverted from lot area. Stock excluded from streams or ditches.	Live water fenced, with stock water provided in water gap.	Stock water provided by live stream or irrigation ditch.	3
3. Surface water diversion	All upslope and roof water diverted. Diversion and gutters well maintained.	Most upslope surface and roof water diverted. Diversions and gutters occasionally maintained.	No surface water diverted. Some roof water collected and redirected. Gutters and diversions not maintained.	All water (surface and roof water) runs through the yard.	2
4. Lot runoff control system	No yard runoff. Fully covered area or runoff from surfaced lot directed to waste storage facility.	All runoff collected from compacted, earthen lot. Solids mounded and collected or stored.	Most of lot runoff diverted to filter strip and collected. Some solids removed.	Lot runoff uncontrolled. Solids rarely collected.	2
5. Yard cleaning and scraping	No yard (animals confined)	Every month or two lot smoothed, leveled, and regularly shaped.	Quarterly. Lot rough and irregular in shape.	Rarely. Lot poorly sited and developed for cleaning and scraping.	N/A
6. Dairy cow concentration on yard	No yard. Confined to barn, roofed yard or pasture.	75 sf/a or more on fenced, curbed concrete pad and/or 400 sf/a on graded earthen surface. More than 1800 sf/a in exercise area.	50 sf/a or more on concrete pad and/or 200-300 sf/a on earthen surface. More than 1200 sf/a in exercise area.	Some concrete, less than 50 sf/a and less than 200 sf/a on earthen surface.	N/A
7. Dairy replacements concentration	No yard. Confined to barn, roofed yard, or pasture.	More than 40 sf/a on fenced, curbed concrete pad and/or more than 150 sf/a on earthen yard.	40-20 sf/a on concrete and/or 75-150 sf/a on earthen surface.	Less than 75 sf/a on earth.	3
8. Beef feeder concentrations	No yard. Confined to barn.	Barn and/or paved lot more than 50 sf/a. Earthen lot with mound more than 300 sf/a, or without mound more than 500 sf/a.	No shelter. Paved lot with 30-50 sf/a. Earthen lot with mound 150-300 sf/a or earthen without mound 250-500 sf/a.	Paved less than 30 sf/a. Earthen less than 250 sf/a.	—
9. Beef cows/heifers concentrations	Barn, roofed yard, or pasture.	Barn with paved lot more than 60 sf/a. Earthen with mound 400 sf/a or without mound 600 sf/a.	Paved lot more than 30 sf/a. Earthen with mound 200-400 sf/a or without mound 300-600 sf/a.	Paved less than 30 sf/a. Earthen without mound less than 200 sf/a.	—
10. Sheep/ewes concentrations	No yard. Confined to barn, roofed yard, or pasture.	Barn and paved lot more than 20 sf/a. Earthen more than 40 sf/a.	Barn and paved lot 15-20 sf/a. Earthen 25-40 sf/a.	Barn and paved lot less than 15 sf/a. Earthen less than 25 sf/a.	—
11. Feeder lambs concentrations	No yard. Confined to barn, roofed yard, or pasture.	Barn and paved lot more than 10 sf/a. Earthen more than 25 sf/a.	Barn and paved lot 5-10 sf/a. Earthen 10-25 sf/a.	Barn and paved lot less than 5 sf/a. Earthen less than 10 sf/a.	—
12. Hogs/sows Concentrations	No yard. Confined to barn.	Shed and paved lot more than 30 sf/a.	Shed and earthen lot more than 10 sf/a	Shed and earthen lot less than 10 sf/a.	—
13. Horses concentrations	No yard. Confined to barn, roofed yard, or pasture.	Earthen exercise lot more than 2,500 sf/a.	Earthen exercise lot 1,000-2,500 sf/a.	Earthen exercise lot less than 1,000 sf/a	—
14. Poultry concentrations	No lot. In building.		Earthen lot of more than 4 sf/a.	Earthen lot of less than 4 sf/a.	
Livestock Yard Rating		Accumulative Score (Sum of above rating items)			
		Average Score (Accumulative/no. items rated)			2.6

Ratings: 3.6-4=Low risk, 2.6-3.6=Low to moderate risk, 1.6-2.5=Moderate to high risk, 1-1.5=High Risk

Note: sf/a = square feet per animal

Source: Modification of Oregon Home*A*Syst, EM 8546, Worksheet #8, Livestock Yards Management

GENERALLY, IN THE LOWER WILLAMETTE BASIN, A SCORE OF 2.6 OR HIGHER MEETS QUALITY CRITERIA,

Nutrients, Organics & Pathogens - Livestock Manure Storage Worksheet

Ground & Surface Water Contaminants - Nutrients, Organics & Pathogens - Livestock Manure Storage					
Farm:					
Rating Item	Low Risk 4 Points	Low-Moderate Risk 3 Points	Mod-High Risk 2 Points	High Risk 1 Point	Score
1. No on-farm storage facilities	Wastes hauled off farm for proper storage and disposal			Daily spreading of livestock wastes	NA
2. On-farm storage Manure stack and/or Liquid/Slurry storage	Manure stack covered; on impermeable surface; rainfall and runoff diverted; built to NRCS standards. Concrete, clay lined, or other liquid tight design; designed and built to NRCS standards; properly maintained; no cracks and leaks.	Manure covered; on low permeable soil; rainfall and runoff diverted. Earthen structure built to NRCS standards and properly maintained.	Manure partially covered; on slightly permeable soils; some runoff collected. Not designed to NRCS standards; on slightly permeable soils; poorly maintained, some evidence of cracks and leaks.	Manure not covered; runoff not collected. Not designed to NRCS standards; on permeable soils; not maintained; leaks and cracks.	4 4
3. Storage volume	Not full at end of rainy season; if liquid/slurry adequate capacity to hold 25-year, 24-hour storm; solids removed to avoid loss of storage capacity.	Not full at end of rainy season; if liquid/slurry not adequate capacity to hold 25-year, 24-hour storm.	Storage facility requires occasional emptying during the rainy season; if liquid/slurry not adequate capacity to hold 25-year, 24-hour storm.	Storage facility requires regular emptying during the rainy season; if liquid/slurry not adequate capacity to hold 25-year, 24-hour storm.	4
4. Storage location	Manure stack or earthen pond located more than 500 feet from well, stream, pond, or drainageway. Or Liquid/slurry storage located more than 200 feet from well, stream, pond, or drainageway or has emergency containment dike for accidental spills or leaks.	Manure stack or earthen pond located between 250-500 feet from well, stream, pond, or drainageway. Or Liquid/slurry storage located between 100-200 feet from well, stream, pond, or drainageway	Manure stack or earthen pond located less than 250 feet downslope from well, stream, pond, or drainageway. Or Liquid/slurry storage located more than 100 feet downslope from well, stream, pond, or drainageway	Manure stack or earthen pond located less than 250 feet upslope from well, stream, pond, or drainageway. Or Liquid/slurry storage located 100 feet from upslope well, stream, pond, or drainageway	3 N/A
Livestock Waste Storage Rating for Ground & Surface Waters		Accumulative Score (Sum of above rating items)			15
		Average Score (Accumulative/4)			3.75

Ratings: 3.6-4=Low risk, 2.6-3.5=Low to moderate risk, 1.6-2.5=Moderate to high risk, 1-1.5=High Risk

Source: Modification of Oregon Home*A*Syst, EM 8546, Worksheet #7, Livestock Waste Storage

GENERALLY, IN THE LOWER WILLAMETTE BASIN,
A SCORE OF 2.6 OR HIGHER MEETS QUALITY
CRITERIA.

Field Sheet 2B₁: Animal Waste – Page 1 of 1
Indicators for Pasture or Range Animals

Evaluator: MOBERG Date: MAY 2007
 Farm/Field Evaluated: MARSH HOMESTEAD Total Score: _____

(Circle one number among the four choices in each row which BEST describes the conditions of the field or area being evaluated. If a condition has characteristics of two categories, you can "split" a score.)

Rating Item	Excellent	Good	Fair	Poor
1. Runoff Potential	Low: • Runoff Curve Number (RCN) 61-70. • Very flat to flat terrain (0-5% slope). • Dry, low rainfall (< 20"). • Even, gentle impact (scattered shower-type) of rainfall. 10	Moderate: • RCN 71-80. • Flat to gently sloping (0.5-2.0% slope). • Semidry (20-30"). • Even, gentle to moderate intensity rainfall. 8	Considerable: • RCN 81-90. • Gently to moderately sloping (2-5% slope). • Semiwet (30-40"). • Even but intense rainfall. 4	High: • RCN greater than 90. • Moderately sloping to steep (> 5%). • Wet (more than 40" rain). • Intense uneven rainfall in seasons when soil is exposed. 0
2. Ungrazed Buffer Zone	• Pasture or range with a strip of intervening vegetation greater than 200 ft. 9	• Pasture or range with 50 to 200 ft. strip of intervening vegetation 7	• Pasture or range with 10 to 50 ft. of intervening vegetation. 3	• Pasture or range in close proximity to edge or adjacent to water course. 2
3. Rate of Waste Decomposition	• Rapid decomposition of waste due to hot, sunny climate. 9	• Moderate to rapid decomposition due to warm sunny climate. 7	• Slow to moderate decomposition due to cooler, more overcast climate. 3	• Slow decomposition due to cold climate with little direct solar radiation. 2
4. Pasture or Range Management	Excellent: • 90% cover. • Proper grazing. • Animal numbers within the carrying capacity • No fertilization or pH adjustment and application of recommended amounts of fertilizer for maximum forage utilization based on soil tests. 9	Good: • 70-90% cover. • Occasional bare areas. • Animals exceed carrying capacity only 1 to 2 times per year. • No fertilization or recommended amounts for maximum forage utilization. 6	Fair: • 50-70% cover. • Some bare spots. • Animals exceed carrying capacity over 25% of the year. • Fertilization at greater than recommended amounts for forage utilization. 3	Poor: • 50% or less cover. • Numerous bare spots. • Animal numbers exceed carrying capacity 100% of year. • Significant over-application of animal waste or commercial fertilizer close to water's edge. 0
5. Potential for ground water contamination	Low: • Soils rich to very rich in organic matter (> 0.5%). • Slow to very slow percolation in light-textured soils such as clays, silty or sandy clays, or silty clay loams. • Perched water table present. • In protected bedrock areas (50 ft. of soil & shale cap) well depth is 75-100 ft. • In protected bedrock areas overlain with 50 ft. of sand or gravel, well depth is greater than 150 ft. • In shallow bedrock areas (25-50 ft. soil & shale cap), well depth greater than 200' • In Karst areas, well depth is greater than 1,000 ft. if aquifer is "confined." 9	Moderate: • Soils rich to moderate in organic matter (3.0 to 1.5%). • Slow to moderate percolation in clay loams or silts. • Perched watertable present. • In protected bedrock areas, well depth is 30-74 ft. • In protected bedrock areas overlain with 50 ft. of sand or gravel, well depth is 100-149 ft. • In shallow bedrock areas, well depth is 50-199 ft. • In Karst areas, well depth is 500-999 ft. 6	Considerable: • Soils moderate to low in organic matter (1.5 to 0.5%). • Moderate to rapid percolation in silty loams, loams, or silts. • In protected bedrock areas, well depth is 15-29 ft. • In protected bedrock areas overlain with 50 ft. of sand or gravel, well depth is 50-99 ft. • In shallow bedrock areas, well depth is 25-49 ft. • In Karst areas, well depth is 100-499 ft. 4	High: • Soils low to very low in organic matter (< 0.5%). • Rapid percolation in coarse textured loamy sands or sands. • In protected bedrock areas, well depth is less than 15 ft. • In protected bedrock 50 ft. of sand or areas overlain with gravel, well depth is less than 50 ft. • In shallow bedrock areas, well depth is less than 25 ft. • In Karst areas, well depth is less than 100 ft. 0
1. Add the circled Rating Item scores to get a total for the field sheet			TOTAL = 37	
2. Circle the ranking for this site based on the total field score.				
RANKING	Excellent (40-46)	Good (25-39)	Fair (10-24)	Poor (9 or less)

Field Sheet 3B: Nutrients – Page 1 of 2
Indicators for Cropland, Hayland, or Pasture

Evaluator: Moberg Date: MAY 2007
 Farm/Field Evaluated: MARSH HOMETEAD Total Score: 44

(Circle one number among the four choices in each row which BEST describes the conditions of the field or area being evaluated. If a condition has characteristics of two categories, you can "split" a score.)

Rating Item	Excellent	Good	Fair	Poor
1. Erosion Potential 10	<ul style="list-style-type: none"> Not significant. Less than T (tolerance) little sheet & rill erosion, no gullies. Blocky, platy or massive soil structure. 10 X	<ul style="list-style-type: none"> Some erosion evident. About T, some sheet & rill erosion. Very few gullies. Coarse granular to medium granular soils. 6	<ul style="list-style-type: none"> Moderate erosion. T to 2T gullies from heavy storm events obvious. Fine granular soils Potentially highly erodible soils. 3	<ul style="list-style-type: none"> Heavy erosion. More than 2T, many gullies and critical erosion areas. Very fine granular soils, highly erodible. 0
2. Runoff Potential 4	Low: <ul style="list-style-type: none"> Soils hydraulic Group A. Very flat to flat terrain (0.5-2% slope). Dry, low rainfall (less than 20"). Even, gentle impact (scattered shower-type) of rainfall. 10	Moderate: <ul style="list-style-type: none"> Soils Group B. Flat to gently sloping (0.5-2% slope). Semidry (20-30"). Even, gentle to moderate intensity rainfall. 8	Considerable: <ul style="list-style-type: none"> Soils Group C. Gentle to moderately sloping (2-5% slope). Semiwet (30-40"). Even but intense rainfall. 4 X	High <ul style="list-style-type: none"> Soils Group C. Moderately sloping to steep terrain (greater than 5%). Wet (more than 40% rain). Intense uneven rainfall in seasons when soil is exposed. 2
3. Resource Management Systems on whole farm (combined value for all agricultural areas) pastureland, cropland, or animal holding areas) 7	<ul style="list-style-type: none"> Excellent Management. RMS always used as needed. 9	<ul style="list-style-type: none"> Good management. Most (80%) of the needed RMSs installed. Predominance of farming practices diverting runoff away from receiving waters (terraces without tile drains). 7 X	<ul style="list-style-type: none"> Rain management. About 50% of the needed RMSs installed. Cropping confined to proper land class. Predominance of farming practices diverting runoff toward receiving waters (tile drains and field ditches). 3	<ul style="list-style-type: none"> Poor management. Few, if any, needed RMSs installed. Cropping not confined to proper classes. No diversion of runoff water; water flowing directly into receiving waters. 0
4. Buffer Zone 7	<ul style="list-style-type: none"> Cropland is more than 600 ft. from water with intervening herbaceous vegetation (grass). Cropland is less than 100 ft., but more than 50 ft. from water with intervening vegetation (trees). 10	<ul style="list-style-type: none"> Cropland is less than 200 ft. but more than 15 ft. from water with intervening herbaceous vegetation (grass). Cropland is less than 50 ft. but more than 15 ft. from water with intervening woody vegetation (trees). Little bank (riparian) veg. 7 X	<ul style="list-style-type: none"> Cropping up to the water's edge. No bank (riparian) vegetation. 0	0
5. Fertilizer Management Practices 7	<ul style="list-style-type: none"> Excellent management. No fertilizer necessary Well defined schedule as to frequency and timing for inorganic or organic fertilizer depending on crop type, height of growth, etc. Application of exactly the proper (recommended) amounts according to soil tests. Pays close attention to weather forecasts. Never applies before a storm. Fertilizer is incorporated into the soil 9	<ul style="list-style-type: none"> Good management. Mainly follows a schedule but sometimes missed the best timing for the maximum utilization by the crop. Usually follows directions for proper dosages of fertilizer and has soil tested regularly. Follows weather forecasts but once in a while will risk applying when rain is forecast. Fertilizer is mainly of the incorporated slow-release type. 7 X	<ul style="list-style-type: none"> Haphazard management. Follows a schedule about half the time. Application is based on convenience. Tends to "overfertilize" by using more than the recommended dose as "insurance." Occasionally loses much of application in a washout. More than half the fertilizer is applied to the surface. 3	<ul style="list-style-type: none"> Little or erratic mgmt. Seldom follows a schedule. Applications without heed to weather forecasts. Often loses most of the applied fertilizer in a washout. Applies usually too little, sometimes too much. Most of the fertilizer is surface applied without incorporation, e.g., in the North nitrogen application in the autumn for some crops. 0

Field Sheet 3B: Nutrients – Page 2 of 2
Indicators for Cropland, Hayland, or Pasture

6. Potential for groundwater contamination <div style="font-size: 2em; margin-left: 100px;">9</div>	Low: <ul style="list-style-type: none"> • Soils rich to very rich in organic matter (>3.0%). • Slow to very slow percolation in light textured soils such as clays, silty or sandy clays, or silty clay loams. • Perched water table present. • In protected bedrock areas (50 ft. of silt & shale cap), well depth is 75-100 ft. • In protected bedrock areas overlain with 50ft. of san or gravel, well depth is greater than 150 ft. • In shallow bedrock areas (25-50 ft. soil & shale cap), well depth greater than 200 ft. • In Karst areas, well depth is greater than 2,000 ft., if aquifer is "confined." <div style="text-align: center;">9</div>	Moderate: <ul style="list-style-type: none"> • Soils rich to moderate in organic matter (3.0 to 1.5%). • Slow to moderate percolation in clay loams or silts. • Perched water table present. • In protected bedrock areas, well depth is 30-74 ft. • In protected bedrock area overlain with 50 ft. of sand or gravel, well depth is 200-149 ft. • In shallow bedrock areas, well depth is 50-199 ft. • In Karst areas, well depth is 50-999 ft. <div style="text-align: center;">6</div>	Considerable: <ul style="list-style-type: none"> • Soils moderate to low in organic matter (1.5 to 0.5%). • Moderate to rapid percolation in silty loams, loams, or silts. • In protected bedrock areas, well depth is 15-29 ft. • In protected bedrock areas overlain with 50 ft. of sand or gravel well depth is 50-99 ft. • In shallow bedrock areas, well depth is 25-49 ft. • In Karst areas, well depth is 100-499 ft. <div style="text-align: center;">4</div>	High: <ul style="list-style-type: none"> • Soils low to very low in organic matter (less than 0.5%). • Rapid percolation in coarse textured loamy sand or sands. • In protected bedrock areas, well depth is less than 15 ft. • In protected bedrock areas overlain with 50 ft. of sand or gravel, well depth is less than 50 ft. • In shallow bedrock areas, well depth is less than 25 ft. • In Karst areas, well depth is less than 100 ft. <div style="text-align: center;">0</div>
1. Add the circled Rating Item scores to get a total for the field sheet.				TOTAL = 44
2. Circle the ranking for this site based on the total field score.				
RANKING	Excellent (49-57)	<div style="border: 2px solid black; border-radius: 50%; padding: 5px; display: inline-block;">Good (30-48)</div>	Fair (9-29)	Poor (8 or less)

CHECKED BY:

ANIMAL INVENTORY

GRAZING PERIOD

DUNG 2.1simple George Marsh.xls

[illegible]

According to the HQ Map: Main Farm structures H and J also drain to lagoon as well as the bunker silo. Therefore, I ran BRWM to include the additional surface area from the above structures to see how the additional area would effect days of liquid storage

Type of Water Use	Number of Animals	Number of Washes per Day	Gallons of Water Used per Wash-Day	Total Water Use per Day, Gallons	Total Water Use per Day, Cubic Feet
Animal Washwater	110.0	2	2.00	440	58.8
Equipment Wash		2	150.00	300	40.1
Flushwater		2	0.00	0	0.0
Miscellaneous		2	0.00	0	0.0
Total>>>>	>>>>	>>>>	>>>>	740	98.9

Crop Data									
Field Number	Acres	Crop	Condition	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre			
						Nitrogen N	Phosphorous P ₂ O ₅	Potassium K ₂ O	
various	30.0	Corn, Silage(AH)	As Harvested	▼		193	100	230	
various	20.0	Wheat, Winter Soft White Straw Removed	DHM	▼		218	102	126	
various	40.0	Alfalfa Hay	DHM	▼		338	76	338	
various	70.0	Grass/Legume Hay/Pasture	DHM	▼		203	76	249	
				▼					
				▼					
				▼					
				▼					
				▼					
Off-Farm	80.0	Wheat, Winter Hard Red Straw Removed	DHM	▼		267	126	143	

Dean Moberg

Type of Animal	Type of Separator	Separation Factor %	Volume of Solids Separated CF/Day	Volume of Solids in Liquids CF/Day	Volume of Manure in Liquids CF/Day	Volume of Manure in Solids CF/Day	Accumulated Sludge in Storage CF/Day	Density of Separated Solids Lbs/CF	Weight of Separated Solids Lbs/Day
MILKER	Static Inclined Screen(Side Hill Separator)	▼ 15%	11	60	238	5	136	36	378
MILKER (DRY)	Static Inclined Screen(Side Hill Separator)	▼ 15%	5	29	31	1	26	36	182
HEIFERS (12-24 Months)	Dry Scrape System	▼ 100%	121	0	0	68	0	36	4,368
CALVES (1-12 Months)	Dry Scrape System	▼ 100%	61	0	0	34	0	36	2,184
	▼								
	▼								
	▼								
	▼								
	▼								
	▼								
Total Solids	>>>>>>>>>>>>>>>>>>>>>>>>>		198	88	269	106	162		7,112

CLIENT: Marsh Homestead
ASSISTED BY: Dean Moberg, NRCS

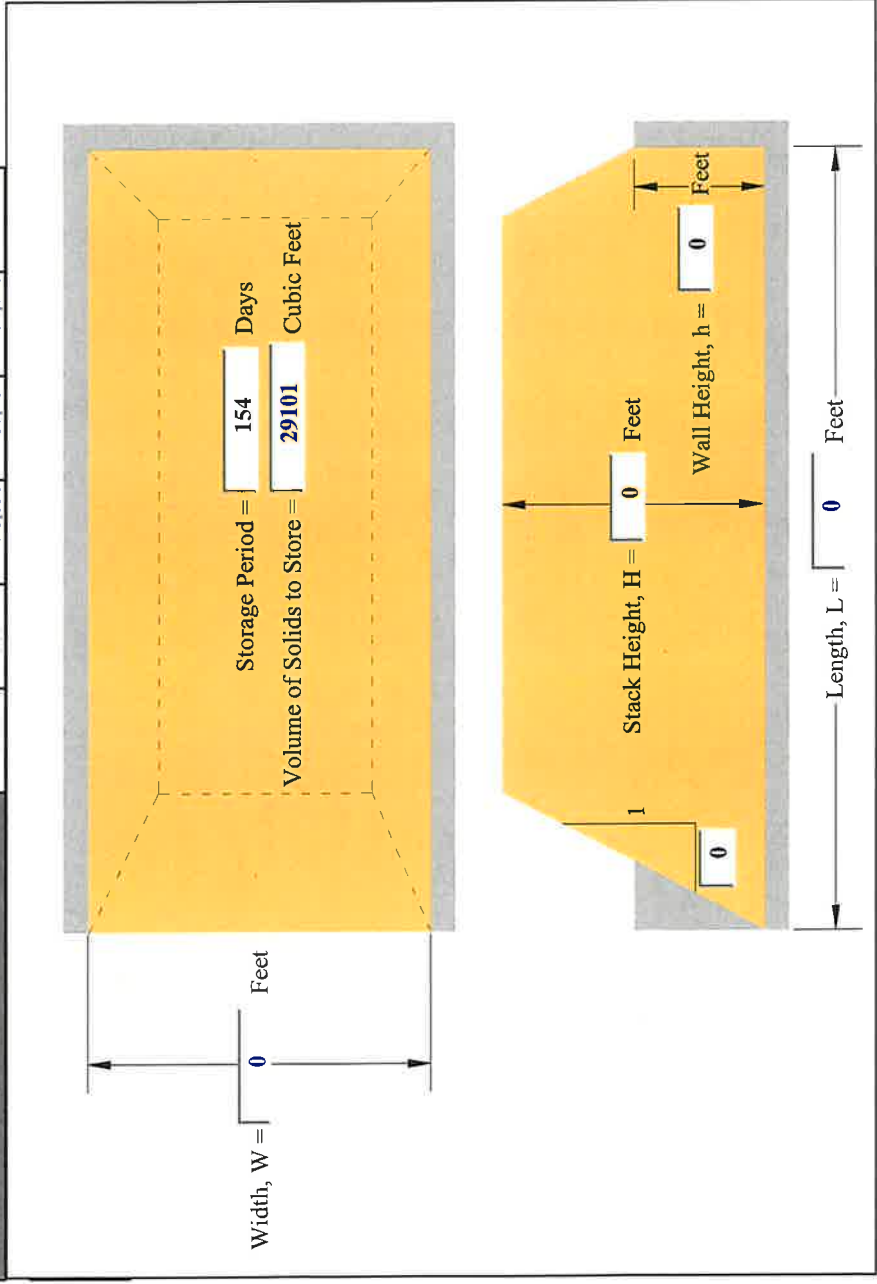
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ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

SOLIDS STACKING FACILITY

MONTHLY SOLIDS VOLUME STACKED IN FACILITY

Solids Storage Facility Parameters	Value	Month	Number of Days	Manure CF	Bedding CF	Solids to Store CF	Normal Runoff CF
Storage Period, Days=	154	October	31	1927	6,238	4,083	0
Stacking Width, W in Feet=	0	November	30	2610	9,138	5,874	0
Stacking Height, H in Feet=	0.00	December	31	2697	9,443	6,070	0
Wall Height, h in Feet=	0.00	January	31	2697	9,443	6,070	0
Stack Side Slope (X:1)=	0.00	February	28	2436	8,529	5,482	0
Existing Storage, Cubic Feet=	30,000	March	31	2316	7,842	5,079	0
Surface Area of Existing Storage, SF=		April	30	1865	6,037	3,951	0
25 Year-24 Hour Storm Runoff, CF=	0	May	31	1927	6,238	4,083	0
Volume Needed, Cubic Feet=	29,101	June	30	1865	6,037	3,951	0
Design Volume, Cubic Feet=	0	July	31	1927	6,238	4,083	0
Is Facility Covered? YES		August	31	1927	6,238	4,083	0
		September	30	1865	6,037	3,951	0
		Annual	365	26,056	87,461	56,758	0

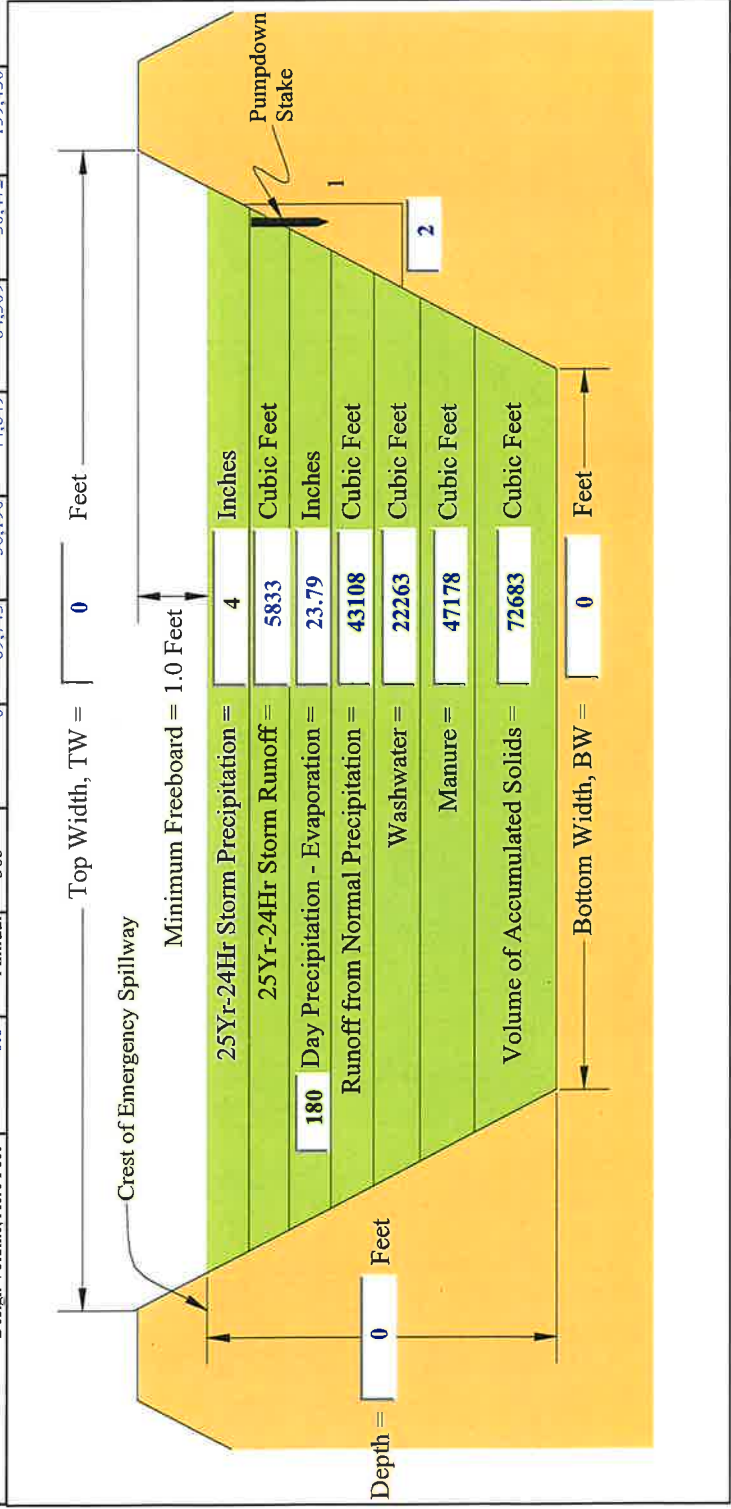


CLIENT: Marsh Homestead
ASSISTED BY: Dean Moberg, NRCS

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ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

WASTE STORAGE POND		MONTHLY INFLOWS INTO WASTE STORAGE POND								
Pond Parameters	Value	Month	Number of Days	Rain-Evap on Pond CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Manure CF	Solids CF	Waste to Store CF
Storage Period, Days=	180	October	31	0	7,840	3,908	3,792	6,290	2,059	12,141
Side Slope (X:1)=	2.00	November	30	0	43,038	8,794	3,670	8,312	3,364	15,347
Bottom Width, BW, Feet=	0	December	31	0	49,082	9,392	3,792	8,590	3,477	15,858
Bottom Length, BL, Feet=	0	January	31	0	43,120	8,400	3,792	8,590	3,477	15,858
Accumulated Solids Duration, Years=	2	February	28	0	31,932	6,883	3,425	7,758	3,140	14,324
Existing Storage, Acre Feet=	10.60	March	31	0	19,273	5,731	3,792	7,639	2,800	14,231
Surface Area of Existing Storage, SF=	98,000	April	30	0	490	3,588	3,670	6,087	1,993	11,749
Minimum Soil Liner Depth, Feet=	1.00	May	31	0	-15,108	2,771	3,792	6,290	2,059	12,141
25 Year-24 Hour Storm Runoff, CF=	5,833	June	30	0	-23,520	2,129	3,670	6,087	1,993	11,749
Top Width, TW, Feet=	0	July	31	0	-39,282	890	3,792	6,290	2,059	12,141
Top Length, TL, Feet=	0	August	31	0	-32,748	1,356	3,792	6,290	2,059	12,141
Volume Needed, Acre Feet=	10.0	September	30	0	-14,373	2,348	3,670	6,087	1,993	11,749
Design Volume, Acre Feet=	0.0	Annual	365	0	69,743	56,190	44,649	84,309	30,472	159,430



CLIENT: George Marsh
ASSISTED BY: Dean Moberg

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ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation	Pounds of Nutrients Available			Percent Nutrients Retained After Storage			Pounds of Nutrients Retained After Storage		
		N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Dairy	Type of Storage Facility									
Liquids	Bank (Uncovered)	28,661	10,631	19,182	70%	85%	85%	20,063	9,037	16,305
Solids	Solids Storage Facility (Roofed)	10,184	3,391	8,167	75%	90%	90%	7,638	3,052	7,351
Grazing	NONE	6,096	1,856	5,296	100%	100%	100%	6,096	1,856	5,296

NUTRIENTS AVAILABLE AFTER APPLICATION

Nutrient Source	Type of Application System	Pounds of Nutrients Available			Percent Nutrients Retained After Application			Pounds of Nutrients Retained After Application		
		N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Liquids	Broadcast (Incorporated 7 or more days after application)	20,063	9,037	16,305	70%	100%	100%	14,044	9,037	16,305
Solids	Broadcast (Incorporated 7 or more days after application)	7,638	3,052	7,351	70%	100%	100%	5,347	3,052	7,351
Grazing	Grazing	6,096	1,856	5,296	85%	100%	100%	5,181	1,856	5,296

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location	Pounds of Nutrients Available			Percent Nutrients Retained After Denitrification			Pounds of Nutrients Retained After Denitrification		
		N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Liquids	Between Coastal and Cascade Mountains	14,044	9,037	16,305	87%	100%	100%	12,218	9,037	16,305
Solids	Soil Drainage Class	5,347	3,052	7,351	87%	100%	100%	4,652	3,052	7,351
Grazing	Moderately Well Drained	5,181	1,856	5,296	87%	100%	100%	4,508	1,856	5,296

CLIENT: George Marsh
ASSISTED BY: Dean Moberg

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ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

PERCENT OF MANURE TO BE APPLIED TO FIELD AND UTILIZATION ACRES NEEDED BASED ON										▼
PHOSPHOROUS, P2O5										
Field Number	Acres	Crop	LIQUIDS			SOLIDS			GRAZING	
			Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied
various	30.0	Corn, Silage(AH)	20%	1,807	18	20%	610	6	0%	0
various	20.0	Wheat, Winter Soft White Straw Removed	0%	0	0	30%	916	9	0%	0
various	40.0	Alfalfa Hay	0%	0	0	0%	0	0	0%	0
various	70.0	Grass/Legume Hay/Pasture	80%	7,229	96	0%	0	0	100%	1,856
0										25
0										
0										
0										
0										
Off-Farm	80.0	Wheat, Winter Hard Red Straw Removed	0%	0	0	50%	1,526	12	0%	0
TOTALS-			100%	9,037	114	100%	3,052	27	100%	1,856
										25

NUTRIENT BALANCE BASED ON AVAILABLE ACRES

Field Number	Acres	Crop	NUTRIENTS APPLIED			NUTRIENTS REMOVED			NUTRIENT BALANCE		
			Nitrogen, N Lbs/Acre	Phosphorous, P2O5 Lbs/Acre	Potassium, K2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P2O5 Lbs/Acre	Potassium, K2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P2O5 Lbs/Acre	Potassium, K2O Lbs/Acre
various	30.0	Corn, Silage(AH)	112	81	158	193	100	230	-80	-20	-72
various	20.0	Wheat, Winter Soft White Straw Removed	70	46	110	218	102	126	-148	-56	-16
various	40.0	Alfalfa Hay	0	0	0	338	76	338	-338	-76	-338
various	70.0	Grass/Legume Hay/Pasture	204	130	262	203	76	249	1	54	13
0											
0											
0											
0											
0											
Off-Farm	80.0	Wheat, Winter Hard Red Straw Removed	29	19	46	267	126	143	-238	-106	-97

CLIENT: Marsh Homestead
ASSISTED BY: Dean Moberg, NRCS

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Worksheet OR10A-7--Waste storage period determination

Basic Storage Period, SPb = **213** Days

Enter average monthly Evapotranspiration(ET) from OSU Extension Publication 8530,
Oregon Crop Water Use and Irrigation Requirements, and Precipitation(Ppt) Data from

Climatic Station- **HILLSBORO**

Day of Year	MONTH	Crop ET, Inches	Accum ET, Inches	Ppt, Inches
1-31	January	0.39	0.39	5.76
32-59	February	0.79	1.18	4.72
60-90	March	1.61	2.79	3.93
91-120	April	3.43	6.22	2.46
121-151	May	4.65	10.87	1.90
152-181	June	5.79	16.66	1.46
182-212	July	6.81	23.47	0.61
213-243	August	5.83	29.30	0.93
244-273	September	3.78	33.08	1.61
274-304	October	2.28	35.36	2.68
305-334	November	0.39	35.75	6.03
335-365	December	0.28	36.03	6.44

a. Determine last day for the month of the year when 3/4 of Annual ET is exceeded-

$$3/4 \text{ of Annual ET} = 0.75 \times \mathbf{36.03} = \mathbf{27.02} \text{ Inches}$$

L = Last Day for Month Accum ET exceeds 3/4 of Annual ET

$$L = \mathbf{243} \text{ Days}$$

b. Determine first day for the month of the year when ET >= Ppt-

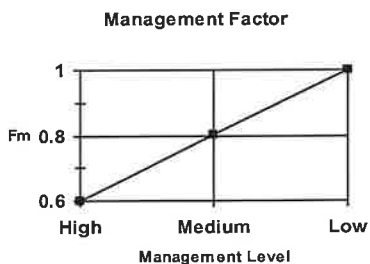
E = First Day of Month ET >= Ppt

$$E = \mathbf{91} \text{ Days}$$

$$c. SPb = 365 - (L - E) = 365 - (\mathbf{243} - \mathbf{91})$$

Management Factor, Fm =

0.7



Low Level, Fm = 1.0

...The operator does not utilize a waste management plan.
...Proper operation and maintenance may not be performed.

Medium Level, Fm = 0.8

...The operator utilizes an up-to-date waste management plan.
...Manure application equipment is calibrated for nutrient applications.
...Maintains adequate soil moisture for crop growth.
...Agronomic treatments which would maximize crop nutrient uptake are not fully utilized.
...Proper operation and maintenance is planned.

High Level, Fm = 0.6

...The operator utilizes an up-to-date waste management plan.
...Soil fertility testing is performed annually.
...Manure in storage is tested for nutrient concentrations.
...Records of time, rate and location of manure applications are maintained.
...Manure application equipment is calibrated for nutrient applications.
...Irrigation water management techniques are practiced.
...Crop nutrient uptake is maximized with appropriate agronomic treatments such as residue management, conservation crop rotation, crop variety selection, prescribed grazing, and pest management.
...Proper operation and maintenance is planned.

CLIENT: Marsh Homestead
ASSISTED BY: Dean Moberg, NRCS

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Worksheet OR10A-7--Waste storage period determination

Soils Factor: $F_{s_{LIQ}} = 0.9$ $F_{s_{SOL}} = 0.7$

Soils must meet the following criteria for F_s to be less than 1.0-

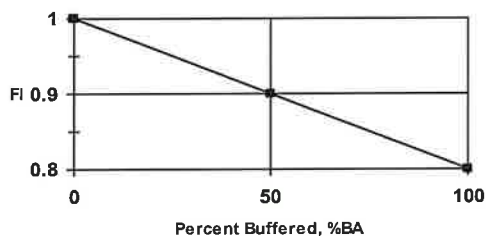
- ... The average water holding capacity for the profile greater than 3.0 inches.
- ... A cation exchange capacity greater than 5 meq/100g of soil.
- ... Depth to a thin layer/cemented pan greater than 20 inches.
- ... Depth to high water table greater than 2 feet.
- ... A permeability greater than 0.06 inches/hr but less than 6 inches/hr.
- ... Cobbles less than 35% by weight in the surface layer.
- ... Stones and boulders less than 15% by weight in the surface

HSG	Soils Factor (F_s)			
	Consistency of Waste			
	Liquid	Slurry	Semi-Solid	Solid
A	1	0.95	0.9	0.8
B	0.8	0.75	0.7	0.6
C	0.9	0.85	0.8	0.7
D	1	1	0.95	0.85

HSG	Area	$F_{s_{LIQ}}$	Wtd $F_{s_{LIQ}}$	$F_{s_{SOL}}$	Wtd $F_{s_{SOL}}$
C	100	0.9	90	0.7	70
Total Weighted $F_{s_{LIQ}} =$		0.9	Total Weighted $F_{s_{SOL}} =$		0.7

Location Factor: $FI = 0.83$

Location Factor



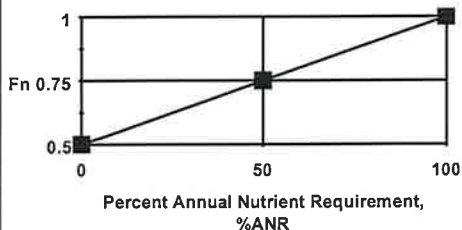
For an application area to be considered buffered there must be a 0 to 5 percent chance of flooding and the area must be at least 50 feet from water bodies, ground water sources(wells), and areas of concentrated flow. The percent buffered area(%BA) is determined by taking the total buffered area(TBA) and dividing it by the total land area(TLA) available for manure application.

$$\%BA = \frac{TBA}{TLA} \times 100\%$$

$$\%BA = \frac{145}{170} \times 100\% = 85\%$$

Nutrient Loading Factor: $F_n = 0.81$

Nutrient Loading Factor



In order for the Nutrient Loading Factor, F_n to be less than 1, the Location Factor, FI must be 0.95 or less.

The percent of annual nutrient requirement(%ANR) is determined by taking the total nutrients applied(TNA) annually and dividing it by the total nutrient requirements(TNR) of all of the crops grown.

$$\%ANR = \frac{TNA}{TNR} \times 100\%$$

$$\%ANR = \frac{1,359}{2,157} \times 100\% = 63\%$$

CLIENT: Marsh Homestead
ASSISTED BY: Dean Moberg, NRCS

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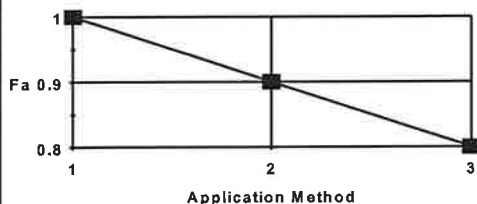
Worksheet OR10A-7--Waste storage period determination

Application Method Factor:

$F_{a\text{LIQUID}} = 0.90$

$F_{a\text{SOLID}} = 1.00$

Application Method Factor



Method 1 - Surface applied solid manure, no incorporation.

Method 2 - Surface applied liquid manure, no incorporation.

Method 3 - Injection or immediate incorporation.

Adjusted Storage Period: $ASP_{\text{LIQUID}} = 82$ Days $ASP_{\text{SOLID}} = 71$ Days

$$ASP = SP_b \times F_m \times F_s \times F_i \times F_n \times F_a$$

$$ASP_{\text{LIQUID}} = 213 \times 0.7 \times 0.9 \times 0.829411764705882 \times 0.814968850162501 \times 0.9$$

$$ASP_{\text{SOLID}} = 213 \times 0.7 \times 0.7 \times 0.829411764705882 \times 0.814968850162501 \times 1$$

Adjusted earliest Day of Year for application, $E_a = ASP - (365 - L)$

$$E_{a\text{LIQUID}} = -40$$

$$E_{a\text{SOLID}} = -51$$

Storage Period: $SP_{\text{LIQUID}} = 154$ Days $SP_{\text{SOLID}} = 154$ Days

The storage period must span the seasonal flooding conditions and must also span frozen ground and snow conditions where the land slope exceeds 5% and a buffer strip of less than 100 feet exists next to open water courses that affect the application area-

- a. Enter L from Sheet 1 and determine the Day of Year L_f when seasonal frozen ground, snow or flooding conditions are first anticipated for the application area-

$$L = 243 \text{ Days}$$

$$L_f = 335 \text{ Days}$$

If L_f comes before L then $L_{sp} = L_f$

If L_f comes after L or there is no seasonal frozen ground, snow or flooding then $L_{sp} = L$

$$L_{sp} = 243 \text{ Days}$$

- b. Determine the Day of Year E_f when seasonal frozen ground, snow or flooded conditions are no longer anticipated for the application area-

$$E_f = 32 \text{ Days}$$

If E_f comes after E_a then $E_{sp} = E_f$

If E_f comes before E_a or there is no seasonal frozen ground, snow or flooding then $E_{sp} = E_a$

$$E_{sp\text{LIQUID}} = 32 \text{ Days}$$

$$E_{sp\text{SOLID}} = 32 \text{ Days}$$

c. $SP_{\text{LIQUID}} = 365 - (L_{sp} - E_{sp\text{LIQUID}}) = 154$ Days

$SP_{\text{SOLID}} = 365 - (L_{sp} - E_{sp\text{SOLID}}) = 154$ Days

- d. Earliest date (E_{sp}) for manure application (month-day):

$$E_{sp\text{LIQUID}} = \text{February 4}$$

$$E_{sp\text{SOLID}} = \text{February 1}$$

e. Latest date (L_{sp}) for manure application (month-day) = September 1***

*** Limited manure will be applied between Sept 1 to Oct 15 on fields that will have a growing crop over the winter.

CLIENT: Marsh Homestead
ASSISTED BY: Dean Moberg, NRCS

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Worksheet OR10A-7--Waste storage period determination

Day of Year Calendar

Day of month	Jan	Feb	Mar	Apr	May	Month Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	32	60	91	121	152	182	213	244	274	305	335
2	2	33	61	92	122	153	183	214	245	275	306	336
3	3	34	62	93	123	154	184	215	246	276	307	337
4	4	35	63	94	124	155	185	216	247	277	308	338
5	5	36	64	95	125	156	186	217	248	278	309	339
6	6	37	65	96	126	157	187	218	249	279	310	340
7	7	38	66	97	127	158	188	219	250	280	311	341
8	8	39	67	98	128	159	189	220	251	281	312	342
9	9	40	68	99	129	160	190	221	252	282	313	343
10	10	41	69	100	130	161	191	222	253	283	314	344
11	11	42	70	101	131	162	192	223	254	284	315	345
12	12	43	71	102	132	163	193	224	255	285	316	346
13	13	44	72	103	133	164	194	225	256	286	317	347
14	14	45	73	104	134	165	195	226	257	287	318	348
15	15	46	74	105	135	166	196	227	258	288	319	349
16	16	47	75	106	136	167	197	228	259	289	320	350
17	17	48	76	107	137	168	198	229	260	290	321	351
18	18	49	77	108	138	169	199	230	261	291	322	352
19	19	50	78	109	139	170	200	231	262	292	323	353
20	20	51	79	110	140	171	201	232	263	293	324	354
21	21	52	80	111	141	172	202	233	264	294	325	355
22	22	53	81	112	142	173	203	234	265	295	326	356
23	23	54	82	113	143	174	204	235	266	296	327	357
24	24	55	83	114	144	175	205	236	267	297	328	358
25	25	56	84	115	145	176	206	237	268	298	329	359
26	26	57	85	116	146	177	207	238	269	299	330	360
27	27	58	86	117	147	178	208	239	270	300	331	361
28	28	59	87	118	148	179	209	240	271	301	332	362
29	29		88	119	149	180	210	241	272	302	333	363
30	30		89	120	150	181	211	242	273	303	334	364
31	31		90		151		212	243		304		365

Kathryn Higgs (ODA)

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

George.Marsh.xls

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Type of Water Use		Number of Washes per Day	Gallons of Water Used per Wash-Day	Total Water Use per Day, Gallons	Total Water Use per Day, Cubic Feet
Animal Washwater	110.0	2	2,000	440	58.8
Equipment Wash		2	150.00	300	40.1
Flushwater		2	0.00	0	0.0
Miscellaneous		2	0.00	0	0.0
Total >>>>>>>>>>>>				740	98.9

Field Number	Acres	Crop	Condition	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre		
						Nitrogen N	Phosphorous P2O5	Potassium K2O
VARIATIONS	30.0	Corn, Silage(AH)	As Harvested	Ton	25.00	193	100	230
VARIATIONS	20.0	Wheat, Winter Soft White Straw R	DHY-	Ton	5.00	218	102	126
VARIATIONS	40.0	Alfalfa Hay	DHY-	Ton	7.50	338	76	338
VARIATIONS	70.0	Grass/Legume Hay/Pasture	DHY-	Ton	6.00	203	76	249
Off-Farm								

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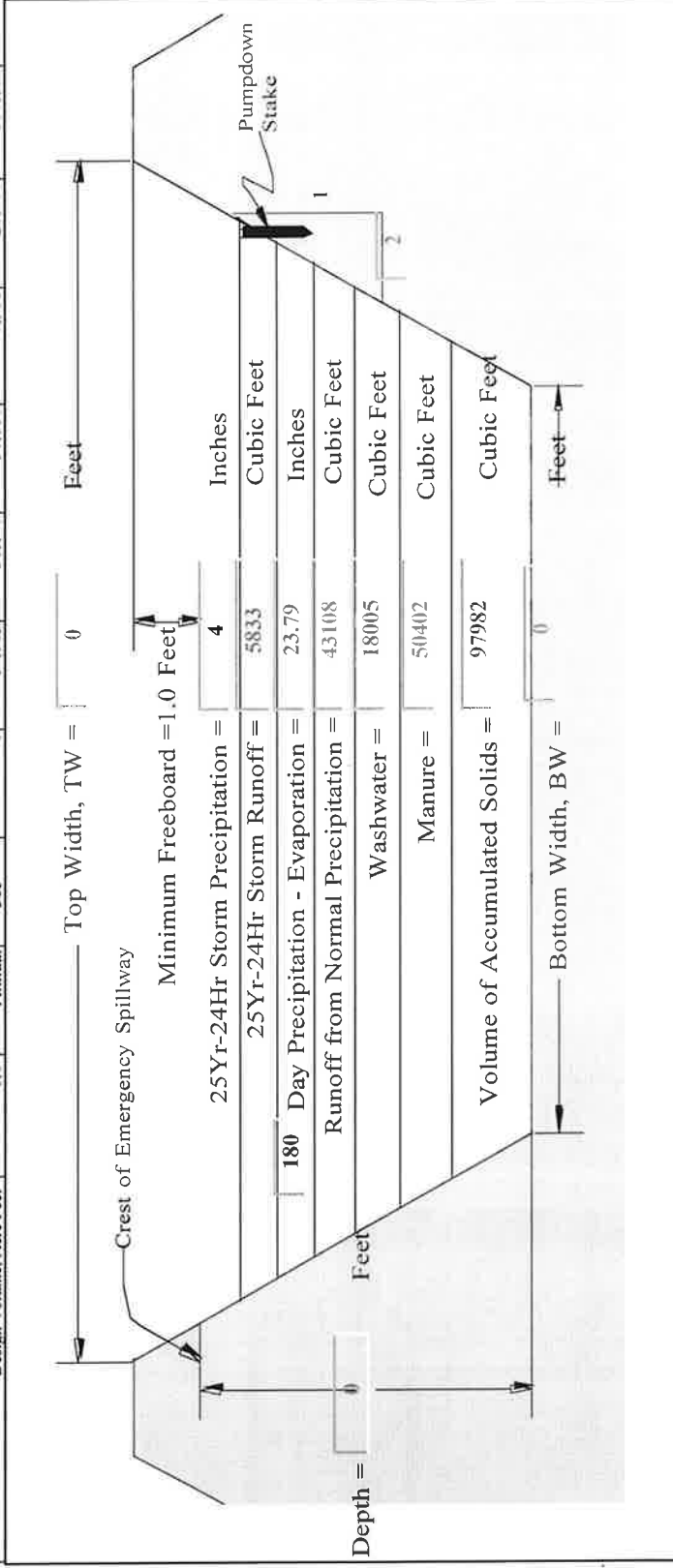
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ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

WASTE STORAGE POND

MONTHLY INFLOWS INTO WASTE STORAGE POND

Pond Parameters	Value	Month	Number of Days	Rain-Evap on Pond CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Manure CF	Solids CF	Waste to Store CF
Storage Period, Days=	180	October	31	0	7,840	3,908	3,067	7,980	1,926	12,973
Side Slope (X:1)=	2.00	November	30	0	43,038	8,704	2,968	8,509	2,707	14,184
Bottom Width, BW, Feet=	0	December	31	0	49,082	9,392	3,067	8,793	2,797	14,637
Bottom Length, BL, Feet=	0	January	31	0	43,120	8,400	3,067	8,793	2,797	14,657
Accumulated Solids Duration, Years=	2	February	28	0	31,932	6,883	2,770	7,942	2,526	13,238
Existing Storage, Acre Feet=	10.00	March	31	0	19,273	5,731	3,067	8,386	2,361	13,815
Surface Area of Existing Storage, SF=	98,000	April	30	0	490	3,588	2,968	7,723	1,864	12,554
Minimum Soil Liner Depth, Feet=	1.00	May	31	0	-15,108	2,771	3,067	7,980	1,926	12,973
25 Year-24 Hour Storm Runoff, CF=	5,833	June	30	0	-23,520	2,129	2,968	7,723	1,864	12,554
Top Width, TW, Feet=	0	July	31	0	-39,282	830	3,067	7,980	1,926	12,973
Top Length, TL, Feet=	0	August	31	0	-32,748	1,356	3,067	7,980	1,926	12,973
Volume Needed, Acre Feet=	10.4	September	30	0	-14,373	2,348	2,968	7,723	1,864	12,554
Design Volume, Acre Feet=	0.0	Annual	365	0	69,743	56,190	36,110	97,511	26,484	160,104



CLIENT: George Marsh
ASSISTED BY: Kathryn Higgs (ODA)

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation	Pounds of Nutrients Available			Percent Nutrients Retained After Storage			Pounds of Nutrients Retained After Storage		
		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Liquids	Dairy									
	Type of Storage Facility									
	Storage Pond (>50%) Dilution	34,547	13,693	19,211	45%	65%	80%	15,546	8,904	15,369
Solids	Solids Storage Facility (Roofed)	11,957	4,325	5,657	75%	90%	90%	8,967	3,892	5,100
Grazing	NONE	5,371	2,311	3,089	100%	100%	100%	5,371	2,311	3,089

NUTRIENTS AVAILABLE AFTER APPLICATION

Nutrient Source	Type of Application System	Pounds of Nutrients Available			Percent Nutrients Retained After Application			Pounds of Nutrients Retained After Application		
		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Liquids	Sprinkling	15,546	8,903	15,369	75%	100%	100%	11,659	8,904	15,369
Solids	Broadcast (Incorporated 7 or more days after application)	8,967	3,892	5,100	70%	100%	100%	6,277	3,892	5,100
Grazing	Grazing	5,371	2,311	3,089	85%	100%	100%	4,565	2,311	3,089

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location	Pounds of Nutrients Available			Percent Nutrients Retained After Denitrification			Pounds of Nutrients Retained After Denitrification		
		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Liquids	Between Coastal Plains and Coast Range Mountains	11,659	8,903	15,369	87%	100%	100%	10,144	8,904	15,369
Solids	Moderately Well Drained	6,277	3,892	5,100	87%	100%	100%	5,461	3,892	5,100
Grazing	Moderately Well Drained	4,565	2,311	3,089	87%	100%	100%	3,972	2,311	3,089

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NITROGEN, N

Field Number	Acres	Crop	LIQUIDS			SOLIDS			GRAZING		
			Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients
various	30.0	Com. Silage(AH)	20%	2,029	11	20%	1,092	6	0%	0	0
various	20.0	When. Winter Soft White Straw Removed	0%	0	0	30%	1,638	8	0%	0	0
various	40.0	Alfalfa Hay	0%	0	0	0%	0	0	0%	0	0
various	70.0	Grass/Legume Hay/Pasture	80%	8,115	40	0%	0	0	100%	3,972	20
Off-Farm			0%	0		50%	2,731		0%	0	
TOTALS	160		100%	10,144	50	100%	5,461	13	100%	3,972	20

NUTRIENT BALANCE BASED ON AVAILABLE ACRES

[illegible]

Conservation Plan

MARSH HOMESTEAD, INC.
GEORGE E MARSH
4675 NW CORNELIUS SCHEFFLIN RD
CORNELIUS, OR 97113
503/357-9152

Objectives

The objectives of this plan are to meet or exceed all requirements of the Oregon Department of Agriculture CAFO program, a USDA Comprehensive Nutrient Management Plan and the Tualatin Basin Water Quality Agricultural Management Area Plan ("Senate Bill 1010").



Marsh Homestead Inc. installed a fabric roof over the drystack facility in 2003 to facilitate handling of solid manure. This roof was installed with assistance from the USDA Environmental Quality Incentive Program.

General narrative farm description

George Marsh and his family operate the Marsh Homestead Inc. farm. It is located approximately 2 miles north of Cornelius in Washington County. The headquarters is on a terrace overlooking Dairy Creek (a tributary of the Tualatin River). This is a dairy farm with average herd numbers of 110 milk cows, 15 dry cows, 65 heifers and 65 calves. Livestock are housed in a series of interconnected barns. All livestock except the calves have access to pasture during the spring, summer and fall. The Marsh's have no current plans to expand the herd.

Details of the manure handling system are provided under the headings "Waste Storage Facility," "Manure Transfer," "Roof Runoff Structure," "Nutrient Management" and "Waste Utilization" on the following pages. Briefly, the manure is either scraped directly to the covered drystack or into a reception pit. A pump moves the reception pit manure to the side hill separator at the covered drystack. Silage leachate is also pumped to the separator. Liquids flow into a two cell storage pond system designed and inspected by NRCS. Some roof water flows onto concrete slabs and then into the reception pit. Other roofs have gutters, downspouts and outlet pipes to convey the clean roof water away from the Headquarters area. Currently, there is plenty of liquid storage capacity, so the roof water that eventually flows into the storage ponds is an asset because it can be used for irrigation. If the Marsh's ever expand the herd and need more liquid storage capacity, they will look into adding more gutters and downspouts.

Manure is spread mostly during April through August, although some spreading is done in September and October. Manure is applied at rates that supply nitrogen in amounts less than or equal to the amount in the harvested crop. Often, manure is applied at rates that somewhat exceed phosphorus uptake. However, all fields have a low or medium phosphorus index risk. Fields with soil test levels over 100ppm Bray P1 will no longer receive phosphorus applications that exceed the amount of phosphorus harvested in the crop.

The farm is located in the Tualatin River Basin. The Tualatin River suffers from excessive phosphorus and bacteria levels. Dairy Creek and an un-named intermittent tributary of Dairy Creek flow through this farm. Dairy Creek is a tributary of the Tualatin River. Some of the cropland on this farm is in the floodplain of Dairy Creek and some of the soils on this farm are hydric. Hydric soils generally indicate areas that once were wetlands. There are tile drains on this farm. All rural residences in this area have private wells for their drinking water supply. In order to protect both ground and surface water resources, this plan includes the use of perennial crops in the rotation, nutrient management of manure and fertilizers and a field border of perennial vegetation (minimum 30 foot width) along Dairy Creek and the un-named intermittent creek.

Animal Mortality Facility (316)

Dead livestock are composted in the drystack on the concrete slab shown in the HQ Site Plan Map.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	203	1 no	6	2007	1 no	2007
	Total:	1 no				

Comprehensive Nutrient Management Plan (100)

This plan meets all requirements of a Comprehensive Nutrient Management Plan, including the handling, storage and application of manure. This plan helps protect surface and ground water resources. After approval by the state, this plan will serve as the Marsh Homestead Inc. Animal Waste Management Plan for the State of Oregon. This plan also serves (after approval by the Soil and Water Conservation District) as the farm's Voluntary Water Quality Farm Plan.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	203	1 no	6	2007	1 no	2007
	Total:	1 no				

Conservation Crop Rotation (328)

The crop rotation varies depending on weather, markets and lifespan of perennial crops. However, the rotation is typically as follows. T859-3 ("Bottom Field"): continuous corn; T863-1: corn silage (3 years) - winter wheat; All other fields: silage corn - wheat - silage corn - wheat - 5 years hay/pasture.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	1	24.8 ac	1	2007	24.8 ac	2007
859	2	12.4 ac	1	2007	12.4 ac	2007
859	3	12 ac	6	2007	12 ac	2007
859	4	13.9 ac	6	2007	13.9 ac	2007
859	5	21.7 ac	1	2007	21.7 ac	2007
860	1	32.7 ac	1	2007	32.7 ac	2007
861	1	41.6 ac	1	2007	41.6 ac	2007
862	1	14.5 ac	1	2007	14.5 ac	2007
863	1	12 ac	1	2007	12 ac	2007
	Total:	185.6 ac			185.6 ac	

Field Border (386)

These fields have good stands of perennial vegetation. The vegetation includes Reed canarygrass, Oregon ash, willow species, snowberry, dogwood and Himalayan blackberry. Mostly, this vegetation established naturally, however some native trees and shrubs have been planted in Field 201 (around the freshwater pond) to improve wildlife habitat. The perennial vegetation filters runoff water and thus reduces the movement of sediment and dissolved contaminants offsite. The borders will be maintained at least 30 feet wide (measured from the edge of the cropland to the top of the stream or creek bank).

Native trees and shrubs will be allowed to grow in the field border along Dairy Creek in order to remain in compliance with the Tualatin Basin Agriculture Water Quality Management Area Plan. "Allowed to grow" means: trees will not be cut down unless they represent a safety hazard, the field border will not be mowed or sprayed with herbicides except as part of a plan to plant native trees and shrubs (like willows and ash) to replace non-native species (like canarygrass and blackberries).

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	201	5900 ft	7	2007	5900 ft	2007
859	202	1500 ft	7	2007	1500 ft	2007
863	201	900 ft	7	2007	900 ft	2007
	Total:	8300 ft			8300 ft	

Irrigation System, Sprinkler (442)

Fields are irrigated with an existing big gun traveling system. It uses a 4-6 inch mainline, has a lateral spacing of approximately 180 to 240 feet, pressure at the nozzle of 80 psi and 0.80, 1.00 or 1.20 inch nozzles. Fresh water is supplied by the Tualatin Valley Irrigation District and liquid manure is supplied from the two cell manure pond system. See enclosed charts of Big Gun Application Rates.

Due to limitations on availability of water and equipment logistics, crops are irrigated only when they approach moisture stress. Irrigation applications never exceed 2 inches at a time, nor 12 inches for a season. At these rates, there is never surface runoff that leaves the field nor deep percolation from irrigation that moves below the root zone.

The irrigation system will be maintained according to the enclosed operation and maintenance plan.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	1	24.8 ac	1	2007	24.8 ac	2007
859	2	12.4 ac	1	2007	12.4 ac	2007
859	3	12 ac	6	2007	12 ac	2007
859	4	13.9 ac	6	2007	13.9 ac	2007
859	5	21.7 ac	1	2007	21.7 ac	2007
860	1	32.7 ac	1	2007	32.7 ac	2007
861	1	41.6 ac	1	2007	41.6 ac	2007
862	1	14.5 ac	1	2007	14.5 ac	2007
863	1	12 ac	1	2007	12 ac	2007
Total:		185.6 ac			185.6 ac	

Manure Transfer (634)

Some solid manure is scraped directly to the drystack with a front end loader or bobcat. Most solid manure flows into the reception pit and is pumped to the side hill separator. Liquids flow from the side hill separator into manure pond cell #1 and then into cell #2. Silage leachate from the bunker silo is captured in a sump and pumped to the side hill separator.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	203	1 no	6	2007	1 no	2007
Total:		1 no			1 no	

Nutrient Management (590)

Nitrogen (N) and phosphorus (P) runoff are concerns in this region. Soil tests for P, K, pH and SMP will be taken on all fields at least once every 5 years according to the enclosed OSU publication "Soil Sampling for Home Gardens and Small Acreages." Herd rations will be tested annually to ensure rations do not exceed 0.40% P.

Soil test P levels for some fields on this farm are over 100 ppm (Bray1). However, P index analyses indicate a LOW OR MEDIUM risk for P runoff from all fields. There is a ratio of 1.5 animal units per acre of cropland on this farm, which indicates that it will be relatively easy to balance N applications with crop N harvest, but more difficult to balance P applications with P harvest by crops. ORAWM (enclosed) predicts that this farm produces approximately 21,000 lbs N, 14,000 lbs P₂O₅ and 29,000 lbs K₂O per year after losses. ORAWM predicts that crops grown in an average year on this farm remove 41,000 lbs N, 15,000 lbs P₂O₅ and 42,000 lbs K₂O.

The Marsh's will apply N via manure and fertilizer combined so as not to exceed the amount of N harvested by the crop. Post harvest soil nitrate tests will be taken in September on each field receiving manure. Adjustments to future manure and fertilizer applications will be made based on OSU's publication "Post Harvest Nitrate Testing for Manured Cropping Systems West of the Cascades" (enclosed). P applications (manure plus fertilizer) to fields with high or very high P index values will be equal to or less than the amount of P₂O₅ harvested. Currently, there are no fields with high or very high P index values. Crop nutrient removal will be measured by keeping records of crop harvest and using the published nutrient values for those crops in ORAWM (enclosed). Records of all manure and fertilizer applications will be kept, indicating the month, rate and nutrient analysis of the material applied.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	1	24.8 ac	1	2007	24.8 ac	2007
859	2	12.4 ac	1	2007	12.4 ac	2007
859	3	12 ac	6	2007	12 ac	2007
859	4	13.9 ac	6	2007	13.9 ac	2007
859	5	21.7 ac	1	2007	21.7 ac	2007
860	1	32.7 ac	1	2007	32.7 ac	2007
861	1	41.6 ac	1	2007	41.6 ac	2007
862	1	14.5 ac	1	2007	14.5 ac	2007
863	1	12 ac	1	2007	12 ac	2007
	Total:	185.6 ac			185.6 ac	

Pest Management (595)

Apply pesticides according to OSU recommendations and label directions. Use scouting reports based on economic thresholds. Mix and load pesticides at least 100 feet away from streams, ditches and wells. Use anti-backflow device and/or keep water input line above tank overflow level at all times. Triple rinse containers, use rinsate in sprayer and dispose of containers properly. Calibrate sprayer(s) at least once each year.

Dairy Creek, which flows through this farm, IS considered a steelhead spawning stream as shown on the Oregon Department of Agriculture map of streams requiring buffer zones for certain pesticides. See enclosed list of pesticides which cannot be applied within 60 feet (by ground application) or within 300 feet (aerial application) of this stream.

Contact NRCS (503/648-3174) at least 3 months before beginning this practice for a Pest Management specification.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	1	24.8 ac	1	2007	24.8 ac	2007
859	2	12.4 ac	1	2007	12.4 ac	2007
859	3	12 ac	6	2007	12 ac	2007
859	4	13.9 ac	6	2007	13.9 ac	2007
859	5	21.7 ac	1	2007	21.7 ac	2007
860	1	32.7 ac	1	2007	32.7 ac	2007
861	1	41.6 ac	1	2007	41.6 ac	2007
862	1	14.5 ac	1	2007	14.5 ac	2007
863	1	12 ac	1	2007	12 ac	2007
Total:		185.6 ac			185.6 ac	

Prescribed Grazing (528)

Schedule grazing to produce optimum pasture yields, healthy livestock and good water quality. Use cross-fences and pasture rotation to protect pastures and optimize herd health. In general, let livestock into pastures only when the grass is over 6 inches tall. Then remove livestock from pastures when the grass is 3 inches tall. Keep records of grazing (date on, height of grass, date off, height of grass, number of cattle).

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	4	13.9 ac	6	2007	13.9 ac	2007
Total:		13.9 ac			13.9 ac	

Roof Runoff Structure (558)

Most roofs that drain eventually to the manure storage ponds have functional gutters, downspouts and outlets. The enclosed HQ site plan map indicates which buildings do not currently have functional gutters and downspouts to direct rainwater away from the concrete slabs. Currently, there is adequate liquid manure storage capability on this farm, so it is not important to install additional gutters. In the future, if additional liquid manure storage capacity is needed because of increased herd numbers or changes in management, gutters may be installed on the buildings that currently drain to the concrete slab.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	203	1 no	6	2007	1 no	2007
	Total:	1 no			1 no	

Upland Wildlife Habitat Management (645)

These areas lie along Dairy Creek and the un-named creek that flows into the farm pond and then into Dairy Creek. These areas will be managed primarily as wildlife habitat and as a filter for water runoff. Allow dead or dying trees to stand or lie where they fall in order to provide habitat. Exception: if trees are a safety concern or interfere with farming, they should be removed. Install bird and bat houses and plant native vegetation. Avoid mowing wildlife areas before July 15 to prevent damage to nesting bird habitat. Contact the Oregon Department of Forestry (503/397-2636) for a logging plan if trees will be harvested. Some of these areas may be wetlands. Contact NRCS before clearing or draining land on these fields.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	201	17.5 ac	7	2007	17.5 ac	2007
859	202	0.9 ac	7	2007	0.9 ac	2007
863	201	2.5 ac	7	2007	2.5 ac	2007
	Total:	20.9 ac			20.9 ac	

Waste Storage Facility (313)

According to the analysis shown in the enclosed form OR10A-1, this farm needs at least 154 days of storage for liquid manure and 154 days of storage for solid manure.

Solids: Solid manure is stored in the roofed drystack area. This drystack is 4300 square feet in area and holds approximately 30,000 cubic feet (520 wet tons) of manure, which is approximately 160 days of storage, according to ORAWM.

Liquids: Cell #1 has a capacity of 1.8 acre-feet and a surface area of 31,000 square feet. Cell #2 is 8.8 acre-feet in capacity with a surface area of 67,000 square feet. The liquid storage ponds were installed with assistance from NRCS. The total liquids capacity of 10.6 acre-feet provides roughly 180 days of storage, according to ORAWM.

The Waste Storage Facility will be maintained according to the enclosed operation and maintenance plan. In case of a spill, leak or failure, the enclosed Emergency Response Plan will be followed.

Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	203	1 no	6	2007	1 no	2007
	Total:	1 no			1 no	

Waste Utilization (633)

The nutrients available in manure will be calculated before manure is applied. Manure nutrient content will be estimated using book values as per OSU publication EM8586 "Dairy Manure as a Fertilizer Source" (enclosed) and/or by using manure test results from the past 5 years. Current estimates of manure nutrient content, N mineralization rate, ammonia volatilization and denitrification are shown in the enclosed Nutrient Application Plan.

The solids spreader and big gun will be calibrated whenever an equipment change is made, using the protocol shown on the enclosed forms. Manure spreading will be according to the following schedule:

Sept 1 - Oct 15: Limit liquid and solid manure applications as much as possible. Only apply manure to fields that will have a growing crop during the winter. Do not apply manure to filter strips or field borders.

Oct 16 - Feb 15: Only apply manure when storage facilities are at risk of overflowing. Then only apply manure to fields with established perennial grass in the emergency areas shown on the enclosed maps. Do not apply within 1000 feet of roads, hydric soil or floodplains (shown on enclosed maps). Do not apply manure to filter strips or field borders.

Feb 16 - Sept 30: Apply most manure during this time. Do not apply manure to filter strips or field borders.

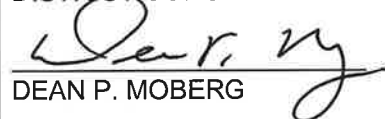
Tract	Field	Planned Amount	Month	Year	Applied Amount	Date
859	1	24.8 ac	1	2007	24.8 ac	2007
859	2	12.4 ac	1	2007	12.4 ac	2007
859	3	12 ac	6	2007	12 ac	2007
859	4	13.9 ac	6	2007	13.9 ac	2007
859	5	21.7 ac	1	2007	21.7 ac	2007
860	1	32.7 ac	1	2007	32.7 ac	2007
861	1	41.6 ac	1	2007	41.6 ac	2007
862	1	14.5 ac	1	2007	14.5 ac	2007
863	1	12 ac	1	2007	12 ac	2007
	Total:	185.6 ac			185.6 ac	

CERTIFICATION OF PARTICIPANTS

 06/07/07
GEORGE E MARSH DATE

CERTIFICATION OF:

DISTRICT CONSERVATIONIST

 6/13/2007
DEAN P. MOBERG DATE

CONSERVATION DISTRICT

TUALATIN SWCD

DATE

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**ANIMAL WASTE MANAGEMENT PLAN
MINIMUM REQUIRED ELEMENT**

OPERATION AND MAINTANENCE

Marsh Homestead

Name of Operation

Mark all that apply to your operation.



Above and/or Below Ground Liquid Tank

The tank serves as a collection point for effluent to drain to or be scraped from the animal feeding areas. If the tank will provide storage capacity to the waste management system it shall be completely emptied at the beginning of the storage period and the contents applied to cropland as weather and crop conditions permit. A 1-foot free board will be maintained to prevent spillage. Continually maintain all pumps, agitators, piping valves and all other electrical and mechanical equipment in good operating condition by following manufacturer's recommendations. Float valves will be maintained in good working order. Perform daily inspections of waterlines including drinking water or cooling water lines. Repair leaking lines immediately to prevent excess water from entering the waste storage system. Depth markers are installed to assure maximum volume will be maintained and checked weekly. At least once every 5 years, the tank shall be emptied and inspected for structural damage and leakage. Any damage found shall be corrected before putting the tank back in service. Remove all foreign debris within the structure that may cause damage to pumps and agitator. If below ground, the tank lid will not be subjected to more than two, 8,000 pound wheel loads. Before entering a tank, for any reason whatever, proper ventilation shall be provided, and self-contained breathing apparatus shall be used, if required, when entering a covered tank. No one shall enter the tank unless safety ropes are used and someone else capable of providing assistance is outside of the tank. Warning: Entering Unventilated Tanks Is Extremely Dangerous.



Animal Access Lanes or Walkways

Damaged components will be repaired or replaced as needed. Debris and excess manure will be removed from roadway surfaces, road ditch and drainage areas. Maintain drainage area capacities. Maintain good vegetative cover on all slopes and watercourses.



Agitator

Preventative maintenance will be in accordance with the manufacturer's recommendations. Periodically examine the agitator for proper operation. Clean debris from the propeller and promptly replace any defective or damaged parts. Remove the agitator from the manure tank or pond and periodically clean and oil as needed to increase the life expectancy of the agitator. Immediately repair any vandalism or livestock damage. Do not allow livestock near the equipment during operation.



Concrete Gutters

Floor gutters and grates will be inspected periodically. All foreign material restricting flow will be removed. Damage will be repaired as needed.



Curbs

Curbs, gutters and slabs that are used to convey effluent will be inspected periodically. Broken sections will be repaired or replaced. Manure or other solids will be prevented from building up next to curbs or flowing over them. If over flow is a consistent problem the curb height should be increased.



Culverts

Inspect annually or after large rainfall event. All foreign objects restricting water flow will be removed. Damaged sections will be repaired or replaced. Erosion around inlet or outlet will be corrected.



Dry Stack Storage Facility

Solid manure storage facility will be inspected annually. Broken slabs and curbs will be repaired. Repair or replace rusted or damaged areas on roof structure. Broken gutters and/or downspouts will be repaired or replaced. Check for adequacy and function of drain away from downspouts. Check side and back walls for soundness. Manure solids and leachate will not escape through cracks in the facility.



Fencing

Fences will be inspected periodically. Broken or decayed posts will be replaced. Sagging wire will be tightened. Broken wire will be spliced or replaced. Broken or missing insulators for electric fencing will be replaced. Vegetation will be controlled under the fences. Electric fencing will be sufficiently charged to detour animals.



Filter Strips

Maintain vigorous growth of vegetative covering. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing, harvesting or grazing may also be needed to control height. Remove all foreign debris that hinders system operation. Limit the traffic from filter strip area. Limit livestock usage to vegetative growth periods when the animals will not damage vegetative root system or compact the soil. Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage.



Gutters and Downspouts

Gutters will be inspected annually to ensure all gutters are free of foreign materials. Broken gutters or downspouts will be replaced or repaired. Gutters will be connected to downspouts. Leaky gutters and downspouts will be repaired. Weeds and sediment will be removed from downspout outlets. All downspouts will be connected to outlets, which are kept free flowing. Outlets will be inspected for rodent guards and repaired or replaced as needed.

x

x

x

x

x

x

x



Irrigation Water Management

Irrigation water application will be at rates that minimize transport of sediment, nutrients, and chemicals to surface water and ground water. Equipment modifications and/or soil amendments such as polyacrylamides and mulches should be considered to reduce erosion if needed.



Manure Application Equipment

All manure application equipment (including but not limited to sprinklers, big gun irrigators, spreaders and/or tank wagons) will be operated and maintained according to the manufacturer's manual. Equipment found to be broken or worn will be replaced. Equipment will be calibrated to ensure recommended rates are applied. Liquids will be drained from sprinklers or big guns prior to freezing weather. When system is flushed, rinse water is used following waste, and liquid and sediment is applied agronomically. Nozzles will be checked periodically and if worn, nozzles will be replaced. Minimize exposure to animal and organic wastes and manure gasses. Wear protective clothing when appropriate. When cleaning equipment after nutrient application, remove and save wastes in an appropriate manner. Avoid applying manure near surface water by establishing buffer strips and set backs, and use extreme care to avoid contaminating ground water.



Manure Effluent and Irrigation Transfer Lines.

Manure, effluent and irrigation lines shall be flushed with clean water periodically to prevent particle buildup and plugging. Manure flushed from the lines will be applied agronomically so that surface and groundwater will be protected. Manure, effluent and irrigation lines shall be inspected periodically for leaks or worn out nozzles, and repairs or replacements made as needed. Special inspection shall be done to pressure relief valves, risers and control valves. Shut off valves will be inspected annually. Avoid unnecessary travel over pipelines that will damage their integrity. Equipment found to be broken or worn will be replaced. Water will be drained during cold weather to prevent frozen or broken lines. These lines can explode if not properly maintained and may cause human injury.



Pumps

Pumps will be maintained in accordance with manufacturer's operation and maintenance manual. Effluent will be drained from pumps prior to freezing weather. Pumps will be inspected periodically to identify and remove debris wrapped around impeller or worn parts. Appropriate action will be taken to repair any worn parts. Liquids will be drained from pump prior to freezing weather to prevent breakage. It is recommended to have a spare pump or back up system in case a pump must be removed for an extended time for repair.



Roofs

Roofs will be inspected annually. Rusted sections will be replaced or repaired if needed. Loose sections will be secured. All broken trusses, beams, poles, gutters and downspouts will be repaired or replaced.



Solid Manure Separator

The separator should be inspected regularly for deterioration of protective coatings and repaired as necessary. All plumbing will be inspected annually and broken lines will be replaced or repaired. Loose connections will be tightened. If applicable, electric motors, pumps and gears should be routinely maintained. Separator will be operated and maintained according to manufacturer's manual.





Subsurface Drainage System

Subsurface drainage will be inspected annually. Fields will be checked for breaks or suck holes. Outlets will be kept free of vegetation and sediment. Erosion at outlets will be corrected with riprap or other means. Damage or broken lines will be repaired. Outlets from fields on which animal waste is being applied will be monitored daily. Animal waste applications will cease if the tile outflow contains any indication of animal waste.



Trough or Tank

Watering facility will be inspected periodically. Damaged tank/trough will be repaired or replaced. Float valves will be maintained in good working order. Area immediately surrounding the trough/tank will be maintained in a stable condition. Watering facility will be inspected periodically. Damaged tank/trough will be repaired or replaced. Float valves will be maintained in good working order. Area immediately surrounding the trough/tank will be maintained in a stable condition. Watering facilities will not be allowed to overflow if additional liquid will affect waste storage capacities.



Waste Storage Pond

Prior to the storage season, empty the pond to provide storage capacity for the accumulation of wastewater and precipitation during the winter storage period. Sludge and accumulated solids will be removed from the pond periodically when buildup limits storage capacity in the pond. Depth markers are installed to assure maximum volume will be maintained and checked weekly. A 2-foot free board will be maintained to prevent spillage.

Maintain all pumps, agitators, pipeline, valves, and electrical and mechanical equipment in good operating condition following the manufacturer's recommendations. Immediately repair any vandalism, vehicular, or livestock damage to any earth fill. Immediately remove any obstructions or blockage of spillways, trash racks or pipe inlets. Settlement or cracks in earthen sections should be investigated to determine cause and immediately repaired. Maintain vigorous growth of vegetative coverings on the dikes to eliminate soil erosion. Eradicate or otherwise remove all rodents or burrowing animals and repair any damage caused by their activity. Fences and/or warning signs should be maintained as necessary to unauthorized human or livestock entry. Operate systems in a manner that minimizes odor and drift.



Signature of Legally Authorized Representative: _____

Print Name: _____

GEORGE MARSH

Date: _____

06/07/07

X

X

X

1000

1000

ANIMAL WASTE MANAGEMENT PLAN

Testing protocols

MANURE

Intensive liquid and solid manure testing was done in 2003-2006, with 12 solid manure and 22 liquid manure samples analyzed at commercial labs. Samples were collected and stored as described in Extension Publication PNW 505, *Which Test is Best? Customizing Dairy Manure Nutrient Testing* (November, 1997). Manure samples were segregated by type and date (e.g. May-June liquid from first cell). All subsequent manure testing will also conform to this protocol.

CROP NUTRIENT REMOVAL

Crop nutrient removal has been, and will continue to be, tested using on-farm yield estimates based on records of loads of forage from each field multiplied times book values of nutrient content as per the ORAWM program.

SOIL TESTING

Soil testing will be done on each field at least once every three years for P, K, pH, SMP and residual soil NO_3^- . The protocol described in two Extension Publications will be used:

- EM 8832-E *Post-harvest Soil Nitrate Testing* (May, 2003).
- EC 628 *Soil Sampling for Home Gardens and Small Acreages* (April, 2003).

Signature of legally authorized representative:


George Marsh

06/07/07
Date

**ANIMAL WASTE MANAGEMENT PLAN
MINIMUM REQUIRED ELEMENT**

RECORD KEEPING AND REPORTING TO OREGON DEPARTMENT OF
AGRICULTURE

RECORD KEEPING:

- a) Applications of manure, litter and process waste will be kept, including the date and the amount of N and P applied during each application.
- b) Records of exporting manure, litter and process waste will also be kept.

REPORTING TO OREGON DEPARTMENT OF AGRICULTURE (ODA):

- a) Any discharge will be reported orally to ODA within 24 hours. Within 5 days, a written statement describing this discharge will also be submitted to ODA.
- b) The amount of manure, litter and process waste applied will be reported annually.
- c) The amount of manure, litter and process waste exported will be reported annually.

Signature of Legally Authorized Representative: _____

George Marsh

Print Name: _____

George Marsh

Date: _____

06/07/07

Pesticide Buffers along steelhead streams

The following pesticides require buffers if used along listed steelhead streams:

Aerial application: do not use the following pesticides within 100 yards of Dairy Creek.

Ground application: do not use the following pesticides within 20 yards of Dairy Creek (this includes backpack sprayers).

Active Ingredient	Sample Trade Names*		Active Ingredient	Sample Trade Names*
2,4-D aquatic**	Various names		Fenbutatin-oxide	Vendex
Azinphos-methyl	Guthion		Lindane	Lindane
Bensulide	Prefar		Malathion	Various names
Bromoxynil	Buctril		Methidathion	Supracide
Carbaryl	Sevin		Methomyl	Lannate
Carbofuran	Furadan		Methyl parathion	Penncap-M
Chlorothalonil	Bravo		Metolachlor	Dual
Chlorpyrifos	Lorsban, Dursban		Naled	Dibrom
Diazinon	Various names		Phorate	Thimet
Dimethoate	Cygon		Prometryn	Caparol
Disulfoton	Di-Syston		Propargite	Omite, Comite
Diuron	Direx, Karmex		Triclopyr (ester)	Garlon 4
Ethoprop	Mocap		Trifluralin	Treflan

*This table may not include every trade name for each active ingredient. Always check the active ingredient list on the label to verify presence of the above ingredients.

** 2,4-D may be applied up to the water's edge, but may not be applied to the water or to weeds that are emerging from the water.

For more information, see the Oregon Department of Agriculture Web site:

<http://oda.state.or.us/pesticide/lawsregs/buffers.html>

Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascades

D.M. Sullivan and C.G. Cogger

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What's in this publication?

This publication describes the use of post-harvest soil nitrate testing as a tool for assessment of nitrogen (N) management in manured cropping systems west of the Cascade Mountains in Oregon, Washington, and south coastal British Columbia.

The first section of this publication gives general information on the test and is designed for use by growers and dairy operators. This section gives a brief introduction to soil sampling, but does not provide all of the technical details. The focus is on how to use the post-harvest test to improve nutrient management. This section describes:

- ◆ What the post-harvest test measures
- ◆ How to collect soil samples
- ◆ Units used in soil nitrate testing
- ◆ How to interpret soil nitrate test results for grass and silage corn crops

In addition, background information explains the rationale for the test:

- ◆ How to use the post-harvest test as a management tool (page 3)
- ◆ Crop and soil response to excess plant-available N (page 4)

The second section of this publication is designed primarily for use by conservation planners and other agricultural professionals working with farmers to implement nutrient management plans. This section is also designed for dairy operators who do their own soil sampling. This section includes detailed suggestions for the following:

- ◆ Collecting, preserving, and analyzing the soil sample
- ◆ Developing a long-term soil sampling plan

The post-harvest test and how to use it

What the post-harvest test measures

The post-harvest soil nitrate test measures the quantity of plant-available nitrogen present in the nitrate form in the surface foot of soil in the late summer or early fall. The test measures nitrate-N not utilized by the recently harvested crop. Because crops differ in their ability to remove nitrate-N from the soil, test interpretation is crop-specific.

The test looks backward in time. It evaluates the balance between N supply and crop uptake for the crops produced during the summer. Nitrate-N accumulates in the soil when more plant-available N is supplied than can be utilized by the summer crop (see "Crop and soil response to excess plant-available N," page 4).

Use the post-harvest test to:

- ◆ Get a general idea of balance between N supply from manure and other sources and crop N demand
- ◆ Identify imbalances in N supply among fields on a farm
- ◆ Identify fields that may respond to changes in timing or amount of manure application or other agronomic practices

Soil sampling protocols

Sampling depth

Sample the 0- to 12-inch depth for the post-harvest test. This shallow sampling depth is a good predictor of nitrate in the rest of the soil profile when (1) in-season irrigation is not excessive, and (2) samples are taken prior to heavy rains in the fall.

Composite soil sample

Collect a composite soil sample consisting of a mixture of 15 to 30 soil cores from each field or management unit. See "Collecting, preserving, and analyzing the soil sample" (page 9) for detailed sampling instructions and suggestions for special situations.

What fields to sample

In general, it is not necessary to sample every field on a farm every year. Consult with your farm advisor to determine any regulatory requirements for sampling frequency. We recommend that you sample selected fields that represent typical manure and crop management practices each year to track long-term trends in post-harvest soil nitrate values. See "Developing a sampling plan" (page 11) for more information.

When to sample

In general, samples for the post-harvest test should be collected as soon as possible after a crop harvest. Avoid sampling a field that has had manure application within the past 30 days.

Samples must be taken before heavy fall rains move nitrate below the 12-inch depth. Because the timing of fall rainfall is unpredictable, the best strategy is to sample fields before October 1 whenever possible.

Collect samples from medium- to fine-textured soils (loams, clay loams, and clays) prior to 5 inches of cumulative fall rainfall. Sandy soils (sand, loamy sand, or sandy loam soil texture) have lower water-holding capacities and should be sampled prior to

continues on page 5

How to use the post-harvest test as a management tool

Sampling depth and timing are critical. Interpretation tables for this test apply only to samples taken to a 12-inch depth. Surface soil (0 to 12 inches) typically contains the highest nitrate-N levels and requires the least time and effort for sample collection. Samples must be taken before heavy fall rains move nitrate below the 12-inch depth. The target sampling period generally is August 15 to October 15.

To get the most value from this test, it is important to understand:

- ◆ How the test fits into an overall nutrient management program
- ◆ Limitations to interpretation of test results
- ◆ How not to use the test

Using the test as part of a nutrient management program

The post-harvest test is but one measure of success in nutrient management. Post-harvest nitrate test data should be assessed in the context of the current N management plan and records of manure application. Successful N management involves a number of components, including:

- ◆ Assessing crop N needs
- ◆ Planning manure application to meet crop N needs
- ◆ Applying manure according to the plan
- ◆ Recording manure application amount and estimated plant-available N amount
- ◆ Measuring crop yield and N content
- ◆ Monitoring success of the plan

All components of the nutrient management system should be evaluated together.

Limitations to test results

Interpretive values for post-harvest soil nitrate are:

- ◆ Calibrated only for high-rainfall portions of the Pacific Northwest (west of the Cascades). Extrapolation to other environments is not recommended.

- ◆ Provided only for corn silage and grass hay/silage crops. Field research has been used as the basis for interpretive levels for these crops. Applicable research data are not available for other crops to determine post-harvest nitrate-N levels associated with good crop and nutrient management practices. However, the test may be used for relative comparisons among fields planted to another crop (e.g., comparisons among grass pasture fields).
- ◆ Based on the assumption that summer irrigation is less than, or close to, evapotranspiration to ensure that significant nitrate leaching does not occur before the fall test.
- ◆ Designed for fields with a history of applied manure (more than 3 consecutive years of regular manure application). Lower post-harvest soil nitrate test values are attainable where only fertilizer N is used, or where manure is applied infrequently.
- ◆ Based on good management of the crop and normal yields. Crop moisture stress, insect damage, or plant disease will reduce crop yield and crop uptake of nitrogen, thus increasing post-harvest soil nitrate test levels.

How not to use the post-harvest test

The test will not:

- ◆ Detect a shortage of plant-available nitrogen for crop production. Continual mineralization of nitrogen (conversion of organic N forms to plant-available N forms in the soil) can provide enough plant-available nitrogen for a crop without accumulation of nitrate-N in soil.
- ◆ Determine the source(s) of excess plant-available N. Sources of N may include manure slurry, lagoon water, fertilizer, soil organic matter, or previous crop residues.
- ◆ Predict crop response to fall manure or N fertilizer applications. The test does not predict the amount of plant-available N that will be mineralized from soil organic matter or crop residues in the fall.

Crop and soil response to excess plant-available N

Crop response to applied N. Crop N uptake is controlled by the environment, crop N uptake potential, and management. Crops respond to plant-available nitrogen supply (ammonium + nitrate-N) by the law of diminishing returns (Figure 1). Without added N, some crop yield is produced from N supplied by soil organic matter, residual plant-available N, and other non-fertilizer sources (e.g., mineralization of crop residues). Additional N supplied from manure or fertilizer increases crop yield until site yield potential is reached.

The application rate of manure or N fertilizer needed to reach near-maximum yield is termed the *agronomic rate*. Rather than a single agronomic rate, the crop response to N is best described as an *agronomic rate range* (Figure 1). The *agronomic rate range* concept allows for variability in crop performance among years and for crop uptake of N beyond the yield maximum (increased protein).

Post-harvest soil nitrate test measures nitrate-N not used by the crop. At excessive plant-available N supply levels, crop yield and crop N uptake do not respond to further N additions. The extra soil N not used by the crop accumulates as nitrate-N.

Elevated post-harvest soil nitrate-N concentrations are an indicator of one or more of the following: (1) excess plant-available N, (2) N supplied too late in the season for crop utilization, or (3) poor crop growing conditions due to insect infestation, moisture/heat stress, plant disease, or other cultural problems. If crop yields are acceptable and crop protein is at typical levels, then the most likely explanation is that plant-available N was supplied in excess of crop needs.

Because grass is more efficient than corn at N uptake, target post-harvest soil nitrate levels given in this publication are lower for grass than for corn. There are two key reasons that grass is more efficient than corn in N removal.

- ◆ Grass has a greater capacity to take up N supplied in excess of that needed for maximum yield. After enough N has been supplied

for maximum yield, grass protein content increases in response to increased N supply. With grass, soil nitrate increases only when the available N supply exceeds that required to produce near-maximum protein. Corn does not take up additional N after the maximum yield is reached. Corn silage protein does not increase much in response to excess N supply.

- ◆ Grass utilizes N mineralized late in the growing season more efficiently. Grass managed for silage or hay continues to take up N until harvest. Corn grown for silage completes its N uptake approximately 4 weeks before harvest. Some of the soil nitrate measured after corn harvest is produced by mineralization of soil organic N to available forms during the final weeks of the growing season.

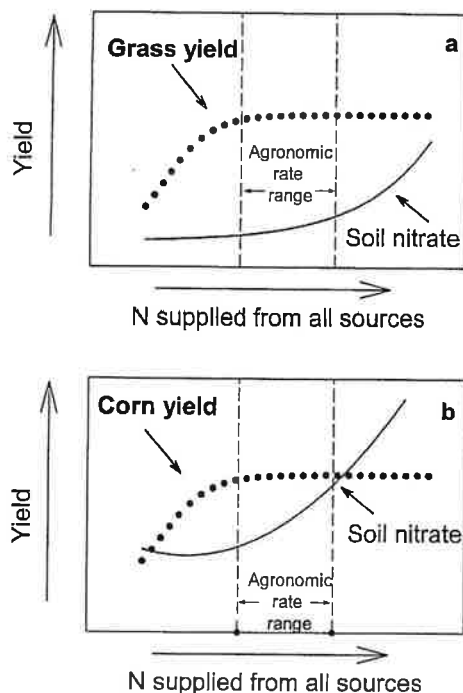


Figure 1.—Crop yield and soil nitrate response to increased N supply. Agronomic rate range = range of N supplied from all sources that results in near-maximum crop yield with acceptable post-harvest nitrate accumulation. Above the agronomic rate range, excess N accumulates as nitrate in soil. More nitrate accumulates in the agronomic rate range with corn (b) than with grass (a).

Table 1.—Average calendar date when cumulative rainfall (after September 1) reaches 5 inches west of the Cascades.*

Cumulative rainfall after Sept. 1 (inches)	Calendar date to reach specified cumulative rainfall							
	Medford (OR)	Salem (OR)	Tillamook (OR)	Coupeville (WA)	Centralia (WA)	Lynden (WA) Abbotsford (BC)	Agassiz (BC)	Comox (BC)
3	10 Nov	20 Oct	26 Sep	31 Oct	8 Oct	1 Oct	26 Sep	10 Oct
5	29 Nov	1 Nov	8 Oct	24 Nov	23 Oct	15 Oct	9 Oct	25 Oct
7	16 Dec	13 Nov	18 Oct	15 Dec	4 Nov	27 Oct	19 Oct	6 Nov

*Average daily precipitation data for many other locations is available at: Western Regional Climate Center (<http://wrcc.dri.edu>) or Environment Canada (http://www.msc-smc.ec.gc.ca/climate/climate_normals/index_e.cfm).

3 inches of cumulative fall rainfall. The starting date for calculating cumulative fall rainfall is September 1. Include inches of irrigation water applied after September 1 in your estimate of cumulative rainfall.

Table 1 shows the average calendar date when cumulative fall rainfall (after September 1) reaches 5 inches at a variety of locations. For most locations, sampling prior to October 15 is acceptable in an average year. In high rainfall areas (coastal areas and the Cascade foothills), plan to sample earlier. A late October sampling date usually is acceptable in lower rainfall areas of southern Oregon, the Puget Sound islands, Olympic Peninsula, or Vancouver Island.

Units used in soil nitrate testing

In this publication, interpretation of a post-harvest soil nitrate test (Tables 3 and 4) is based on units of parts per million (ppm). Some labs report soil test nitrate-N in units of lb/acre by assuming a standard value for soil bulk density. If the lab reports nitrate-N results in pounds per acre, ask them to provide a conversion factor to express data in units of ppm. The conversion factor assumed by laboratories usually is between 3 and 4, because 1 acre-foot of dry soil usually weighs

Table 2.—Units used to report soil nitrate analyses.

Name	Interpretation	Equivalent units
nitrate-N or NO ₃ -N	N present in the nitrate form, soil dry weight basis	mg/kg or ppm (dry weight basis)

about 3.5 million pounds (3.5 lb per acre-foot = 1 ppm).

Interpreting soil nitrate test results

Data quality and variability

The first step in evaluating your soil nitrate data is to verify data quality. Determine whether the sample collection method, timing of sample collection, sample preservation, and laboratory analysis methods are acceptable. Reject data that did not result from reasonable protocols. For example, Tables 3 and 4 should not be used for soil samples collected in November after heavy fall rains.

Make sure that you understand the units used to report test results. See Table 2 for an explanation of units found in soil test reports.

Response of post-harvest soil test N to changes in management

Success in N management is indicated by long-term trends in post-harvest soil nitrate (at least 3 to 5 years). **Because of the large pool of readily mineralizable N in manured soils, fall soil nitrate values may not decline for 3 to 5 years in response to improved management.** For multiyear comparisons, sampling methods and timing must be consistent.

Some portions of a crop rotation will have higher fall nitrate values because of rapid N mineralization stimulated by tillage or incorporation of crop residues. For example, soil nitrate concentrations typically are high, regardless of overall N management, after a perennial grass sod is plowed down and reseeded.

Reductions in fall soil N are most likely to be measured when (1) commercial N fertilizer amounts are reduced or eliminated, (2) cropping systems that maximize N removal in late summer and fall (August to October) are used, and (3) manure or N application is eliminated after August 1. It is more difficult to attain post-harvest soil nitrate-N values of less than 20 ppm for corn than for grass (see "Crop and soil response to excess plant-available N," page 4).

Interpretation for individual fields

Interpretations of soil test nitrate-N should be made first at the field level. You may be able to discover a probable cause for differences in test values among fields. Questions to ask include:

- ◆ Are relationships present between known management factors (e.g., manure application rate or timing, crop yield and quality, irrigation frequency, distance to the barn) and soil test values?
- ◆ Is a large amount of variation present between fields? Is there a logical explanation for unusual values?
- ◆ Are values for grass and corn fields similar?

Annual averages across grass and corn crops

After looking at test values for individual fields, it may be useful to look at averages across all grass or corn fields. You may want to calculate averages only for fields under similar management.

Average nitrate-N test values are most useful for consideration of changes in whole farm nutrient management. Tables 3 and 4 present interpretive information separately for grass and corn fields.

If a few fields have unusual test values, you may be justified in excluding those fields from an average. Although you may want to exclude unusually high test values from the farm average, you definitely should evaluate those fields further to determine the probable cause of the high soil test values. The unusually high test values may reflect the need for management changes or may reflect a soil sampling or analytical error.

Using the interpretive tables (Tables 3 and 4)

Interpretations and management suggestions given in Tables 3 and 4 (pages 7–8) are general in nature and should serve as only one portion of a nutrient management plan evaluation. Some of the management suggestions can be implemented for individual fields, while others need to be implemented on a whole farm basis.

Remember not to focus solely on post-harvest nitrate-N in evaluating N management. Include other important aspects of N management in your evaluation, such as success in following a plan for manure application, calibration of manure application equipment, maintaining good manure application records, and effective irrigation management.

Table 3.—Silage corn. Suggested interpretation for post-harvest soil nitrate-N (0- to 12-inch depth).^a

If post-harvest nitrate-N is less than 20 ppm (less than approximately 70 lb N per acre)

- ◆ Continue present N management.

If post-harvest nitrate-N is 20 to 45 ppm (approximately 70 to 160 lb N per acre)

- ◆ Reduce or eliminate sidedress N fertilizer application. Use the pre-sidedress nitrate test (PSNT). Apply sidedress N only when PSNT indicates a need.
- ◆ Reduce lagoon water application after August 1.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Total applied manure-N + fertilizer-N should be less than 125 percent of documented crop N removal.
- ◆ Reduce manure application on fields where corn follows grass sod plow-down.
- ◆ Plan to reduce manure-N application by 10 to 25 percent.
- ◆ Improve whole farm N balance.

If post-harvest nitrate-N is greater than 45 ppm (greater than approximately 160 lb N per acre)

- ◆ Apply only starter N (20 to 40 lb N/acre at planting).
- ◆ Plan not to sidedress N fertilizer in June. Apply sidedress N only when PSNT indicates a need.
- ◆ Eliminate lagoon water application after August 1.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Apply manure N at a rate less than or equal to crop N removal (approximately 200 lb total N per acre).
- ◆ Eliminate manure application on a few fields or a few strips within a field next year to determine the contribution of mineralized N vs. current-season application of manure.
- ◆ Plan to reduce manure-N application by 25 to 40 percent.
- ◆ Consult experts to improve whole farm nutrient balance.

^aThe post-harvest test values listed above are for the end of a growing season. Management changes (if needed) should be implemented in future years. Interpretive values assume near-optimum crop yields. If yield is below average, improve agronomic practices to increase crop yield and crop N uptake.

Table 4.—Grass for hay or silage. Suggested interpretation for post-harvest soil nitrate-N (0- to 12-inch depth).^a

If post-harvest nitrate-N is less than 15 ppm (less than approximately 55 lb N per acre)

- ◆ Continue present N management.

If post-harvest nitrate-N is 15 to 30 ppm (approximately 55 to 105 lb N/acre)

- ◆ Apply manure earlier in the growing season.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Total applied manure-N + fertilizer-N should be less than 125 percent of documented crop N removal.
- ◆ Check protein levels in forage. Grass crude protein greater than 21 percent is associated with increased potential for nitrate toxicity to cows.
- ◆ Plan to reduce manure-N application by 10 to 25 percent.
- ◆ Improve whole farm nutrient balance.

If post-harvest nitrate-N is greater than 30 ppm N (greater than approximately 105 lb N/acre)

- ◆ Apply manure earlier in the growing season. Reduce manure application after August 1.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Total manure-N + fertilizer-N should be less than or equal to crop N removal. Even if calculated crop removal exceeds 400 lb N per acre, apply manure-N + fertilizer-N not to exceed 400 lb N per acre per year.
- ◆ Consider reseeding or interseeding if grass yield is limited by poor stand or undesirable species.
- ◆ Check protein levels in forage. Grass crude protein greater than 21 percent is associated with increased potential for nitrate toxicity to cows.
- ◆ Plan to reduce manure-N application by 25 to 40 percent.
- ◆ Consult experts to improve whole farm nutrient balance and reduce danger of nitrate toxicity to cows.

^aThe post-harvest test values listed above are for the *end* of a growing season. Management changes (if needed) should be implemented in future years. Interpretive values assume near-optimum crop yields. If yield is below average, improve agronomic practices to increase crop yield and crop N uptake.

Detailed suggestions for soil sampling and planning

Collecting, preserving, and analyzing the soil sample

Tools for field sampling

Collect a sample that is representative of the entire sampling depth. For example, a representative sample for a 0- to 12-inch depth has the same amount of soil from the soil surface (0 to 6 inches) and from the bottom of the sampling depth (6 to 12 inches).

Always use a tool specifically designed for soil sampling. Don't use a shovel, because the samples won't be uniform with depth. Tools for soil sampling often are called soil probes or augers. There are several kinds available.

Push probes are tubes that you push into the soil. They have a T-shaped handle attached to a cylindrical tube (about 1 inch diameter) with a beveled tip. The tube collects a cylinder, or "core," of soil. Push probes work well in soft, uncompacted soils.

Hammer probes are designed for hard or compacted soils. They have a sliding weight (hammer) instead of a T-handle to drive the probe into soil.

Soil test consultants often use hydraulic probes mounted on a tractor or pickup to sample soils. These reduce the time and effort of sampling in hard soils. Gravelly and rocky soils are difficult to sample. A hydraulic probe with a rotating auger can sample some gravelly soils.

A mud auger or bucket auger is the best tool for hand-sampling at sites that are difficult to sample with push probes. Use an auger for compacted, muddy, rocky, or dry soils. Augers can be purchased from several manufacturers. A 2- to 4-inch diameter mud auger (open-sided) works best for most situations because it is easy to remove the sample from the bucket. Use a larger

diameter auger for soils with large rocks. Augers sample a 4- to 6-inch depth. You will need to take several bites from the same hole to sample to 12-inch depth. You will collect a larger sample volume, about 5 to 10 times that collected with a push tube. Because of the extra effort required for auger sampling, use this method only if other sampling methods are difficult or impossible.

Field sampling protocol

Plan ahead. Use field maps and soil maps to divide the farm into different management units. A management unit is usually a field, but you may want to subdivide a large field if sections can be managed separately for nutrient application. The simplest approach is to collect a composite sample from the entire management unit. You may choose to restrict sampling to the dominant soil type if the management unit has soils that differ markedly in visual appearance (soil color, texture, organic matter).

Alternatively, you can restrict your sampling to a representative area (usually about an acre in size) within the management unit. Choosing a representative area within the field where manure application rate, timing, and uniformity are well documented is essential. If you use the "representative area" sampling approach, record the sampling location using a GPS receiver or record the distance from a fixed location (e.g., fenceline).

Avoid large buffer zones that are sometimes present adjacent to water bodies or roads, especially with big gun manure applicators. Avoid small atypical areas such as:

- ◆ Swales
- ◆ Very rocky or shallow soil (less than 12 inches deep)
- ◆ Site of an old manure pile or a feeding, watering, or resting area for livestock
- ◆ Abandoned field roads
- ◆ Field edges

Collect 15 to 30 soil cores from each management unit or representative sampling area with a push probe or similar tool. If you use an auger, 10 holes per management unit or zone is sufficient.

Choose sampling locations in a zigzag pattern across the field. Your general route of travel should be across rows, rather than down one row in the field. Make sure you sample within the part of the field where manure is routinely applied. For grazed pastures, choose sampling locations that have average crop growth and productive forage species.

Scrape away loose crop residues or manure present on the soil surface. Sample only the soil. Including the accumulated organic debris from the soil surface in the soil sample will increase variability in test results.

Once you are satisfied with a sampling strategy, repeat the same procedure each year. This will increase the validity of year-to-year comparisons of results.

Obtaining a representative sample from fields where manure has been injected into soil or placed in bands on the soil surface is difficult. The depth of manure injection, the width of injection zone, and the spacing between bands depend on equipment, soil, and the applicator. Some injection equipment can place manure below the 12-inch sampling depth used for the post-harvest nitrate test. Manure may be injected or banded more than one time per year, with several orientations in a field (e.g., north-south or east-west). Because of the added variability associated with manure injection or banding, plan to collect a larger number of soil cores to obtain a representative composite sample.

Sample handling

Mixing. If it is not too hard to break up the soil cores, break them, mix them all together, and homogenize thoroughly. Take a 1-cup subsample for shipment to the lab. If

the soil cores are too hard to break apart, send the entire sample to the lab, where they can pass the sample through a mechanical grinder. Check with the lab to make sure they will grind and mix the *entire* sample before subsampling.

Preservation. Soils kept moist and warm continue to accumulate nitrate via biological activity after sampling. The simplest way to limit biological activity is to cool the soil after collection. Put the samples in plastic bags and place them in a cooler on ice while still in the field. Refrigerate them when you return from the field. Freeze the samples if they will be held longer than 48 hours before analysis.

Shipment. Keep the samples refrigerated or frozen until you deliver them to the lab. Contact the lab before you sample, so they will be prepared to receive the samples. Use a shipping method that will get the samples to the lab within 48 hours. You may want to freeze the samples before shipping to make sure they remain cool in transit.

Working with an analytical laboratory

Choose a laboratory that has experience with agricultural samples. Ask if they participate in the North American Proficiency Testing Program or a similar quality assurance program for agricultural testing labs. Find out what extraction and analytical procedures they use. Procedures should be consistent with those recommended for the western states (Gavlak et al., 1994).

Labs may use one of several colorimetric (color-based) lab procedures or they may use an electrode method to measure nitrate. Sample comparisons have shown that the colorimetric procedures usually are more precise than the electrode method.

Some testing labs also have sampling and consulting services. This can be convenient for people who have little experience in sampling or need help with sampling.

Find out how the lab reports soil test data. Standard units for soil nitrate-N are parts per million (ppm, Table 2). If you aren't familiar with the lab, it's a good idea to obtain a copy of a sample laboratory report.

Because you will use sample results to compare post-harvest soil nitrate across years, laboratory consistency over time is a major issue. A standard reference sample (soil sample with known concentration of nitrate) can help you assess laboratory variability. Consider submitting a standard reference sample (approximately 50 to 100 g dry weight) with a nitrate-N concentration of 20 to 45 ppm with each batch of soil samples. Keep track of test results for the standard reference sample over time. If you note a major error in the nitrate concentration reported for the standard reference sample, then the test data is questionable.

Standard reference samples are available from the North American Proficiency Testing Program (see "For more information," page 15). Standard reference samples must be dried, ground, and thoroughly mixed.

We do not recommend that you split a field sample to check laboratory consistency. The one-time nature of such comparisons, the uncertainty of obtaining a homogeneous sample, and the uncertainty of sample preservation in-transit to the lab limit the interpretation of split-sample data.

Developing a sampling plan

Nutrient management plans can be voluntary, required by regulatory agencies, or a part of an agreement with a conservation planning agency (e.g., Natural Resources Conservation Service or conservation district). If your nutrient management plan is not voluntary, consult the agency that supervises your nutrient management plan to determine whether they have specific requirements for how often fields must/should be sampled.

Suggestions given here for sampling frequency are general in nature and are not intended to serve as policy for any agency.

Representative fields for long-term monitoring

Representative fields are fields that you sample every year to track trends in sample values over time. Select fields that represent typical management practices. Criteria that can be used to choose representative fields include: (1) records or estimates of annual manure application rate, (2) number of years of continuous manure application, (3) soil test values for P and K. On dairies where P and K fertilizers are not routinely applied, soil test values above 75 ppm P (Bray P1 method) and 400 ppm K (ammonium acetate method) usually reflect substantial manure application in the past.

Sample the representative fields every year to assess trends over time. If you grow corn silage and perennial grass forage, plan to sample at least four grass fields and four corn fields each year. At a small dairy (fewer than four fields), sample all fields each year.

Other fields

Periodically, you will need to evaluate the fields not designated as "representative" fields. Consider sampling all fields every 3 years. Compare whole farm soil data to representative field data.

If you have only a few fields with elevated soil test N, then focus management on those fields. If all fields on the farm give similar test data, then focus your N management efforts at the whole farm level. If representative fields consistently have test values of less than 15 ppm (grass) or less than 20 ppm (corn) over a 3-year period, and all other fields sampled have similar test values, consider reducing the number of post-harvest soil nitrate tests.

Sampling priority

Prioritize fields for fall sampling ahead of time so that you get high-priority fields sampled at an appropriate time. Highest priority should be given to representative fields used to track long-term trends. Fields with high manure application rates or elevated soil test N the previous year should also have a high priority.

Corn fields can be sampled for soil nitrate in June (PSNT, pre-sidedress nitrate test) or in the fall (post-harvest test described in this publication). You will get the most management information by sampling your high-priority representative corn fields both in June (PSNT) and after harvest. You also may want to sample fields with PSNT values greater than 45 ppm nitrate-N again in the fall.

For other corn fields where only one soil test per year is planned, we recommend using the PSNT in preference to the post-harvest soil nitrate test. The PSNT is preferred because test results are applicable to in-season N management. Growers can save money and reduce post-harvest nitrate by omitting sidedress N fertilizer application on fields where sufficient soil nitrate-N is present in June.

Sampling corn fields at PSNT time also will reduce the number of post-harvest samples that need to be collected during the short interval between harvest and the end of the fall sampling window (approximately October 15). If you miss a planned fall sampling on a corn field, consider sampling next year using the PSNT.

Grass fields are best sampled in the fall, using the protocols described in this publication. Think carefully about the best way to achieve consistent timing of sample collection for your fields. The timing of manure application and the timing of grass harvest are key variables to consider.

Samples collected shortly after manure application are not a good indicator of the

balance between N supply and crop N demand over the entire growing season. If manure is applied late in the year, postpone soil sampling until after a fall grass harvest. Wait at least 30 days after a late-season manure application before sampling. Sampling need *not* be postponed until after the last manure application or until after the last grass harvest in the fall.

Questions and answers

Why is it difficult to achieve post-harvest nitrate-N less than 15 to 20 ppm with organic sources such as manure?

First, the timing and rate of application for organic sources is less flexible than for fertilizer N. Second, environmental processes that control the quantity and timing of N availability from organic sources are difficult to manage. The biggest factors controlling N availability are soil temperature and moisture. The timing of crop N uptake usually does not match the timing of N supplied from manure and other organic sources. Soil temperature and moisture often support continued release of available N after crop N uptake is complete.

Is there a relationship between soil organic matter content and potential N mineralization?

Research west of the Cascades has demonstrated a lack of correlation between soil organic matter content and N mineralization potential for soils having 3 to 8 percent organic matter. The active fraction of soil organic matter that controls annual N mineralization rates is a small proportion of total organic matter (usually less than 10 percent of total). Recent site management affects soil N mineralization potential; it does not have much effect on soil organic matter content. Because most soil total N is contained in soil organic matter, soil total N is also an unreliable indicator of mineralization potential.

What other soil tests can be used to provide information to guide N management for corn?

Soil nitrate testing in spring and early summer can assist with N management for silage corn. Test soil ammonium + nitrate-N several weeks after a spring manure application to track early-season N availability. Test soil nitrate when corn is at the four- to six-leaf stage (pre-sidedress nitrate test, PSNT) to determine the need for sidedress N application to corn.

How much variability should I expect in post-harvest nitrate-N test values for the same grass field sampled between August 15 and October 15?

It all depends on weather, soil biology, and crop management. A good stand of actively growing grass can maintain nitrate-N concentrations of less than 15 ppm throughout the post-harvest sampling period. Where soil is dry in late summer, increased N availability may occur for 2 or 3 weeks following the first heavy rain. It may be useful to take several soil nitrate tests from the same field in the fall to document changes in nitrate concentration with time. Soil nitrate values given in the interpretive table in this publication are for typical precipitation and sampling date.

Ammonium-N is plant-available. Why doesn't the post-harvest test include ammonium-N analysis?

Post-harvest ammonium-N analyses cost money, and they do not yield reliable interpretive information. Ammonium-N does not accumulate in soils supplied with an excess of plant-available N. It is rapidly converted to nitrate. Soil samples taken at least 30 days after manure application usually have negligible ammonium-N concentrations unless soil has remained dry.

Drying of soils after sampling releases ammonium-N from microbial biomass. Most dried soils have 2 to 20 ppm ammonium-N

that is caused by the soil drying process. Dry soil ammonium-N concentrations are poorly correlated with other indices of N availability in controlled experiments.

Should post-harvest nitrate tests be used for fields with organic soils?

Other methods should be used to assess the success of nutrient management plans on organic soils. Goals for post-harvest nitrate-N of less than 20 ppm are difficult if not impossible to attain on organic soils, which contain more than 20 percent organic matter. These soils formed as organic matter accumulated under natural poorly drained conditions. Soil organic matter decomposition and N mineralization processes are greatly accelerated under typical farming practices such as artificial drainage and tillage.

Should I measure or estimate soil bulk density to estimate post-harvest nitrate-N in units of pounds per acre?

The variation in bulk densities among soils typically is less than the variation associated with soil nitrate sampling and testing. Interpretive information in this publication is based on units of parts per million (ppm; mg per kg dry soil). You can approximate soil nitrate-N in the surface foot of soil by assuming typical bulk density ($\text{ppm} \times 3.5 = \text{lb/acre}$). This conversion factor is based on the weight of 1 acre-foot of soil at a bulk density of 1.3 g cm^3 (1 acre-foot = 3.5 million lb). Organic soils (more than 20 percent organic matter) have lower bulk density (0.6 to 0.8 g cm^3).

What is whole farm nutrient management?

The goals of whole farm management are: (1) to move toward a balance of nutrient imports and exports, and (2) to utilize nutrients on the farm at agronomic rates that minimize nutrient losses to the environment. Managing nutrients at the whole farm level requires knowledge of the major nutrient imports, major nutrient exports, crop

utilization of nutrients on the farm, and nutrient losses to air and water.

The Livestock and Poultry Environmental Stewardship (LPES) Curriculum, available through the Midwest Plan Service, includes a Web presentation of whole farm nutrient management principles and a worksheet for evaluating whole farm nutrient balance. See "For more information" (page 15) for details.

What is the role of post-harvest nitrate testing in connection with Comprehensive Nutrient Management Plans (CNMPs)?

CNMPs, developed by the Natural Resources Conservation Service (NRCS) or other nutrient management professionals under NRCS supervision, are broader than just nutrient management. Other components of a CNMP are: (1) manure and wastewater handling and storage, (2) land treatment practices, (3) record-keeping, (4) feed management, and (5) other waste utilization options.

Post-harvest nitrate test values may be used as part of a process to develop a new CNMP or to update an existing CNMP. The CNMP typically includes a plan for regular

soil testing. Appropriate timing of the post-harvest nitrate test is critical (see "When to sample," page 2), while soil samples for P and K analysis may be collected any time of the year. Soil samples collected for the post-harvest nitrate test can be analyzed by routine agronomic soil testing procedures and used in developing plans for P and K utilization in a CNMP.

What are the implications of high nitrate concentrations in forages?

Nitrate in ensiled forages can interfere with normal fermentation processes, resulting in poor-quality forage. Forage nitrate affects the distribution of nitrogen compounds in silage. It is difficult to use the silage to formulate rations that meet cow needs for specific protein fractions. Enough nitrate is sometimes present in the silage itself to create a health risk to the animal. Grass silage that is greater than 21 percent crude protein should be tested for the level of nitrate-N. See Johnson et al. (2002) for interpretation of forage nitrate concentrations.

For more information

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Many OSU Extension Service publications, as well as additional gardening information, may be viewed or downloaded from the Web (<http://eesc.oregonstate.edu>).

Copies of many of our publications and videos also are available from OSU Extension and Experiment Station Communications. For prices and ordering information, visit our online catalog (<http://eesc.oregonstate.edu>) or contact us by fax (541-737-0817), e-mail (puborders@oregonstate.edu), or phone (541-737-2513).

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Bary, A.I., C.G. Cogger, and D.M. Sullivan. 2000. Fertilizing with Manure, PNW 533.

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Visit the WSU Cooperative Extension publications Web site at <http://pubs.wsu.edu>

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Midwest Plan Service. Livestock and Poultry Environmental Stewardship (LPES) Curriculum. Available at: <http://www.lpes.org/>. Verified 14 January 2002.

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The authors acknowledge the involvement of the following individuals in development of portions of the publication:

Andy Bary, WSU Cooperative Extension,
Puyallup, WA

Don Horneck, OSU Extension Service,
Hermiston, OR

Joe Harrison, WSU Cooperative Extension,
Puyallup, WA

John Gillies, Washington State NRCS,
Lynden, WA

John Hart, OSU Extension Service,
Corvallis, OR

Mary Staben, OSU Extension Service,
Corvallis, OR

Orlando Schmidt, BC Ministry of Agriculture,
Food and Fisheries, Abbotsford, BC

Robert Dyk, Thurston Conservation District,
Tumwater, WA

Robert Stevens, WSU Cooperative Extension,
Prosser, WA

Steve Campbell, Oregon NRCS, Portland,
OR

Tom Gohlke, Oregon NRCS, Portland, OR

Valerie Oksendahl, Washington State
NRCS, Spokane, WA

Review comments on a draft of the publication were provided by:

Aria Baker, Linn Conservation District,
Tangent, OR

Brad Brown, University of Idaho, Parma, ID

Chris Clark and Chuck Timblin, Whatcom
Conservation District, Lynden, WA

Dean Moberg, Oregon NRCS, Hillsboro, OR

Fred Likkel, David Haggith, and Joy Hawley,
N3 Consulting, Lynden

Glenn Gately, Jefferson Conservation District,
Port Hadlock, WA

Jerry Lemunyon, NRCS, Fort Worth, TX

Lee Ko, Oregon NRCS, Oregon City, OR

Marty Chaney, Washington State NRCS,
Olympia, WA

Mike Gamroth, Animal Science, OSU,
Corvallis, OR

Mike Gangwer, OSU Extension Service,
Salem, OR

Shabtai Bittman, Agriculture and Agri-Food
Canada, Agassiz, BC

Troy Downing, OSU Extension Service,
Tillamook, OR

Wym Matthews, Oregon Department of
Agriculture, Tillamook, OR

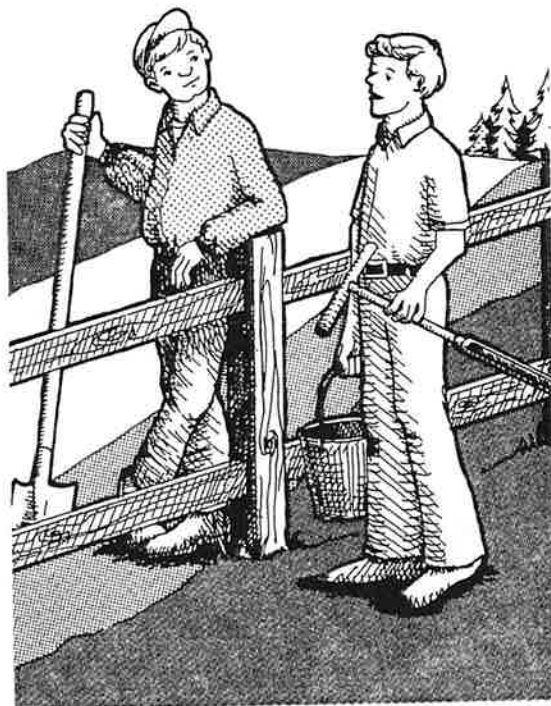
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Soil Sampling

for Home Gardens
and Small Acreages



OREGON STATE UNIVERSITY
EXTENSION SERVICE

Laboratory soil tests will help you develop and maintain more productive soil and increase crop production by providing information on the available nutrient content of your soil. Soil testing helps you select the correct kind and amount of fertilizer and liming material. Recommendations are based on the results of fertilizer experiments, soil surveys, and results obtained by farmers.

A soil sample weighing about 0.5 pound represents from 2 to 40 million pounds of soil in the field. Thus, care in sampling is essential.

When should I test my soil?

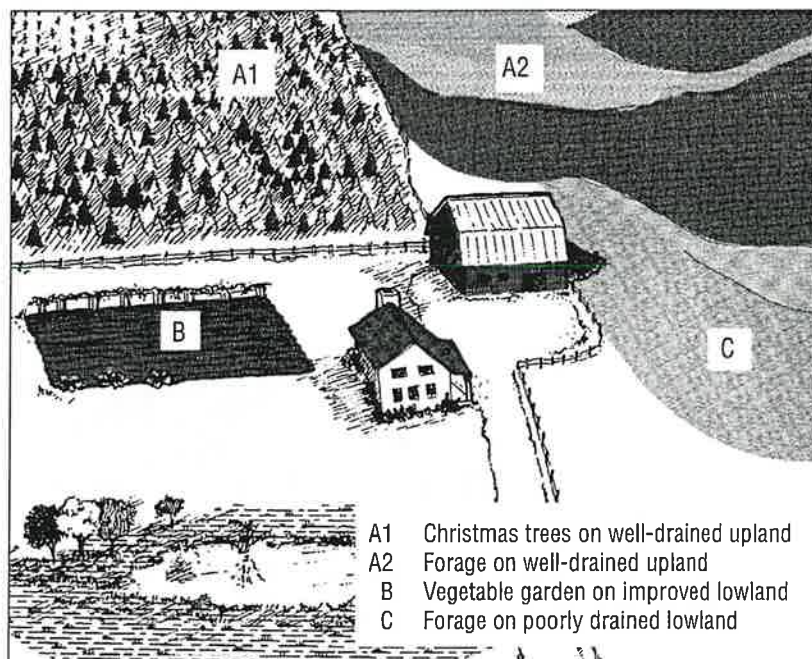
- *For perennial crops* such as orchards, Christmas trees, alfalfa, grass seed, and permanent pasture, the most important time to test the soil is before planting so that necessary nutrients can be mixed into the soil. This test is especially important in acidic soils where liming is likely to be needed. Apply lime and mix it with the soil several months before planting (for example, in the fall for spring planting), since it reacts slowly with the soil. Then:
 - For perennial grass seed, legumes, and pastures, test soil every 3 years after planting.
 - Soil testing usually is not used for established fruit trees, berries, or grapes. Use foliar nutrient analysis instead.
 - Testing soil in timber or Christmas tree plantings usually is not necessary until replanting, unless tree growth is unsatisfactory.

- *For annual crops*, especially vegetables, test soil each year before planting. If you plant successive crops in a single season, you don't need to test before each planting.
- *Additional information* on nutrient testing methods and requirements for various crops is available in OSU Extension publications.

Each soil sample should represent only one soil type or soil condition

The farm in the illustration below has three soil types: A (upland), B (improved lowland), and C (poorly drained lowland). On the upland soil, two areas have different management histories: A1 (Christmas trees) and A2 (pasture).

Sample each soil type (A, B, and C) separately. Areas with different management histories (A1 and A2) also should be sampled separately. In this example, a separate soil sample should be taken from each of the four areas.



How to sample

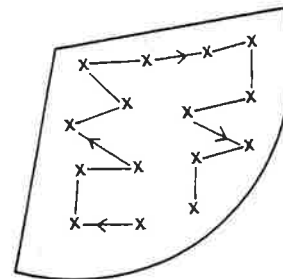
Sample where the crop will be planted

If you are using raised beds, such as for vegetable crops, take your samples in the beds, not in the areas between them.



Take 15 to 20 subsamples

Each sample should consist of subsamples (X) taken from 15 to 20 locations within the sampling area.



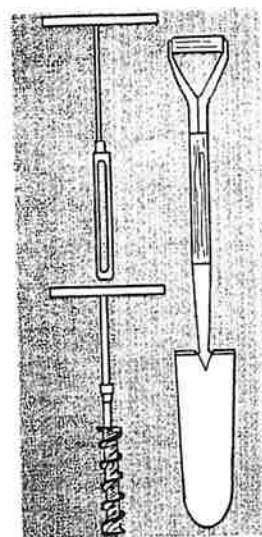
Avoid unusual areas

Avoid sampling in small areas where you know that conditions are different than the rest of the field (for example, former manure piles or fertilizer bands). You often can spot these areas by looking for plants growing very well or very poorly.



Avoid contaminating the sample

- Use clean sampling tools and avoid contaminating the sample during mixing or packaging. A small amount of fertilizer residue on tools or hands, for instance, can cause serious contamination of the soil sample.
- Do not use galvanized, brass, or bronze sampling tools to collect samples that will be tested for micronutrients such as zinc.



Note: This publication is not intended to be used as guidance for obtaining soil samples for environmental testing.

Take the soil sample to the correct depth

- Sample the part of the soil where the plant roots will grow. For most annual and perennial crops, sample from the surface down to about 6 to 9 inches.



Carefully mix the soil sample

Place all of the soil subsamples from a single sampling area in a clean container and mix thoroughly.



Forwarding the soil sample

- A list of laboratories that perform soil tests is available on the Web (<http://eesc.oregonstate.edu>) or from your county office of the OSU Extension Service.
- Call one or more labs to determine the cost of the soil test you need.
- After choosing a lab, request any necessary paperwork (such as an information sheet), find out how you should prepare and submit the sample, and obtain the address where you should send the sample.
- Prepare and submit the sample according to the instructions. Plastic zipper bags work best; do not use a paper bag. Most laboratories ask you to label the sample bag with identifying information and to fill out and include an information sheet with the sample. Don't forget to include payment.
- Number each sample and keep a record of the fields and areas sampled.



What analysis should I request?

The standard soil test from most laboratories measures organic matter, phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), and soil pH (acidity). For acidic soils, the SMP buffer test is the best way to determine how much lime is needed. Certain crops might have higher requirements for specific nutrients. Consult OSU Extension publications to determine whether you should test for nutrients such as sulfur (S), boron (B), or zinc (Zn).

Special soil-sampling techniques sometimes are required

- Nitrate nitrogen soil tests are recommended only for a few crops in eastern Oregon.
- For orchards, leaf sampling is more useful than soil sampling.

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This publication, originally prepared by E. Hugh Gardner, former Extension soil science specialist, was revised by Michael Robotham, Extension small farms faculty, Clackamas County, and John Hart, Extension soil science specialist, Oregon State University.

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NUTRIENT MANAGEMENT FOR DAIRY PRODUCTION

Which test is best?

Customizing dairy manure nutrient testing

D. Sullivan, C. Cogger, and A. Bary

Manure is a nutrient resource. To get the most value from this resource, you need accurate information on manure nutrient content. A regular manure testing program will:

- Help you save money on fertilizer
- Assist in refining application rates to meet, but not exceed, crop needs
- Demonstrate your commitment to protecting surface and groundwater quality
- Establish the value of manure for off-farm marketing
- Serve as a reliable data source for long-term farm plans

Both laboratory analyses and on-farm quick tests of manure nutrient content play an important role in manure management. Laboratory testing is the most reliable method of manure nutrient testing and is valuable for long-term planning and as a check on quick test results. Quick tests are valuable for rapid assessment of manure N content. Quick tests help guide daily management decisions.

Dan M. Sullivan, Extension soil scientist, Oregon State University; Craig G. Cogger, Extension soil scientist, Washington State University; and Andy I. Bary, scientific assistant, Washington State University.

This publication discusses the following aspects of a successful manure testing program:

- Collecting a manure sample that reflects average nutrient composition
- Selecting an analytical laboratory
- Requesting key nutrient analyses and usable reporting units from analytical labs
- Determining testing needs for different manure handling and storage systems
- Choosing on-farm tests for manure N content



On-farm quick tests determine manure N content within a few minutes.

Manure application plans often are based on average manure analyses for a particular manure handling and storage system. However, manure nutrient composition also is related to your specific management practices, including:

- Source and quality of feed
- Water added to manure
- Type and amount of bedding
- How long the manure is stored

Because these factors often vary during the year, manure nutrient content also varies.

The importance of nitrogen

Nitrogen (N) usually is the most important nutrient in a manure testing program. Farm management plans approved by your local conservation district, the Natural Resources Conservation Service, or the Oregon Department of Agriculture require an agronomic manure application rate. The agronomic rate usually is based on N. Agronomic rates supply appropriate amounts of plant-available N for crop growth without excessive loss of nitrate to groundwater.

Crops take up N from the soil in the ammonium or nitrate forms (plant-available N). Manure usually contains little or no nitrate as applied. Nitrogen in manure usually is present as ammonium and organic forms (amino acids, proteins, etc.). Manure ammonium-N is plant-available immediately after application. Soil microorganisms slowly convert manure organic N to plant-available forms after application.

Manure analytical methods determine total N and ammonium N. Organic N is not measured directly. It is calculated as the total N content minus the ammonium-N content.

You can use nitrogen analyses of manure for both long-term planning and short-term decision making. First, analyses collected over a period of years serve as a good data source for long-term farm plans (e.g., determining land area needs for manure utilization). Second, you can use analyses to guide daily management decisions (e.g., calculating an

application rate for a particular field). Simple, rapid on-farm testing procedures are well-suited for daily management decisions.

Effect of manure storage and handling on nitrogen content

How predictable is manure N content from your operation? The more variable the manure, the more samples you need to accurately characterize manure N content. Factors contributing to variability include:

Storage. Generally, the longer manure is stored, the higher the proportion of total N in the ammonium form, which is immediately available to plants. Organic N in stored manure is converted to ammonium-N by microbes; some of the ammonium-N then is lost as ammonia-N to the atmosphere.

Drying. Dried manure generally is low in ammonium-N; it is lost as ammonia during the drying process. Drying increases manure total N concentration (per unit volume).

Dilution. The more water added to manure, the lower its nutrient content. If you periodically add fresh water to a lagoon for summer irrigation, manure N content is reduced. Straw or other bedding materials usually are low in N and also reduce manure N concentration.

Tables 1 through 4 summarize the range in nutrient analyses for different manure-handling systems in the Pacific Northwest. We make the following observations:

Lagoon liquid pumped without agitation usually contains less than 5 lb N/1,000 gal; most of the N is in the ammonium form. Average total N content reported for two-cell Yakima Valley lagoons is 2.0 lb N/1,000 gal (Stevens and Prest, 1992, unpublished data). This is considerably lower than the average content reported for two-cell Willamette Valley lagoons, which is 4.4 lb N/1,000 gal (Table 1).

Agitated slurry from a lagoon or storage tank is highly variable; its N content varies with the total solids content of the slurry (Table 2).

Dry stack manure can have highly variable N contents because of variability in straw and moisture content (Table 3).

Separated manure solids from a mechanical separator are quite uniform in N content across a variety of separator and bedding types (Table 4).

Composted dry stack manure or composted separated solids are quite uniform in N content. Piles are mixed repeatedly during the composting process.

Table 1.—Nitrogen content of secondary lagoon liquid.^a

Dairy	Usual range ^b		
	Low	High	Average
	lb N/1,000 gal		
A	3.0	6.0	4.4
B	1.8	3.5	2.6
C	3.0	6.0	4.9
D	2.0	7.0	4.2
E	3.0	6.0	4.9
F	3.0	7.0	5.6
G	3.0	4.5	3.8
H	3.5	6.0	5.0
Average	2.8	5.8	4.4

^aSource: Gangwer, M., and M. Graham, 1994.

^b"Usual range" contains 80 percent of monthly measurements over a 2-year period (locations A-E), or a 1-year period (locations F-H). Nitrogen determined via an Agros meter. For these lagoons with less than 1 percent total solids, Agros nitrogen was approximately equal to total nitrogen.

Table 2.—Nutrient content of dairy slurries from agitated lagoons or agitated storage pits.^a

Total solids	Total N	Total P	Total K
%	lb/1,000 gal		
2	6–10	1.4–2.0	7–15
4	10–14	2.8–3.4	10–18
6	14–18	4.0–4.8	14–22
8	18–24	5.2–6.2	17–25

^aSource: Sullivan, et al., 1994. Based on 37 analyses (Whatcom County, WA). Average total N was 3.7 percent, average total P was 0.9 percent, and average total K was 4.4 percent on a dry weight basis.

Table 3.—Nutrient content of dry stack manure.^a

Nutrient	Analysis	
	Average	Standard deviation
	% (dry matter basis)	
Total N	1.3	0.30
Total P	0.81	0.19
Total K	1.86	0.51
	lb/wet ton (as-received basis) ^b	
Total N	8.6	1.6
Total P	4.0	0.8
Total K	13.1	2.8

^aSource: Stevens, R.G., and V.I. Prest, 1992, unpublished data. Analyses are an average of composite samples from 14 dry stack facilities in the Yakima Valley (WA).

^blb/wet ton based on an average total solids content of 35 percent (65 percent moisture). Standard deviation in total solids content was 8 percent.

Table 4.—Nutrient content of separated manure solids.

Nutrient	Analysis	
	Oregon ^a	Washington ^b
	% (dry matter basis)	
Total N	1.2 (0.28) ^c	1.5 (0.33)
Total P	0.21 (0.11)	0.26 (0.15)
Total K	0.46 (0.22)	0.51 (0.26)
C:N Ratio	33.1 (7.0)	25.6 (5.0)
	lb/wet ton (as-received basis) ^d	
Total N	4.6	5.6
Total P	0.8	1.0
Total K	1.7	1.9

^aSource: Gangwer, M., and M. Graham, 1995. Analyses are an average of 51 Willamette Valley (OR) facilities.

^bSource: Sullivan, D., and H. Bierlink, 1992, unpublished data. Analyses are an average of nine Whatcom County (WA) facilities.

^cValues in parentheses are standard deviations in dry matter nutrient analyses.

^dlb wet/ton based on an average total solids content of 19 percent (81 percent moisture). Standard deviation in total solids content was 4 percent.

Collecting samples and choosing a test

You can analyze composite samples by on-farm quick tests or ship them to an analytical laboratory for analysis. We recommend using both laboratory and quick tests.

Quick tests are less precise than laboratory analyses. You can use quick tests frequently during the application season to check the variability in manure nutrient content. Use laboratory tests periodically to:

- Check the accuracy of the quick test results
- Obtain nutrient analyses not provided by the quick tests

See "Setting up a sampling program for your farm" for a detailed discussion of when to choose a laboratory analysis and when to use a quick test.

Collecting samples

Collecting a sample that represents the average composition of a manure source (lagoon, dry stack, etc.) is essential in obtaining accurate information from manure analyses. Usually, a number of individual samples are collected and mixed together to make a composite sample, which is analyzed for nutrient content.

The choice of sample collection methods depends on the kind of manure storage or application equipment. The greater the potential variability in manure composition, the more individual samples ("grab" samples) you should mix to obtain a composite sample. Call upon local experts (extension agents, conservation district or NRCS staff, private consultants) to assist you in designing an appropriate sampling strategy for your dairy.

For liquid manure, sample agitated manure immediately before application. Some operators have installed sampling ports in irrigation lines, so liquid manure can be easily sampled as it is pumped.

Sprinkler-applied liquid also can be collected in buckets placed in the field. Samples collected after sprinkling usually have lower ammonium-N content because of ammonia volatilization.

For solid manure, take 10–20+ small grab samples from the pile to make one composite sample. If piles have substantially different amounts

of bedding, you will get better information by taking a separate composite sample from each pile.

After collection, thoroughly mix the grab samples and remove a composite sample (approximately 1 quart) for analysis.

Preparing samples for shipment to a lab

Preserve samples for laboratory analysis by refrigeration or freezing. Plan shipment so that samples are not left unrefrigerated over a weekend. Samples should arrive at the laboratory within 48 hours of shipment.

Check with your laboratory to discuss containers, preservation methods, and sample delivery schedules. Generally, laboratories prefer receiving samples in plastic containers with wide mouths and screw-top lids. Plastic bags are not recommended. (Nobody wants leaky manure samples!) Fill containers no more than two-thirds full to allow room for gases produced by fermenting manure.

Laboratory nutrient analysis

Description: Nutrient content determined via laboratory instruments.

Test procedure: Sample is homogenized, and analyses are run on a small subsample.

How it works: There are established procedures for each nutrient.

Manure type where it works best: Tests are valid for all forms of manure.

Nutrients estimated: Total N, ammonium-N, total P, total K, and total solids

Cost (for above analyses): \$30–\$60 per sample

Accuracy: Excellent. Major differences between laboratories usually are due to sample handling and preparation techniques, not analytical procedures.

Other comments: It is best to consistently use the same laboratory. See "Choosing a laboratory" for suggestions on selecting a laboratory, sample preservation, and shipping.

Choosing a laboratory

Find a lab that knows how to test manure and report results in a usable form. We suggest reporting manure analyses on both an "as-received" and a "dry weight basis" (Table 5). The "as-received" analysis can be used to determine application rates. The "dry weight" analyses can be used to track the consistency of manure nutrient composition over time. To develop a track record of manure analyses over time, use the same laboratory for each test.

To help you locate a suitable analytical laboratory, the Oregon State University Extension Service and Washington State University Cooperative Extension periodically compile lists of analytical laboratories serving the Pacific Northwest (see "Extension directories of analytical laboratories" at the end of this publication). Some extension and NRCS offices also have lists of laboratories doing business in their local areas.

Important questions to ask laboratory representatives include:

- Is the lab equipped to analyze manure samples for total N, ammonium-N, total P, total K, and total solids? How long will it take to provide results?
- How are analytical results reported? It's a good idea to obtain a sample laboratory report. Table 5 shows the preferred reporting units.
- How does the lab prepare the sample for analysis? For ammonium analysis, it is recommended that labs thoroughly mix and subsample wet samples. Drying samples prior to analysis results in loss of much of the ammonium-N.

- Does the lab participate in regional or national sample exchange programs coordinated by unbiased third parties (universities or trade associations)? Is the lab willing to share performance results from such sample exchange programs? Participation in sample exchange programs is a good indicator of a laboratory's commitment to precise and accurate results.

For composts marketed off-farm, we recommend additional analyses for pH, nitrate-N, cation exchange capacity, exchangeable bases (calcium, magnesium, potassium, and sodium), and conductivity (salinity). These analyses will help your customers successfully utilize compost.

Choosing an appropriate quick test

Quick tests are less precise than laboratory analyses. We recommend using both laboratory and quick tests (see "Setting up a sampling program for your farm"). Suggested applications for currently available quick tests are shown in Table 6.

Table 6.—Suggested on-farm quick tests for dairy manure N.

Type of manure	Hydrometer for total N	Nova meter for ammonium-N
Liquid less than 2% total solids	No	Yes
Liquid 2–6% total solids	Yes	Yes
Semi-solid 6–15% total solids	Yes ^a	Yes

^aSample must be diluted with water to 2–6 percent total solids; appropriate only for solid manure with little bedding; not suitable for separated solids.

Table 5.—Preferred reporting units for laboratory manure analyses. Results should be reported on both an "as-received" and "dry weight" basis.

Analysis	"As-received" basis		Dry weight basis
	Solid manure	Liquid manure	
Total solids ^a	%	%	
Total N, ammonium-N, total P, and total K	lb/wet ton	lb/1,000 gal	% ^b

^aTotal solids is another way to express the moisture content of the manure "as-received." For example, a sample having 20 percent total solids would have 80 percent moisture content.

^bFor liquid manure with a total solids content less than 2 percent, laboratory nutrient analyses reported on a dry matter basis often have substantial variability. This usually is due to small differences in total solids analyses.

The hydrometer is a useful quick test for agitated lagoon slurry or semi-solid manure that has been scraped and stored in a pit or tank. Such manure sources, with solids contents above 2 percent, usually contain a substantial portion of their N in the solid part of the manure.

The hydrometer works best for slurries containing from 2 to 6 percent total solids. It is not appropriate for estimating the nutrient content of separated solids or of solid manure with large amounts of bedding.

On-farm quick test: Hydrometer

Description: Floating glass apparatus with a weighted bottom.

Test procedure: Collect a representative sample of slurry in a 5-gallon bucket. Stir to suspend solids. Place the hydrometer in the bucket and read the result after 15 seconds. If the slurry is too thick for the hydrometer to float freely, mix the slurry with water, stir well, and take a hydrometer reading. For a 1:1 dilution (water:slurry), double the hydrometer reading to get the correct value for undiluted slurry.

How it works: Measures the density (specific gravity) of liquid manure.

Manure type where it works best: Slurries, 2 to 6 percent total solids.

Initial cost: \$30 to \$60. No additional cost per sample.

Nutrients estimated: Total solids, total N, and total P.

Accuracy: Fair. We developed the following regression equations for agitated manure slurries (Sullivan, et al., 1994):

$$\text{Total N (lb/1,000 gal)} = 3.7 + 2.14 \times (\text{percent total solids}), R^2 = 0.72$$

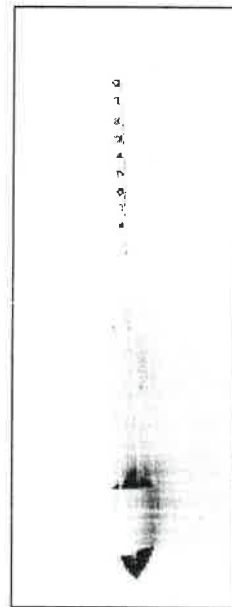
$$\text{Total P (lb/1,000 gal)} = 0.42 + 0.66 \times (\text{percent total solids}), R^2 = 0.84$$

These regression equations were based on 37 composite samples collected from dairies in Whatcom County, WA over a 4-month period. Our regression equations for the hydrometer are similar, but not identical, to those previously reported for dairy slurry from North Carolina (Chescheir, 1985).

If your hydrometer is calibrated in units of specific gravity, use this table to estimate total solids:

Specific Gravity	Total Solids (%)
1.011	2.0
1.020	4.0
1.028	6.0

Other comments: To use a hydrometer to estimate slurry nutrient content, you must have a calibration equation to relate slurry density to nutrient content. Calibration equations given in this publication are valid only for dairy manure. Hydrometers are available that read out in units of specific gravity, percent total solids, or percent total N. Measurement scales for hydrometers that read out in units other than specific gravity are based on manufacturers' regression equations.



The hydrometer measures slurry density and estimates total slurry N via a regression equation (see page 6). It also provides an estimate of slurry P content.

The Nova meter, which measures only ammonium-N, provides a helpful quick test for the N that is immediately plant-available. It is the quick test of choice for lagoon liquids, which contain most of their N in the ammonium form.

On-farm quick test: Nova meter or Agros meter

Description: Stainless steel or plastic chamber with a built-in pressure gauge. The Nova meter (plastic chamber) is a recent replacement for the Agros meter (stainless steel chamber). Both Nova and Agros meters use the same chemical process to estimate manure N.

Test procedure: Add manure to the main chamber using the scoop provided by the manufacturer. Add hypochlorite reagent to a separate reservoir inside the chamber. After the lid is secured, mix the hypochlorite and the manure inside the chamber following the manufacturer's instructions. Wait 2-5 minutes. Manure N content is given on the pressure gauge.

How it works: Hypochlorite oxidizes ammonium-N to form nitrogen gas (N_2) inside the chamber. The higher the manure ammonium-N, the more pressure is generated. The pressure gauge is calibrated by the manufacturer to read out in units of N.

Manure type where it works best: This quick test gives results very similar to a laboratory ammonium-N analysis. Use for manure where ammonium-N is a major proportion of total N. This is the best quick test for liquid manure with less than 2 percent solids.

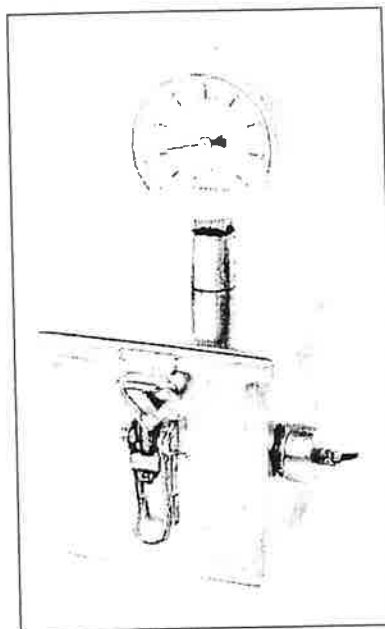
Cost: Initial cost is \$350 to \$500. Hypochlorite reagent is consumed with each test.

Nutrients estimated: Ammonium-N only.

Accuracy: Excellent (See Sullivan, et al., 1994; Chescheir, et al., 1985).

Caution: Hypochlorite reagent is hazardous to eyes and irritates the nose and skin. Protect yourself with safety glasses, gloves, and a dust mask. Perform the tests outdoors in a well-ventilated area. Hypochlorite also is corrosive. Rinse metal parts with water after each use. Don't dispose of excess reagent in the garbage; it is a strong oxidizer.

Other comments: On some Nova or Agros meters, the pressure gauge has units of $kg\ N/m^3$. To convert kg/m^3 to $lb/1,000\ gal$, multiply by 8.34.



Setting up a sampling program for your farm

Manure from different handling systems (dry stack, lagoon liquid, etc.) should be sampled and analyzed separately. The amount of time and money devoted to sampling manure from different sources should reflect its relative importance as a nutrient source and its potential variability. The more variability, the more sampling is required. Samples collected close to the time of application best reflect the nutrients applied to the field.

Let's take a look at how the general principles of manure sampling and testing apply to a specific dairy operation. For our example, let's consider a large dairy in western Washington or western Oregon with a flush barn-cleaning system, a mechanical solids separator, and a two-cell lagoon. Manure is generated from three sources: the separated solids, the secondary lagoon liquid, and periodic agitation of the primary and secondary lagoon for solids removal.

The suggested sampling plan is shown in Table 7 and is discussed below. To check the accuracy of the quick tests (Nova meter and hydrometer), we recommend splitting a composite sample once each year and analyzing it via both laboratory and quick test methods.

Secondary lagoon liquid. For this dairy operation, the most frequent manure application is in the form of secondary lagoon liquid. A yearly laboratory test is recommended to serve as a reliable record of the nutrient value of the secondary liquid (see

Table 5 for recommended analyses). The samples for laboratory analysis can be taken at almost any time, but are most useful if taken when the lagoon is at least half full.

Since the secondary lagoon liquid contains N primarily in the ammonium form, its N content can be estimated using a Nova meter. Testing with the Nova meter can be used throughout the application season to refine application rates. It is especially helpful in the summer when the operator mixes secondary lagoon effluent with fresh irrigation water.

Agitated lagoon slurry. Each spring, the operator agitates the lagoon to remove accumulated solids from the bottom. The slurry produced by agitation is much higher in N content because of the suspended solids. We recommend at least one laboratory analysis per year. A hydrometer can be used on a daily or weekly basis to measure changes in N content due to differing amounts of suspended solids.

Separated solids. The nutrient analysis of the separated solids is not expected to vary significantly from published values (Table 4). Furthermore, for the current growing season, the separated solids represent only a small risk of excess N application, because most of the N is present in organic compounds that are slow to release plant-available N. Therefore, using average analytical values for separated solids (Table 4) is acceptable. We do not recommend routine testing of separated solids for on-farm utilization.

Table 7.—Example of a yearly sampling plan utilizing both laboratory and on-farm quick test methods.^a

Manure applied as:	Application period	Suggested test frequency	
		Lab test	Quick test
Secondary lagoon liquid	April–Sept.	yearly	Nova—monthly
Separated solids	April–Sept.	none	none
Agitated lagoon slurry	April–May	yearly	Hydrometer—weekly

^aExample location: western Oregon/Washington. Two-cell lagoon storage with solids separator.

Calculating manure application rates

A manure analysis is only part of the information you need for site-specific estimates of appropriate N application rates (volume or weight per acre).

Other information needed includes:

- Crop N requirement
- Proportion of manure-N that will be plant-available during the growing season (less than 100 percent)
- Quantity of N supplied from other sources (e.g., decomposition of soil organic matter, fertilizer N)
- Crop N uptake efficiency—proportion of plant-available N removed by the crop (less than 100 percent)

We suggest you work with an agronomist in calculating site-specific application rates. You can get a rough idea of appropriate manure N application rates by assuming that crop N uptake is approximately equal to the needed manure N inputs. An example of this approach is found in OSU Extension publication EM 8585, *Manure Application Rates for Forage Production* (Hart, et al., 1996). It is a reasonable approach if manure is applied every year to the same fields.

Periodic soil testing also helps you apply manure at rates that match crop requirements.

Manure testing as part of whole-farm nutrient management

Manure testing is a more powerful tool when used together with other tools for nutrient management. Records of feed inputs, field-by-field manure application amounts and timing, fertilizer applications, and soil and plant tissue test results are some of the other components of whole-farm nutrient management. When data from these sources are used together, you can consider environmental as well as economic consequences when making long-range management decisions.

The references listed at the end of this publication can help you get started with whole-farm nutrient management. Together with manure analyses, these tools can help you adjust manure management to meet economic and water-quality goals.

Suppliers for quick tests

Both hydrometers and Nova meters may be available for short-term use from your local conservation district or NRCS office.

Hydrometers

Whatcom Conservation District, 6975 Hannegan Rd., Lynden, WA 98264; phone: 360-354-2035.

Various laboratory supply companies. Choose a hydrometer used for measuring the specific gravity of soil suspensions. We recommend a model that is equivalent to ASTM #151H specifications (measures specific gravity from 0.995 to 1.038 g/cm³).

Nova meters

Farm Home Offices, Inc. 1965 64th St., Box 840, Vinton, Iowa 52349; phone: 800-788-7218 (sells a version of the Nova meter called "On-the-farm manure nitrogen test kit").

Grass Roots Project Management, P.O. Box 136, Chilliwack, BC, Canada V2P 6H7; phone: 604-795-2350 (sells a version of the Nova meter called the "Nova MK2 meter").

For more information

Selected research publications

Chescheir, G.M., P.W. Westermann, and L.M. Safley. 1985. Rapid methods for determining nutrients in livestock manures. *Transactions of the ASAE* 28 (6): 1817-1824 (American Society of Agricultural Engineers, St. Joseph, MI).

Sullivan, D.M., H. Bierlink, and W. Matthews. 1994. Tools for getting more value out of dairy manure. pp. 55-65. In: *Proc. 26th Annual Dairy Producers Short Course*, Feb. 8-9, 1994, Clearbrook, BC, Canada. BC Ministry of Agriculture, Fisheries and Food, Chilliwack, BC (available from Dan Sullivan, Department of Crop and Soil Science, Oregon State University).

Manure analyses for Willamette Valley dairies

Available from:

M. Gangwer
Marion County Office
OSU Extension Service
3180 Center St. NE, Room 1361
Salem, OR 97301
Phone: 503-588-5301

Gangwer, M., and M. Graham. *Wastewater volume and nitrogen concentrations in Willamette Valley, Oregon dairy ponds*, SR 939 (Oregon State University, Corvallis, 1994). No charge.

Gangwer, M., and M. Graham. *Analysis of separated manure solids from selected manure separators in Willamette Valley, Oregon dairy facilities*, SR 945 (Oregon State University, Corvallis, 1995). No charge.

Extension directories of analytical laboratories

See ordering instructions on page 11.

Hart, J. *A list of analytical laboratories serving Oregon*, EM 8677 (Oregon State University, Corvallis, 1997). No charge.

Schreiber, A., and C.H. Daniels. *Analytical laboratories and consultants serving the Pacific Northwest*, EB 1578 (Washington State University Cooperative Extension, Pullman, 1994). \$1.50

Extension publications on whole-farm nutrient management

See ordering instructions on page 11.

Sullivan, D.M., C.G. Cogger, and A.I. Bary. *Date, rate, and place: The field book for dairy manure applicators*, EM/PNW 506 (Oregon State University Corvallis, 1997). \$5.50

Gardner, E.H., and J. Hart. *How to take a soil sample . . . and why*, EC 628 (Oregon State University, Corvallis, revised 1995). No charge.

Grusenmeyer, D., and B. Peterson. *Manure management guidelines for western Washington* (Washington State University Cooperative Extension, Whatcom County, 1995). Available from Whatcom County Office, 1000 N. Forest, Bellingham, WA 98225.

Hart, J., M. Gangwer, M. Graham, and E. Marx. *Dairy manure as a fertilizer source*, EM 8586 (Oregon State University, Corvallis, reprinted 1997). 75¢

Hart, J., E.S. Marx, and M. Gangwer. *Manure application rates for forage production*, EM 8585 (Oregon State University, Corvallis, reprinted 1997). \$1.00

Hermanson, R.E. *Manure sampling for nutrient analysis with worksheets for calculating fertilizer values*, EB 1819 (Washington State University, Pullman, 1996). \$1.00

Hermanson, R.E., A.C.S. Rao, W.L. Pan, K.F. Duncan, and M.A. Wright. *MNB: Manure nutrient balancer* (computer software for IBM-compatible computers) (Washington State University, Pullman, 1995). Order number MCP 0026. \$25.00

Marx, E.S., J. Hart, and R.G. Stevens. *Soil test interpretation guide*, EC 1478 (Oregon State University, Corvallis, reprinted 1997). \$1.50

Marx, E.S., N.W. Christensen, J. Hart, M. Gangwer, C.G. Cogger, and A.I. Bary. *The pre-sidedress soil nitrate test (PSNT) for western Oregon and western Washington*, EM 8650 (Oregon State University, Corvallis, reprinted 1997). 75¢

Moore, J., and M.J. Gamroth. *Calculating the fertilizer value of manure for livestock operations*, EC 1094 (Oregon State University, Corvallis, reprinted 1993). \$1.00

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Manure testing quick tips

A regular manure testing program will:

- Help you save money on fertilizer
- Assist in refining application rates to meet, but not exceed, crop needs
- Demonstrate your commitment to protecting surface and groundwater quality
- Establish the value of manure for off-farm marketing
- Serve as a reliable data source for long-term farm plans

Variability in manure analyses. The more variable the manure source, the more often you need to test it to characterize its nutrient content. This publication summarizes the variability observed for different manure handling systems in the Pacific Northwest. Use this information to budget your testing dollars.

Collecting samples for nutrient analysis. Collect a sample that represents the average composition of a manure source (lagoon, dry stack, etc.) to obtain accurate results.

Laboratory testing is the most reliable testing method. Find a lab that knows how to test manure and report results in a usable form. We recommend analysis for total N, ammonium-N, total phosphorus (P), total potassium (K), and total solids (moisture content). Ask the lab to report nutrient analyses on both an "as-received" and a "dry weight" basis.

Quick tests for nitrogen. Although laboratory tests are more accurate, quick tests provide information to guide daily management decisions. Two simple, rapid, on-site test procedures for N analysis are described in this publication (the hydrometer and the Nova meter). Verify quick test results with periodic laboratory analyses.

Calculating agronomic manure application rates. A manure analysis is only part of the information you'll need. An agronomist can help you calculate site-specific manure application rates to meet crop needs.

Fertilizer Guide

FG 10
Revised April 1983

FIELD CORN (Western Oregon—West of Cascades)

Good management practices are essential if optimum fertilizer responses are to be realized. These practices include use of recommended varieties, selection of adapted soils, weed control, disease and insect control, good seed bed preparation, proper seeding methods, and timely harvest.

Because of the influence of soil type, climatic conditions, and cultural practices, crop response from fertilizer may not always be accurately predicted. Soil test results, field experience, and knowledge of specific crop requirements help determine the nutrients needed and the rate of application.

Recommended soil sampling procedures should be followed in order to estimate fertilizer needs. The Oregon State University Extension Service agent in your county can provide you with soil sampling instructions and soil sample bags and information sheets.

Plant Population

The fertilizer applications suggested in this guide are based on a population of 20,000 plants/A. Where the plant population exceeds 20,000/A, fertilizer rates should be increased by 10% for each additional 5,000 plants/A. Fertilizer rates should be reduced similarly for populations less than 20,000/A.

Area 1 and Area 2

Fertilizer responses in western Oregon differ between:

Area 1: Willamette Valley and northwest Oregon

Area 2: southwest Oregon

} NITROGEN (N)

Irrigated Corn

1. Following grain, silage corn, or non-legume crops: Apply 150 to 200 lbs N/A.
2. For corn following a good growth of legumes: Apply 80 to 100 lbs N/A.

Non-Irrigated Corn - Area 1 only

1. For corn following grain or other non-legumes: Apply 60 to 90 lbs N/A.

2. For corn following a good growth of legumes: Apply 50 to 70 lbs N/A.

For best results, part of the N should be banded 2" to 3" to the side and 2" to 3" below the seed. To avoid salt injury to young seedlings, the total of banded N plus added potash (K_2O) should not exceed 100 lbs/A. When fertilizer is banded within 1" of the seed N + K_2O should not exceed 40 lbs/A.

Additional N can be applied broadcast or as a top dressing.

Some factors affecting salt injury are:

- ° Injury is aggravated as the fertilizer band comes closer to the seed.
- ° The danger of injury is greater with sandy than with finer textured soil.
- ° Immediate irrigation at the first sign of burn should reduce further injury.

PHOSPHORUS (P)

P fertilizer should be banded 2" to 3" to the side and 2" to 3" below the seed at the time of planting. Immediately available P is necessary to assure good seedling growth and a good root development, especially when corn is planted early before the soil is warm.

If the OSU soil test for P reads (ppm):	Apply this amount of phosphate (P_2O_5) (lb/A):										
	<table><tr><th>Area 1</th><th>Area 2</th></tr><tr><td>0 - 7</td><td>60-100</td></tr><tr><td>7 - 15</td><td>40-60</td></tr><tr><td>15 - 30</td><td>30-40*</td></tr><tr><td>Over 30</td><td>30-40*</td></tr></table>	Area 1	Area 2	0 - 7	60-100	7 - 15	40-60	15 - 30	30-40*	Over 30	30-40*
Area 1	Area 2										
0 - 7	60-100										
7 - 15	40-60										
15 - 30	30-40*										
Over 30	30-40*										

If banding equipment is not available, little response from P can be expected with P soil test values above 30 ppm in Area 1 or above 15 ppm in Area 2. Where banding equipment is not available, P fertilizer should be plowed down or worked into the seed bed and the rate of application should be increased by 50%.

These fertilizer rates assume that soil pH is greater than 5.5.



OREGON STATE UNIVERSITY EXTENSION SERVICE

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POTASSIUM (K)

If the OSU soil test for K reads (ppm):	Apply this amount of potassium (K ₂ O) (lb/A)	
	Area 1	Area 2
0 - 75	80 - 120	60 - 100
75 - 100	60 - 80	40 - 60
100 - 150	40 - 60	0
Over 150	0	0

Up to 50 lbs of K₂O/A can be included in the fertilizer band when the band is located at least 2" from the seed. The total of banded N and banded K₂O should not exceed 100 lbs/A. When fertilizer is banded within 1" of the seed, N + K₂O should not exceed 40 lbs/A. The remainder of the K should be broadcast prior to seeding.

On poorly drained Dayton and related soils K should not be banded, and with these soils potassium sulfate may give better results than potassium chloride.

SULFUR (S)

Plants absorb S in the form of sulfate. Fertilizer materials supply S in the form of sulfate and elemental S. Elemental S must convert to sulfate in the soil before the S becomes available to plants. The conversion of elemental S to sulfate is usually rapid for fine ground (less than 40 mesh) material in warm moist soil.

The S requirements of field corn can be provided by:

1. The application of 10-15 lbs S/A in the form of sulfate at planting time.
2. Applying 30-40 lbs S/A as fine ground elemental S the preceding year.
3. Applying coarser ground elemental S at higher rates and less frequently.

Responses to S fertilization may not occur for a period of at least 4 or 5 years on "red hill" soils which have a history of high S fertilization. These soils have a comparatively high ability to adsorb S and frequently have a history of high S fertilization through the use of S-containing fertilizer such as ammonium sulfate.

MAGNESIUM (Mg)

Responses of field corn to Mg have not been observed in western Oregon. Trial applications of Mg are suggested where soil test levels are below 0.8 meq/100g soil.

Mg can be banded at 10 to 15 lbs/A at planting. Mg can also be supplied in dolomite, which is a liming material that reduces soil acidity to about the same degree as ground limestone. Dolomite should be mixed into the seed-bed at least several weeks in advance of seeding.

An application of dolomite will supply magnesium and reduce soil acidity for several years.

ZINC (Zn)

The application of Zn has increased the yields of sweet corn in the Stayton area, especially on the gravelly, dark colored soils.

Field corn and sweet corn have similar Zn requirements.

If the OSU soil test for Zn reads (ppm):	Apply this amount of Zn (lb/A):
Less than 0.8	3-4 banded or 10 broadcast
Over 0.8	None

When the soil test is below 0.8 ppm Zn, a response to Zn is expected on all soils. When the soil test is between 0.8 and 1.5 ppm Zn, a response to Zn is expected on most soils in the Stayton area.

Where Zn is required, either 10 lb/A of Zn should be broadcast and worked into the soil prior to planting or 3 to 4 lbs/A of Zn should be banded with the fertilizer at planting time. A broadcast application of 10 lbs Zn/A should supply Zn needs for 2 or 3 years.

BORON (B)

Responses of field corn to B applications have not been observed in western Oregon. Trial applications of 2 lbs/A B are suggested when soil test B levels are below 0.5 ppm. B should be applied uniformly to the field and should not be banded.

LIME

Experimental work has shown that corn will produce good yields over a fairly wide range of soil acidity. Lime applications should be made when the soil pH is 5.5 or below, or when calcium (Ca) levels are below 5 meq Ca/100g of soil.

If the OSU SMP Buffer test for lime reads:	Apply this amount of lime (T/A):
Below 5.2	4 - 5
5.2 - 5.6	3 - 4
5.6 - 5.9	2 - 3
5.9 - 6.2	1 - 2
Over 6.2	0

The liming rate is based on 100-score lime. Lime should be mixed into the seed bed at least several weeks before seeding. A lime application is effective over several years.

Do not apply lime when the soil pH is above 6.0. Yields were reduced in Willamette Valley experiments when lime raised the soil pH to 6.5. Responses of field corn to lime have not been observed in Jackson or Josephine counties.

P, K, Mg, Zn, B, and lime recommendations are based on soil test values from the Soil Testing Laboratory, OSU, Corvallis, Oregon.

This guide is largely based on the results of experiments conducted by T. L. Jackson, John Yungen, and L. Boersma, Oregon Agricultural Experiment Station, and observations of growers' fields.

Prepared by E. Hugh Gardner and T. L. Jackson, Extension Soil Scientists; and T. A. Doerge, Dept. of Soil Science; Extension Service and Agricultural Experiment Station, Oregon State University. Reviewed by a committee of western Oregon county extension agents.



Winter wheat

Western Oregon—west of Cascades

J. Hart, N.W. Christensen, T.L. Jackson, R. Karow, and W.E. Kronstad

This fertilizer guide is based on wheat yield response to nutrients applied in experiments conducted by Oregon State University. The guide applies to fertilization of soft white winter wheat in western Oregon, where the risk of take-all root rot is low (first-year wheat or where take-all decline has become established). For further information about growing and fertilizing wheat in high take-all risk situations, refer to EC 1453, *Combating Take-All Root Rot of Winter Wheat in Western Oregon*.

Management Practices

Fertilizer recommendations assume good management practices such as weed and disease control, planting date, and cultivar selection. One cultivar seldom is adapted to all production environments. Of the currently available high-yielding cultivars, Yamhill is more tolerant of limited drainage than are Stephens, Malcom, or Hill-81. Yamhill and Hill-81 are more tolerant of low soil pH than is Stephens.

Plant wheat at the end of September to early October in a take-all free environment. Delay planting if temperatures are unseasonably warm in late September and early October. Planting after a period of cool weather assumes reduced aphid population and less possibility of aphid damage to young wheat plants. If planting is delayed, Stephens can be planted until mid-February, Hill-81 and Malcom until late January. Do not plant Yamhill or Daws after January 1. Delayed planting can cause substantial yield reductions.

Banding P, K, S, and some N fertilizers with or near the seed at planting has proven to be an effective method of fertilizer application for small amounts of nutrients and immobile nutrients such as P and K. (*Caution:* Fertilizer placed with the seed can delay emergence and reduce stands during exceptionally dry years.)

Surface drainage is important as wheat is likely to be killed if water stands on fields for more than a few days during the vegetative growth stage. Planting wheat on ridges will improve survival on poorly drained valley floor soils. (See FS 269, *Growing Winter Wheat on Poorly Drained Soil*, for more information.)

Follow recommended soil sampling and testing procedures for P, K, and lime to estimate fertilizer and lime needs.

County offices of the OSU Extension Service can provide soil sampling instructions and a list of soil testing laboratories serving Oregon.

Nitrogen (N)

An application of 20 lb N/a at seeding time is recommended if wheat follows a grass seed or grain crop. This fertilizer can be banded in combination with P fertilizers near or with the seed. Fall N application is not recommended for wheat following row crops or a good legume crop.

Spring application

The first step toward determination of optimum spring N rates is to identify a realistic yield goal. Wheat grain yield potential is 120 to 140 bu/a for deep, well-drained valley floor soils, 80 to 100 bu/a for well-drained hill soils with a rooting depth greater than 3 ft, and 60 to 80 bu/a on shallow hill soils and valley floor soils with restricted drainage. Over-fertilization with N is detrimental to the environment, especially groundwater supplies.

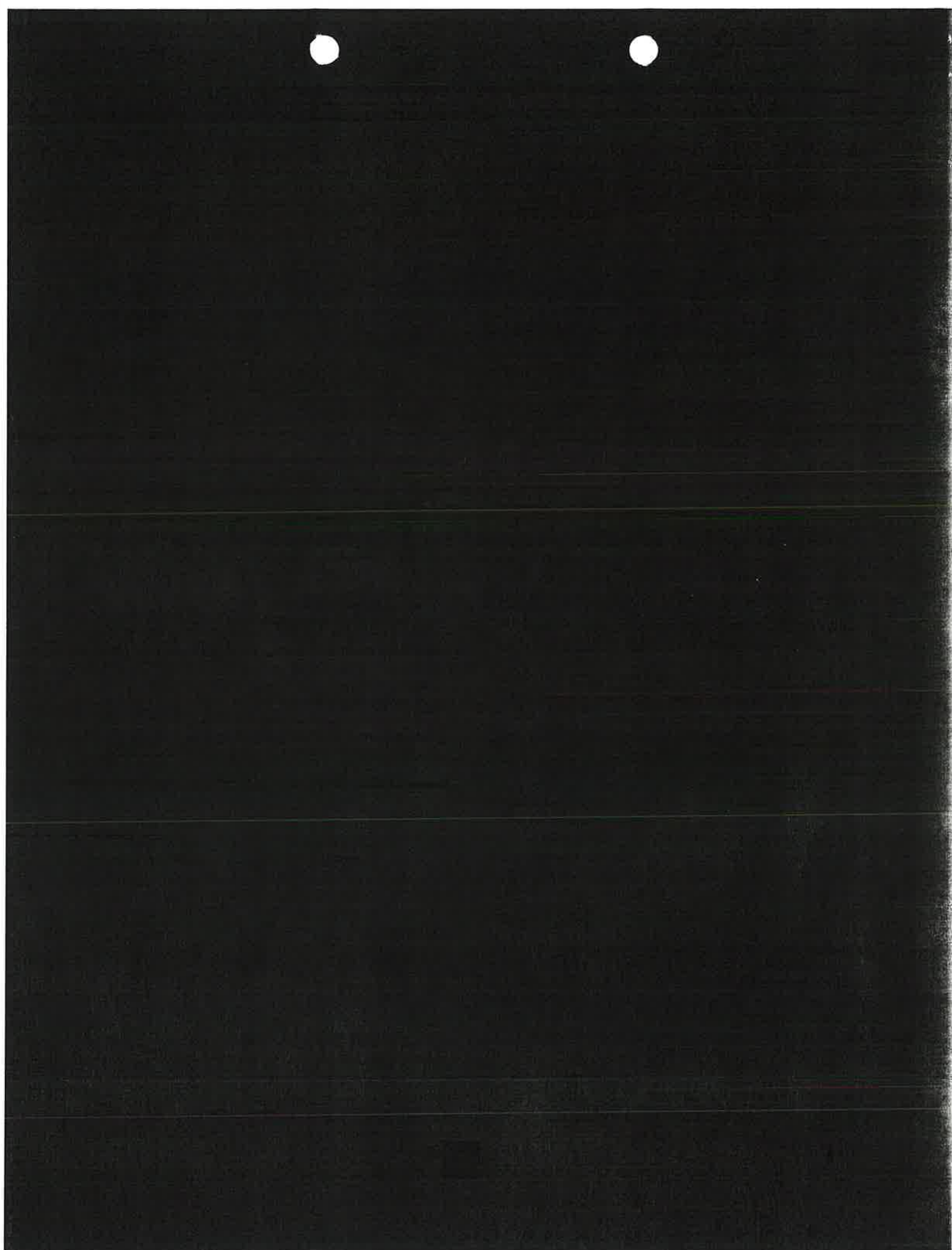
For wheat following wheat, grass seed, or other grain crops, apply 140 to 180 lb N/a before jointing (Feekes 6.0). If the spring N application is delayed after this time, a yield reduction can occur. An alternative is to apply 40 lb of N during late tillering (Feekes 5.0), generally mid-February, and the remaining N 1 month later. A split application will increase wheat yields 10 to 12 bu/a over a delayed single application. Some N may be spring applied with pesticides. Read and follow pesticide label directions.

Apply 100 to 140 lb N/a where wheat follows row crops, vetch, peas, or a poor perennial legume stand. An application of 60 to 100 lb N/a is recommended where wheat is grown after a good crop of alfalfa, crimson clover, or red clover.



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John Hart, Extension soil scientist; Neil W. Christensen, professor of soil science; Tom L. Jackson, professor emeritus of soil science; Russ Karow, Extension agronomist; and W.E. Kronstad, professor of crop science; Oregon State University.



For More Information

OSU Extension Service publications

Growing Winter Wheat on Poorly Drained Soil, FS 269, by N.R. Goetz, M. Stoltz, T.L. Jackson, and R.S. Karow (revised 1996). No charge.

How to Take a Soil Sample ... and Why, EC 628, by E.H. Gardner (revised 1997). No charge.

A List of Analytical Laboratories Serving Oregon, EM 8677, by J. Hart (revised 1997). No charge.

Combatting Take-All Root Rot of Winter Wheat in Western Oregon, EC 1423, by N.W. Christensen and J.M. Hart (1993). 75¢

To order copies of the above publications, send the complete title and series number, along with a check or money order for the amount listed (payable to Oregon State University), to:

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World Wide Web

Fertilizer and Lime Materials, FG 52, by J. Hart (reprinted 1997). No charge.

You can access the above publications, as well as FG 9, *Winter Wheat: Western Oregon—West of Cascades*, our Publications and Videos catalog, and many other publications via our Web site at eesc.orst.edu

Other publications

Caputo, J.A. 1985. Effects of nitrogen applied on wheat straw on winter wheat (*triticum aestivum* L.) yields in western Oregon. M.S. thesis, Oregon State University, Corvallis, OR.

Christensen, N.W. and M. Brett. 1988. Wheat yield and N uptake as influenced by treating crop residue with urea-sulfuric acid. *J. of Fertilizer Issues* 5(2):50-55.

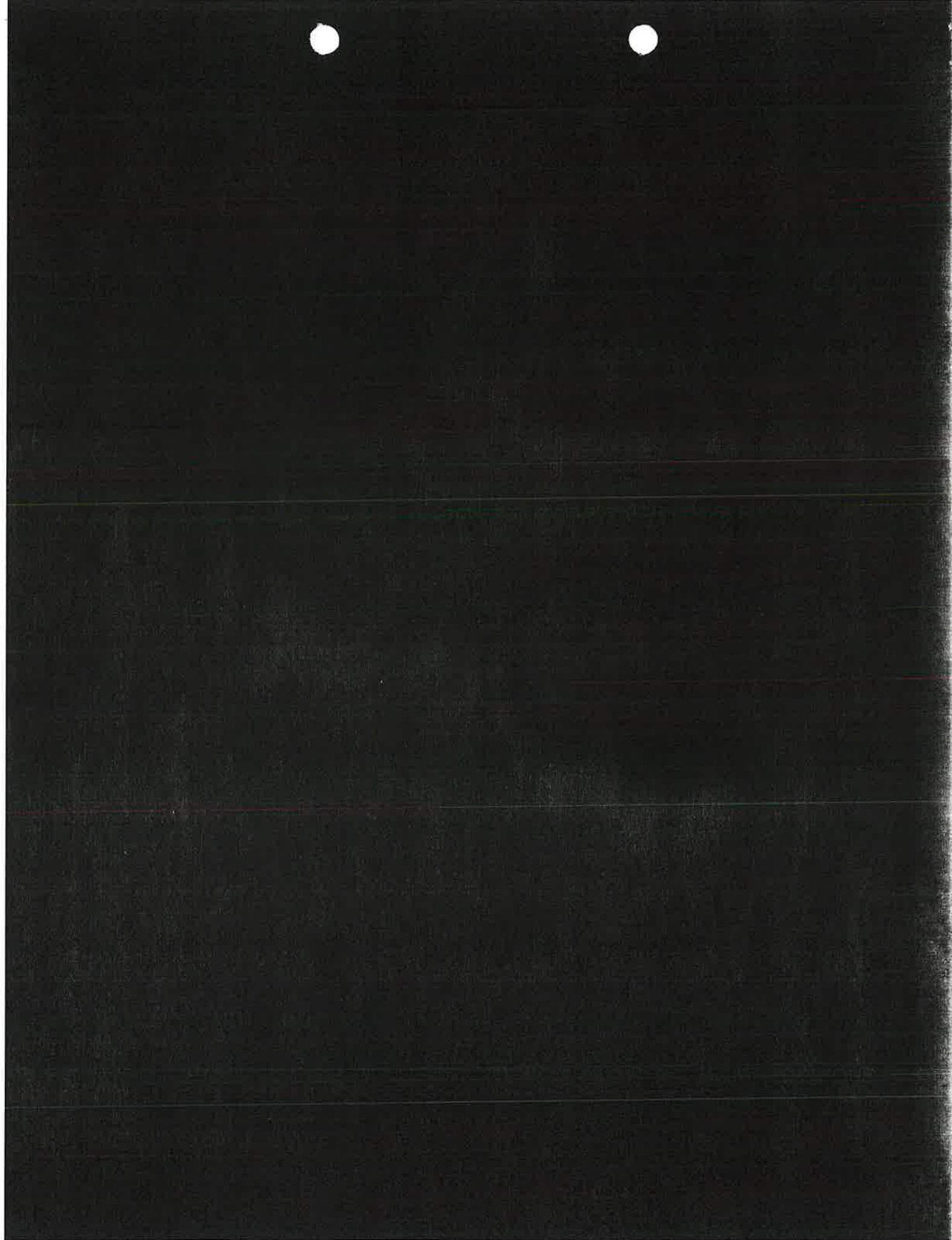
Hart, J.M. and N.W. Christensen. 1987. Economic considerations for N fertilization of wheat in the Willamette Valley. In *Proceedings Northwest Fert. Conf.*, Pasco, WA. July 14-15, Soil Imp. Comm. and NW Plant Food Assoc.

Kjelgren, R.K. 1984. Fertilizer nitrogen use efficiency by winter wheat in the Willamette Valley. M.S. thesis, Oregon State University, Corvallis, OR.

Yungen, J.A. 1984. The response of winter wheat to mid and late winter nitrogen rates, agronomic and truck crops data. Oregon State University, Southern Oregon Experiment Station, Medford, OR, pp. 22-25.

This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties. Oregon State University Extension Service offers educational programs, activities, and materials—without regard to race, color, religion, sex, sexual orientation, national origin, age, marital status, disability, and disabled veteran or Vietnam-era veteran status—as required by Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and Section 504 of the Rehabilitation Act of 1973. Oregon State University Extension Service is an Equal Opportunity Employer.

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Using the Nitrogen Mineralization Soil Test to Predict Spring Fertilizer N Rate

Soft White Winter Wheat Grown in Western Oregon

J.M. Hart, N.W. Christensen, M.E. Mellbye, and M.D. Flowers

Soft white winter wheat grown in western Oregon requires a spring application of nitrogen (N) fertilizer for optimum production. Determining the amount of N to apply has been a challenge for growers because wheat is produced in numerous rotations that provide varying amounts of N to the wheat crop. Inadequate N results in reduced yield. However, excess N causes lodging, higher-than-desired grain protein, and added expense.

Wheat obtains N from two sources: soil and fertilizer. Soil N is provided in available mineral form (nitrate or ammonium-N) and as mineralizable N (nitrogen that will become available during the growing season). Nitrate and ammonium-N supply only 5 to 15 percent of the total N requirement. Mineralizable soil N supplies 5 to 40 percent of the total N requirement. The remainder (40 to 70 percent) comes from N fertilizer.

Both available and mineralizable N can be measured to predict the spring fertilizer N rate for winter wheat using the "Nmin" soil test developed at Oregon State University. Research between 1993 and 2004 identified the relationship between the mineralizable N soil test and available N. In more than 30 research sites and grower fields, the test accurately predicted the spring fertilizer N requirement. The research was conducted across a range of soil types and crop rotations, and in fields using both

conventional tillage and direct seeding to establish stands.

Using the mineralizable N soil test for irrigated winter wheat, spring wheat, or other crops is not recommended. *Current research, through January 2006, has calibrated the Nmin test only for use in western Oregon winter wheat. It is not intended for use with any other crop.*

Using the mineralizable nitrogen test (Nmin)

Taking a sample

The first step is to collect a composite soil sample from the 0- to 12-inch depth using a soil sampling tube. The sample should include a minimum of 20 soil cores representing the area to be fertilized. The best time to take soil samples is during the last 2 weeks of January.

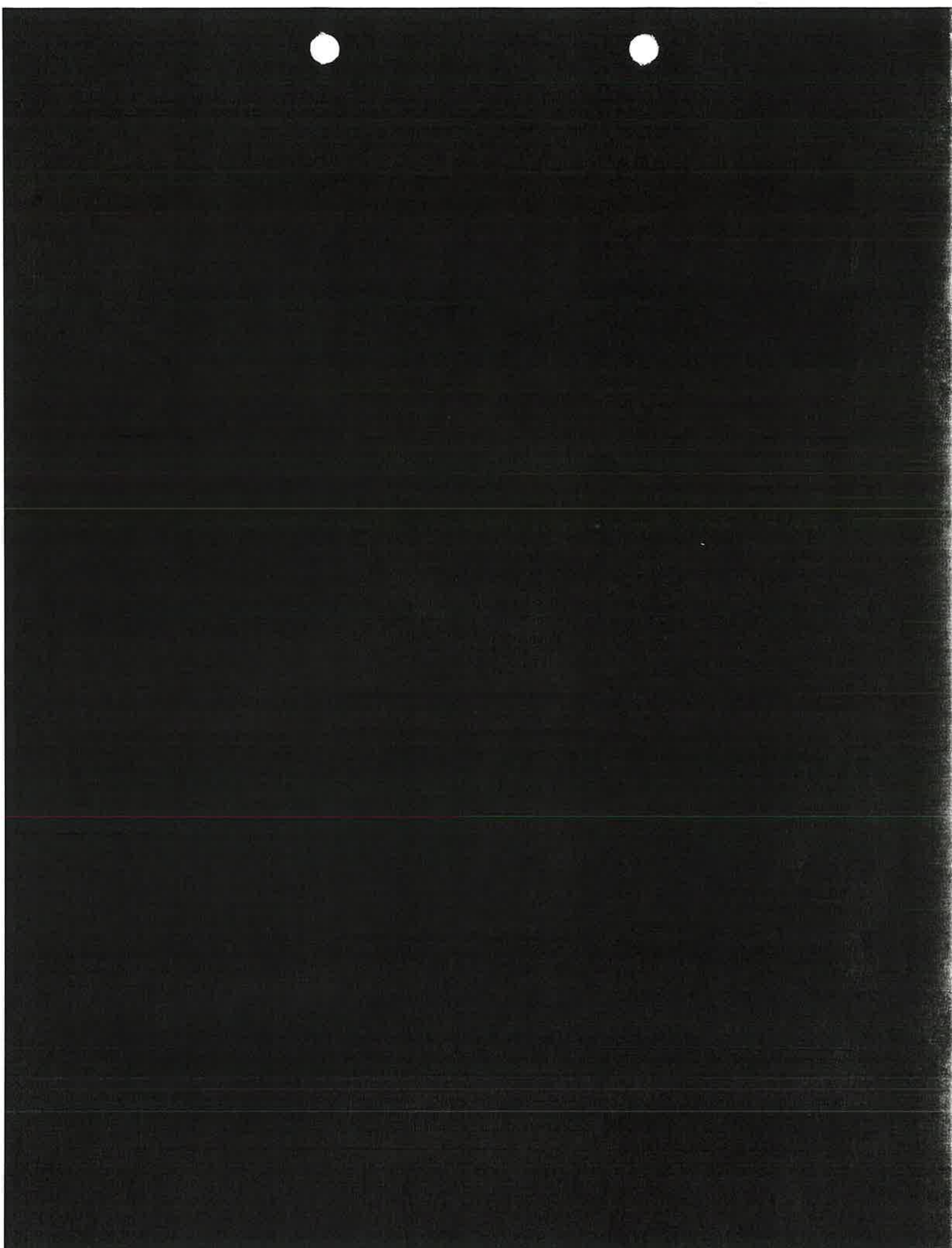
January is the best time to sample for two reasons. First, the relationship between the Nmin test and wheat N uptake at this time is well correlated. Also, the Nmin test requires much more time than traditional soil tests. Sampling in January allows enough time for analysis of the soil sample (about 2 weeks) and calculation of fertilizer needs before application of N fertilizer at Feekes GS 5 (generally the end of February). Application of some spring N by Feekes GS 5 is critical since rapid N uptake begins at the next development stages. For more information about wheat N use, see Pacific Northwest Extension publication PNW 513, *Nitrogen Uptake and Utilization by Pacific Northwest Crops*.



Through more than 10 years of research, Neil Christensen, OSU soil scientist, developed the Nmin test for wheat, a method for accurately predicting the spring fertilizer N requirement.

After taking the sample, keep it cool until delivery to the laboratory. Request three analyses from the laboratory: (1) ammonium-N, (2) nitrate-N, and (3) mineralizable N. Be sure the laboratory you choose can provide all analyses. Not all laboratories offer a test for mineralizable N by anaerobic incubation. Request that analyses be expressed in parts per million (ppm) or milligrams per kilogram (mg kg^{-1}), not as pounds per acre (lb/a). For a list of analytical laboratories serving Oregon, see Extension publication EM 8677.

John M. Hart, Extension soil scientist; Neil W. Christensen, emeritus professor of soil science; Mark E. Mellbye, area Extension agent, Linn County; and M.D. Flowers, Extension cereal specialist; all of Oregon State University. For more information, contact M.D. Flowers, OSU Department of Crop and Soil Science.





Alfalfa

Willamette Valley and Northwest Oregon

E.H. Gardner, D.B. Hannaway, T.L. Jackson, and W.S. McGuire

Alfalfa is capable of producing high yields of forage when grown on deep, well-drained soils. Good management practices are essential if optimum fertilizer responses are to be realized. These practices include use of recommended varieties, selection of adapted soils, weed control, disease and insect control, good seedbed preparation, proper inoculation and seeding methods, and timely harvest.

Alfalfa removes substantial amounts of mineral nutrients. Field experiments have shown that under different conditions in western Oregon, alfalfa has responded to phosphorus, potassium, sulfur, boron, and lime. The need for nutrients other than sulfur can be determined with a soil test. With borderline test values, retest every year.

Follow recommended soil sampling procedures to estimate fertilizer needs. The Oregon State University Extension Service agent in your county can provide you with soil sampling instructions, soil sample bags, and information sheets.

Inoculation

All alfalfa seed should be inoculated immediately before seeding to ensure an adequate supply of nitrogen-fixing bacteria. Use a fresh, effective, live culture of the correct strain of Rhizobia.

Nitrogen (N)

If alfalfa responds to applied N, the alfalfa has not been nodulated effectively.

Phosphorus (P)

The need for P fertilization can be determined by a soil test (Tables 1 and 2).

P can be applied to alfalfa fields most effectively by banding $\frac{1}{2}$ –1 inch to the side or below the seed when seeding. Some soil should separate the seed from fertilizer.

Do not include boron in band applications.

Broadcasting and working P into the surface 2 inches of soil during seedbed preparation is more effective than broadcasting following seeding.

P recommendations assume the soil pH is above 6.0

On established stands, apply P in the fall (Table 2).

Table 1.—P fertilization rates for new alfalfa seedings.

If the soil test for P is (ppm)	Apply this amount of phosphate (P_2O_5) (lb/a)*
0–10	100–150
10–20	70–100
20–40	40–70
over 40	0

*For nonband applications, increase the P rate by 50 percent.

Table 2.—P fertilization rates for established alfalfa stands.

If the soil test for P is (ppm)	Apply this amount of phosphate (P_2O_5) (lb/a)
0–10	80–100
10–20	50–80
20–40	30–50
over 40	0

Potassium (K)

Alfalfa requires large amounts of K. Available soil K may decline rapidly under established stands. Check soil tests every year on soils with borderline values. Retesting is especially important on "Red Hill" soils.

Table 3.—K fertilization rates for alfalfa.

If the soil test for K is (ppm)	Apply this amount of potash (K_2O) (lb/a)
0–75	200
75–150	100–200
150–200	100 on hill soils 0 on valley floor soils
over 200	0



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E. Hugh Gardner, Extension soil scientist emeritus; David B. Hannaway, Extension agronomist; T.L. Jackson, Extension soil scientist emeritus; and W.S. McGuire, professor emeritus of agronomy; Oregon State University. Reviewed by a committee of northwest Oregon county Extension agents.

On new seedlings

Broadcast K and work it into the seedbed prior to seeding.

On established stands

On nonirrigated alfalfa, broadcast half of the K in the fall or early spring and apply the other half after the first cutting.

A K deficiency is indicated by light-colored spots around the margins of the leaves. If K deficiency symptoms become apparent on alfalfa leaves, apply at least 90 lb K₂O to provide the needs of the following crop.

Responses to K fertilizer often are obtained before leaf deficiency symptoms are apparent.

Sulfur (S)

Include 20–40 lb S/a in the annual fertilizer program. Apply S in the fall or early spring. An early spring application is suggested for valley floor soils.

One ton of alfalfa hay removes about 5 lb S.

S is contained in several fertilizer materials used to supply other nutrients. Plants absorb S in the form of sulfate. Fertilizer materials supply S in the form of sulfate and elemental S. Elemental S must be converted to sulfate in the soil before the S becomes available to plants. The conversion of elemental S to sulfate usually is rapid for fine-ground (less than 40-mesh) material in warm, moist soil.

The S requirements of alfalfa can be provided by:

1. Annually applying 20–40 lb S/a in the form of sulfate or fine-ground (finer than 40-mesh) elemental S. Elemental S will not be available to plants until the soil warms up.
2. Applying 40–60 lb S/a as sulfate or fine-ground elemental S every second year.
3. Applying coarser ground elemental S at higher rates and less frequently.

Magnesium (Mg)

Responses to Mg applications have not been measured in alfalfa fertility experiments to date. Trial applications are suggested when soil test values are below 0.8 meq Mg/100 g or when the amount of calcium is more than 10 times the amount of Mg.

Mg can be applied in the form of dolomite lime, which is equal to ground limestone in reducing soil acidity.

Boron (B)

On established stands, apply 3 lb B/a if the soil test is 1 ppm B or less. The application of B is not recommended for new seedlings.

Apply B uniformly to the soil. B and other materials should be thoroughly mixed when B application is combined with other fertilizers. Apply B in fall or early spring.

B can be toxic to plants if applied at rates higher than recommended.

Response to B is most apparent on the second or third cutting.

Lime

Alfalfa is sensitive to soil acidity and is responsive to liming of acid soils. Apply lime if the soil pH is below 6.4 or the soil test for calcium is below 5 meq Ca/100 g of soil.

Table 4.—Lime application rates for alfalfa.

If the SMP buffer test for lime is	Apply this amount of lime (t/a)
under 5.2	5–7
5.2–5.5	4–5
5.5–6.0	3–4
6.0–6.4	2–3
6.4–6.6	1–2
over 6.6	0

These liming rates are based on dry 100-score lime. Check liming materials for moisture content and score.

Apply lime preferably a season ahead, or at least several weeks before seeding, and thoroughly mix it with the surface 5–6 inches of soil. A lime application is effective for several years. Broadcasting lime on established alfalfa fields is not effective.

Dolomite lime, which can be used as a source of Mg, is equal to ground limestone in reducing soil acidity.

For More Information

How to Take a Soil Sample ... and Why, EC 628, by E.H. Gardner (revised 1997). No charge.

A List of Analytical Laboratories Serving Oregon, EM 8677, by J. Hart (revised 1997). No charge.

You can access the above publications, FG 18, *Alfalfa: Willamette Valley and Northwest Oregon*, our Publications and Videos catalog, and many other publications via our Web site at eesc.orst.edu

Fertilizer recommendations are based on experiments conducted by T.L. Jackson, E.H. Gardner, D.B. Hannaway, and H. Hickerson, Oregon State University.

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Spring grains

Western Oregon—west of Cascades

E.H. Gardner, T.L. Jackson, and W.E. Kronstad

Good management practices are essential if optimum fertilizer responses are to be realized. These practices include use of recommended varieties, selection of adapted soils, weed control, disease and insect control, good seedbed preparation, proper seeding methods, and timely harvest.

Because of the influence of soil type, climatic conditions, and cultural practices, crop response to fertilizer may not always be predicted accurately. Soil test results, field experience, and knowledge of specific crop requirements help determine the nutrients needed and the rate of application.

Follow recommended soil sampling procedures to estimate fertilizer needs. The Oregon State University Extension Service agent in your county can provide you with soil sampling instructions, soil sample bags, and information sheets.

Field experiments with spring grains in western Oregon have shown that early seeding (by April 1 or earlier) and the proper use of fertilizer give best results. Near normal yields can be obtained even if the crop is infected with yellow dwarf virus.

In recent years, yellow dwarf virus disease has reduced yields of spring grain in western Oregon. Damage has varied with the seasons and between areas. The virus is carried by aphids, and infection can be serious whenever conditions favor mass movement of aphids into the grain in the early stages of growth. If virus infection occurs when the young grain plants have only two or three leaves, severe stunting and possible crop failure may result. Damage is less severe if the plants develop at least five or six leaves before the aphid infestation occurs.

Method of Applying Fertilizer

Banding the fertilizer close to the seed is essential for maximum seedling growth. Band applications of nitrogen, phosphorus, potassium, and sulfur have increased yields. Yield response of virus-susceptible varieties to banded phosphorus and potassium has been profitable in years when virus is present, even on soils with these nutrients at levels normally considered adequate.

Broadcast fertilizers may not be effective in increasing early seedling growth.

With early seeding in moist soil, up to 40 lb N/a + 40 lb P_2O_5 /a + 40 lb K_2O /a have been banded with the seed without serious damage. Banding higher rates of fertilizer with the seed could decrease yields.

Urea and DAP (diammonium phosphate) can be toxic to seedlings and therefore should not be used as an N source when fertilizer is banded close to seed. Vigorous seedling growth has more than compensated for any fertilizer burn with other fertilizer materials.

The "burning" effect of banded fertilizer increases as the soil becomes drier and decreases when the band is located a short distance (1–2 inches) from the seed.

Nitrogen (N)

Spring grain yields are increased by the application of N.

The application of too much N can result in lodging, particularly where weaker strawed varieties are seeded.

The amount of N recommended depends on the preceding crop (Table 1).

Table 1.—N fertilization rates for spring grains.

Preceding crop	Apply this amount (lb N/a) ¹		
	Total	Band and broadcast ^{2,3}	
		Close to seed	With seed
Good stand of legumes or row crop	20	20(0) or	20(0)
Grain or grass seed ⁴	40–50	40(0–10) or	20(20–30)

¹The difference between total N and banded N should be broadcast before or at the time of planting.

²The figures in parentheses represent the lb N/a that should be broadcast.

³Urea should not be banded close to seed.

⁴Broadcast N should be increased by 10 lb/a for each ton of grain or grass straw incorporated in the spring.



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Prepared by E. Hugh Gardner, professor emeritus of soil science; T.L. Jackson, former Extension soil scientist; and W.E. Kronstad, professor of crop science; Oregon State University. Reviewed by a committee of western Oregon county Extension agents.

Estimating N Rates from Yield Potential

About 40 lb of added N are required for each 1,000 lb yield increase. Experienced growers can adjust N rates for maximum economic yield with this formula. However, you must be realistic when estimating maximum yield potentials. Yield potential varies with crop, soil depth, drainage, and previous management.

Example: The estimated yield is 2,000 lb/a with 40 lb of applied N on a field that should produce 3,000 lb/a. To increase the yield by 1,000 lb requires about 40 lb of additional N if other factors are not limiting.

Phosphorus (P)

Band applications of P, close to or with the seed, are much more effective than broadcast applications (Table 2). When P is broadcast, increase the rate by 50 percent.

Table 2.—Rate of band application of P for spring grains.

If the soil test for P is (ppm)	Band this amount of phosphate (P_2O_5) (lb/a)*
0–30	40–60
over 30	40

*These P rates assume that soil pH is 5.6 or higher.

When the soil test value for P exceeds 30 ppm, it is doubtful that a response to broadcast P will be obtained.

Potassium (K)

Band applications of K close to or with the seed are more effective than broadcast applications (Table 3).

With early planting and favorable soil moisture, up to 40 lb K_2O/a can be banded with the seed with little risk of seedling burn.

Table 3.—Rate of band application of K for spring grains.

If the soil test for K is (ppm)	Band this amount of potash (K_2O) (lb/a)
0–100	40
over 100	30

When K is broadcast, increase the rate to 70 lb/a.

When the soil test value for K is greater than 125 ppm, it is doubtful there will be a response to broadcast K.

Sulfur (S)

Plants absorb S in the form of sulfate. Fertilizer materials supply S in the form of sulfate and elemental S. Elemental S must be converted to sulfate in the soil before the S becomes available to plants. The conversion of elemental S to sulfate usually is rapid for fine-ground (less than 40-mesh) material in warm, moist soil.

The S requirements of spring grains can be provided by:

1. Applying 15–20 lb S/a in the form of sulfate at planting time
2. Applying 30–40 lb S/a as fine-ground elemental S the preceding year
3. Applying coarser ground elemental S at higher rates and less frequently

Some S fertilizer materials, such as elemental S and ammonium sulfate, have an acidifying effect on soil.

Magnesium and Micronutrients

To date, increases of spring grain yields from applications of magnesium and micronutrient elements have not been observed in western Oregon.

Lime

Lime application is not suggested if the soil pH is 5.8 or higher. Lime application rates can be estimated from Table 4.

Table 4.—Lime application rates for spring grains.

If the SMP buffer test for lime is	Apply this amount of lime (t/a)
under 5.5	3–4
5.5–5.8	2–3
5.8–6.2	1–2
over 6.2	0

Lime rate is based on 100-score lime.

Mix lime into the seedbed several weeks before seeding. Lime applications are effective for several years.

Some soils may have a fairly high SMP buffer value (over 6.2) and a low pH (below 5.3). This condition can be caused by the application of acidifying fertilizer. This temporary “active” acidity from fertilizer is found after applications of most nitrogen fertilizers. Acidifying fertilizers also have a long-term, cumulative acidifying effect on soils.

Recommendations based on experiments conducted by T.L. Jackson and W.H. Foote, Oregon Agricultural Experiment Station.

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Pastures

Western Oregon and Western Washington

J. Hart, G. Pirelli, L. Cannon, and S. Fransen

In western Oregon and Washington, forage shortages typically occur in late fall and early spring. In contrast, an excess supply may exist in late spring. By fertilizing in early fall and late winter, you can increase forage supply in deficient times. To reduce production in times of excess, reduce or eliminate late spring fertilization.

A single fertilization program will not fit all pastures. Determine which combination of grazing management, fertilization, and irrigation fits your resources and environment. Use a soil test and an assessment of forage supply and forage species to determine fertilizer need.

If suitable species are not present, fertilization will not compensate. In this case, consider renovating the pasture.

New Seedings

Match the pasture species to site conditions and livestock needs when renovating a pasture. Cows prefer grasses over legumes and graze perennial ryegrass before tall fescue. Sheep graze selectively, preferring clover and grass mixtures with short, lush feed to tall, coarse plants.

Horses are selective grazers, eating a wide range of plants. The horse digestive system cannot handle large amounts of legumes. Small and frequent amounts of forage are best. Horses avoid grazing near their own manure and urine; therefore, managing grazing on horse pastures is difficult.

Cool season forages such as tall fescue, perennial ryegrass, orchardgrass, subclover, and white clover are suited for our climate.

After choosing the appropriate forage species and planting method, use a soil test as the basis for fertilization. EC 628, *How to Take a Soil Sample . . . and Why*, contains instructions for obtaining a soil sample.

For a preplant soil test, obtain samples from the tillage depth, generally the surface to 6 inches. If you use a minimum tillage method of planting, you may wish to divide the sample into two parts: the top 2 inches and the lower 4 inches.

Analyze the soil sample for the following:

- pH
- Lime requirement (SMP or LR)
- Phosphorus (P)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)

Soil pH indicates whether lime is needed, and the SMP buffer or lime requirement (LR) test estimates the amount of lime needed. Estimate the rate of lime application from the following SMP buffer table.

Table 1.—Lime application rates for grass or white clover-grass pastures.

If the SMP buffer test for lime is:	Apply this amount of lime (t/a):
under 5.5	4–5
5.5–5.8	3–4
5.8–6.1	2–3
6.1–6.5	1–2
over 6.5	0–1

If soil pH is below 5.5, incorporate lime for stand establishment and longevity. Mix lime into the seedbed before seeding to allow time for lime to neutralize soil acidity.

Exceptions to Table 1 are subclover seedlings and pastures on coastal county bottomland soils. For new subclover seedlings where the pH of the top 2 to 3 inches of soil is 5.5 or lower, mix 1 to 2 t lime/a into the surface 2 inches of soil before seeding. Using lime-pelleted seed also can improve seedling establishment on acidic soils.

If your pasture is on coastal county bottomland soils, apply a maximum of 2 t lime/a if the soil pH is below 5.5.

Additional information about lime requirement and the SMP buffer is in FG 52, *Fertilizer and Lime Materials*.

Nitrogen fertilization usually is necessary to establish grass forages in western Oregon and Washington. Broadcast 20 to 40 lb N/a at planting, or band this amount 1 to 2 inches below the seed. When P or K is needed, N can be banded with these nutrients. The total N plus K₂O in the band should not exceed 100 lb/a. Do not include B in band applications because this concentration of B can be toxic to seedlings.

Working P into the top 2 inches of the soil during seedbed preparation is more effective than broadcasting after seeding. The most effective P application method is banding.

If you band P, place the band 1 to 2 inches to the side or below the seed. Some soil should separate seed from fertilizer. Phosphorus fertilization rates are given in Table 2.

In new clover or clover and grass seedings, broadcast K and work it into the seedbed anytime before seeding. See Table 3 for fertilization rates based on a soil test.



OREGON STATE UNIVERSITY
EXTENSION SERVICE

John Hart, Extension soil scientist; Gene Pirelli, Extension agent, Polk County; Lynn Cannon, Extension agent emeritus, Coos County; Oregon State University; and Steve Fransen, Washington State University. Reviewed by western Oregon county Extension agents.

If soil test K is below 125 ppm, band an additional 20 lb K_2O/a at the time of planting. At least 1 inch of soil should separate the seed and fertilizer. Potassium can be banded with N and P. Potassium fertilization at planting will not meet the need for K in subsequent years.

Inoculate legume seed immediately before planting to ensure an adequate supply of nitrogen-fixing bacteria. Use fresh, effective live culture of the correct rhizobial strain.

Established Pastures

Manage fertilization and grazing jointly in established pastures. Although growth rates are influenced by temperature, moisture, solar radiation, and soil fertility, grazing management has a profound impact on pasture production.

New Zealand sheep producers use plant growth phases in ryegrass pastures to manage pasture growth, grazing, and fertilizer applications. Phase I (lag phase), Phase II (vegetative phase), and Phase III (maturity) describe the stages of growth and the impact on grazing and dry matter production.

Grass-clover pastures in Phase II provide high-quality feed. The goal is to graze before excess forage is produced (Phase III) and to supply fertilizer for rapid regrowth after grazing.

Figure 1 is an example of how this works with a perennial ryegrass pasture grazed by sheep or cattle. In Phase I ($3/4$ inch, 550 lb of dry matter), the plants grow very slowly because they lack sufficient leaf area for photosynthesis.

Phase II ($3/4$ to $4 1/4$ inches high, 550 to 1,900 lb of dry matter/a) growth is desired in pastures. Plants grow most rapidly and efficiently in this stage. Their leaf area is great enough for efficient use of sunlight.

Growth slows in Phase III (greater than $4 1/4$ inches), as lower leaves become shaded and die, and the plant moves toward maturity and seed production.

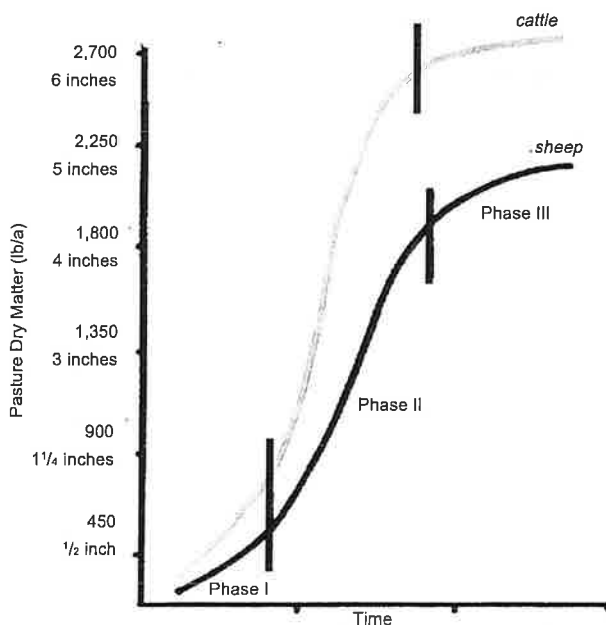


Figure 1.—Rate of perennial ryegrass pasture regrowth following grazing. For other grasses, multiply height by 2.

The grey line represents Phases I, II, and III if the pasture were managed for cattle. Cattle do not graze as closely as sheep, so the growth curve is based on higher initial and residual dry matter amounts. Other grass species such as orchardgrass and tall fescue have similar growth phases, but the grass heights listed for perennial ryegrass should be multiplied by two.

Fertilization of established pastures should be based on a soil test and the amount of forage needed. Obtain soil samples the year after establishment and every 2 to 3 years thereafter. Obtain samples from the top 3 inches of established pastures.

Nitrogen (N)

N fertilization should be based on moisture and temperature, which control pasture growth. Time N applications to crop and forage production needs. Avoid the following:

- *N applications in November and December.* N applied to cold, wet soils in winter can be leached beyond the root zone before slow-growing plants can use the fertilizer.
- *Late winter or early spring N application to saturated soils.* Soils that are too wet to drive on with a tractor may be too wet for plant growth. The plants may be yellow due to lack of oxygen from wet conditions and not lack of fertilizer. Wait for conditions conducive to plant growth before applying fertilizer.

See Figure 2 for an application schedule.

Fall

Assume the growing season begins with the fall rains. If sufficient rain falls in September to initiate growth, apply 40 to 60 lb N/a for the fall growing season (September and October). Do not apply N if adequate rain does not fall until late October or if the air temperature drops to or below freezing in October.

Many growers apply fertilizer to dry soil and note that the granules disappear before any rain. They fear volatile N loss. Nitrogen fertilizers, especially ammonium nitrate, often disappear overnight. Usually, this N has dissolved in dew and has moved onto the surface soil.

Winter

In cold conditions, pastures will not grow enough to use fertilizer. Forages in southwest coastal sites generally grow throughout winter, while conditions in the northern Willamette Valley allow only occasional winter growth.

For warm winters in the south coastal counties, apply 50 to 60 lb N/a in January or February (in addition to fall N application). Apply 50 to 60 lb N/a in the Willamette Valley or other cooler areas when a temperature of 40 to 45°F is maintained in the surface 2 inches.

Another method to estimate nitrogen demand is to monitor air temperature, then change the air temperature into heat units. A heat unit is the average of the high and low temperature for the day (in centigrade) and is a way to measure heat accumulation over time.

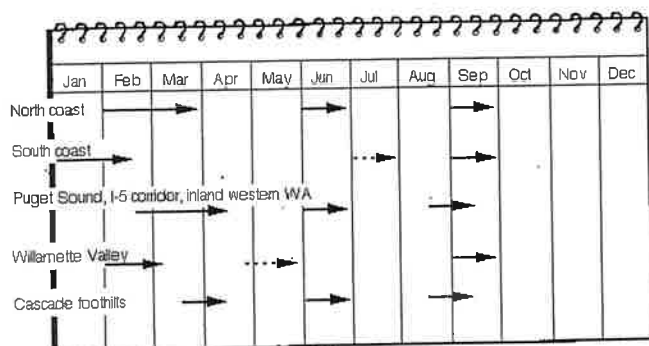


Figure 2.—Pasture nitrogen application calendar. Apply 50 to 60 lb N/a each time a solid arrow appears for your region. Additional applications for irrigated pastures are indicated by dotted lines. See nitrogen section in text for an explanation.

Table 4 shows a sample calculation of heat units. The process is as follows:

1. Beginning January 1, add together each day's maximum temperature and minimum temperature, and divide this total by 2. The result is the day's average temperature (column 4).

2. If this average temperature is in Fahrenheit, convert it to centigrade (column 5). To convert to centigrade, subtract 32 from the Fahrenheit temperature and then multiply by 0.556. For example:

$$42^{\circ}\text{F} - 32 = 10$$

$$10 \times 0.556 = 5.6^{\circ}\text{C}$$

The centigrade average temperature is the number of heat units accumulated for that day. (If the average temperature is below freezing, give it a heat unit value of zero.)

3. To find the number of heat units that have accumulated since January 1, add together the heat units for each day (column 6).

Apply nitrogen when 200 heat units are accumulated or soon thereafter. The 30-year average for accumulation of 200 heat units is January 30 to February 14 in the Willamette Valley. Foothill temperatures and pasture growth typically lag 2 to 3 weeks behind the Willamette Valley.

Spring

Intensively grazed pastures that are expected to produce a high level of forage through June should receive a second application of nitrogen. Apply nitrogen only if moisture is sufficient for additional growth after mid-May. Apply summer N in July on irrigated coastal pastures.

Phosphorus (P)

Adequate P fertilization is particularly important for clover. Estimate the need for P fertilization with a soil test.

Table 2.—Phosphorus application rates for pastures.

If the Bray soil test for P is (ppm)	Apply this amount of phosphate (P_2O_5) (lb/a)
0–15	60–100
15–30	0–60
over 30	0

Apply P on established pastures in the fall or spring before growth begins. When using ammonium phosphate materials, do not over-apply N to supply adequate P.

Moderate rates of N and P (40 to 60 lb/a) applied together sometimes have a synergistic effect on plant growth. Fall applications of N and P from ammonium phosphate materials on south coastal Oregon pastures produced more forage than individual applications of either N or P.

Potassium (K)

An adequate level of available K is essential for optimal growth of clover-grass pastures. Potassium is particularly important for clover. Grass competes vigorously with clover for K. High-producing pastures can rapidly deplete soil test K. Test soil every 2 years to determine available K levels.

Potassium deficiency is indicated by light-colored spots around the margins of clover leaves and yellow to brown coloring of grass leaf tips. Growth responses to K fertilizer often can be obtained before deficiency symptoms are seen.

Table 3.—Potassium application rates for pastures.

If the soil test for K is (ppm)	Apply this amount of potash (K_2O) (lb/a)
0–125	100–150
125–200	70–100
over 200	None—Watch soil tests for K depletion

We suggest split applications of K for established, high-yielding irrigated pastures, with the first application in late

Table 4.—Sample heat unit calculation.

Day	Max Temp. ($^{\circ}\text{F}$)	Min Temp. ($^{\circ}\text{F}$)	Average Temp ($^{\circ}\text{F}$) (Max T + Min T)/2	Average Temp. ($^{\circ}\text{C}$) = Daily Heat Units	Cumulative Heat Units
Jan 1	47	37	42	5.6	5.6
Jan 2	46	32	39	3.9	9.5
Jan 3	45	36	40	4.7	14.2

heat unit = (Max T + Min T)/2. Convert temperatures to centigrade to determine heat units. The equation to convert Fahrenheit to centigrade is: $(^{\circ}\text{F} - 32) \times 0.556$.

spring to avoid tetany and the second in midsummer. For other pasture types, apply K in the fall or spring.

Sulfur (S)

Plants absorb S as sulfate. Most fertilizer materials (ammonium sulfate, gypsum, sulpomag) supply S as sulfate.

Soil sulfate, which increases in the fall, is decreased by leaching in November and December and use by microorganisms in the spring. Thus, we recommend late winter or spring applications unless there is a severe deficiency, which may require additional fall or spring applications.

You can meet pasture S requirements by applying 20 to 30 lb S/a annually as sulfate or by applying 30 to 40 lb S/a as sulfate every other year.

Boron (B)

Clover-grass pastures need adequate B. Clovers have a higher B requirement than grasses. Too much B can be highly toxic to plants; therefore, do not exceed suggested rates of B application. Distribute B evenly over the field. *Never band B containing fertilizer materials.*

If the soil test for B is below 0.7 ppm, we suggest an application of 2 to 3 lb B/a. Mix thoroughly when applying B with other fertilizers. Spring applications are preferred. Apply B in the fall only when B is critically low.

Lime, Calcium (Ca), and Magnesium (Mg)

Soils west of the Cascades are naturally acidic. Lime applications overcome soil acidity, allowing for increased

grass and legume growth. Determine the need for lime by soil pH or a calcium (Ca) soil test. The amount of lime required to raise soil pH is determined by the SMP buffer or lime requirement (LR) test. Additional information is available in FG 52, *Fertilizer and Lime Materials*.

Grass pastures have a moderate tolerance to soil acidity. We suggest a lime application if the soil pH is below 5.4 or the Ca soil test is below 5 meq Ca/100 g of soil. For acidic soils low in Mg (less than 0.8 meq Mg/100 g of soil), use 1 t/a of dolomitic lime as an Mg source. Dolomitic lime and ground limestone have about the same ability to neutralize soil acidity. Liming rate is based on 100-score lime.

Subclover is an annual, reseeding itself each year. We recommend lime on subclover pastures where soil pH in the surface 2 to 3 inches of soil is below 5.5. Broadcast 1 t lime/a on established stands.

Clovers other than subclover are more responsive to liming than grasses. We recommend a 1–2 t/a lime application when soil pH is below 5.8. Broadcasting lime on established pastures is not as effective as mixing lime with the soil at planting, but is the only alternative on established pastures.

Pasture yield responses to Mg have not been observed in western Oregon and Washington. We suggest trial applications of a soluble Mg fertilizer where soil test levels are below 0.8 meq/100 g soil.

Incidence of grass tetany, however, may make Mg applications desirable. If tetany is a problem, do not apply K fertilizer until after the tetany period, since K reduces plant Mg and can induce tetany.

For More Information OSU Extension publications

To order copies of the following publications, send the publication's complete title and series number to:

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119

Gardner, E.H., and J. Hart. *How to take a soil sample... and why*, EC 628 (Revised 1995). No charge

Hart, J. *Fertilizer and lime materials*, FG 52, (Reprinted 1998). No charge

Hart, J. *A List of Analytical Laboratories Serving Oregon*, EM 8677 (reprinted 1999). No charge

Other publications

Controlled Grazing Systems, Farm Production and Practice 681, New Zealand Ministry of Agriculture and Fisheries, P.O. Box 2526 (Wellington, New Zealand, 1983).

Dawson, M.D., and W.S. McGuire. *Recycling nitrogen and sulfur in grass-clover pastures*, Agricultural Experiment Station Bulletin 610 (Oregon State University, Corvallis, 1972).

Jackson, T.L., H.H. Rampton, and J. McDermid. *The effect of lime and*

phosphorus on the yield and phosphorus content of legumes in western Oregon, Agricultural Experiment Station Technical Bulletin 83 (Oregon State University, Corvallis, 1964).

Kilgour, R., and C. Dalton. *Livestock behavior, a practical guide*. Mathuen Publications (New Zealand, 1942).

McCarthy, M.J. *Some effects of sulfur fertilization on the nutrient value of subclover-grass forage*. M.S. thesis (Oregon State University, Corvallis, 1976).

Rogers, J. *The Effect of Topdressed Lime Upon Pasture Production and Quality*. M.S. thesis (Oregon State University, 1996).

Suggested P, K, Mg, B, and lime applications are based on soil test methods used in the Central Analytical Laboratory, OSU, Corvallis, OR. This fertilizer guide is based on experiments and field trials conducted by Lynn Cannon, M.D. Dawson, E. Hugh Gardner, John Hart, T.L. Jackson, W.S. McGuire, and Gene Pirelli, Agricultural Experiment Station and Extension Service, Oregon State University. This guide replaces FG 1, *Irrigated Clover-Grass Pastures (W. Ore.)*; FG 4, *Subclover-Grass Pasture (W. Ore.)*; FG 16, *Perennial Grass Pasture (W. Ore.)*; FG 58, *Irrigated Clover-Grass Pastures (SW Ore.)*; and FG 63, *Subclover-Grass Pastures (W. Ore.)*.

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Revised April 1996. Reprinted January 2000.

WELL TESTING INSTRUCTIONS

1. COLIFORM BACTERIA, E. COLI AND FECAL COLIFORM

- a. Get a sterile sample bottle from a lab.
- b. Connect a garden hose to the faucet in the pump house. If you don't have a faucet in the pump house, use the outdoor faucet that's closest to the well. Do not use a kitchen faucet for this test.
- c. Let the water run for 3 minutes. While the water's running, wash your hands with soap and water. Dry hands with a clean towel.
- d. Turn off the faucet and disconnect the hose.
- e. Using a propane torch, cigarette lighter or a candle, sterilize the end of the faucet by heating it thoroughly. All water at the end of the faucet should evaporate in this process.
- f. Turn the faucet on gently (no splashing) and let the water run for about 10 seconds.
- g. Take the cap off the sterile bottle, being sure not to touch the inside of the cap or the bottle. Don't set the cap down.
- h. Fill the bottle to the neck and replace the cap.
- i. Turn off the faucet and take the sample to the lab within two hours. If possible, put the sample in a cooler with some ice during transport.
- j. Usually, the bacteria level in drinking water is determined by the way your well is constructed and whether any pipes or fittings are cracked. Test for this once per year. You can choose any of the three bacterial forms: coliform bacteria, E. coli or fecal coliform. Ask your lab which test they recommend. After you choose the kind of bacteria to test for, ask the lab if they do Most Probable Number analysis (this gives you an approximate count of how many bacteria there are) or just a presence/absence test. It doesn't matter too much which test you choose, however you should do this test at least once per year. If bacteria are present, you should fix any well problems you have (e.g. cracked casing) and disinfect the well with chlorine. See the OSU well safety web site: <http://wellwater.oregonstate.edu/>

2. LEAD

- a. Get a lead test sample bottle from a lab. This bottle will have acid in it that keeps the lead (if there is any) dissolved.
- b. Take this sample from the kitchen faucet first thing in the morning before running any water.
- c. Lead sample bottles aren't sterile, so you don't have to go through the procedures as above. Just remove the cap, fill the bottle up to the neck (don't let the bottle overflow) and replace the cap.
- d. Take sample to the lab within one day. No refrigeration needed.
- e. Usually the lead levels in drinking water is determined by the kind of plumbing in your home. Test for lead any time you change the plumbing, install new pipes or install a new faucet. The "safe" level of lead in drinking water changes as new research is done. As of 2005, the EPA has set a goal for drinking water of zero milligrams of lead per liter of drinking water and has set an action level of 0.015 milligrams of lead per liter of drinking water. "Action level" means you should take action immediately if your lead level exceeds that concentration. See the EPA drinking water website:
<http://www.epa.gov/safewater/mcl.html#mcls>

3. NITRATE AND FLUORIDE

- a. Nitrate and fluoride can be sampled at outdoor or indoor faucets, but don't sample "downstream" of any treatment devices (water softeners, etc.).
- b. Let the water run for 3 minutes before sampling.
- c. Remove cap, fill bottle to the neck and recap.
- d. Refrigerate sample and take to the lab within one day. Keep sample in a cooler if possible while enroute to the lab.
- e. Test for nitrate every year in agricultural areas (especially if you live near livestock farms) or if you have sandy soil. Test every three years otherwise. Test for fluoride every year if there are children living in the home.
- f. Usually, the nitrate and fluoride levels in drinking water are determined by the kind of soils, geology and landuses in your area. The EPA states that drinking water should contain less than 10 milligrams of nitrate nitrogen per liter, especially if consumed by infants, pregnant moms or nursing moms.
Too little fluoride is bad for kid's teeth. Too much is bad for kids and adults. Take your fluoride test results to your dentist and ask whether your child should get supplemental fluoride drops.
See:
<http://www.epa.gov/safewater/mcl.html#mcls>

EMERGENCY RESPONSE PLAN

In Case of a Storage Facility Spill, Leak, or Failure

- a. Stop all other activities to address the emergency.
- b. Stop all flow into the storage facility.
- c. If the storage facility is at maximum capacity or overtopping, draw the waste level in the facility down by making an application to the emergency application area shown on the plan map in accordance with the Waste Utilization instructions found in the Operations section of this plan.
- d. Assess the extent of the emergency and determine how much help is needed to correct the problem.
- e. Call for help & excavator if needed.
- f. If possible, use a skid loader or tractor with blade to contain or divert spill or leak away from environmentally sensitive areas.
- g. If containment material is needed, excavate soil from appropriate areas away from the storage facility.
- h. If possible, begin applying the stored waste to the utilization fields at the prescribed application rates described in Section 6 of this plan.
- i. Complete the clean-up and repair the necessary components.

In Case of a Manure/Waste Discharge

- a. Stop all other activities to deal with the emergency.
- b. Call for help if needed.
- c. Call sheriffs office if spilled on road for traffic control and clean the spill immediately from the road and roadside if needed.
- d. Contain the spill or runoff from entering the stream or waterway using straw bales, saw dust, or soil material.
- e. If flow is coming from a tile, plug the tile with a tile plug immediately.
- f. Assess the extent of the emergency and determine how much help is needed.

Contacts to be made within 24 Hours of a Discharge

(SEE NEXT PAGE FOR REQUIREMENTS FOR FILING A WRITTEN REPORT)

Organization	Phone
Oregon Department of Agriculture	1-800-282-9378
Oregon Emergency Response System (ORES)	1-800-452-0311

Be prepared to provide the following information:

- a. Your Name (See next page)
- b. Farm Identification (See next page)
- c. Description of emergency.
- d. Estimate of the amounts, area covered, and distance traveled.
- e. Has manure reached surface waters or major field drains?
- f. Is there any obvious damage: employee injury, fish kill, or property damage?
- g. What is currently in progress to contain situation?

EMERGENCY RESPONSE PLAN

Emergency Contact Information

Farm Name	George Marsh
Address	4675 Cornelius-Schefflin Road Cornelius, OR 97113
Farm Phone	(503) 357-9152
Permit #	
DIRECTIONS TO FARM	Take Cornelius-Schefflin Road north of Cornelius for 1.9 miles. Take the first right hand turn out of the traffic circle. Proceed north on Cornelius-Schefflin Road an additional 0.1 miles. Farm is on west side of Cornelius-Schefflin Rd.
Emergency Phone Numbers:	
Farm Owner	(503) 357-9152
Farm Manager	(503) 357-9152
FIRE or AMBULANCE	911

If a Discharge Occurs a Written Report is to be made by Owner or Operator to Oregon Department of Agriculture within 5 Days that contains the following information:

- A description and cause of the discharge.
- The period of discharge including exact dates, times and duration of discharge.
- An estimate of discharge volume.
- Name or location of receiving water.
- Corrective steps taken, if appropriate, to reduce, eliminate or prevent reoccurrence of the discharge.

[illegible]

NOTES:

Nutrient Application Plans

1. This packet includes one Phosphorus Index Map and numerous Nutrient Application Plan sheets.
2. You will need the Phosphorus Index Map and records of recent (not more than 3 years old) soil tests to complete the Nutrient Application Plan sheets.
3. Complete one Nutrient Application Plan sheet for each field.
4. The plan sheets begin in September and end in August.
5. The best method is to complete all of the plan sheets for next year in August based on what you plan to do. Complete the plan sheets in pencil so if your plans change, you can update the plan sheets.
6. Do the math before you apply manure or fertilizer! Make sure that each application will stay below the total crop uptake for Nitrogen (N) and Phosphorus (P2O5).
7. Before the next season, call USDA-NRCS (503/648-3174, x113) to get a new set of plan sheets for that season.

2007



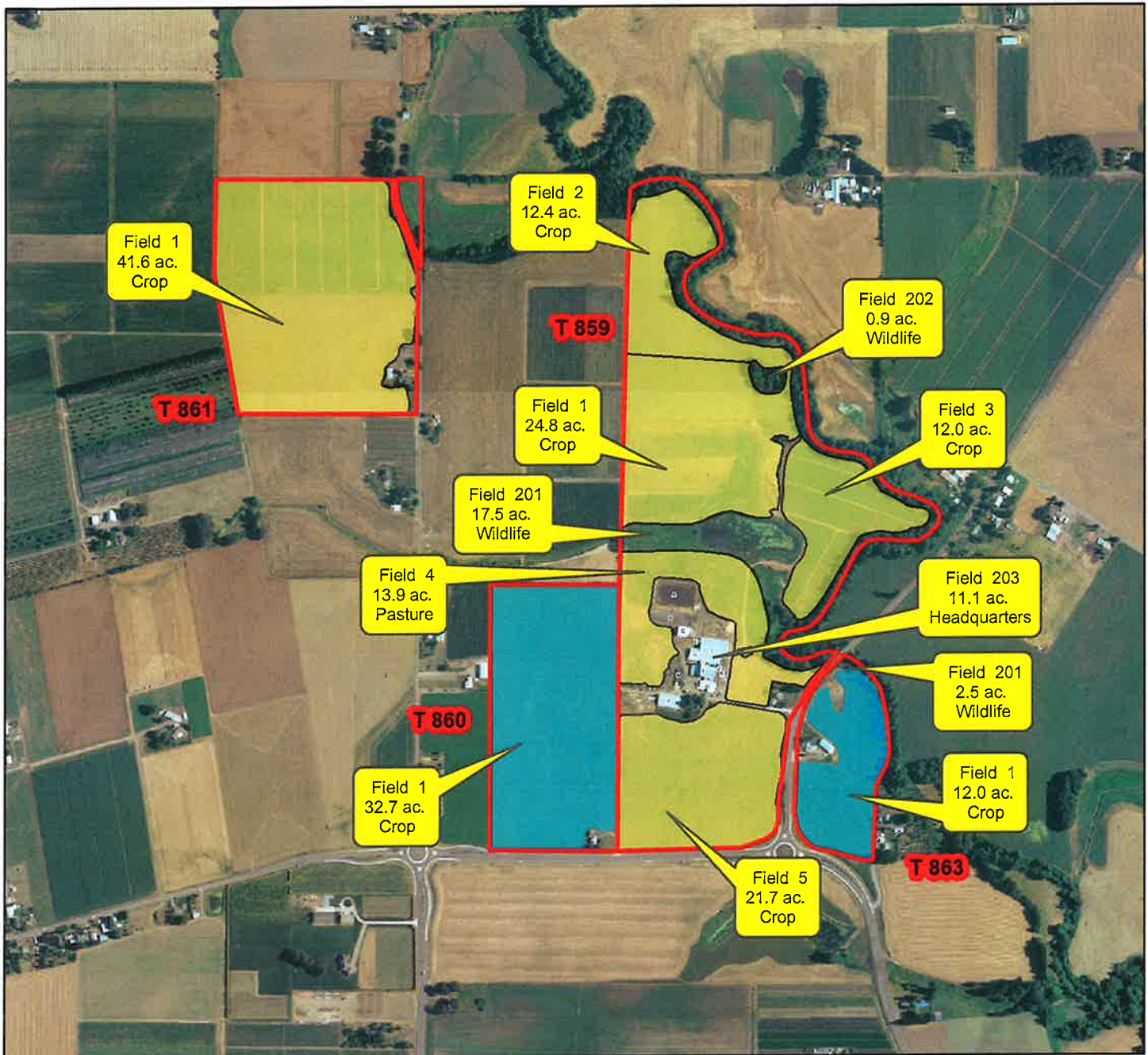
Marsh Homestead, Inc. P Index Map

N



T1N, R3W, S33
Forest Grove USGS Quad

Assisted By Dean Moberg
USDA-NRCS
30 April 2007
503/648-3174, x113



Legend

- Tract Boundaries
- CNMP
- P index low
- P index med

The P index is an estimate of the relative risk of phosphorus leaving the field via erosion, runoff or tile drainage. P runoff contaminates streams and rivers.

Image: 2005



Nutrient Application Plan

Grower:
Application Plan by:

George Marsh

Dean P. Moberg

Crop year:

Directions:

1. Complete these plans before you apply manure or fertilizer.
2. This is essential to operating a CAFO. Do the math BEFORE YOU APPLY!
3. Complete gray cells for Field, Soil Test and P Index information.
4. Circle the months you apply manure or fertilizer.
5. Enter your plan for manure or fertilizer applied per acre in yellow cells. The "year" starts in September.
6. For manure, the lbs of N-P2O5-K2O per ton or per inch of manure is calculated for you.
7. For fertilizer, you need to enter %N-P2O5-K2O in green cells.
8. Multiply yellow cells x green cells to get blue cells.
9. Add blue cells to get total planned N-P2O5-K2O per acre (red cells).

Assumptions:

Soils are

Moderately well

drained.

Manure

is not

incorporated in 7 days.

	Solids	Liquids
NH3 volatilized cool weather	18%	25%
NH3 volatilized warm weather	27%	25%
Organic N mineralized	80%	70%
Denitrification cool weather	40%	40%
Denitrification warm weather	6%	6%

Tract: T859-1
 Field: Upper Bottom
 P index: medium

← see map.

Crop: Wheat, Winter Soft White Straw Removed
 Yield: 4 Ton

Post Harvest NO₃ ← Post harvest test is in Sept.
 All others are before planting.

Soil test:	P	K	pH	SMP	PSNT	Post Harvest NO ₃
	104	477	6.5	6.6		

			Nutrients Per Unit				Nutrients Per Acre			
1	2	3	4	5	6	7	3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)	
Source	Month	Applic. per Acre	Units	N	P2O5	K2O				
Separated solids	Sep Oct Nov Dec Jan Feb		tons	4.4	7.0	16.2				
Separated solids	Mar Apr May Jun July Aug		tons	6.6	7.0	16.2				
Spring pen pack	Sep Oct Nov Dec Jan Feb		tons	4.5	4.5	13.2				
Spring pen pack	Mar Apr May Jun July Aug		tons	6.8	4.5	13.2				
Mixed solids	Sep Oct Nov Dec Jan Feb		tons	2.7	2.3	5.2				
Mixed solids	Mar Apr May Jun July Aug		tons	4.1	2.3	5.2				
Cell 1 agitated	Sep Oct Nov Dec Jan Feb		inches	88	158	383				
Cell 1 agitated	Mar Apr May Jun July Aug		inches	139	158	383				
Cell 2 agitated	Sep Oct Nov Dec Jan Feb		inches	71	60	264				
Cell 2 agitated	Mar Apr May Jun July Aug		inches	112	60	264				
Cells 1 and 2 not agitated	Sep Oct Nov Dec Jan Feb		inches	49	34	204				
Cells 1 and 2 not agitated	Mar Apr May Jun July Aug		inches	77	34	204				
Commercial fertilizer	40-0-0-6	40-0-0-6	lbs							
Commercial fertilizer	40-0-0-6	250	lbs	40.0			100			
			Total to apply (lbs/ac):				100	0	0	
			Total crop uptake (lbs/ac):				174	81	101	

- Rules:** 1. N applied must not exceed uptake.
 2. If P index is high or very high, P2O5 applied must not exceed uptake.

Tract:	T859-2	Crop:	Alfalfa Hay
Field:	Kemper Alfalfa	Yield:	7.5 Ton
P index:	Medium		

← see map.

← Post harvest test is in Sept.
All others are before planting.

Soil test:	P	K	pH	SMP	PSNT	Post Harvest NO ₃
	93	442	6.6	6.9		

1	Source	2 Month	3 Applic. per Acre	Nutrients Per Unit				Nutrients Per Acre		
				4 Units	5 N	6 P2O5	7 K2O	3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)
Separated solids		Sep Oct Nov Dec Jan Feb		tons	4.4	7.0	16.2			
Separated solids		Mar Apr May Jun July Aug		tons	6.6	7.0	16.2			
Spring pen pack		Sep Oct Nov Dec Jan Feb		tons	4.5	4.5	13.2			
Spring pen pack		Mar Apr May Jun July Aug		tons	6.8	4.5	13.2			
Mixed solids		Sep Oct Nov Dec Jan Feb		tons	2.7	2.3	5.2			
Mixed solids		Mar Apr May Jun July Aug		tons	4.1	2.3	5.2			
Cell 1 agitated		Sep Oct Nov Dec Jan Feb		inches	88	158	383			
Cell 1 agitated		Mar Apr May Jun July Aug		inches	139	158	383			
Cell 2 agitated		Sep Oct Nov Dec Jan Feb		inches	71	60	264			
Cell 2 agitated		Mar Apr May Jun July Aug		inches	112	60	264			
Cells 1 and 2 not agitated		Sep Oct Nov Dec Jan Feb		inches	49	34	204			
Cells 1 and 2 not agitated		Mar Apr May Jun July Aug		inches	77	34	204			
Commercial fertilizer				lbs						
Commercial fertilizer				lbs						
				Total to apply (lbs/ac):				338	76	338
				Total crop uptake (lbs/ac):						

- Rules:** 1. N applied must not exceed uptake.
2. If P index is high or very high, P2O5 applied must not exceed uptake.

T859-3
"Bottom"
MEDIUM

"Bottoming"
MEDICINE

medium

Crop:	Corn, Silage(AH)
Yield:	25 Ton

◄—Post harvest test is in Sept.
All others are before planting.

[illegible][illegible]

	Total to apply (lbs/ac):	Total crop uptake (lbs/ac):
100% N	168	179
75% N + 25% S	168	179
50% N + 50% S	168	179
25% N + 75% S	168	179
100% S	168	179

-
2. If P index is high or very high, P2O5 applied must not exceed uptake.

Tract:

Field:

P index:

7859-4
Lagoon grass
mod

← see map.

Crop: Grass/Legume Hay/Pasture
Yield: 6 Ton

weat

← Post harvest test is in Sept.
All others are before planting.

Soil test:	P	K	pH	SMP	PSNT	Post Harvest NO ₃ ⁻
	137	592	6.1	6.8		

1		2		3		Nutrients Per Unit				Nutrients Per Acre			
Source		Month		Applic. per Acre		4	5	6	7	3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)	
						Units	N	P2O5	K2O				
Separated solids	Sep Oct Nov Dec Jan Feb					tons	4.4	7.0	16.2				
Separated solids	Mar Apr May Jun July Aug					tons	6.6	7.0	16.2				
Spring pen pack	Sep Oct Nov Dec Jan Feb					tons	4.5	4.5	13.2				
Spring pen pack	Mar Apr May Jun July Aug					tons	6.8	4.5	13.2				
Mixed solids	Sep Oct Nov Dec Jan Feb					tons	2.7	2.3	5.2				
Mixed solids	Mar Apr May Jun July Aug					tons	4.1	2.3	5.2				
Cell 1 agitated	Sep Oct Nov Dec Jan Feb					inches	88	158	383				
Cell 1 agitated	Mar Apr May Jun July Aug					inches	139	158	383				
Cell 2 agitated	Sep Oct Nov Dec Jan Feb					inches	71	60	264				
Cell 2 agitated	Mar Apr May Jun July Aug					inches	112	60	264				
Cells 1 and 2 not agitated	Sep Oct Nov Dec Jan Feb					inches	49	34	204				
Cells 1 and 2 not agitated	Mar Apr May Jun July Aug					inches	77	34	204				
Commercial fertilizer	40-0-0-6			250		lbs	40	0	0	100	0	0	
Commercial fertilizer						lbs							
						Total to apply (lbs/ac):				100	0	0	
						Total crop uptake (lbs/ac):				203	76	249	

Rules: 1. N applied must not exceed uptake.

2. If P index is high or very high, P2O5 applied must not exceed uptake.

Tract: T859-5
 Field: Front Field
 P index: medium

Crop: Corn, Silage(AH)
 Yield: 25 Ton

← see map.

← Post harvest test is in Sept.
 All others are before planting.

Soil test:	P	K	pH	SMP	PSNT	Post Harvest NO ₃ ⁻
	119	305	6.6	6.7		

1	Source	2		3	Nutrients Per Unit				Nutrients Per Acre			
		Month	Applic. per Acre		4	5	6	7	3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)	
					Units	N	P2O5	K2O				
	Separated solids	Sep Oct Nov Dec Jan Feb			tons	4.4	7.0	16.2				
	Separated solids	Mar Apr May Jun July Aug			tons	6.6	7.0	16.2				
	Spring pen pack	Sep Oct Nov Dec Jan Feb			tons	4.5	4.5	13.2				
	Spring pen pack	Mar Apr May Jun July Aug			tons	6.8	4.5	13.2				
	Mixed solids	Sep Oct Nov Dec Jan Feb			tons	2.7	2.3	5.2				
	Mixed solids	Mar Apr May Jun July Aug			tons	4.1	2.3	5.2				
	Cell 1 agitated	Sep Oct Nov Dec Jan Feb			inches	88	158	383				
	Cell 1 agitated	Mar Apr May Jun July Aug			inches	139	158	383				
	Cell 2 agitated	Sep Oct Nov Dec Jan Feb			inches	71	60	264				
	Cell 2 agitated	Mar Apr May Jun July Aug			inches	112	60	264				
	Cells 1 and 2 not agitated	Sep Oct Nov Dec Jan Feb			inches	49	34	204				
	Cells 1 and 2 not agitated	Mar Apr May Jun July Aug			inches	77	34	204	192	85	570	
	Commercial fertilizer				lbs							
	Commercial fertilizer				lbs							
					Total to apply (lbs/ac):				192	85	570	
					Total crop uptake (lbs/ac):				193	100	230	

- Rules: 1. N applied must not exceed uptake.
 2. If P index is high or very high, P2O5 applied must not exceed uptake.

Tract:

Field:

P index:

T860	1
Helena	
Low	

← see map.

Crop:	Grass/Legume Hay/Pasture
Yield:	6 Ton

← Post harvest test is in Sept.
All others are before planting.

Soil test:	P	K	pH	SMP	PSNT	Post Harvest NO ₃ ⁻
	121	396	6.5	6.0		

1	2	3	Nutrients Per Unit				Nutrients Per Acre			
			4	5	6	7	3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)	
Source	Month	Applic. per Acre	Units	N	P2O5	K2O				
Separated solids	Sep Oct Nov Dec Jan Feb		tons	4.4	7.0	16.2				
Separated solids	Mar Apr May Jun July Aug		tons	6.6	7.0	16.2				
Spring pen pack	Sep Oct Nov Dec Jan Feb		tons	4.5	4.5	13.2				
Spring pen pack	Mar Apr May Jun July Aug		tons	6.8	4.5	13.2				
Mixed solids	Sep Oct Nov Dec Jan Feb		tons	2.7	2.3	5.2				
Mixed solids	Mar Apr May Jun July Aug		tons	4.1	2.3	5.2				
Cell 1 agitated	Sep Oct Nov Dec Jan Feb	1/2	inches	88	158	383	44	79	191	
Cell 1 agitated	Mar Apr May Jun July Aug		inches	139	158	383				
Cell 2 agitated	Sep Oct Nov Dec Jan Feb		inches	71	60	264				
Cell 2 agitated	Mar Apr May Jun July Aug		inches	112	60	264				
Cells 1 and 2 not agitated	Sep Oct Nov Dec Jan Feb		inches	49	34	204				
Cells 1 and 2 not agitated	Mar Apr May Jun July Aug	1/2	inches	77	34	204	115	51	306	
Commercial fertilizer			lbs							
Commercial fertilizer			lbs							
Total to apply (lbs/ac):							159	130	497	
Total crop uptake (lbs/ac):							203	76	249	

Rules: 1. N applied must not exceed uptake.

2. If P index is high or very high, P2O5 applied must not exceed uptake.

Tract:	T 861	Crop:	Grass/Legume Hay/Pasture
Field:	Daisy South	Yield:	6 Ton
P index:	medium		

← see map.

← Post harvest test is in Sept.
All others are before planting.

Soil test:	P	K	pH	SMP	PSNT	Post Harvest NO ₃ ⁻
	36	80	6.4	7.0		

1	2	3	Nutrients Per Unit				Nutrients Per Acre		
			4	5	6	7	3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)
Source	Month	Applic. per Acre	Units	N	P2O5	K2O			
Separated solids	Sep Oct Nov Dec Jan Feb		tons	4.4	7.0	16.2			
Separated solids	Mar Apr May Jun July Aug		tons	6.6	7.0	16.2			
Spring pen pack	Sep Oct Nov Dec Jan Feb		tons	4.5	4.5	13.2			
Spring pen pack	Mar Apr May Jun July Aug		tons	6.8	4.5	13.2			
Mixed solids	Sep Oct Nov Dec Jan Feb	30T	tons	2.7	2.3	5.2	81	69	156
Mixed solids	Mar Apr May Jun July Aug		tons	4.1	2.3	5.2			
Cell 1 agitated	Sep Oct Nov Dec Jan Feb		inches	88	158	383			
Cell 1 agitated	Mar Apr May Jun July Aug		inches	139	158	383			
Cell 2 agitated	Sep Oct Nov Dec Jan Feb		inches	71	60	264			
Cell 2 agitated	Mar Apr May Jun July Aug		inches	112	60	264			
Cells 1 and 2 not agitated	Sep Oct Nov Dec Jan Feb		inches	49	34	204			
Cells 1 and 2 not agitated	Mar Apr May Jun July Aug		inches	77	34	204			
Commercial fertilizer	40-0-0-6	200	lbs	40				20	
Commercial fertilizer			lbs						
Total to apply (lbs/ac):							203	76	249
Total crop uptake (lbs/ac):							161	69	156

Rules: 1. N applied must not exceed uptake.

2. If P index is high or very high, P2O5 applied must not exceed uptake.

Tract:

Field:

P index:

T 861 - 22 1 N
@ Daisy - north
mid

Alfa/la

Crop: Grass/Legume Hay/Pasture
Yield: 6 Ton

no manure or
fertilizer applied
see map.

← Post harvest test is in Sept.
All others are before planting.

Soil test:	P	K	pH	SMP	PSNT	Post Harvest NO ₃	Nutrients Per Acre
	77	221	6.5	6.9			

1	2	3	Nutrients Per Unit				Nutrients Per Acre		
			4	5	6	7	3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)
Source	Month	Applic. per Acre	Units	N	P2O5	K2O			
Separated solids	Sep Oct Nov Dec Jan Feb		tons	4.4	7.0	16.2			
Separated solids	Mar Apr May Jun July Aug		tons	6.6	7.0	16.2			
Spring pen pack	Sep Oct Nov Dec Jan Feb		tons	4.5	4.5	13.2			
Spring pen pack	Mar Apr May Jun July Aug		tons	6.8	4.5	13.2			
Mixed solids	Sep Oct Nov Dec Jan Feb		tons	2.7	2.3	5.2			
Mixed solids	Mar Apr May Jun July Aug		tons	4.1	2.3	5.2			
Cell 1 agitated	Sep Oct Nov Dec Jan Feb		inches	88	158	383			
Cell 1 agitated	Mar Apr May Jun July Aug		inches	139	158	383			
Cell 2 agitated	Sep Oct Nov Dec Jan Feb		inches	71	60	264			
Cell 2 agitated	Mar Apr May Jun July Aug		inches	112	60	264			
Cells 1 and 2 not agitated	Sep Oct Nov Dec Jan Feb		inches	49	34	204			
Cells 1 and 2 not agitated	Mar Apr May Jun July Aug		inches	77	34	204			
Commercial fertilizer			lbs						
Commercial fertilizer			lbs						
			Total to apply (lbs/ac):				203	76	249
			Total crop uptake (lbs/ac):						

Rules: 1. N applied must not exceed uptake.

2. If P index is high or very high, P2O5 applied must not exceed uptake.

Tract:

Field:

P index:

T 863-1
Ron's upper bottom
LOW

Crop: Corn, Silage(AH)
Yield: 25 Ton

← see map.

Soil test:	P	K	pH	SMP	PSNT	Post Harvest NO ₃ ⁻
	123	520	6.4	6.6		

← Post harvest test is in Sept.
All others are before planting.

1		2		3		Nutrients Per Unit				Nutrients Per Acre			
Source		Month		Applic. per Acre		4	5	6	7	3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)	
						Units	N	P2O5	K2O				
Separated solids		Sep Oct Nov Dec Jan Feb				tons	4.4	7.0	16.2				
Separated solids		Mar-Apr May Jun July Aug				tons	6.6	7.0	16.2				
Spring pen pack		Sep Oct Nov Dec Jan Feb				tons	4.5	4.5	13.2				
Spring pen pack		Mar Apr May Jun July Aug				tons	6.8	4.5	13.2				
Mixed solids		Sep Oct Nov Dec Jan Feb				tons	2.7	2.3	5.2	13.5	11	26	
Mixed solids		Mar Apr May Jun July Aug				tons	4.1	2.3	5.2	217.3	121.9	275	
Cell 1 agitated		Sep Oct Nov Dec Jan Feb				inches	88	158	383				
Cell 1 agitated		Mar Apr May Jun July Aug				inches	139	158	383				
Cell 2 agitated		Sep Oct Nov Dec Jan Feb				inches	71	60	264				
Cell 2 agitated		Mar Apr May Jun July Aug				inches	112	60	264				
Cells 1 and 2 not agitated		Sep Oct Nov Dec Jan Feb				inches	49	34	204				
Cells 1 and 2 not agitated		Mar Apr May Jun July Aug				inches	77	34	204				
Commercial fertilizer						lbs							
Commercial fertilizer						lbs							
						Total to apply (lbs/ac):							
						Total crop uptake (lbs/ac):							
							231	123	301	193	100	230	

Rules: 1. N applied must not exceed uptake.

2. If P index is high or very high, P2O5 applied must not exceed uptake.

Tract:
Field:
P index:

T862-1
Speeschaert Rd
MCOIVM

Crop: Grass/Legume Hay/Pasture
Yield:
6
Ton

see map.

Soil test:		P	K	pH	SMP	PSNT	Post Harvest NO ₃ ⁻	Nutrients Per Acre			
								3x5 N (lb/ac)	3x6 P2O5 (lb/ac)	3x7 K2O (lb/ac)	
1	2	3	4	5	6	7	Nutrients Per Unit				
Source	Month	Applic. per Acre	Units	N	P2O5	K2O					
Separated solids	Sep Oct Nov Dec Jan Feb		tons	4.4	7.0	16.2					
Separated solids	Mar Apr May Jun July Aug		tons	6.6	7.0	16.2					
Spring pen pack	Sep Oct Nov Dec Jan Feb		tons	4.5	4.5	13.2					
Spring pen pack	Mar Apr May Jun July Aug		tons	6.8	4.5	13.2					
Mixed solids	Sep Oct Nov Dec Jan Feb	30 T	tons	2.7	2.3	5.2					
Mixed solids	Mar Apr May Jun July Aug		tons	4.1	2.3	5.2					
Cell 1 agitated	Sep Oct Nov Dec Jan Feb		inches	88	158	383					
Cell 1 agitated	Mar Apr May Jun July Aug		inches	139	158	383					
Cell 2 agitated	Sep Oct Nov Dec Jan Feb		inches	71	60	264					
Cell 2 agitated	Mar Apr May Jun July Aug		inches	112	60	264					
Cells 1 and 2 not agitated	Sep Oct Nov Dec Jan Feb		inches	49	34	204					
Cells 1 and 2 not agitated	Mar Apr May Jun July Aug		inches	77	34	204					
Commercial fertilizer	4000-0-6	200	lbs	40	0	0					
Commercial fertilizer			lbs								
			Total to apply (lbs/ac):					161	69	156	
			Total crop uptake (lbs/ac):					203	76	249	

- Rules:
1. N applied must not exceed uptake.
2. If P index is high or very high, P2O5 applied must not exceed uptake.

FIELD SUMMARY & P INDEX

Grower: George Marsh
Application Plan by: Dean P. Moberg
Date: June 13, 2007

Field Acres	T859-1	T859-3	T859-5	T859-2	T861-IN	T859-4	T863-1	T861-1S	T860-1
1, Aloha silt loam	14	12	21.7	12.4	20	13.9	12	20.0	32.7
Soil test date	October 18, 2005	September 19, 2006	May 1, 2007	September 19, 2006	September 19, 2006	September 19, 2006	May 1, 2007	September 19, 2006	September 19, 2006
Bray 1 P (ppm)	104	95	119	93	77	137	123	36	121
Acetate K (ppm)	477	501	395	442	221	592	520	80	396
pH	6.5	6.5	6.6	6.6	6.5	6.1	6.4	6.4	6.5
SMP	6.6	6.9	6.7	6.9	6.9	6.8	6.6	7	6
TRANSPORT FACTORS									
Sheet & rill erosion (tons/ac-yr)	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3
Irrigation erosion (tons/ac-yr)	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff
Runoff Class	medium	medium	medium	medium	medium	medium	medium	medium	medium
Flooding Frequency	none	frequent	none	none	none	none	none	none	none
Distance to stream (ft)	<100 ft	<100 ft	<100 ft	<100 ft	<100 ft	<100 ft	>500 ft	>500 ft	<100 ft
Buffers	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.
Drainage	tiles	tiles	tiles	tiles	tiles	tiles	tiles	tiles	tiles
SOURCE FACTORS									
Commercial P2O5 rate (lbs/ac)	0	0	0	0	0	0	0	0	0
Commercial P2O5 method	None applied	None applied	None applied	None applied	None applied	None applied	None applied	None applied	None applied
Commercial P2O5 timing	None applied	None applied	None applied	None applied	None applied	None applied	None applied	None applied	None applied
Organic P2O5 rate (lbs/ac)	0	189	85	0	0	0	133	69	130
Organic P2O5 method	Not incorp. in 5 days	Not incorp. in 5 days	Not incorp. in 5 days	Not incorp. in 5 days	Not incorp. in 5 days	Not incorp. in 5 days	Not incorp. in 5 days	Not incorp. in 5 days	Not incorp. in 5 days
Organic P2O5 timing	No app. Nov. thru Jan.	No app. Nov. thru Jan.	No app. Nov. thru Jan.	No app. Nov. thru Jan.	No app. Nov. thru Jan.	No app. Nov. thru Jan.	No app. Nov. thru Jan.	No app. Nov. thru Jan.	No app. Nov. thru Jan.
SCORE	15.7	21.5	18.9	14.6	13.0	19.0	16.2	18.8	0.0
P RUNOFF RISK RATING	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Low

COMMENTS

Soil test P and K levels are excessively high on several fields.

MANURE

Big Gun Application rates using ring nozzles

by: Dean Moberg

Gun Speed (ft/min)	Inches Applied		
	1.00" Nozzle	1.10" Nozzle	1.20" Nozzle
0.5	2.9	4.6	6.8
0.6	2.5	3.9	5.6
0.7	2.1	3.3	4.8
0.8	1.8	2.9	4.2
0.9	1.6	2.6	3.8
1.0	1.5	2.3	3.4
1.1	1.3	2.1	3.1
1.2	1.2	1.9	2.8
1.3	1.1	1.8	2.6
1.4	1.1	1.7	2.4
1.5	1.0	1.5	2.3
1.6	0.9	1.4	2.1
1.7	0.9	1.4	2.0
1.8	0.8	1.3	1.9
1.9	0.8	1.2	1.8
2.0	0.7	1.2	1.7
2.1	0.7	1.1	1.6
2.2	0.7	1.1	1.5
2.3	0.6	1.0	1.5
2.4	0.6	1.0	1.4
2.5	0.6	0.9	1.4
2.6	0.6	0.9	1.3
2.7	0.5	0.9	1.3
2.8	0.5	0.8	1.2
2.9	0.5	0.8	1.2
3.0	0.5	0.8	1.1

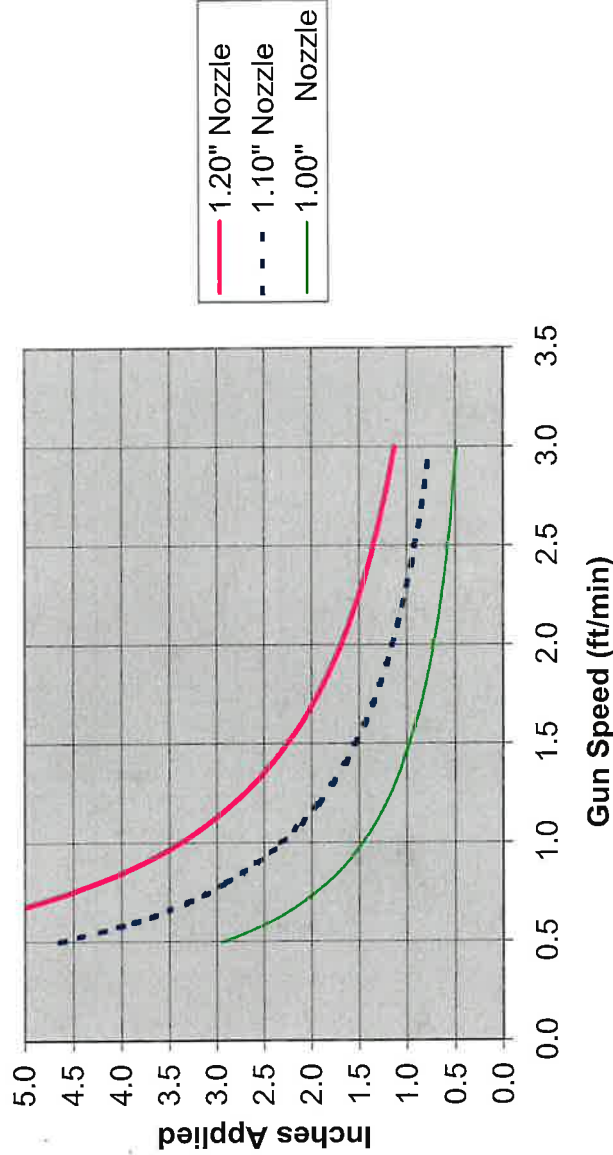
Reference: AWMH, Table 12-15.

Assumptions:

- Pressure at nozzle = 80 psi
- Flow for 0.80" nozzle = 165 gpm
- Flow for 1.00" nozzle = 260 gpm
- Flow for 1.20" nozzle = 380 gpm
- Lane spacing = 180 ft

Note: these flow rates are estimates. Actual flow rates vary by manufacturer. Also, these rates are for liquid manure, NOT WATER.

Big Gun Application Rates



MANURE

Big Gun Application rates using ring nozzles

by: Dean Moberg

Gun Speed (ft/min)	Inches Applied		
	0.80" Nozzle	1.00" Nozzle	1.20" Nozzle
0.5	2.2	3.5	5.1
0.6	1.8	2.9	4.2
0.7	1.6	2.5	3.6
0.8	1.4	2.2	3.2
0.9	1.2	1.9	2.8
1.0	1.1	1.7	2.5
1.1	1.0	1.6	2.3
1.2	0.9	1.4	2.1
1.3	0.8	1.3	2.0
1.4	0.8	1.2	1.8
1.5	0.7	1.2	1.7
1.6	0.7	1.1	1.6
1.7	0.6	1.0	1.5
1.8	0.6	1.0	1.4
1.9	0.6	0.9	1.3
2.0	0.6	0.9	1.3
2.1	0.5	0.8	1.2
2.2	0.5	0.8	1.2
2.3	0.5	0.8	1.1
2.4	0.5	0.7	1.1
2.5	0.4	0.7	1.0
2.6	0.4	0.7	1.0
2.7	0.4	0.6	0.9
2.8	0.4	0.6	0.9
2.9	0.4	0.6	0.9
3.0	0.4	0.6	0.8

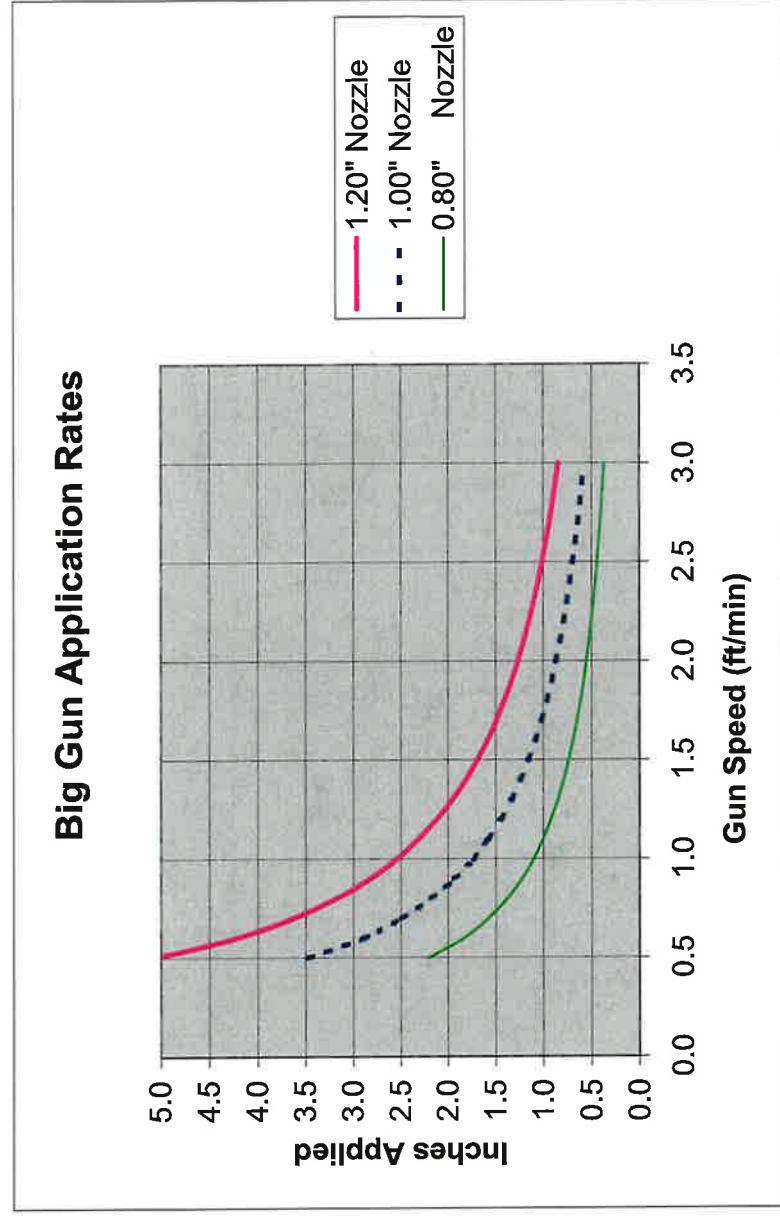
Reference: AWMH, Table 12-15.

Assumptions:

- Pressure at nozzle = 80 psi
- Flow for 0.80" nozzle = 165 gpm
- Flow for 1.00" nozzle = 260 gpm
- Flow for 1.20" nozzle = 380 gpm
- Lane spacing = 240 ft

Note: these flow rates are estimates. Actual flow rates vary by manufacturer and by consistency of liquid manure.

Big Gun Application Rates



Enter data in gray cells.

Grass/Manure

Can #1 is 10 feet to the right of the traveller.

Can #1 is 10 feet to the left of the traveller.

Average of Lowest 1/4 =	95	ml
	0.60	in

Average of all =	158	ml
	1.00	in

Uniformity coefficient = (should be > 70%) **60%**

**Uniformity coefficient =
(should be > 70%)**

Big gun traveller calibration explanation

Calibrating your big gun irrigator is essential for good irrigation and nutrient management.

This process should be done once each year.

Plastic buckets should be set out to the right and the left of the big gun irrigator, at the distances shown on the preceding page.

Do this test near the center of a field so your results are not affected by changes in pressure as the system starts up or by excess irrigation applied if the big gun is allowed to run longer at the end of a pull.

Your uniformity coefficient for this field was:

60%

This is less than the minimum suggested value of 70%. We suggest you contact an irrigation specialist to determine how to improve your uniformity.

Your average application rate at a traveller speed of

2.5

ft/min

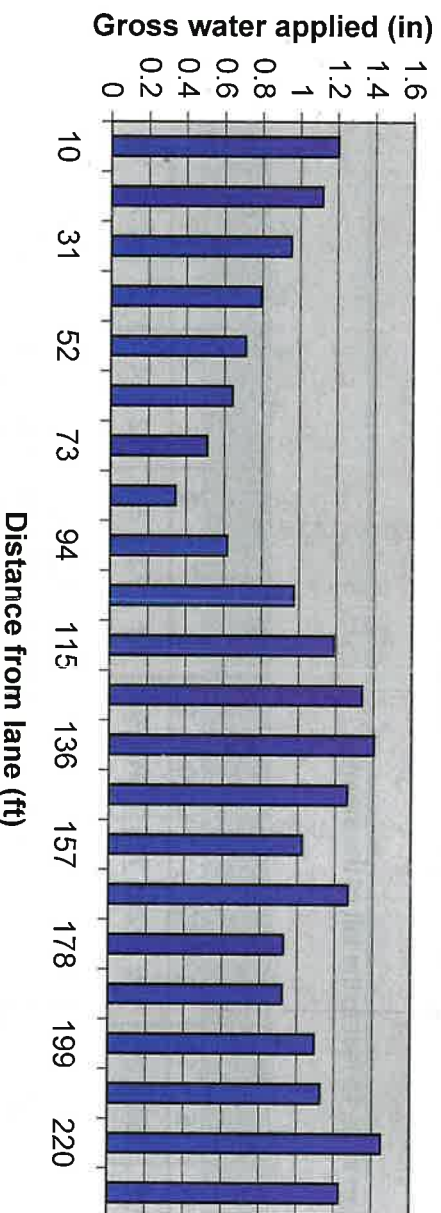
was

1.00

inches

You can use this value to determine application rates, assuming you keep the same nozzle size, pressure and traveller speed.

Big Gun Application



NOTES: While the calibration was going on, the wind speed was about 10 mph and coming from the north. So the manure was being spreaded more towards the left side of the traveler when looking at the traveler.

Conservation Plan Map



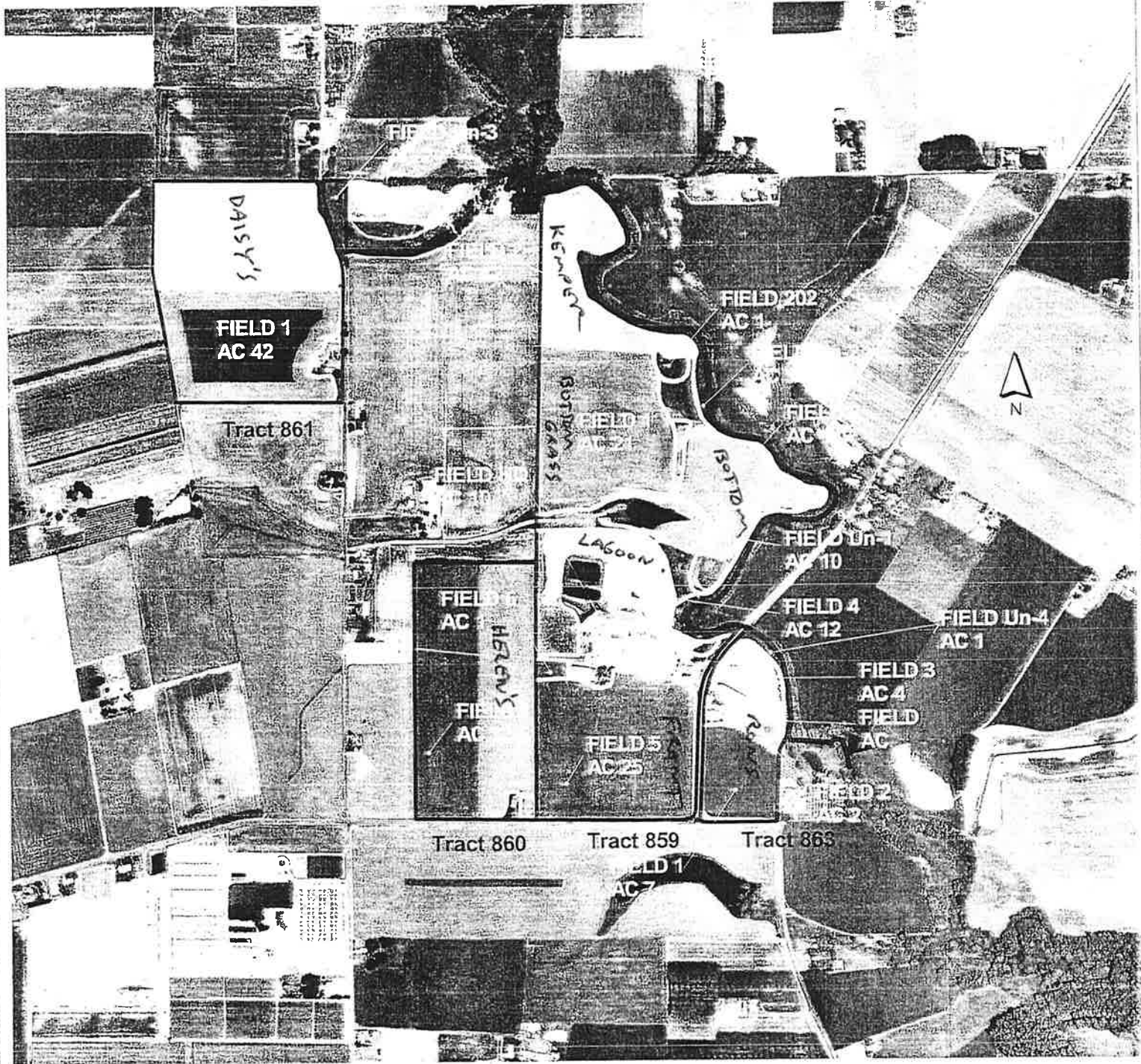
Mr. George E. Marsh
Washington County SWCD
211.6 Acres
Date: 03/28/2003

SOIL TESTS

1:12000

1000 0 1000 2000 Feet

USDA-NRCS
Dean P. Moberg
(503) 648-3174 x113



KEY TO FARMER NAMES OF FIELDS

Existing features

Planned Land Units

Streams

Un-named stream



Council Creek



Dairy Creek

Conservation Plan



Silage Sump & Pipe



Filter Strip

Conservation Plan Map

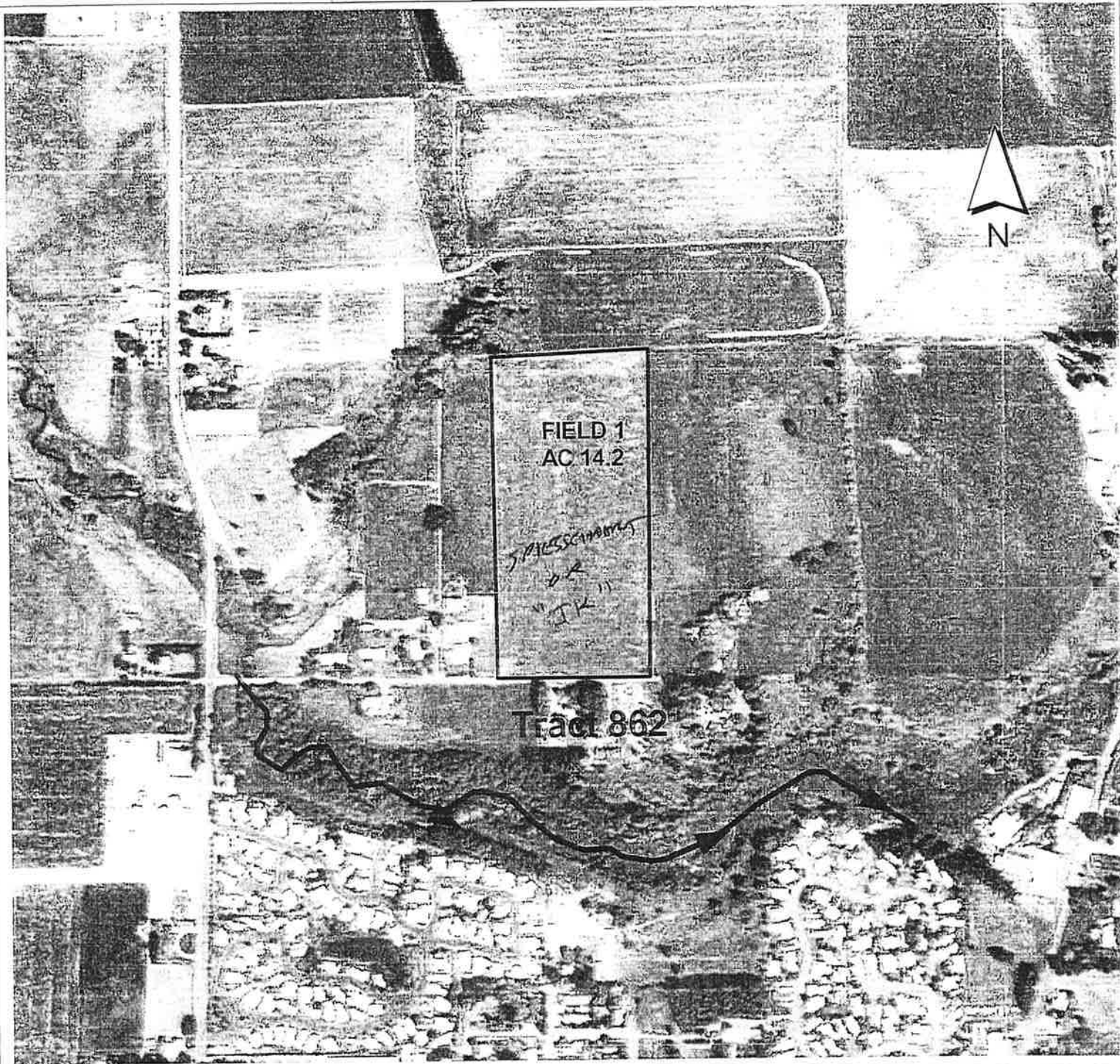


Mr. George E. Marsh
Washington County SWCD
14.2 Acres
Date: 04/03/2003

1:6000

500 0 500 1000 Feet

USDA-NRCS
Dean P. Moberg
(503) 648-3174 x113



Existing features

Planned Land Units

Streams



Council Creek

Dairy Creek

Un-named stream

Approved by: _____
Date: _____
BRANCH NAME: CORNELIUS-WFS
TEST ID #: 2851
CROP: SOIL

24730 Avenue 13
Madera, CA 93637
Phone: 559-661-6386
FAX: 559-661-6135



LOG IN #: 275057
DATE SAMPLED: 4/27/2007
DATE SUBMITTED: 5/1/2007
DATE REPORTED: 5/4/2007

FIELDMAN

HOUSE

REPORT OF SOIL ANALYSIS

GROWER/CLIENT
MARSH HOMESTEAD

-----reported in parts per million (ppm)-----

No.	DESCRIPTION	meq/100g Soil					-----reported in parts per million (ppm)-----								
		pH	SMP	pH	Ca	Mg	Ca/Mg Ratio	PO4-P	K	B	S	Zn	Fe	Mn	Cu
1	FRONT HOUSE FIELD T859-5	6.6	6.7		8.0	2.2	3.7	119.3	305						
2	RONS UPPER FIELD T863-1	6.4	6.6		7.9	1.5	5.1	123.1	520						

MOST
RECENT
RESULTS

September 19, 2008 FAX TO CLIENT: 503/640-5973

AGRI-CHECK, INC.

MAIL: 88203
REPORT:

REPORT: S8203

WESTERN FARM SERVICE - Comelius

MARSH. GEORGE

BRIAN SCHULTZ

UPPER BOTTOM CORN

CROP:



**Agricultural Testing Laboratory
323 81xth St. - P.O. Box 1350
Umatilla, OR 97882
800-537-1188 * 541-822-4884**

SOIL ANALYSIS REPORT

SOIL ANALYSIS REPORT																						
Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	NITROGEN										MOISTURE							
					P ppm	K ppm	Ca meq	Mg meq	NO3 #/A	NH4 #/A	S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf.ph	Total Avail. % Inches
0044	0.5"	6.5			95	501	8.3	2.8		41												
																12.4		6.9				

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

[illegible]

NOTE. East of Cascades, $\text{pH} = 4.5$ and Acetate K extractions may change a 10% application of gypsum or lime. West of Cascades, $\text{pH} = 5.5$ and Acetate K extractions may change a 10% application of gypsum or lime.

DATE: September 19, 2006
REPORT: S8203
CLIENT: WESTERN FARM SERVICE - Cornelius
GROWER: MARSH, GEORGE
SAMPLED: BRIAN SCHULTZ
FIELD: KEMPER ALFALFA
CROP: T859-2

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O. M. %	NITROGEN					S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat %	SMP % Buf.pH	MOISTURE		TKN %	Cl ppm
					NO3 #/A	NH4 #/A															Total Avail. Inches			
4041	0-6"	6.6			93	442	11.2	3.0		0.4							15.3			6.9				

TOTALS:

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:
PREVIOUS CROP:
GYPSUM REQUIREMENT:
LIME REQUIREMENT:
DOLOMITE REQUIREMENT:

SOIL TEXTURE ANALYSIS:

CLASS:
% SAND:
% SILT:
% CLAY:

TOTAL INCHES:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %		Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades Block K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Buffer and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: September 19, 2006 FAX TO CLIENT: 503/640-5973
REPORT: S 8203
CLIENT: WESTERN FARM SERVICE - Cornelius
GROWER: MARSH, GEORGE
SAMPLED: BRIAN SCHULTZ
FIELD: DAISY N ALFALFA
CROP: T861-1N

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf. pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
4037	0-6"	6.5			77	221	9.9	1.4	12			0.4								11.9		6.9			

TOTALS: 12

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYPSUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

PREPLANT:

SIDEDRESS:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades Bicarb P & K extraction/SMP=4000 ppm Buffer pH. West of Cascades Weak Bray P and Acetate K extraction. Fertility recommendations may change after application of gypsum or lime.

DATE: September 19, 2006 FAX TO CLIENT: 503/640-5973

REPORT: S8203
CLIENT: WESTERN FARM SERVICE - Cornelius
GROWER: MARSH, GEORGE
SAMPLED: BRIAN SCHULTZ
FIELD: DAISY S ALFALFA
CROP: *T 861-15*

AGRI-CHECK, INC.

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O. M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN					S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	MOISTURE			TKN %	CI ppm
									NO3 #/A	NH4 #/A			Total Bases %									Avail. %	inches			

4038 0-6" 6.4 36 80 9.7 1.0

10.9 7.0

TOTALS:

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:
PREVIOUS CROP:
GYPSUM REQUIREMENT:
LIME REQUIREMENT:
DOLOMITE REQUIREMENT:

TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES

PREPLANT:

SIDEDRESS:

COMMENTS:

TOTAL INCHES:

SOIL TEXTURE ANALYSIS:

CLASS:
% SAND:
% SILT:
% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades Bioscience K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Br and Acetate K extractions. Fertility recommendations may change after a season of gypsum or lime.

September 19, 2006 FAX TO CLIENT: 503/640-5973

AGRI-CHECK, INC.

WESTERN FARM SERVICE - Cornelius
MARSH, GEORGE
BRIAN SCHULTZ
FRONT FIELD

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Basas	Base Sat. %	SMP Buf. pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		

4039 0-6" 6.2 113 288 8.4 1.9 33

11.0 6.7

TOTALS: 33

TOTAL INCHES:

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYPSUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

PREPLANT:

SIDEDRESS:

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:

% SILT:

% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTES: If Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; Western Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: September 19, 2006 FAX TO CLIENT: 503/640-5973

REPORT: S8203

CLIENT: WESTERN FARM SERVICE - Cornelius

GROWER: MARSH, GEORGE

SAMPLED: BRIAN SCHULTZ

FIELD: HELENS

CROP:

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf.pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
4040	0-6"	6.5			121	396	7.5	2.0	27										10.5			6.9			

TOTALS: 27

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
 PHOSPHORUS: LBS PER ACRE P205
 POTASSIUM: LBS PER ACRE K2O
 SULFUR: LBS PER ACRE ACTUAL S
 BORON: LBS PER ACRE ACTUAL B
 ZINC: LBS PER ACRE ACTUAL Zn
 MAGNESIUM: LBS PER ACRE ACTUAL Mg
 OTHERS:

TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES

PREPLANT:

SIDEDRESS:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD: DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades Bkcarb P & K extraction/SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extraction. Fertility recommendations may change after application of gypsum.

DATE: September 19, 2006 FAX TO CLIENT: 503/640-5973
REPORT: S8203
CLIENT: WESTERN FARM SERVICE - Cornelius
GROWER: MARSH, GEORGE
SAMPLED: BRIAN SCHULTZ
FIELD: LAGOON GRASS
CROP:

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt		P	K	Ca	Mg	NITROGEN		S	B	Zn	Mn	Cu	Fe	CEC	Na	Total Bases	Base Sat %	SMP	MOISTURE		TKN	Cl
			mmhos	%					NO3 #/A	NH4 #/A												Total %	Avail. Inches		

4042	0-6"	6.1			137	592	10.2	3.6	74										15.3				6.8		
------	------	-----	--	--	-----	-----	------	-----	----	--	--	--	--	--	--	--	--	--	------	--	--	--	-----	--	--

***** TOTALS: 74 *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE: _____
ACRES: _____
PREVIOUS CROP: _____
GYPSUM REQUIREMENT: _____
LIME REQUIREMENT: _____
DOLOMITE REQUIREMENT: _____
PREPLANT: _____
SIDEDRESS: _____

SOIL TEXTURE ANALYSIS:

CLASS: _____
% SAND: _____
% SILT: _____
% CLAY: _____

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

Notes: East of Cascades Bicarb. P & K extraction/SMP=1/4 SMP Buffer pH. West of Cascades Weak Bray-P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: September 19, 2006 FAX TO CLIENT: 503/640-5973

REPORT: S8203

CLIENT: WESTERN FARM SERVICE - Cornelius

GROWER: MARSH, GEORGE

SAMPLED: BRIAN SCHULTZ

FIELD: LOWER BOTTOM CORN

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP % Buf	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
4043	0-6"	6.3			61	498	12.8	4.7	42											18.8			6.7		

TOTAL INCHES:

TOTALS: 42

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES

PREPLANT:

SIDEDRESS:

COMMENTS:

SOIL TEXTURE ANALYSIS:

CLASS:
% SAND:
% SILT:
% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades: Bicarb P & K extraction/SMI. West of Cascades: Weak Bray P and Acetate K extraction/SMI. Fertility recommendations may change after application of gypsum.

Older Results

DATE: May 04, 2005
REPORT: S 1937
CLIENT: PACIFIC HARVEST SUPPLY CO.
GROWER: MARSH, GEORGE
SAMPLED: DAISIES NORTH
FIELD:
CROP:

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O. M. %	NITROGEN		Ca meq	Mg meq	NO3 #/A	NH4 #/A	S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf. pH	MOISTURE		TKN %	CI ppm
					#/A	#/A																Total %	Avail. Inches		
4354	0-6"	6.0			58	212	8.1	1.3	30	18									9.9		6.4				

***** TOTAL INCHES: *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:
PREVIOUS CROP: TONS PER ACRE 6-INCHES
GYPSUM REQUIREMENT: TONS PER ACRE 6-INCHES
LIME REQUIREMENT: TONS PER ACRE 6-INCHES
DOLOMITE REQUIREMENT: TONS PER ACRE 6-INCHES

PREPLANT:

SIDEDRESS:

COMMENTS:

SOIL TEXTURE ANALYSIS:

CLASS:
% SAND:
% SILT:
% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD: DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

Notes: Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: October 06, 2004

REPORT: S 2514

CLIENT: PACIFIC HARVEST SUPPLY CO.

GROWER: MARSH HOMESTEAD DAIRY

SAMPLED:

FIELD: BOTTOM - END OF SEASON

CROP: CORN

7859-1

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases ppm	Base Sat. %	SMP Buf. pH	MOISTURE		CI ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches	TKN %

4229 0-7"

128 30

11 2x 10/10c

11 64 ppm
11 15 ppm

TOTAL INCHES:

TOTALS: 128 30

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYPSUM REQUIREMENT:

LIME REQUIREMENT:

DOLomite REQUIREMENT:

PREPLANT:

SIDEDRESS:

TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:

% SILT:

% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No. FIELD: DESCRIPTION:

Total N % Nitrate N ppm S % P % K % Ca % Mg % B ppm Zn ppm Mn ppm Cu ppm Fe ppm Chloride ppm Na ppm Moisture %

COMMENTS:

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: October 04, 2004 FAX TO CLIENT: 503/358-4289
 REPORT: S 2482
 CLIENT: PACIFIC HARVEST SUPPLY CO.
 GROWER: MARSH, GEORGE
 SAMPLED: KEMPER POST-HARVEST
 FIELD: CORN
 CROP: 7859-2

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Agricultural Testing Laboratory

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800-537-1129 # 541-922-4884



SOIL ANALYSIS REPORT

Lab No. Depth Foot pH S.Salt O.M. % P ppm K ppm Ca meq Mg meq NITROGEN NO3 #/A NH4 #/A S ppm B ppm Zn ppm Mn ppm Cu ppm Fe ppm CEC meq Na meq Total Bases Sat.% Base Sat.% Bufr.pH SMP Total Avail. Inches TKN % Cl ppm

4013 0-6"

71 32

11 175 T/KC
 11 18 ppm
 41 ppm

TOTALS: 71 32

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
 PHOSPHORUS: LBS PER ACRE P2O5
 POTASSIUM: LBS PER ACRE K2O
 SULFUR: LBS PER ACRE ACTUAL S
 BORON: LBS PER ACRE ACTUAL B
 ZINC: LBS PER ACRE ACTUAL Zn
 MAGNESIUM: LBS PER ACRE ACTUAL Mg
 OTHERS:

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYP-SUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

PREPLANT:

SIDE DRESS:

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:

% SILT:

% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No. FIELD DESCRIPTION: Total N % Ntrate % S % P % K % Ca % Mg % B ppm Zn ppm Mn ppm Cu ppm Fe ppm Chloride ppm Mo ppm Moisture %

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: August 06, 2004 FAX TO CLIENT: 503/359-3582
REPORT: S 1779
CLIENT: PACIFIC HARVEST SUPPLY CO.
GROWER: MARSH HOMESTEAD DAIRY
SAMPLED: GEORGE MARSH
FIELD: PASTURE
CROP:

AGRI-CHECK, INC.

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP But. pH	MOISTURE		Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches	
465	0-6"	6.0	0.18	3.3	108	368	7.3	1.9	21	9	16.0	0.4	3.1	24	2.4	96			10.1		6.6			

fine

Boron
1-2 Ton Lim e

***** TOTAL INCHES: *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:
PREVIOUS CROP: TONS PER ACRE 6-INCHES
GYPSUM REQUIREMENT: TONS PER ACRE 6-INCHES
LIME REQUIREMENT: TONS PER ACRE 6-INCHES
DOLOMITE REQUIREMENT: TONS PER ACRE 6-INCHES

PREPLANT:

SIDEDRESS:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: August 06, 2004
REPORT: S 1779
CLIENT: PACIFIC HARVEST SUPPLY CO.
GROWER: MARSH HOMESTEAD DAIRY
SAMPLED: GEORGE MARSH
FIELD: PASTURE
CROP:

FAX TO CLIENT: 503/359-3582

AGRI-CHECK, INC.

Agricultural Testing Laboratory
323 Sixth St. - P.O. Box 1350
Umatilla, OR 97882
800-537-1129 * 541-922-4894



SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf.pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
465	0-6"	6.0	0.18	3.3	108	368	7.3	1.9	21	9	16.0	0.4	3.1	24	2.4	96			10.1		6.6				

***** TOTALS: 21 9 ***** TOTAL INCHES: *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYPSUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

PREPLANT:

SIDEDRESS:

SO

CL

% S

% S

% C

WHAT
FIELD?

PLANT TISSUE ANALYSIS REPORT

Lab No. FIELD: DESCRIPTION:

Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %
-----------	---------------	-----	-----	-----	------	------	-------	--------	--------	--------	--------	--------------	--------	------------

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: June 28, 2004

FAX TO CLIENT: 503/359-3582

AGRI-CHECK, INC.

Agricultural Testing Laboratory

323 Sixth St. - P.O. Box 1350

Umatilla, OR 97882

800-537-1129 * 541-922-4894

REPORT: S1182 MA

CLIENT: PACIFIC HARVEST SUPPLY CO.

BROWER: MARSH HOMESTEAD DAIRY

SAMPLED: GEORGE MARSH

CROP: CORN



SOIL ANALYSIS REPORT

-ab	Depth	pH	S.Salt	O. M.	P	K	Ca	Mg	NO3	NH4	S	B	Zn	Mn	Cu	Fe	CEC	Na	Total	Base	Base	Sat. %	Buf.pH	Fld.	Avail.	TKN	Cl
Vo.	Foot		mmhos	%	ppm	ppm	meq	meq	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	meq	meq	meq	Bases	Base	Sat. %		Cap.%	Inches	%	ppm
	FIELD: BOTTOM																										
5738	0-6"								98.8																		
	FIELD: KEMPER																										
5739	0-6"								75.0																		

T859-1

T859-2

FIELD: BOTTOM

5738 0-6"

FIELD: KEMPER

5739 0-6"

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions.

DATE: October 23, 2003

REPORT: S 8931

CLIENT: PACIFIC HARVEST SUPPLY CO.

GROWER: MARSH HOMESTEAD DAIRY

SAMPLED:

FIELD: BOTTOM - CORN

CROP:

AGRI-CHECK, INC.

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T859 Field #3

SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Bufl.pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
2230	0-8"	6.4			50	431	12.0	4.6	42	19										17.7		6.6			

11 2.3 x 10 5/16 180ppm 11 11 8 ppm

TOTAL INCHES:

TOTALS: 42 19

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYPSUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

PREPLANT:

SIDEDRESS:

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:

% SILT:

% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD: DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

COMMENTS:

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

October 23, 2003

ORT: S8931
CLIENT: PACIFIC HARVEST SUPPLY CO.
GROWER: MARSH HOMESTEAD DAIRY

SAMPLED:
FIELD:
CROP:

FRONT FIELD
GRASS/ALFALFA

T859

Field #5

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Agricultural Testing Laboratory

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Umatilla, OR 97882

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S-Salt mmhos	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf.pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
2232	0-8"	6.1			97	271	8.1	2.0	63	48										10.8		6.4			

2.3 x 10⁶ / A.C.

2700 ppm

2100 ppm

***** TOTAL INCHES: *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYPSUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

PREPLANT:

SIDEDRESS:

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:

% SILT:

% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.

FIELD:

DESCRIPTION:

Total N %

Nitrate N ppm

S %

P %

K %

Ca %

Mg %

B ppm

Zn ppm

Mn ppm

Cu ppm

Fe ppm

Chloride ppm

Na ppm

Moisture %

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

October 23, 2003

REPORT: S8931
CLIENT: PACIFIC HARVEST SUPPLY CO.
GROWER: MARSH HOMESTEAD DAIRY

SAMPLED: BOTTOM - GRASS
FIELD: + 859
CROP: Fred #1

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S-Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
231	0-8"	6.4			116	476	8.5	2.7	64	34									12.4		6.7				

***** TOTALS: 64 34 ***** TOTAL INCHES: *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:
ACRES:

PREVIOUS CROP:

GYPHOSUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

PREPLANT:

SIDEDRESS:

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:

% SILT:

% CLAY:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

Date of Analysis: February 26, 2003

Date of Report: February 26, 2003



Grower: MARSH HOMESTEAD DAIRY Sample I.D. CORNDAISYN

Soil Analysis

OM	P ₁	P ₂	P _{bicarb}	K	Mg	Ca	Na	pH	BpH	CEC	K %	Mg %	Ca %	H %	Na %	Surf NO ₃ -N	Sub NO ₃ -N	Sub(2) NO ₃ -N	Total NO ₃	
2.0	70	99	-	98	104	1352	16	6.1	6.8	9.2	2.7	9.4	73.5	13.6	0.8	8 / 14	-	-	14	
%				ppm				ppm / lbs												lbs

S	Zn	Mn	Fe	Cu	B	Ex Lime	Sol. Salts	% Sand	% Clay	% Silt	Type	Mo Cl
9	1.3	8	124	1.0	0.5	L	0.1	-	-	-	-	-

Recommendations

[illegible]

RESULTS

Date of Analysis: February 26, 2003
Date of Report: February 26, 2003



grower: MARSH HOMESTEAD DAIRY Sample I.D. ALFDAISYS

Soil Analysis

	P ₁	P ₂	P _{bicarb}	K	Mg	Ca	Na	pH	BpH	CEC	K %	Mg %	Ca %	H %	Na %	Surf NO ₃ -N	Sub NO ₃ -N	Sub(2) NO ₃ -N	Total NO ₃
OM	53	100	-	134	149	1516	14	7.0	-	9.2	3.7	13.5	82.1	0.0	0.7	11 / 20	-	-	20
2.1	53	100	-	134	149	1516	14	7.0	-	9.2	3.7	13.5	82.1	0.0	0.7	11 / 20	-	-	lbs

		ppm													
%		S	Zn	Mn	Fe	Cu	B	Ex Lime	Sol. Salts	% Sand	% Clay	% Silt	Type	Mo	Cl
9		1.1	6	73	0.7	0.6		L	0.1	-	-	-	-	-	-
ppm															

Recommendations

[illegible]

WHAT
IS
THIS
FIELD
P + K
RESULT
SPLANGG
T861-1-11
100%



REPORT NUMBER

3227-0001

REPORT DATE

AUG 13, 2003

ACCOUNT NO.

12734

GROWER

T859 Field 2 GEORGE HARCH

TO: PACIFIC HARVEST SUPPLY CO

JEFF DUYCK

PO BOX 309

CORNELIUS OR

97112

COPY TO:

SOIL ANALYSIS REPORT

(SEE EXPLANATION ON BACK)

Info Sheet: 67204

LAB NUMBER	SAMPLE IDENTIFICATION	ORGANIC MATTER WALKLEY BLACK PERCENT RATE	PHOSPHORUS			POTASSIUM		MAGNESIUM		CALCIUM		SODIUM		pH		CATION EXCHANGE CAPACITY C.E.C. meq/100g	PERCENT BASE SATURATION (COMPUTED)				
			P ₁ (WEAK BRAY) ppm	P ₂ (STRONG BRAY) ppm	BICARBONATE P ppm	K ppm	Mg ppm	Ca ppm	Na ppm	SOIL pH 1:1	BUFFER INDEX	% K	% Mg	% Ca	% H		% Na				
																		RATE	RATE	RATE	RATE
65555	ALFALFA	3.51	104VH	129VH		450 VH	244 VH	1374M	29					6.3	6.8	13.4	10.1	17.8	60.8	13	1
DTPA EXTRACTION																					
NITRATE - N (FIA)			SULFUR S ICAP		ZINC Zn	COPPER Cu	IRON Fe	MANGA- NESE Mn	BORON B WATER SOLUBLE	EXCESS LIME RATE	SOLUBLE SALTS 1:1 mmhos/ cm										
ppm	lbs/A	IN	ppm	lbs/A	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
5			107		2.7M	3.1VH	374VH	15H	0.6L		3.1L										
COMMENTS:																					

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

REV. 1/96

T859 7/21/11 #3

DATE: July 17, 2003
REPORT: S7734 A
CLIENT: PACIFIC HARVEST SUPPLY CO.
GROWER: MARSH, GEORGE
SAMPLED: GEORGE
FIELD: BOTTOM
CROP: CORN

FAX TO CLIENT: 503/359-3582
AGRI-CHECK, INC.
Agricultural Testing Laboratory
323 Sixth St. - P.O. Box 1350
Umatilla, OR 97882
800-537-1128 * 541-922-4884



SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf. pH	MOISTURE		TKN %	CI ppm
									NO3 ppm	NH4 ppm												Total %	Avail. inches		

4861 28.5

357-9152-
503-349-0031

TOTALS: 28.5

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
OTHERS:

YIELD GOAL/ACRE:
ACRES:
PREVIOUS CROP:
GYPSUM REQUIREMENT:
LIME REQUIREMENT:

SOIL TEXTURE ANALYSIS:

CLASS:
% SAND:
% SILT:
% CLAY:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N		Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %
		N %	N %														

NOTE: East of Cascades Bicarb P & K Extraction/SMP=1/4 SMP Buffer pH West of Cascades Weak Bray P and Acetate X extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: July 11, 2003 FAX TO CLIENT: 503/359-3582
 REPORT: S7631 A
 CLIENT: PACIFIC HARVEST SUPPLY CO.
 GROWER: MARSH, GEORGE
 SAMPLED: JULIE
 FIELD: DAISY N-20
 CROP: *T861 N side*
No manure 7000

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases ppm	Base Sat. %	SMP Buf. pH	MOISTURE		TKN %	Cl ppm
									NO3 ppm	NH4 ppm												Total %	Avail. Inches		

4156

175 ?
73.8 high

TOTAL INCHES:

TOTALS: 73.8

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
 PHOSPHORUS: LBS PER ACRE P205
 POTASSIUM: LBS PER ACRE K2O
 SULFUR: LBS PER ACRE ACTUAL S
 BORON: LBS PER ACRE ACTUAL B
 ZINC: LBS PER ACRE ACTUAL Zn
 OTHERS:

YIELD GOAL/ACRE:
 ACRES:
 PREVIOUS CROP:

GYPSUM REQUIREMENT:
 LIME REQUIREMENT:
 TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES

SOIL TEXTURE ANALYSIS:

CLASS:
 % SAND:
 % SILT:
 % CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD: DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.



Date: February 26, 2003 Grower Name: MARSH HOMESTEAD DAIRY Samples: Page: 1

Sample ID	Analysis Date	OM	P ₁	P ₂	P _{bic}	K	Mg	Ca	Na	pH	BpH	CEC	K %	Mg %	Ca %	H %	Na %	Surf NO ₃ ⁻ N	Sub NO ₃ ⁻ N	S	Zn	Mn	Fe	Cu
ALFDAISYS	02-03	2.1	53	100	-	134	149	1516	14	7.0	-	9.2	3.7	13.5	82.1	0.0	0.7	11	-	9	1.1	6	73	0.7
CORNDASYN	02-03	2.0	70	99	-	98	104	1352	16	6.1	6.8	9.2	2.7	9.4	73.5	13.6	0.8	8	-	9	1.3	8	124	1.0

9.5
ppm

1.1 15.6 90.6'

WHAT FIELDS ARE THESE?

DATE: June 20, 2002

REPORT: S2494 MA

CLIENT: PACIFIC HARVEST SUPPLY CO.

GROWER: MARSH HOMESTEAD DAIRY

SAMPLED: LESLIE

CROP:

AGRI-CHECK, INC.

Agricultural Testing Laboratory

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Umatilla, OR 97882

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SOIL ANALYSIS REPORT

SOIL ANALYSIS REPORT																												
Lab No.	Depth Foot	pH	S.Salt mmhos	Q. M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN					S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf.pH	MOISTURE		TKN %	CI ppm
									NO3 ppm	NH4 ppm			Fld. Cap. %												Avail. %			
FIELD: T 859-3 BOTTOM																												
6480																												
FIELD: T 863-3 RON'S																												
6																												

VOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions.

DATE: October 30, 2001

REPORT: S 267

CLIENT: PACIFIC HARVEST GRAIN & SUPPLY

BROWER: MARSH HOMESTEAD DAIRY

SAMPLED: LESLIE

FIELD: T 859-2 KEMPER RON'S BOTTOM

CROP:

AGRI-CHECK, INC.

Agricultural Testing Laboratory

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SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf. pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
4283	0-6"	5.8			67	377	10.8	2.2	108	23												14.0	6.3		

***** TOTAL INCHES: 14.0 *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYPSUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

TONS PER ACRE 6-INCHES

TONS PER ACRE 6-INCHES

TONS PER ACRE 6-INCHES

PREPLANT:

SIDEDRESS:

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:

% SILT:

% CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab FIELD:

No. DESCRIPTION:

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades Bicarb F & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.



AGRI-CHECK, INC.
Agricultural Testing Laboratory
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Umatilla, OR 97882
800-537-1129 * 541-922-4894

DATE: October 30, 2001
PORT: S 267
FERT: PACIFIC HARVEST GRAIN & SUPPLY
TOWER: MARSH HOMESTEAD DAIRY
SAMPLED: LESLIE
FIELD: T 861-1 DAISY N+S
TOP:

OIL ANALYSIS REPORT

OIL ANALYSIS REPORT																													
lb	Depth	pH	S.Salt	O.M.	P	K	Ca	Mg	NITROGEN			S	B	Zn	Mn	Cu	Fe	CEC	Na	Total	Base	SMP	MOISTURE		TKN	Cl			
									mmhos	%	ppm												ppm	ppm			%	Total	Avail.
	Foot						meq	meq	#/A	NH4	#/A	ppm	ppm	ppm	ppm	ppm	ppm	meq	meq	meq	Bases	Sat.	%	%	Inches	%			
285	0-6"	5.8			98	413	6.9	1.7	103	24										9.7		6.4							

***** TOTALS: 103 24 *****

TOTAL INCHES:

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:
ACRES:

PREVIOUS CROP:
GYPSUM REQUIREMENT:
LIME REQUIREMENT:
DOLOMITE REQUIREMENT:

SOIL TEXTURE ANALYSIS:

CLASS:
% SAND:
% SILT:
% CLAY:

PREPLANT:
SIDEDRESS:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

Lab	FIELD:	No.	DESCRIPTION:	Total	Nitrate	S	P	%	K	%	Ca	%	Mg	%	B	ppm	Zn	ppm	Mn	ppm	Cu	ppm	Fe	ppm	Chloride	ppm	Na	ppm	Moisture	%
				N %	N ppm	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: October 30, 2001

REPORT: S 267
CLIENT: PACIFIC HARVEST GRAIN & SUPPLY
ROWER: MARSH HOMESTEAD DAIRY
SAMPLED: LESLIE
ELD: T 863-3 3+2 RON'S BOTTOM
ROP:

AGRI-CHECK, INC.

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Umatilla, OR 97882
800-537-1129 * 541-922-4894



SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Buf. pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
286	0-6"	5.4			46	189	9.3	2.0	46	12												11.8	6.2		

***** TOTAL INCHES: *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:
ACRES:

PREVIOUS CROP: TONS PER ACRE 6-INCHES
GYPSUM REQUIREMENT: TONS PER ACRE 6-INCHES
LIME REQUIREMENT: TONS PER ACRE 6-INCHES
DOLOMITE REQUIREMENT:

PREPLANT:

SIDEDRESS:

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:
% SILT:
% CLAY:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD: DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %

NOTE: East of Cascades Bicarb & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: October 30, 2001
REPORT: S 267
CLIENT: PACIFIC HARVEST GRAIN & SUPPLY
GROWER: MARSH HOMESTEAD DAIRY
SAMPLED: LESLIE
FIELD: T 859-1 BOTTOM GRASS
PROP:

AGRI-CHECK, INC.

Agricultural Testing Laboratory
323 Sixth St. - P.O. Box 1350
Umatilla, OR 97882
800-537-1129 * 541-922-4894



COPY

SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	NITROGEN				Na meq	Total Bases	Base Sat.%	SMP Buf.pH	MOISTURE			TKN %	CI ppm
					NO3 #/A	NH4 #/A	S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Total %	Avail. Inches		
1282	0-6"	6.3			115	486	8.0	2.1	65	20						11.3	6.5

***** TOTALS: 65 20 ***** TOTAL INCHES: *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:
PREVIOUS CROP:
GYPSUM REQUIREMENT:
LIME REQUIREMENT:
DOLOMITE REQUIREMENT:

TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES

PREPLANT:
SIDEDRESS:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD: DESCRIPTION:	Total N %		Nitrate N ppm		S %		P %		K %		Ca %		Mg %		B ppm		Zn ppm		Mn ppm		Cu ppm		Fe ppm		Chloride ppm		Na ppm		Moisture %	

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acelate K extractions. Fertility recommendations may change after application of gypsum or lime.



AGRI-CHECK, INC.
Agricultural Testing Laboratory
323 Sixth St. - P.O. Box 1350
Umatilla, OR 97882
800-537-1129 * 541-922-4894

October 30, 2001
S 267
PACIFIC HARVEST GRAIN & SUPPLY
MARSH HOMESTEAD DAIRY
LESLIE
T 859-3 BOTTOM
ROD

SOIL ANALYSIS REPORT

ab	Depth	Foot	pH	S.Salt	O.M.	P	K	Ca	Mg	NITROGEN		S	B	Zn	Mn	Cu	Fe	CEC	Na	Total Bases	Base Sat. %	SMP Buf. pH	MOISTURE		TKN	CI
										NO3	NH4												Total %	Avail. Inches		
284	0-6"		5.5			55	394	10.6	3.6	128	15									15.2		6.2				

***** TOTAL INCHES: *****

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P205
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg
OTHERS:

YIELD GOAL/ACRE:

ACRES:
PREVIOUS CROP:
GYPSUM REQUIREMENT:
LIME REQUIREMENT:
DOLomite REQUIREMENT:

TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES
TONS PER ACRE 6-INCHES

PREPLANT:
SIDEDRESS:

COMMENTS:

PLANT TISSUE ANALYSIS REPORT

ab FIELD:
No. DESCRIPTION:

Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %
-----------	---------------	-----	-----	-----	------	------	-------	--------	--------	--------	--------	--------------	--------	------------

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

DATE: September 12, 2001

REPORT: S 9762

CLIENT: PACIFIC HARVEST GRAIN & SUPPLY

GROWER: MARSH, GEORGE

SAMPLED: LESLIE

FIELD: SPIESCHEAUT

CROP:

AGRI-CHECK, INC.

Agricultural Testing Laboratory

323 Sixth St. - P.O. Box 1350

Umatilla, OR 97882

800.537.1128 * 541.922-4884



SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos %	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN		S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat %	SMP Bur.pH	MOISTURE		TKN %	Cl ppm
									NO3 #/A	NH4 #/A												Total %	Avail. Inches		
8		5.7			95	225	5.7	1.5				0.4								7.8		5.6			

TOTALS:

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
PHOSPHORUS: LBS PER ACRE P2O5
POTASSIUM: LBS PER ACRE K2O
SULFUR: LBS PER ACRE ACTUAL S
BORON: LBS PER ACRE ACTUAL B
ZINC: LBS PER ACRE ACTUAL Zn
MAGNESIUM: LBS PER ACRE ACTUAL Mg

YIELD GOAL/ACRE:

ACRES:

PREVIOUS CROP:

GYPSUM REQUIREMENT:

LIME REQUIREMENT:

DOLOMITE REQUIREMENT:

PREPLANT:

SIDEDRESS:

SOIL TEXTURE ANALYSIS:

CLASS:

% SAND:

% SILT:

% CLAY:

TOTAL INCHES:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %		S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %
		N	N													

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or lime.

WASTE UTILIZATION WORKSHEET**Spreader Equipment Calibration**

(Using a Full Spreader Load)

Name: _____ Date: _____

Operator: _____ Spreader ID: _____

Perform the following operations to calibrate the solids spreader equipment:
✓ Determine the weight of the waste material loaded in the spreader by using truck scales to weigh the spreader equipment when it is empty and full.
✓ Spread the loaded spreader on the field using consistent speed and spreader settings to cover the field uniformly. Spread in a rectangular pattern so the area calculation will be simple. Record engine rpm and gear settings used.
✓ Measure the length and width covered by the full load and compute the application rate in tons per acre using this worksheet.

Data and Calculations:						
Steps	ID of Calibration Test					
	A	B	C	D	E	F
1. Date of calibration test-						
2. Engine RPM during spreading -						
3. Gear selected during spreading -						
4. Weight of empty spreader (lb) =						
5. Weight of loaded spreader (lb) =						
6. Weight of Waste in spreader (lb) - line 5 - line 4 =						
7. Length of spreading area (ft) =						
8. Width of spreading area (ft) =						
9. Area spread (sq ft) - line 7 x line 8 =						
10. Waste applied (lb/sq ft) - line 6 ÷ line 9 =						
11. Convert to tons per acre - Line 10 x 21.78 =						
12. Average Application Rate (tons per acre) - Sum of values in cells A11 through F11 divided by the total number of calibrations completed =						

Additional Notes:

WASTE UTILIZATION WORKSHEET**Traveling Big Gun Sprinkler Calibration****(Using Catch Cans)**

Name: _____ Date: _____

Perform the following operations to calibrate the traveling big gun sprinkler:	
✓	Use 5 to 10 catch cans to collect the sprinkler-irrigated waste. Use straight-sided buckets for catch cans. Two pound coffee cans work well. Make sure all of the catch cans have the same diameter.
✓	Place one of the catch cans on a level surface and fill it with water to a known depth (1-3 inches). Pour the water from the catch can into a large measuring cup. Determine how many measuring cups of water are equal to an inch of water in the catch can.
✓	Place at least five catch cans across the towpath of the big gun sprinkler. Try to space the catch cans uniformly from the center of the towpath to the outer edge of the wetted area of the sprinkler. Stake the catch can in place or put a rock in the bottom of the catch can to keep it upright. Allow the traveling big gun sprinkler to completely pass over the catch cans. Use the measuring cup previously used to calibrate the catch cans to measure the amount of liquid collected in each can and convert the volume to inches. Be sure to add together the amount measured from the catch cans that would receive overlap from the adjacent towpath. For example, if catch can #4 will receive liquids from the adjacent towpaths, add the amount from container #4 on the left to container #4 on the right side to compute the total amount applied at the location of container #4 on the right and left sides of the towpath.
Catch Can Calibration:	
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Example: 1 inch = <u>5</u> Cups</p> <p>1 cup = <u>0.2</u> Inches</p> <p>Your Catch Cans: 1 inch = _____ Cups</p> <p>1 cup = _____ Inches</p> </div> <div style="width: 50%; text-align: center;"> </div> </div>	
Travel Rate Setting During Test:	

Data and Calculations:

Catch Can ID	Volume of Liquid							
	Cups	Inches	Cups	Inches	Cups	Inches	Cups	Inches
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
Average =								



PHONE:
(541) 922-4894

MAIL SAMPLES TO:

P.O. BOX 1350

UMATILLA, OR 97582

SOIL TEST REQUEST FORM

UPS SAMPLES TO:

323 SIXTH ST.

UMATILLA, OR

97582

CLIENT _____

DATE SAMPLED _____

ADDRESS _____

DATE REC'D _____

PLEASE EMAIL COPY OF
RESULTS:

dean.moberg@or.usda.gov

GROWER _____

SAMPLE IDENTIFICATION:		Additional Elements Requested	If fertilizer recommendations are required, fill in below.			
Field #	Test Requested:		Previous Crop:	Intended Crop:	Yield Goal:	Irrigated ____ Yes ____ No
Remarks:						
Field #	Test Requested:		Previous Crop:	Intended Crop:	Yield Goal:	Irrigated ____ Yes ____ No
Remarks:						
Field #	Test Requested:		Previous Crop:	Intended Crop:	Yield Goal:	Irrigated ____ Yes ____ No
Remarks:						
Field #	Test Requested:		Previous Crop:	Intended Crop:	Yield Goal:	Irrigated ____ Yes ____ No
Remarks:						

TESTING PACKAGES:

East of Cascades

1. pH, OM, P, K, Ca, Mg, NO₃, NH₄, SO₄, B, Zn, Mn, Cu, Fe, Sol. Salts, Total Bases
2. pH, P, K, NO₃, NH₄, SO₄, B, Zn
3. pH, P, K, NO₃, NH₄, SO₄
4. Dryland Crops
1 ft. pH, OM, P, K, NO₃, NH₄, SO₄, Moisture
2 ft. NO₃, SO₄, Moisture
3-6 ft. NO₃, Moisture

INDIVIDUAL TESTS AVAILABLE:

Any of the above plus CEC, Soil Texture Analysis, Nematodes.

West of Cascades

1. pH, P, K, Ca, Mg, SMP Buffer pH
2. pH, P, K, Ca, Mg, B, SMP Buffer pH
3. pH, P, K, Ca, Mg, NO₃, NH₄, SMP

Central Oregon

1. See Test #1, East of Cascades
2. See Test #2, East of Cascades
3. pH, P, K, Ca, Mg, Total Bases, S, B, Zn
4. Saline-Sodic Reclamation Test:
pH, Soluble Salts, Ca, S, Na
5. pH, P, K, S, B, Zn



323 SIXTH STREET • P.O. BOX 1350 • UMATILLA, OREGON 97882

SOIL TESTING FEE SCHEDULE (West of Cascades)

• PHONE (541) 922-4894

SOIL ANALYSIS PACKAGES:

#1 - pH, P*, K, Ca, Mg, SMP Buffer pH	\$ 26.70
#2 - pH, P*, K, Ca, Mg, B, SMP Buffer pH	\$ 31.90
#3 - pH, P*, K, Ca, Mg, NO3, NH4, SMP Buffer pH	\$ 37.15
#4 - pH, P*, K, Ca, Mg, SO4, B, SMP Buffer pH	\$ 37.15
#5 - pH, P*, K, Ca, Mg, NO3, NH4, B, SMP Buffer pH	\$ 42.35
#6 - pH, P*, K, Ca, Mg, NO3, NH4, SO4, B, Soluble Salts, OM, Zn, Mn, Cu, Fe, SMP Buffer pH	\$ 50.90

Individual Analyses from group A added to above packages \$ 5.25 each

INDIVIDUAL ANALYSES:

A. pH, OM, P, K, Ca, Mg, NO3, NH4, SO4, B, Zn, Mn, Cu, Fe, Na, Sol. Salts, Moisture	\$ 6.90 each
B. Lime Requirement (SMP Buffer pH)	\$ 9.10 each
C. Chloride	\$ 14.85 each
D. Cation Exchange Capacity (CEC)	\$ 19.25 each
E. Texture Analysis (Sand, Silt, Clay + Classification)	\$ 24.75 each
F. Total Kjeldahl Nitrogen (TKN)	\$ 28.90 each
G. Gypsum Requirement (pH, Sol. Salts, Na)	\$ 20.65 each
H. Heavy Metals, DTPA extractable (Pb, Cd, Cr or Ni)	\$ 24.75 each
I. Total Element Analysis (from Group A, per element)	\$ 13.20 each
J. Saturated Paste Extraction	\$ 6.35 each
K. Nematode Analysis (with Species I.D.)	\$ 49.00 each
L. Nematode Analysis (without Species I.D.)	\$ 39.00 each

***SOIL TEST EVALUATION & FERTILIZER GUIDELINES: \$ 15.00
(each field)

***** Other analyses available on request. *****

*Western Oregon: Weak Bray P Extraction as specified by O.S.U.
Western Washington: Bray (Morgan's P Extraction will be performed only on request.)

RESULTS AVAILABLE THE NEXT WORK DAY
FOLLOWING SAMPLE RECEIPT

Prices are subject to change without notice.

Effective Date: 01-01-06



323 SIXTH STREET • P.O. BOX 1350 • UMATILLA, OREGON 97882

• PHONE (541) 922-4994

PLANT ANALYSIS FEE SCHEDULE

PLANT ANALYSIS PACKAGES:

#1 - NO ₃ , P, K, Ca, Mg, S, B, Zn, Mn, Cu, Fe	\$ 45.10
#2 - Total N, P, K, Ca, Mg, S, B, Zn, Mn, Cu, Fe	\$ 50.60
#3 - NO ₃ , P, K, S (Water Extract P + K)	\$ 24.75
#4 - Total N, P, K, S	\$ 31.35
#5 - NO ₃ , P, K, S (Wet Ash Extract P + K)	\$ 29.15

Individual analyses from group A added to above packages: \$ 5.25 each

INDIVIDUAL ANALYSES:

A. NO ₃ , P, K, Ca, Mg, S, B, Zn, Mn, Cu, Fe, Moisture, <u>or</u> Ash	\$ 6.90 each
B. Total Nitrogen	\$ 14.60 each
C. Chloride	\$ 14.85 each
D. Heavy Metals (Pb, Cd, Cr <u>or</u> Ni)	\$ 27.50 each

***** Other analyses available on request. *****

LOCAL SAMPLING: Call for current pricing. No charge for plant tissue sampling done in conjunction with soil sampling.

Samples requiring special handling or preparation may be subject to additional charges.

RESULTS AVAILABLE THE NEXT WORK DAY
FOLLOWING SAMPLE RECEIPT

Prices subject to change without notice.

Effective date: 01-01-06


AGRI - CHECK, INC.

 AGRICULTURAL TESTING LABORATORY
 CROP SCIENCE CONSULTANTS

323 SIXTH STREET • P.O. BOX 1350 • UMATILLA, OREGON 97882

• PHONE (541) 822-4394

MANURE & COMPOST ANALYSIS FEE SCHEDULE

MANURE & COMPOST ANALYSIS PACKAGES:

- #1 - Total: Nitrogen, Phosphorous & Potassium plus Salts and Solids \$ 44.00
- #2 - Total: Nitrogen, Phosphorous & Potassium plus Ammonium and Solids. \$ 55.00
- #3 - Total: Nitrogen, Phosphorous & Potassium plus Ammonium, Salts and Solids. . \$ 61.60
- #4 - Total: Nitrogen, Phosphorous, Potassium, Sulfur, Zn, Mn, Cu, and Fe
plus Ammonium, Salts and Solids \$ 77.00

Individual analyses from group A added to above packages: \$ 8.80 each

INDIVIDUAL ANALYSES:

- A. NH₄-N, P, K, Ca, Mg, S, B, Zn, Mn, Cu, Fe, Solids, pH, Salts or Ash \$ 16.50 each
- B. Total Nitrogen \$ 27.50 each
- C. Total Nitrogen with Solids \$ 33.00 each
- D. Total Nitrogen %, Organic N %, and Inorganic N % \$ 44.00 lot
- E. Chloride \$ 14.30 each
- F. Heavy Metals (Pb, Cd, Cr or Ni) \$ 22.00 each
- G. Interpretations for land application (minimum 1 hr.) \$ 60.00/ hr.
- H. Nitrate (NO₃-N) \$ 16.50 each
- I. Total Organic Carbon (from O.M. by LOI) \$ 16.50 each
- J. Cation Exchange Capacity \$ 19.25 each

Manure samples will be analyzed on an as received basis for total nutrient content.

Results reported in pounds per ton or pounds per 1000 gallons on an as received basis unless requested otherwise.

Handling and digestion fees are included in the above prices.
 Samples are analyzed for Total N by Macro-Kjedahl or Combustion.
 Total nutrients are determined by Ashing.

***** Other analyses available on request *****

Prices subject to change without notice.

Effective Date: 01-01-06

RECORD KEEPING**Off-Farm Transfer Worksheet**

Transferred To:	Date	Amount (tons or Gallons)	Nutrient Content		
			N	P2O5	K2O

NOTES:

RECORD KEEPING

Record of Application Equipment Calibration

Date	Equipment Calibrated	Calibrated by:
NOTES:		

[illegible]

NOTES:

[illegible]

NOTES: