ANIMAL WASTE MANAGEMENT PLAN

Date:

Farm Name: Gomes Dairy

Operated by: Edward Gomes

Facility Address: 7550 Kilchis River Road
Tillamook, Oregon 97141

As the owner/operator of Gomes Dairy I agree to manage the dairy operation in accordance with this animal waste management plan and maintain those practices described in the plan.

Signature: Edward Gomes Date: 5-30-12

Edward Gomes
03/12

BUSINESS NARRATIVE

This CAFO Plan is for 366-1,000 lb Jersey animal unit operation. There will be 305 lactating cows, 60 dry cows, 80 heifers, and 40 calves. The lactating cows normally will be confined for 187 days and on pasture for 178 days. The dry cows and heifers are normally confined for 258 days and on pasture for 107 days. The calves are confined for 365 days. The confinement days may vary from day to day, week to week, month to month and or year to year based on weather conditions, economic conditions, livestock health, and/or excessive forage production during late fall, winter, and early spring. Livestock mortality service will be provided by the Tillamook County Creamery Association.

The operation consists of 136.3 acres of owned pastureland which receives manure applications. There are 94 acres located within the 100-year floodplain. Liquid manure is transported to fields 2, 4, and 7 by a pump and buried manure mainline and applied to the fields with a manure gun traveler. A 1,700 gallon or a 7,500 gallon tank wagon and tractor are used to transport and apply liquid manure to fields 1,3,5,6, 8, and 9.The solid manure is transported and applied to all the fields with a 354 bushel manure spreader. The pasture and hay land fields are in fair to good condition. The primary forage species are fescue, orchard-grass and ryegrass. The target yield is 22 tons at 30% dry matter per acre per year.

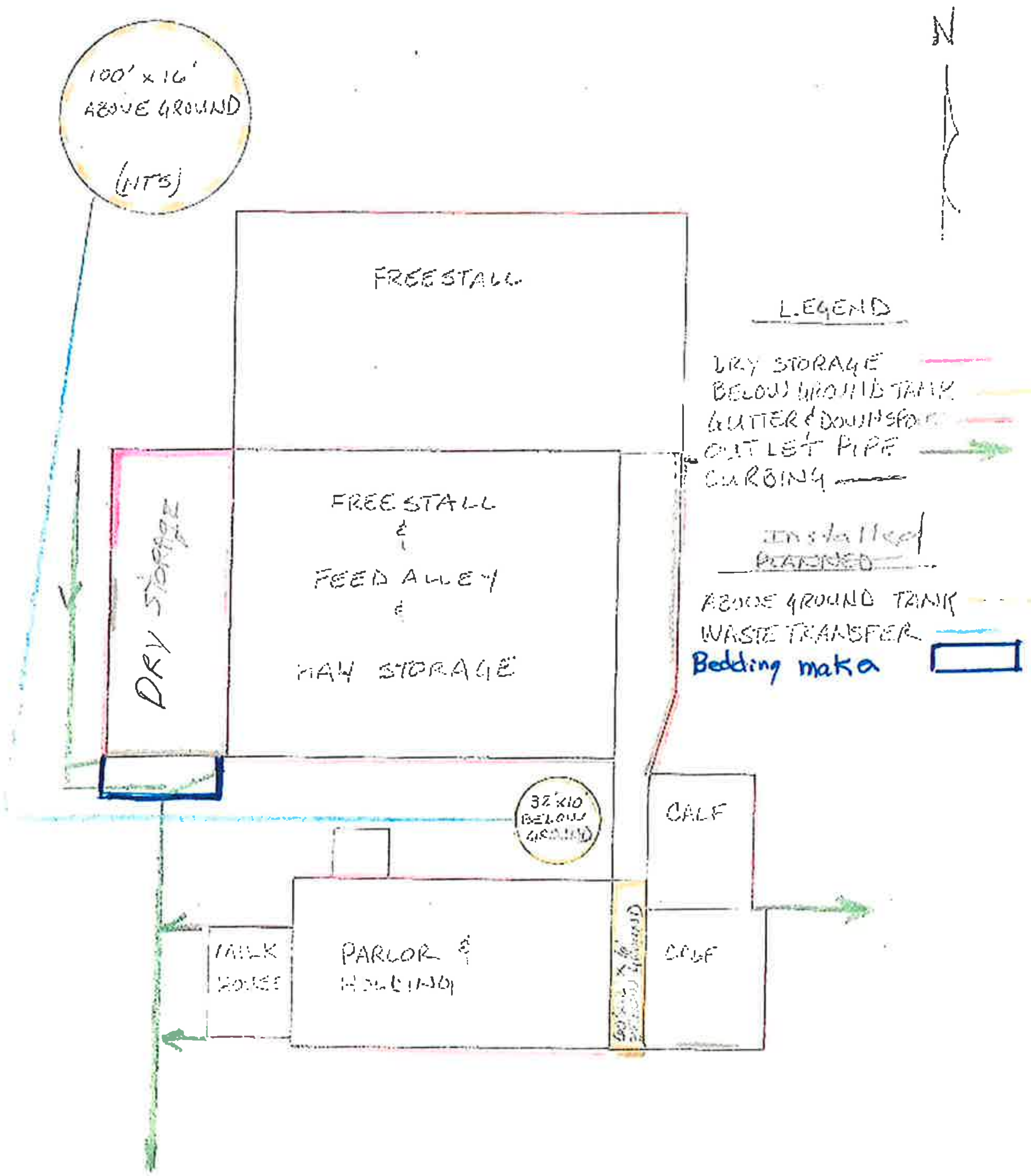
The lactating, dry cow, and heifer manure is processed through a bedding maker/separator. Sixty percent of the manure is handled as liquids and 40% handled as solids. Calf manure is handled 100% solids. There are two existing below ground liquid waste storage tanks. They are 60' x 12' x 6' and 32' x 10'.There is a 100' x 16' above ground liquid waste storage facility. The three liquid waste storage tanks, in combination, can store the liquid wastes produced by the 362-1,000 lb. animal units for 94 days. The solid manure storage facility is 30' x 40' x 6'. The separated manure is recycled as bedding. Between the solid manure used in the stalls and the solid manure storage facility the separated solid manure produced can be stored for 84 days. The manure storage days are based on the 30 year average annual precipitation recorded at KTIL Radio Station in the City of Tillamook.. When manure is exported off the operation, a record will be maintained on the amount of manure, type, and the date manure was exported.

The confinement buildings have been guttered, down-spouted, and outletted in an area free of manure. All conservation practices installed will be maintained in accordance with the enclosed "CONSERVATION PRACTICE OPERATION AND MAINTENANCE WORKSHEETS".

Soils where manure is applied are: Logsden-Nehalem silt loams, 0 to 5% slopes, Brenner silt loam, 0-1% slopes, Nehalem, silt loam, 0-3% slopes, Condorbridge gravelly medial loam, 0-7% slopes, Walluski-Chitwood medial silt loams, 3-15% slopes, and Quillamook complex, 0-7% slopes. The Brenner soil is poorly drained. The Walluski-Chitwood soil is moderately drained. The Logsden-Nehalem, Quillamook, Nehalem, and Condorbridge soils are well drained.

DESIGN
MAP 6-23-04
FARMSTEAD LAYOUT

EDDY JONES



SCALE: 1" = 50'

Land Use Summary

Name: Eddie Gomes
Date: Mar-12
KI006

Tract	Field	Land Use	Acres
197	1	Pasture (Irrigated)	21.2
	2	Pasture (Irrigated)	16.4
	3	Pasture (Irrigated)	22.2
	4	Pasture (Irrigated)	4.2
	5	Pasture (Irrigated)	3.6
	6	Pasture (Irrigated)	6.4
	7	Pasture (Irrigated)	11.2
	8	Pasture (Irrigated)	30.7
	9	Pasture (Irrigated)	20.4
	10	Wildlife	3.6
	11	Wildlife	12.7
	12	Wildlife	0.9
	13	Wildlife	0.5
	14	Wildlife	2.0
	15	Woodland	43.6
	F	Farmstead	3.8
		Subtotal	**203.4**
		Total	**203.4**

Summary

Pasture		**136.3**
Woodland		**43.6**
Wildlife		**19.7**
Farmstead		**3.8**
	Total	**203.4**

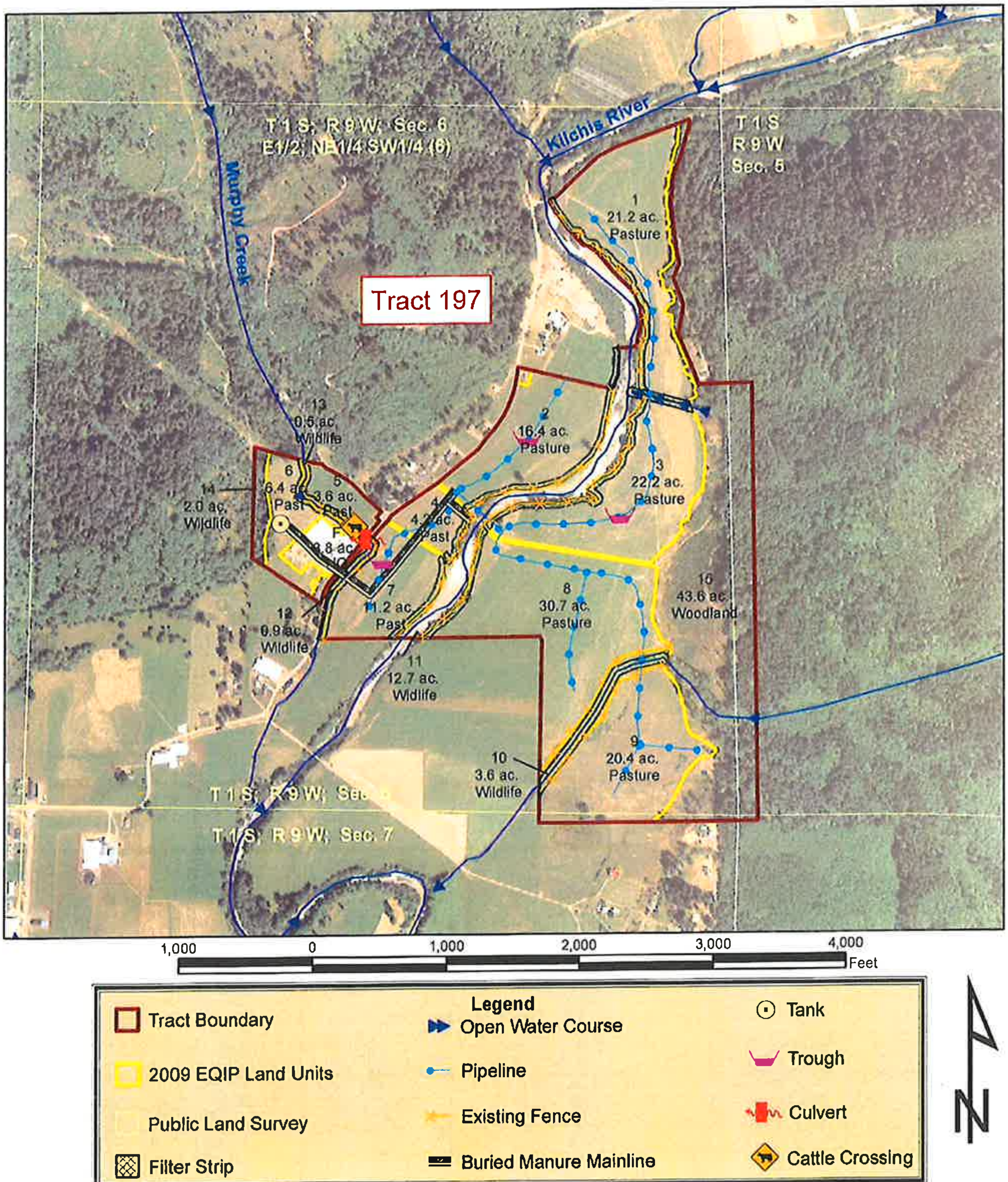
EDWARD GOMES
Gomes Dairy
KI006

TILLAMOOK SERVICE CENTER
Tillamook County SWCD
TILLAMOOK COUNTY, OREGON

District: Tillamook County SWCD
Approximate Acres: 203.4
Date: 7/10/2009

2009 EQIP Conservation Plan Map

Scale = 1:12,000

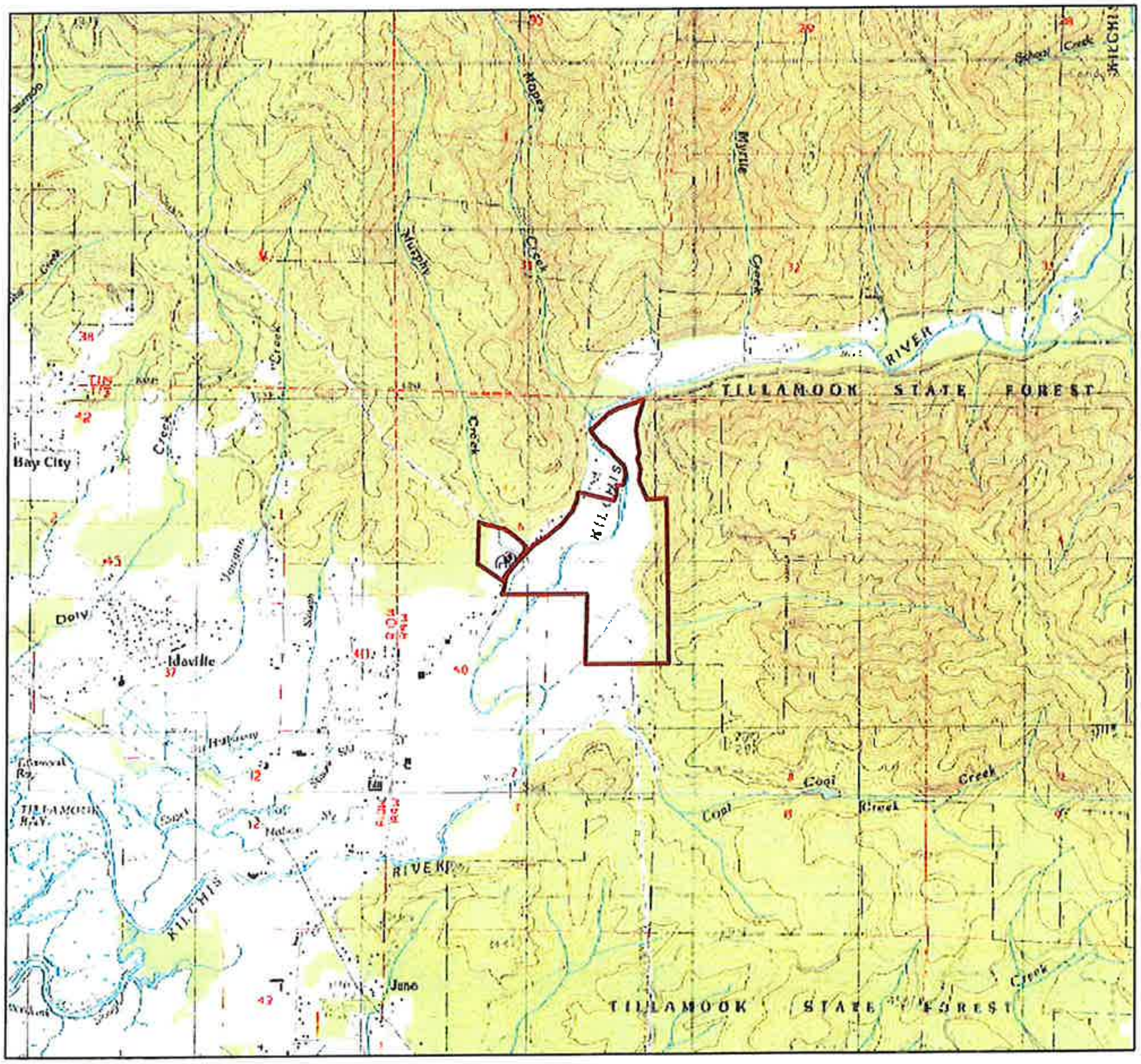


EDWARD GOMES
Gomes Dairy
KI006

TILLAMOOK SERVICE CENTER
Tillamook County SWCD
TILLAMOOK COUNTY, OREGON

Tillamook County SWCD
Approximate Acres: 203.4
Date: 11/7/2008

7.5 Min. Topo Map



2,000 0 2,000 4,000 6,000 8,000 Feet

Legend

Tract Boundary

Farmstead Lat/Long (NAD83)
45 30' 44.3" N; 123 50' 6.2" W

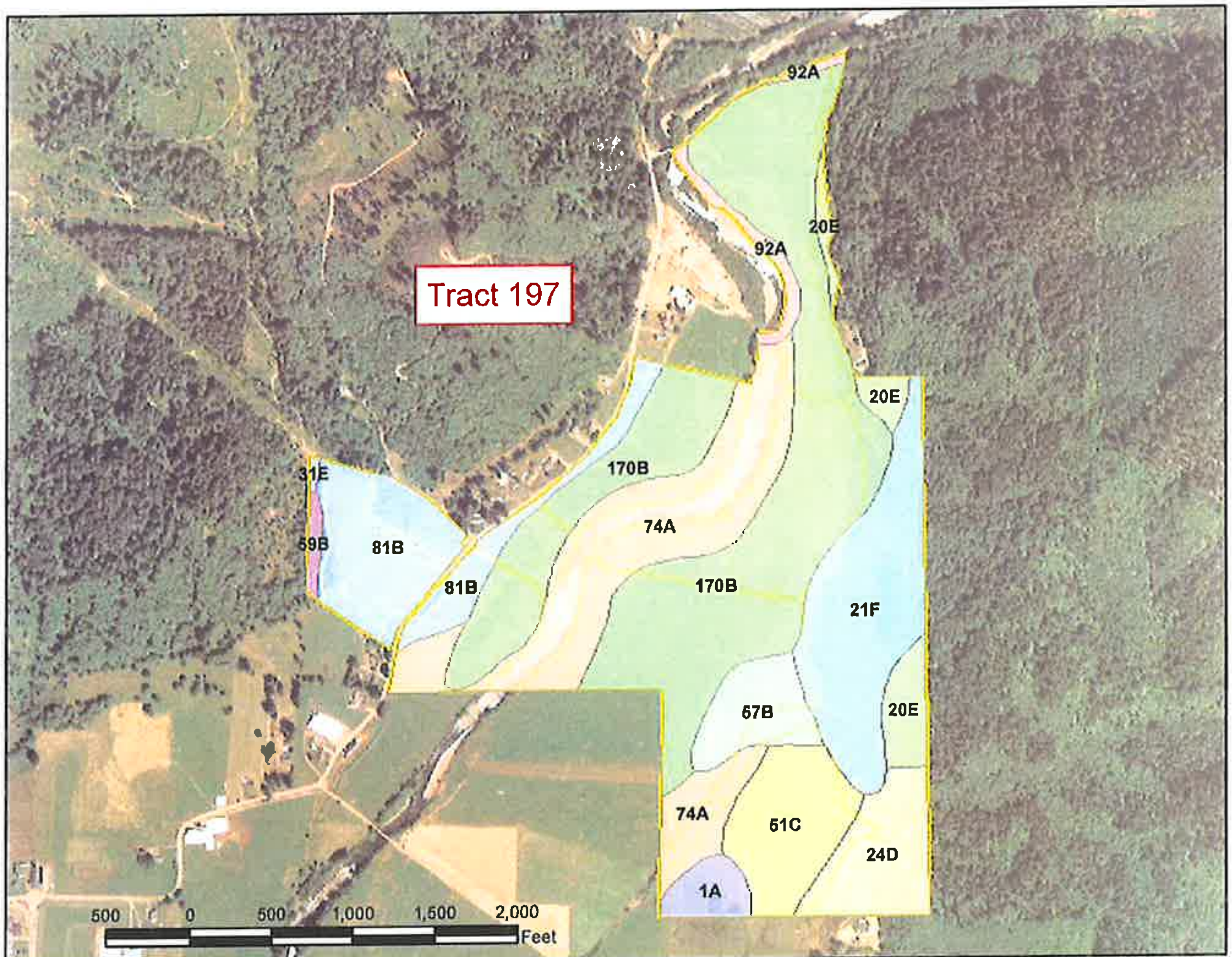
N
W E
S

EDWARD GOMES
KI006

TILLAMOOK SERVICE CENTER
Tillamook County SWCD
TILLAMOOK COUNTY, OREGON

Tillamook County SWCD
Approximate Acres: 203.4
Date: 7/10/2009

Soils Map



Legend

- 170B, Logsden-Nehalem silt loams, 0 to 5 percent slopes
- 1A, Brenner silt loam, 0 to 1 percent slopes
- 20E, Klootchie-Necanicum complex, 30 to 60 percent slopes
- 21F, Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes
- 24D, Lebam medial silt loam, 5 to 30 percent slopes
- 31E, Tolovana-Templeton medial silt loams, 30 to 60 percent slopes
- 51C, Walluski-Chitwood medial silt loams, 3 to 15 percent slopes
- 57B, Condorbridge gravelly medial loam, 0 to 7 percent slopes
- 59B, Chitwood-Knappa medial silt loams, 0 to 7 percent slopes
- 74A, Nehalem silt loam, 0 to 3 percent slopes
- 81B, Quillamook complex, 0 to 7 percent slopes
- 92A, Yachats-Gauldy complex, 0 to 3 percent slopes
- Planned Land Units

N

Soils Inventory Report

Fri Mar 23 07:17:15 PDT 2012

EDWARD GOMES

Tract	Land Unit	Map Unit Symbol	Map Unit Name	Acres	Percent
0		81B	Quillamook complex, 0 to 7 percent slopes	0.3	100%
			Total:	0.3	
197	1	20E	Klootchie-Necanicum complex, 30 to 60 percent slopes	0.3	1%
197	1	74A	Nehalem silt loam, 0 to 3 percent slopes	0.4	2%
197	1	92A	Yachats-Gauldy complex, 0 to 3 percent slopes	2.1	10%
197	1	170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	18.4	87%
			Total:	21.2	
197	2	81B	Quillamook complex, 0 to 7 percent slopes	2.1	13%
197	2	74A	Nehalem silt loam, 0 to 3 percent slopes	4.2	26%
197	2	170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	10.1	62%
			Total:	16.4	
197	3	21F	Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes	0.4	2%
197	3	74A	Nehalem silt loam, 0 to 3 percent slopes	6.4	29%
197	3	170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	15.3	69%
			Total:	22.1	
197	4	74A	Nehalem silt loam, 0 to 3 percent slopes	0.6	14%
197	4	81B	Quillamook complex, 0 to 7 percent slopes	0.9	21%
197	4	170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	2.7	64%
			Total:	4.2	
197	5	81B	Quillamook complex, 0 to 7 percent slopes	3.6	100%
			Total:	3.6	
197	6	81B	Quillamook complex, 0 to 7 percent slopes	6.4	100%
			Total:	6.4	
197	7	81B	Quillamook complex, 0 to 7 percent slopes	2.6	23%
197	7	74A	Nehalem silt loam, 0 to 3 percent slopes	3	27%
197	7	170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	5.6	50%
			Total:	11.2	
197	8	21F	Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes	0.4	1%
197	8	57B	Condorbridge gravelly medial loam, 0 to 7 percent slopes	5.7	19%
197	8	74A	Nehalem silt loam, 0 to 3 percent slopes	6.3	21%

197	8	170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	18.3	60%
			Total:	30.7	
197	9	21F	Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes	0.1	0%
197	9	57B	Condorbridge gravelly medial loam, 0 to 7 percent slopes	0.6	3%
197	9	24D	Lebam medial silt loam, 5 to 30 percent slopes	1.3	6%
197	9	74A	Nehalem silt loam, 0 to 3 percent slopes	2.1	10%
197	9	1A	Brenner silt loam, 0 to 1 percent slopes	3.7	18%
197	9	51C	Walluski-Chitwood medial silt loams, 3 to 15 percent slopes	12.7	62%
			Total:	20.5	
197	10	21F	Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes	0.1	3%
197	10	57B	Condorbridge gravelly medial loam, 0 to 7 percent slopes	1.5	42%
197	10	74A	Nehalem silt loam, 0 to 3 percent slopes	2	56%
			Total:	3.6	
197	11	81B	Quillamook complex, 0 to 7 percent slopes	0.1	1%
197	11	170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	0.7	5%
197	11	92A	Yachats-Gauldy complex, 0 to 3 percent slopes	1	8%
197	11	74A	Nehalem silt loam, 0 to 3 percent slopes	11	86%
			Total:	12.8	
197	12	74A	Nehalem silt loam, 0 to 3 percent slopes	0.1	12%
197	12	81B	Quillamook complex, 0 to 7 percent slopes	0.7	88%
			Total:	0.8	
197	13	81B	Quillamook complex, 0 to 7 percent slopes	0.5	100%
			Total:	0.5	
197	14	31E	Tolovana-Templeton medial silt loams, 30 to 60 percent slopes	0.3	14%
197	14	81B	Quillamook complex, 0 to 7 percent slopes	0.7	33%
197	14	59B	Chitwood-Knappa medial silt loams, 0 to 7 percent slopes	1.1	52%
			Total:	2.1	
197	15	57B	Condorbridge gravelly medial loam, 0 to 7 percent slopes	0	0%
197	15	92A	Yachats-Gauldy complex, 0 to 3 percent slopes	0.1	0%
197	15	51C	Walluski-Chitwood medial silt loams, 3 to 15 percent slopes	0.5	1%
197	15	170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	3.7	8%
197	15	20E	Klootchie-Necanicum complex, 30 to 60 percent slopes	6.6	15%
197	15	24D	Lebam medial silt loam, 5 to 30 percent slopes	9.7	22%

197	15	21F	Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes	23	53%
			Total:	43.6	

197	F	81B	Quillamook complex, 0 to 7 percent slopes	3.8	100%
			Total:	3.8	

Soil Description Report - Edward Gomes

Tillamook County, Oregon

[Minor map unit components are excluded from this report]

Map unit: 1A - Brenner silt loam, 0 to 1 percent slopes

Component: Brenner (85%)

The Brenner component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on flood plains. The parent material consists of alluvium derived from igneous and sedimentary rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is high. Shrink-swell potential is moderate. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, November, December. Organic matter content in the surface horizon is about 8 percent. Nonirrigated land capability classification is 4w. This soil meets hydric criteria.

Map unit: 20E - Klootchie-Necanicum complex, 30 to 60 percent slopes

Component: Klootchie (55%)

The Klootchie component makes up 55 percent of the map unit. Slopes are 30 to 60 percent. This component is on mountain slopes. The parent material consists of colluvium derived from basalt and/or colluvium derived from tuff. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Component: Necanicum (30%)

The Necanicum component makes up 30 percent of the map unit. Slopes are 30 to 60 percent. This component is on mountain slopes. The parent material consists of colluvium derived from basalt. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map unit: 21F - Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes

Component: Necanicum (40%)

The Necanicum component makes up 40 percent of the map unit. Slopes are 60 to 90 percent. This component is on mountain slopes. The parent material consists of colluvium derived from basalt. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria.

Component: Ascar (25%)

The Ascar component makes up 25 percent of the map unit. Slopes are 60 to 90 percent. This component is on mountain slopes. The parent material consists of colluvium derived from basalt. Depth to a root restrictive layer, bedrock, lithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria.

Component: Klootchie (20%)

The Klootchie component makes up 20 percent of the map unit. Slopes are 60 to 90 percent. This component is on mountain slopes. The parent material consists of colluvium derived from basalt and/or colluvium derived from tuff. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 75 percent. Nonirrigated

Map unit: 21F - Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes

Component: Klootchie (20%)

land capability classification is 7e. This soil does not meet hydric criteria.

Map unit: 24D - Lebam medial silt loam, 5 to 30 percent slopes

Component: Lebam (85%)

The Lebam component makes up 85 percent of the map unit. Slopes are 5 to 30 percent. This component is on benches, ridges. The parent material consists of colluvium derived from tuff and/or residuum weathered from tuff. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map unit: 31E - Tolovana-Templeton medial silt loams, 30 to 60 percent slopes

Component: Tolovana (50%)

The Tolovana component makes up 50 percent of the map unit. Slopes are 30 to 60 percent. This component is on mountain slopes, hillslopes. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Component: Templeton (25%)

The Templeton component makes up 25 percent of the map unit. Slopes are 30 to 60 percent. This component is on hillslopes, mountain slopes. Depth to a root restrictive layer, bedrock, paralithic, is 40 to 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map unit: 51C - Walluski-Chitwood medial silt loams, 3 to 15 percent slopes

Component: Walluski (45%)

The Walluski component makes up 45 percent of the map unit. Slopes are 3 to 15 percent. This component is on terraces. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is very high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 27 inches during January, February, March, April, November, December. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 3e. Irrigated land capability classification is 4e. This soil does not meet hydric criteria.

Component: Chitwood (30%)

The Chitwood component makes up 30 percent of the map unit. Slopes are 3 to 15 percent. This component is on terraces. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is very low. Shrink-swell potential is high. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 11 inches during January, February, December. Organic matter content in the surface horizon is about 9 percent. Nonirrigated land capability classification is 3e. This soil does not meet hydric criteria.

Map unit: 57B - Condorbridge gravelly medial loam, 0 to 7 percent slopes

Component: Condorbridge (85%)

The Condorbridge component makes up 85 percent of the map unit. Slopes are 0 to 7 percent. This component is on fans. Depth to a

Map Unit Description

Tillamook County, Oregon

Map unit: 57B - Condorbridge gravelly medial loam, 0 to 7 percent slopes

Component: Condorbridge (85%)

root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 20 percent. Nonirrigated land capability classification is 2e. This soil does not meet hydric criteria.

Map unit: 59B - Chitwood-Knappa medial silt loams, 0 to 7 percent slopes

Component: Chitwood (45%)

The Chitwood component makes up 45 percent of the map unit. Slopes are 0 to 7 percent. This component is on terraces. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is very low. Shrink-swell potential is high. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 11 inches during January, February, December. Organic matter content in the surface horizon is about 9 percent. Nonirrigated land capability classification is 3e. This soil does not meet hydric criteria.

Component: Knappa (40%)

The Knappa component makes up 40 percent of the map unit. Slopes are 0 to 7 percent. This component is on terraces. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very low. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 9 percent. Nonirrigated land capability classification is 2e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria.

Map unit: 74A - Nehalem silt loam, 0 to 3 percent slopes

Component: Nehalem (80%)

The Nehalem component makes up 80 percent of the map unit. Slopes are 0 to 3 percent. This component is on flood plains. The parent material consists of alluvium derived from igneous and sedimentary rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is occasionally flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 8 percent. Nonirrigated land capability classification is 2w. Irrigated land capability classification is 2w. This soil does not meet hydric criteria.

Map unit: 81B - Quillamook complex, 0 to 7 percent slopes

Component: Quillamook, gravelly substratum (60%)

The Quillamook, gravelly substratum component makes up 60 percent of the map unit. Slopes are 0 to 7 percent. This component is on stream terraces. Depth to a root restrictive layer, strongly contrasting textural stratification, is 40 to 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 17 percent. Nonirrigated land capability classification is 2e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria.

Component: Quillamook (25%)

The Quillamook component makes up 25 percent of the map unit. Slopes are 0 to 7 percent. This component is on stream terraces. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 17 percent. Nonirrigated land capability classification is 2e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria.

Map Unit Description

Tillamook County, Oregon

Map unit: 92A - Yachats-Gauldy complex, 0 to 3 percent slopes

Component: Yachats (45%)

The Yachats component makes up 45 percent of the map unit. Slopes are 0 to 3 percent. This component is on flood plains. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 7 percent. Nonirrigated land capability classification is 3w. Irrigated land capability classification is 3w. This soil does not meet hydric criteria.

Component: Gauldy (40%)

The Gauldy component makes up 40 percent of the map unit. Slopes are 0 to 3 percent. This component is on flood plains. Depth to a root restrictive layer, strongly contrasting textural stratification, is 20 to 30 inches. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 4s. This soil does not meet hydric criteria.

Map unit: 170B - Logsden-Nehalem silt loams, 0 to 5 percent slopes

Component: Logsden (50%)

The Logsden component makes up 50 percent of the map unit. Slopes are 0 to 5 percent. This component is on stream terraces. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very low. Shrink-swell potential is moderate. This soil is rarely flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 7 percent. Nonirrigated land capability classification is 2e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria.

Component: Nehalem, occasional (40%)

The Nehalem, occasional component makes up 40 percent of the map unit. Slopes are 0 to 5 percent. This component is on flood plains. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is occasionally flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 8 percent. Nonirrigated land capability classification is 2e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria.

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

The Map Unit Description (Brief, Generated) report displays a generated description of the major soils that occur in a map unit. Descriptions of non-soil (miscellaneous areas) and minor map unit components are not included. This description is generated from the underlying soil attribute data.

Additional information about the map units described in this report is available in other Soil Data Mart reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the Soil Data Mart reports define some of the properties included in the map unit descriptions.

Nonirrigated Capability Class - **Edward Gomes**

Aggregation Method: Dominant Condition
Tie-break Rule: Higher

Tillamook County, Oregon
Survey Area Version and Date: 1 - 09/21/2006

Map symbol	Map unit name	Rating
1A	Brenner silt loam, 0 to 1 percent slopes	4
20E	Klootchie-Necanicum complex, 30 to 60 percent slopes	6
21F	Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes	7
24D	Lebam medial silt loam, 5 to 30 percent slopes	6
31E	Tolovana-Templeton medial silt loams, 30 to 60 percent slopes	6
51C	Walluski-Chitwood medial silt loams, 3 to 15 percent slopes	3
57B	Condorbridge gravelly medial loam, 0 to 7 percent slopes	2
59B	Chitwood-Knappa medial silt loams, 0 to 7 percent slopes	3
74A	Nehalem silt loam, 0 to 3 percent slopes	2
81B	Quillamook complex, 0 to 7 percent slopes	2
92A	Yachats-Gauldy complex, 0 to 3 percent slopes	3
170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	2

Nonirrigated Capability Class

Rating Options

Attribute Name: Nonirrigated Capability Class

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels -- capability class, subclass, and unit. Only class and subclass are included in this dataset.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value to represent the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. The components in the map unit name represent the major soils within a map unit delineation. Minor components make up the balance of the map unit. Great differences in soil properties can occur between map unit components and within short distances. Minor components may be very different from the major components. Such differences could significantly affect use and management of the map unit. Minor components may or may not be documented in the database. The results of aggregation do not reflect the presence or absence of limitations of the components which are not listed in the database. An on-site investigation is required to identify the location of individual map unit components.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be generated. Aggregation must be done because, on any soil map, map units are delineated but components are not.The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Tie-break Rule: Higher

Nonirrigated Capability Class

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Drainage Class - **Edward Gomes**

Aggregation Method: Dominant Condition
Tie-break Rule: Higher

Tillamook County, Oregon
Survey Area Version and Date: 1 - 09/21/2006

Map symbol	Map unit name	Rating
1A	Brenner silt loam, 0 to 1 percent slopes	Poorly drained
20E	Klootchie-Necanicum complex, 30 to 60 percent slopes	Well drained
21F	Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes	Well drained
24D	Lebam medial silt loam, 5 to 30 percent slopes	Well drained
31E	Tolovana-Templeton medial silt loams, 30 to 60 percent slopes	Well drained
51C	Walluski-Chitwood medial silt loams, 3 to 15 percent slopes	Moderately well drained
57B	Condorbridge gravelly medial loam, 0 to 7 percent slopes	Well drained
59B	Chitwood-Knappa medial silt loams, 0 to 7 percent slopes	Somewhat poorly drained
74A	Nehalem silt loam, 0 to 3 percent slopes	Well drained
81B	Quillamook complex, 0 to 7 percent slopes	Well drained
92A	Yachats-Gauldy complex, 0 to 3 percent slopes	Well drained
170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	Well drained

Drainage Class

Rating Options

Attribute Name: Drainage Class

Drainage class (natural) refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized -- excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value to represent the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. The components in the map unit name represent the major soils within a map unit delineation. Minor components make up the balance of the map unit. Great differences in soil properties can occur between map unit components and within short distances. Minor components may be very different from the major components. Such differences could significantly affect use and management of the map unit. Minor components may or may not be documented in the database. The results of aggregation do not reflect the presence or absence of limitations of the components which are not listed in the database. An on-site investigation is required to identify the location of individual map unit components.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be generated. Aggregation must be done because, on any soil map, map units are delineated but components are not.The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN

Cooperator: **Edward Gomes** Date:

Field No.	Amount	Planned	Applied	LAND USE AND PRACTICE
				Farmstead T-197
F	1	x	x	**Waste Storage Facility** A 32' x 10' below ground liquid waste storage tank was installed. The 8,038 cubic foot below ground liquid waste storage tank, in combination with the other below ground liquid waste storage tank and the above ground liquid waste storage tank, will store the liquikd waste produced by the 362-1,000 lb. animal units for 94 days.
F	1	x	x	**Waste Storage Facility** A 60' x 12' x 6' below ground liquid waste storage tank was installed. The 4,320 cubic foot liquid waste storage tank, in combination with the other below ground liquid waste storage tanks and the above ground liquid waste storage tank, will store the liquid waste produced by the 362-1,000 lb. animal units for 94 days.
F	1	x	x	**Waste Storage Facility** A 100' x 16' above ground liquid waste storage tank was installed. The 125,600 cubic foot liquid waste storage tank, in combination with the other two below ground liquid waste storage tanks, will store the liquid waste produced by the 362-1,000 lb. animal units for 94 days.
F	1	x	x	**Waste Storage Facility** A 30' x 40' x 6' solid manure storage facility was installed. The 7,200 cubic foot storage facility, in combination with the stalls, can store the seperated solid manure from the 366-1,000 lb. animal units for 84 days.
F	1	x	x	**Bedding Maker/Manure Separator** A bedding maker/manure separator was installed to proccess manure for bedding.
F	2	x	x	**Agitator** Agitators were installed in the above ground liquid waste storage tank and the below ground liquid waste storage tank to prevent solid manure buildup in the liquid waste storage tanks.
F	1	x	x	**Manure Pump** A manure pump was installed in to transfer liquid waste from the below ground liquid waste storage tank to the above ground liquid waste storage tank.

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN

Cooperator: **Edward Gomes**

Date:

Field No.	Amount	Planned	Applied	LAND USE AND PRACTICE
				Farmstead T-197
F	1	x	x	**Manure Transfer** 250 feet of 5 inch PVC pipeline was installed to transfer liquid waste from the below ground liquid waste storage tank to the above ground liquid waste storage tank.
F	1	x	x	**Waste Storage Facility** A 42.5' x 70.3' roof was installed. The 2,988 square foot was installed over a manure accumulation slab to prevent manure runoff on the west side of the animal confinement building on the south side of of the solid manure storage facility.
F	2	x	x	**Waste Storage Facility** 3,377 square feet of roofs were installed over manure accumulation areas on the east side of the animal confinement buildings to prevent manure runoff.
F	1	x	x	**Gutters and Downspouts** 1,663 feet of gutters and downspouts were installed on the animal confinement builings.
F	183 ft	x	x	**Gutter Outlets** 183 feet of underground pipeline was installed to outlet the gutter downspouts in an area free of manure.
F	1,800 ft	x	x	**Buried Manure Mainline** Buried manure mailine was installed to transfer liquid manure to the fields in a non-polluting manner.
				Pastureland T-197
1-9	136.3 ac	x		**Prescribed Grazing** Pastures will be managed in accordance with the enclosed Prescribed Grazing Specification Sheet.
1-9	136.3 ac	x		**Nutrient Management** Manure will be used for forage production. Soil tests will be used to determine manure application rates. Nutrient management will be implemented in accordance with the enclosed Nutrient Management Specification Sheet.
1-9	136.3 ac	x		**Waste Utilization** Manure will be applied to pastures in accordance with the enclosed Waste Utilization Specification Sheet.

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN

Cooperator: **TillaBay Farms Inc.**

Date:

Field No.	Amount	Planned	Applied	LAND USE AND PRACTICE
				Pastureland T-197
1,2,4,7	1	x	x	**Manure Gun Traveler** A manure gun traveler is used to apply liquid manure to the pastures.
1-9	13.9 ac	x		**Filter Strip** A grass filter strip adjacent to the open watercourses will be established and maintained as part of the animal confinement water quality plan to prevent agricultural waste from entering the watercourses. The filter strip will be establish in accordance with the enclosed Filter Strip Specification Sheet .
5	1	x	x	**Livestock Bridge** A 50 foot livestock bridge was installed over Murphy Creek.
5	700 ft	x	x	**Access Road** An access road has been installed for livestock access to the pastures.
1-9	5,563 ft	x	x	**Fence** Watercourses have been fenced to exclude livestock from the stream corridor.
1	1,100 ft	x	x	**Pipeline** A buried pipeline has been installed to convey water to the livestock troughs.
2,3,4	3	x	x	**Watering Facilities** Livestock watering facilities have been installed.

CERTIFICATION OF PARTICIPANTS

Edward Gomes 5-30-12

DATE

CERTIFICATION OF:

CONSERVATION DISTRICT

Robert A. Pedersen Date 5/30/12 5-30-12

CAFO PLANNER TILLAMOOK COUNTY SWCD DATE

TILLAMOOK COUNTY SOIL AND WATER CONSERVATION DISTRICT:

Conservation Development Self Government

Tillamook County Soil and Water Conservation District is an Equal Opportunity Provider and Employer

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 3.6

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Edward Gomes	Tract(s): 197	Field(s): T197 1	
Assisted by: Pedersen		Date: October 4, 2010	

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Perennial Hay/Pasture(High Intensity)	22

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC
NA	93	1664	6.1		

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			
422		121		318		3 tons		

Table 2. Nutrient Sources

Credits	N	P_2O_5	K_2O
	pounds per acre		
1. Nitrogen credits from previous legume crop	0		
2. Residual from long-term manure application	0		
3. Irrigation water	0	0	0
4. Other (e.g., atmospheric deposition)	0	0	0
5. Total Credits-	0	0	0

Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other Commercial Fertilizer	39		0		0	
8. Manure / Organic Materials (Source-)	Dairy	383	0	229	0	407	0
9.	Subtotal (sum of lines 6, 7 and 8)	422	0	229	0	407	0
10.	Nutrients Recommended (from Table 1)	422	0	121	0	318	0
11.	Nutrient Status (subtract line 10 from line 9)	0	0	108	0	89	0

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.

If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS						
Amount to be Applied (lb/ac)	N	422	P_2O_5	229	K_2O	407

Method, Form, and Timing of Application

The 1664 ppm of potassium in the soil is excessive. High potassium levels in the soil may cause livestock health problems. Recommend forage tests for fields to evaluate the potassium level in the forage. The 93 pm of phosphorus is high. Recommend commercial nitrogen fertilizer only be applied to achieve the 22 tons at 30% dry matter per acre per year. See attached letter from the Dairy Extension Agent. Manure and fertilizer should be applied in split applications. Apply the 39 lbs of nitrogen per acre per application in early spring. No manure shall be applied to high risk runoff fields during the wet season. Apply nutrient material uniformily to the application areas. See attached Nutrient Specification Sheet, the Manure Distribution Sheet Section, for the manure application rates per field. Recommend soil test in mid September to mid October to evaluate how well the biosolid application rate matches the nitrogen needs of the forage. SEE ATTACHED WASTE SPECIFICATION SHEET FOR ADDITIONAL MANURE APPLICATION GUIDANCE.

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer:	Edward Gomes	Tract(s):	197	Field(s):	2
Assisted by:	Pedersen			Date:	October 4, 2010

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Perennial Hay/Pasture(High Intensity)	22

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC
NA	85	1704	6		

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B	3 tons		
422		121		318				

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop		0					
2. Residual from long-term manure application		0					
3. Irrigation water		0		0		0	
4. Other (e.g., atmospheric deposition)		0		0		0	
5. Total Credits-		0		0		0	
Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other Commercial Fertilizer	39		0		0	
8. Manure / Organic Materials (Source-)	Dairy	383		229		407	
9.	Subtotal (sum of lines 6, 7 and 8)	422	0	229	0	407	0
10.	Nutrients Recommended (from Table 1)	422	0	121	0	318	0
11.	Nutrient Status (subtract line 10 from line 9)	0	0	108	0	89	0

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS

Amount to be Applied (lb/ac)	N	422	P_2O_5	229	K_2O	407

Method, Form, and Timing of Application

The 1704 ppm of potassium in the soil is excessive. High potassium levels in the soil may cause livestock health problems. Recommend forage tests for fields to evaluate the potassium level in the forage. The 85 pm of phosphorus is high. Recommend commercial nitrogen fertilizer only be applied to achieve the 22 tons at 30% dry matter per acre per year. See attached letter from the Dairy Extension Agent. Manure and fertilizer should be applied in split applications. Apply the 39 lbs of nitrogen per acre per application in early spring. No manure shall be applied to high risk runoff fields during the wet season. Apply nutrient material uniformily to the application areas. See attached Nutrient Specification Sheet, the Manure Distribution Sheet Section, for the manure application rates per field. Recommend soil test in mid September to mid October to evaluate how well the biosolid application rate matches the nitrogen needs of the forage. SEE ATTACHED WASTE SPECIFICATION SHEET FOR ADDITIONAL MANURE APPLICATION GUIDANCE.

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Edward Gomes	Tract(s): 197	Field(s): 3	
Assisted by: Pedersen		Date: April 13, 2012	

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Perennial Hay/Pasture(High Intensity)	22

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			
422		121		318				

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop		0					
2. Residual from long-term manure application		0					
3. Irrigation water		0		0		0	
4. Other (e.g., atmospheric deposition)		0		0		0	
5. Total Credits-		0		0		0	
Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other						
8. Manure / Organic Materials (Source-)	Dairy	383		229		407	
9. Subtotal (sum of lines 6, 7 and 8)		383	0	229	0	407	0
10. Nutrients Recommended (from Table 1)		422	0	121	0	318	0
11. Nutrient Status (subtract line 10 from line 9)		-39	0	108	0	89	0

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS						
Amount to be Applied (lb/ac)	N	383	P_2O_5	229	K_2O	407

Method, Form, and Timing of Application

No soil tests available. Recommend that soil tests be taken to evaluate the biosolid application rates vs the nitrogen needs of the forage. A test is also needed to develop a phosphorus index for the field. No manure shall be applied to high risk runoff fields during the wet season. Apply nutrient material uniformily to the application areas. SEE ATTACHED WASTE SPECIFICATION SHEET FOR ADDITIONAL MANURE APPLICATION GUIDANCE.

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Edward Gomes	Tract(s): 197	Field(s): 4,7
Assisted by: Pedersen		Date: October 4, 2010

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Perennial Hay/Pasture(High Intensity)	22

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC
NA	60	1687	6.2		

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			
422		121		318		3 tons		

Table 2. Nutrient Sources

Credits	N		P_2O_5		K_2O	
	pounds per acre					
1. Nitrogen credits from previous legume crop	0					
2. Residual from long-term manure application	0					
3. Irrigation water	0		0		0	
4. Other (e.g., atmospheric deposition)	0		0		0	
5. Total Credits-	0		0		0	
Plant-Available Nutrients Applied to Field	N		P_2O_5		K_2O	
(Circle column that is landuser's decision)	Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)	0	0	0	0	0	0
7. Fertilizer — Starter	0					
7. Fertilizer — Other Commercial Fertilizer	39		0		0	
8. Manure / Organic Materials (Source-) Dairy	383		229		407	
9. Subtotal (sum of lines 6, 7 and 8)	422	0	229	0	407	0
10. Nutrients Recommended (from Table 1)	422	0	121	0	318	0
11. Nutrient Status (subtract line 10 from line 9)	0	0	108	0	89	0

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS

Amount to be Applied (lb/ac)	N	422	P_2O_5	229	K_2O	407

Method, Form, and Timing of Application

The 1687 ppm of potassium in the soil is excessive for Field 7. Recommend soil test for field 4 be taken to evaluate the biosolid application rates vs the nitrogen needs of the forage. High potassium levels in the soil may cause livestock health problems. Recommend forage tests for field 7 to evaluate the potassium level in the forage. The 60 pm of phosphorus in field 7 is high. Recommend commercial nitrogen fertilizer only be applied to achieve the 22 tons at 30% dry matter per acre per year. See attached letter from the Dairy Extension Agent. Manure and fertilizer should be applied in split applications. Apply the 39 lbs of nitrogen per acre per application in early spring. No manure shall be applied to high risk runoff fields during the wet season. Apply nutrient material uniformly to the application areas. See attached Nutrient Specification Sheet, the Manure Distribution Sheet Section, for the manure application rates per field. Recommend soil test in mid September to mid October to evaluate how well the biosolid application rate matches the nitrogen needs of the forage. SEE ATTACHED WASTE SPECIFICATION SHEET FOR ADDITIONAL MANURE APPLICATION GUIDANCE.

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Edward Gomes	Tract(s): 197	Field(s): 5,6
Assisted by: Pedersen		Date: April 13, 2012

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Perennial Hay/Pasture(High Intensity)	22

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			
422		121		318				

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop		0					
2. Residual from long-term manure application		0					
3. Irrigation water		0		0		0	
4. Other (e.g., atmospheric deposition)		0		0		0	
5. Total Credits-		0		0		0	
Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other						
8. Manure / Organic Materials (Source-)	Dairy	383		229		407	
9. Subtotal (sum of lines 6, 7 and 8)		383	0	229	0	407	0
10. Nutrients Recommended (from Table 1)		422	0	121	0	318	0
11. Nutrient Status (subtract line 10 from line 9)		-39	0	108	0	89	0

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS

Amount to be Applied (lb/ac)	N	383	P_2O_5	229	K_2O	407

Method, Form, and Timing of Application

No soil tests available. Recommend that soil tests be taken to evaluate the biosolid application rates vs the nitrogen needs of the forage. A test is also needed to develop a phosphorus index for the field. No manure shall be applied to high risk runoff fields during the wet season. Apply nutrient material uniformly to the application areas. SEE ATTACHED WASTE SPECIFICATION SHEET FOR ADDITIONAL MANURE APPLICATION GUIDANCE.

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 3.6

4/13/2012

Producer:	Edward Gomes	Tract(s): 197		Field(s): 8
Assisted by:	Pedersen			Date: April 13, 2012

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Perennial Hay/Pasture(Med-High Intensity)	22

CURRENT SOIL TEST LEVELS (ppm or lb/ac)

N	P	K	pH	S.O.M.%	EC

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD

N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			
383		121		318				

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop		0					
2. Residual from long-term manure application		0					
3. Irrigation water		0		0		0	
4. Other (e.g., atmospheric deposition)		0		0		0	
5. Total Credits-		0		0		0	
Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other						
8. Manure / Organic Materials (Source-)	Dairy	347		207		369	
9.	Subtotal (sum of lines 6, 7 and 8)	347	0	207	0	369	0
10.	Nutrients Recommended (from Table 1)	383	0	121	0	318	0
11.	Nutrient Status (subtract line 10 from line 9)	-36	0	86	0	51	0

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.

If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS

Amount to be Applied (lb/ac)	N	347	P_2O_5	207	K_2O	369

Method, Form, and Timing of Application

No soil tests available. Recommend that soil tests be taken to evaluate the biosolid application rates vs the nitrogen needs of the forage. A test is also needed to develop a phosphorus index for the field. No manure shall be applied to high risk runoff fields during the wet season. Apply nutrient material uniformily to the application areas. SEE ATTACHED WASTE SPECIFICATION SHEET FOR ADDITIONAL MANURE APPLICATION GUIDANCE.

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Edward Gomes	Tract(s): 197	Field(s): 9
Assisted by: Pedersen		Date: April 13, 2012

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Perennial Hay/Pasture(High Intensity)	22

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			
422		121		318				

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop		0					
2. Residual from long-term manure application		0					
3. Irrigation water		0		0		0	
4. Other (e.g., atmospheric deposition)		0		0		0	
5. Total Credits-		0		0		0	
Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other						
8. Manure / Organic Materials (Source-)	Dairy	383		229		407	
9.	Subtotal (sum of lines 6, 7 and 8)	383	0	229	0	407	0
10.	Nutrients Recommended (from Table 1)	422	0	121	0	318	0
11.	Nutrient Status (subtract line 10 from line 9)	-39	0	108	0	89	0
If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.							
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.							

PLANNED NUTRIENT APPLICATIONS						
Amount to be Applied (lb/ac)	N	383	P_2O_5	229	K_2O	407

Method, Form, and Timing of Application

No soil tests available. Recommend that soil tests be taken to evaluate the biosolid application rates vs the nitrogen needs of the forage. A test is also needed to develop a phosphorus index for the field. No manure shall be applied to high risk runoff fields during the wet season. Apply nutrient material uniformly to the application areas. SEE ATTACHED WASTE SPECIFICATION SHEET FOR ADDITIONAL MANURE APPLICATION GUIDANCE.

EXTENSION SERVICE
Tillamook County Office

OREGON
STATE
UNIVERSITY

2204 Fourth Street
Tillamook, Oregon
97141

May 28, 2002

Bob Pedersen
Tillamook NRCS Field Office
6415 Signal St.
Tillamook, OR 97141

Dear Bob,

Over the past five years, I have had the opportunity to study nutrient cycling dynamics on dairies in the Tillamook area. It has been observed that pastures will very in productivity based on environment, grazing management and soil fertility. Nitrogen utilization has been a major focus of my work looking specifically at nitrogen up takes by the pasture plant. I have seen pastures remove as little as 200.lbs of N per acre a year to as high as 750. Average pastures on dairies will use between 300 and 400lbs of nitrogen per acre each year.

With this understanding, it makes logical sense to me to use nitrogen utilization numbers in our animal waste management planning of 300 pounds nitrogen per year as a reasonable starting point. I think this is a conservative guess and would not hesitate adjusting this number if the landowner has other data indicating they are using N at higher levels. For example, yield data, grazing rotation records with removal data, and/or soil test data.

Sincerely,

Troy Downing

Troy Downing
Area Dairy Extension Agent

Telephone
503·842·3433

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

WASTE STORAGE FACILITY

For: Landowner/Operator Edward Gomes.

Job Location: T 1S; R 9W; Sec 6;

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

60' x 12' x 6' below ground liquid waste storage tank

32' x 10' below ground liquid waste storage tank

100' x 16' above ground liquid waste storage tank

Operation and Maintenance Items

A properly operated and maintained waste storage structure is an asset to your farm. This waste storage structure was designed and installed for temporary storage of animal wastes. The estimated life span of this installation is at least 10 years. If at any time this structure is taken out of service, the Natural Resources Division of the Oregon Department of Agriculture should be contacted for guidance in decommissioning the structure to avoid environmental concerns. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Do not allow equipment that exceeds the design loading to operate within 20 feet of the structure.

⇒ **WARNING: ENTERING AN UNVENTILATED TANK IS EXTEREMELY "HAZARDOUS" !** Do not allow human entry into the enclosed structure without safety equipment that includes ladders and breathing apparatus.

⇒ Continually maintain all pumps, agitators, piping, valves and all other electrical and mechanical equipment in good operating condition by following the manufacturer's recommendations.

⇒ Continually maintain grounding rods and wiring for all electrical equipment in good condition.

⇒ Facilities will be ready by November1st to begin winter storage.

⇒ A one foot free board will be maintained to prevent spillage.

⇒ The waste storage facility will be inspected weekly to ensure structural integrity.

⇒ 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.

⇒ The depth of all liquid manure will be recorded during each week's inspection.

⇒ Immediately repair any vandalism, vehicular or livestock damage to the structure, earthen areas surrounding the structure, or any appurtenances.

⇒ Pump out the facility within the first two years following construction to check for structural damage. If damage is noted, immediately seek a qualified engineer to assess the situation. Thereafter, it should be pumped out at least every four years to check for damages, remove gravel, rocks, sand, wire and other debris to maintain the designed storage capacity.

⇒ Immediately remove all foreign debris within the structure that may cause damage to pumps and agitator.

⇒ During de-watering of the structure, ensure that waste is spread at minimum rates in areas where crops are grown See Filter Strip Specification Sheet for manure spreading guidance.

⇒ Dead animals will not be disposed of in the liquid waste storage facility.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

HIGH-PRESSURE UNDERGROUND, PLASTIC PIPELINE

Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W;Sec.6

County Tillamook SWCD Tillamook Tract No. T-197

Prepared By Pedersen Date 03/12

Waste Transfer Pipe

Operation and Maintenance Items

A properly operated and maintained waste transfer system is an asset to your farm. This waste transfer system was designed and installed for transferring liquid wastes from a below ground liquid storage facility to an above ground liquid waste storage facility. The estimated life span of this installation is at least 20 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Check to make sure all values and air vents are set at the proper operating condition so they may provide protection to the pipeline. Remove foreign materials and vegetation that can interfere with proper valve operation.

⇒ Pipeline will be flushed regularly to prevent clogging.

⇒ Leaks or broken sections will be replaced and/or repaired.

⇒ Maintain the designed depth of cover over the pipeline.

⇒ Limit traffic over the pipeline to designated sections that were designed for traffic loads.

⇒ Avoid travel over pipelines by tillage equipment when the soil is saturated.

⇒ Avoid any sub-soiling operation that may disturb the pipeline.

⇒ Maintain a vigorous growth of vegetative covering. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing may also be needed to control height of vegetation.

⇒ Non-buried pipelines will be inspected weekly to assure there is no leaks that is causing waste spillage. Leaks will be repaired immediately.

⇒ Eradicate or otherwise remove all rodents or burrowing animals that can potentially damage or displace the pipe. Immediately repair any damages caused by their activity.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

MANURE PUMP

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W. Sec. 6

County Tillamook SWCD Tillamook Tract No. T-197

Prepared By: Pedersen Date 03/12

Operation and Maintenance Items

A properly operated and maintained manure pump is an asset to your farm. The manure pump was designed to transfer the liquid waste to the pasture and haylands for application. The estimated life span of this installation is at least 10 years. The life of the manure pump can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Preventive maintenance will be in accordance with the manufacturer's recommendations.

⇒ Periodically examine the pump for proper operation. Clean debris from the propeller, and promptly replace any defective or damaged parts.

⇒ Periodically clean and oil as needed to increase the life expectancy of the pump.

⇒ Immediately repair any vandalism or livestock damage. Do not allow livestock near equipment during operation.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

MANURE TANK AGITATOR

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; Sec. 6

County Tillamook SWCD Tillamook Tract No. T-197

Prepared By: Pedersen Date 03/12

Operation and Maintenance Items

A properly operated and maintained manure tank agitator is an asset to your farm. The manure agitator was designed and installed to stir the liquid waste and keep the solids in suspension so solid manure will not buildup in the bottom of the tank and reduce the designed storage capacity. The estimated life span of this installation is at least 10 years. The life of the manure agitator can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Preventive maintenance will be in accordance with the manufacturer's recommendations.

⇒ Periodically examine the agitator for proper operation. Clean debris from the propeller, and promply replace any defective or damaged parts.

⇒ Remove the agitator from the manure tank 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 equipment during operation.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

MANURE GUN TRAVELER

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; Sec 6

County Tillamook SWCD Tillamook Tract No. T-197

Prepared By: Pedersen Date 3/12

Operation and Maintenance Items

A properly operated and maintained manure gun traveler is an asset to your farm. The manure gun was designed and must be operated to apply manure to the fields in a non-polluting matter. The estimated life span of this installation is at least 10 years. The life of the manure gun can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Preventive maintenance will be in accordance with the manufacturer's recommendations.

⇒ Liquids will be drained from the manure gun during freezing weather.

⇒ Nozzle will be checked periodically.

⇒ Worn nozzles will be replaced.

⇒ Manure gun traveler will be calibrated at least once a year.

⇒ Physically examine the manure gun for proper operation.

⇒ Immediately repair any vandalism or livestock damage. Do not allow livestock near equipment during operation.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

BEDDING MAKER/ SEPARATOR

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; 6

County Tillamook SWCD Tillamook Tract No. T-197

Prepared By: Pedersen Date 03/12

Operation and Maintenance Items

A properly operated and maintained manure bedding/separator is an asset to your farm. The manure bedding/separator is designed so solid manure will not buildup in the bottom of the tank and reduce the designed storage capacity. The estimated life span of this installation is at least 10 years. The life of the manure separator can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Preventive maintenance will be in accordance with the manufacturer's recommendations.

⇒ Periodically examine the bedding marker/separator for proper operation. Clean debris from it and promptly replace any defective or damaged parts.

⇒ Periodically clean and oil as needed to increase the life expectancy of the separator.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

WASTE STORAGE FACILITY (SOLID MANURE STORAGE FACILITY)

For: Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W;Sec 6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

30' x 40' x 6' Solid Manure Storage Facility

Operation and Maintenance Items

A properly operated and maintained waste storage structure is an asset to your farm. This waste storage structure was designed and installed for temporary storage of animal wastes. The estimated life span of this installation is at least 10 years. If at any time a structure is taken out of service, the Natural Resources Division of the Oregon Department of Agriculture should be contacted for guidance in decommissioning the structure to avoid environmental concerns. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Do not allow equipment that exceeds the design loading to operate within 20 feet of the structure

⇒ Immediately repair any vandalism, vehicular or livestock damage to the structure, earthen areas surrounding the structure, or any appurtenances.

⇒ Storage facility will be ready by November 1st to begin winter storage.

⇒ During de-watering of the structure, ensure that waste is spread at minimum rates in areas where crops are grown. See Filter Strip Specification Sheet. Avoid applying waste during heavy rainfall events.

⇒ Roofs of the solid manure storage facilities will be inspected annually.

⇒ All roof sections that are rusted and leaking will be repaired and/or replaced.

⇒ Loose roof sections on the solid manure storage facilities will be secured.

⇒ Broken trusses, beams, poles, gutters and downspouts will be repaired or replaced on the solid waste storage facilities.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

ROOF RUNOFF MANAGEMENT

For: Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W; Sec.6

County Tillamook SWCD Tillamook Farm/Tract No. T 197

Prepared By Pedersen Date 03/12

Gutters and Downspouts

Operation and Maintenance Items

Properly operated and maintained roof runoff facilities are an asset to the farm. Roof runoff facilities were designed and installed to control roof runoff. Estimated life span of this installation is at least 10 years. Facility life can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require periodic maintenance and may require operational items to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Perform weekly inspections of gutters, downspouts and above ground pipelines, and appurtenances for proper operation. Repair or replace if needed.

⇒ Periodically remove debris from gutters, downspouts and outlet facilities.

⇒ Protect downspouts from damage by livestock and equipment. Repair or replace damaged components as needed.

⇒ Keep gutters, downspouts, conveyance pipelines and ditches and appurtenances in good operating condition.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENCE WORKSHEET

UNDERGROUND OUTLETS

For: Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W;Sec. 6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 3/12

Gutter Outlet

Operation and Maintenance Items

Properly operated and maintained under ground outlet for the guttering system is an asset to the farm. This outlet was designed and installed to convey roof runoff in an underground pipeline to where it can be released without causing erosion. The estimated life span of this installation is at least 10 years. The life of the practice can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require periodic maintenance and may require operational items to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Check all above ground connections, rodent guards, inlets and outlets to make sure they are functioning properly.

⇒ Maintain design depth of cover on all pipelines.

⇒ Avoid operation of tillage and sub-soiling equipment that could damage any component of the gutter outlet system.

⇒ Remove all foreign debris that hinders the gutter system operation.

⇒ Limit traffic over pipeline to designated sections that were designated for traffic loads.

⇒ Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing may also be needed to control growth.

⇒ Eradicate of otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

⇒ Immediately repair any vandalism, vehicular livestock damage.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

WASTE STORAGE FACILITY (ROOF)

For: Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W; Sec. 6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

Operation and Maintenance Items

A properly operated and maintained roof is an asset to your farm. These roofs were designed and installed for preventing manure runoff from manure accumulation areas. The estimated life span of this installation is at least 10 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Roof will be inspected weekly.

⇒ All roof sections that are rusted and leaking will be replaced or repaired to prevent rainwater from entering the liquid waste storage system.

⇒ Loose roof sections will be secured.

⇒ Broken trusses, beams, poles, gutters and downspouts will be repaired or replaced.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET
IRRIGATION WATER CONVEYANCE

HIGH-PRESSURE UNDERGROUND, PLASTIC PIPELINE

Landowner/Operator Edward Gomes Job Location: T 1S; R 9W; Sec 6

County Tillamook SWCD Tillamook Tract No. T-197

Prepared By Pedersen Date 03/12

Buried Manure Mainline

Operation and Maintenance Items

A properly operated and maintained waste application system is an asset to your farm. This waste application system was designed and installed for applying liquid wastes to the pasture and hayland fields. The estimated life span of this installation is at least 20 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Check to make sure all values and air vents are set at the proper operating condition so they may provide protection to the pipeline. Remove foreign materials and vegetation that can interfere with proper valve operation.

⇒ Maintain the designed depth of cover over the pipeline.

⇒ Limit traffic over the pipeline to designated sections that were designed for traffic loads.

⇒ Avoid travel over pipelines by tillage equipment when the soil is saturated.

⇒ Avoid any sub-soiling operation that may disturb the pipeline.

⇒ Maintain a vigorous growth of vegetative covering. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing may also be needed to control height of vegetation.

⇒ Eradicate or otherwise remove all rodents or burrowing animals that can potentially damage or displace the pipe. Immediately repair any damages caused by their activity.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

ACCESS ROAD

Land Owner/Operator Edward Gomes

Job Location T 1S R 9W; Sec 6

County: Tillamook SWCD Tillamook County Farm/Tract No:T-197

Prepared By Pedersen Date 03/12

OPERATION AND MAINTENANCE ITEMS

A properly operated and maintained access road is an asset to the farm. The access road was designed and installed as a travelway for livestock. Estimated life span of this installation is at least 10 years. The life of the structure can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require periodic maintenance and may also require operational items to maintain satisfactory performance. A good operation and maintenance program includes:

⇒ Maintain the road surface in good condition, which includes periodic patching surface material when necessary. Prevent surface ponding by localized additional blqcktop of gravel to remove depressions

⇒ Promptly repair or replace damaged components. Maintain road ditch and drainage facility capacities.

⇒ Limit livestock use to periods that permit usage without physical damage to the access road surface, and excavated or embankment side slopes. Protect vegetation from overgrazing.

⇒ Maintain installed fence gates to provide warning and/or unauthorized human or livestock entry.

⇒ Remove debris or blockage in road ditches, drop inlets, road culverts, bridges waterways and storm water outlets. Remove litter from access surfaces, road ditches and drainage facilities.

⇒ Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

⇒ Immediately repair any vandalism, vehicular, or livestock damage to access road.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

ANIMAL TRAILS AND WALKWAYS

For: Landowner/Operator Edward Gomes)

Job Location: T1S, R 9W; Sec. 6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

Operation and Maintenance Items

A properly operated and maintained livestock crossing asset to your farm. This structure was designed and installed to prevent water pollution and allow livestock improved access to pastures to improve pasture management. The estimated life span of this practice is at least 10 years. The life of this practice can be assured and usually increased by developing and carrying out a good operation and maintenance program

This practice will require you to perform periodic maintenance and may also require operation items to maintain satisfactory performance. Some recommendations to assist you develop a good operation and maintenance program:

⇒ Periodically inspect the bridge particularly after storm events. Repair damaged parts as needed. Remove trapped debris from the structure as well as upstream and down stream of the structure to prevent potential damage to the structure.

⇒ Check any erosion control structure periodically for increased erosion. Repair damaged erosion control sections.

⇒ Eradicate all rodents or burrowing animals. Immediately repair any damages caused by their activity.

⇒ Prior to wet weather conditions remove excess manure from the structure.

⇒ Periodically check elevations of earthfill and restore to grade and shape, if necessary. All settlement or cracks in the soil should be investigated to determine the cause and immediately repair.

⇒ Maintain vigorous growth of vegetative coverings along the channel upstream and downstream of the structure. This includes reseeding, when necessary.

⇒ Immediately repair any vandalism, vehicular, or livestock damage to the structure.

⇒ Determine cause of any structural failure and take appropriate scions to prevent further loss of the structure.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

PRESCRIBED GRAZING

For: Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W; Sec.6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

Operation and Maintenance Items

Prescribed Grazing can provide economic and resource benefits if applied properly which are assets to the dairy operation. Proper Prescribed Grazing requires certain operational procedures to be followed and evaluated on an annual basis.

⇒ Pastures are reestablished when forage production falls below planned yield threshold.

⇒ A rotational grazing system is used to maintain plant vigor.

⇒ Pastures are clipped and dragged during the growing season to maintain plant vigor and spread the livestock droppings to prevent grass from becoming rank.

⇒ Manure and commercial fertilizer applied in accordance with soil and forage tests.

⇒ Pasture weeds are controlled.

⇒ Pasture grasses are not grazed below 2 inches during the growing season

⇒ Livestock are removed when the soils become wet in the fall.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

NUTRIENT MANAGEMENT

For: Landowner/Operator Edward Gomes

Job Location: T1S; R 9W; Sec 6;

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

Operation and Maintenance Items

Waste Utilization can provide economic and resource benefits if applied properly which are assets to the dairy operation. Proper waste utilization requires certain operational procedures to be followed and evaluated on an annual basis.

⇒ Manure application equipment is calibrated at least once per year to ensure uniform distribution and accurate application rates.

⇒ Records are maintained of manure applications.

⇒ Manure application equipment is cleaned up and residual material from the equipment is disposed of properly and in a place where surface runoff does not occur.

⇒ Nutrient management plans are reviewed annually and adjustments are made as needed.

⇒ Unnecessary exposure to manure is avoided. Protective clothing is worn when necessary.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

WASTE UTILIZATION

For: Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W; Sec. 6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 3/12

Operation and Maintenance Items

Waste Utilization can provide economic and resource benefits if applied properly which are assets to the dairy operation. Proper waste utilization requires certain operational procedures to be followed and evaluated on an annual basis.

⇒ Manure application equipment is calibrated at least once per year to ensure uniform distribution and accurate application rates.

⇒ Records are maintained of manure applications.

⇒ Manure application equipment is cleaned up and residual material from the equipment is disposed of properly and in a place where surface runoff does not occur.

⇒ Nutrient management plans are reviewed annually and adjustments are made as needed.

⇒ Unnecessary exposure to manure is avoided. Protective clothing is worn when necessary.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

WATERING FACILITY

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; Sec 6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 3/12

Operation and Maintenance Items

Properly operated and maintained water troughs and tanks are an asset to the farm. This practice was designed and installed to provide a source of water to the grazing units so livestock do not need access to open watercourse for drinking water. Practice will prevent pollution and prevent streambank erosion and riparian habitat damage due to livestock access. The estimated life span of this installation is at least 10 years. The life of the practice can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require periodic maintenance and may require operational items to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Check all above ground connections, valves, gates, rodent guards, inlets and outlets to make sure they are functioning properly. Check troughs and tanks for leaks or cracks and repair or replace.

⇒ Make certain the area adjacent to the trough is well protected with gravel, paving, or good cover. Be sure that the outlet pipe has a free outlet and is not causing any serious erosion problems.

⇒ Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization and application of herbicides when necessary. Periodical mowing may also be needed to control growth.

⇒ Check periodically to see if debris has fallen into the troughs and tanks which may restrict inflow or planned function of the outflow system.

⇒ Clean the entire system periodically and remove moss, algae growth, and/or sludge. Chemicals such as cooper sulfate and chlorine can be used to prevent moss and algae growth. Local rules and regulations are to be followed when using chemicals to make sure they are safe for animals.

⇒ Maintain, when necessary, coverings and insulation to prevent damage by freezing.

⇒ Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

⇒ Immediately repair any vandalism, vehicular, or livestock damage to inlets, outlets, valves, and other appurtenances.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEETS

PIPELINE

For: Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; Sec.6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

Operation and Maintenance Items

Properly operated and maintained pipeline is an asset to the farm. This pipeline was designed and installed to provide a source of water to the grazing units so livestock do not need access to open watercourse for drinking water Practice will prevent pollution and prevent streambank erosion and riparian habitat damage due to livestock access. The estimated life span of this installation is at least 10 years. The life of the practice can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require periodic maintenance and may require operational items to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Check to make sure all valves and air vents are set at the proper operating conditions so they provide protection to the pipeline.

⇒ Maintain the design depth of cover over the pipeline. Limit traffic over the pipeline to designated sections that were designed for traffic loads.

⇒ Maintain vigorous growth of vegetation coverings. This includes reseeding, fertilization and application of herbicides when necessary. Periodically mowing may also be needed to control vegetative height.

⇒ Remove all foreign debris that hinders system application.

⇒ Drain the system and components in areas that are subject to freezing.

⇒ Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

⇒ Immediately repair any vandalism, vehicular, or livestock damage to inlets, outlets, valves, and other appurtenances.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

FENCING

For: Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W;Sec.6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

Operation and Maintenance Items

A properly operated and maintained fence is an asset to the farm. This practice was designed and installed to provide so livestock do not need access to open watercourse for drinking water Practice will prevent pollution and prevent streambank erosion and riparian habitat damage due to livestock access. The estimated life span of this installation is at least 5 years. The life of the practice can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require periodic maintenance and may require operational items to maintain satisfactory performance. A good operation and maintenance plan includes:

⇒ Regular inspections of fences should be part of the on-going management program.

⇒ Inspection of fences after storm event is needed to facilitate the intended use of the fence

⇒ Broken or damaged posts will be replaced

⇒ Sagging wire will be tightened.

⇒ Broken or missing insulators will be replaced.

⇒ Any broken wires will be spliced or replaced.

⇒ Vegetation will be controlled under the fences.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

USE EXCLUSION WORKSHEET

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; Sec. 6

County: Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 3/12

Operation and Maintenance Items

A properly operated and maintained livestock exclusion practice will keep livestock out of the sloughs and open ditches and improve water quality. The estimated life span of the practices is 5 years. The life span can be assured and usually increased by developing and carrying out a good operation and maintenance program.

⇒ The fence barrier along the stream will be periodically inspected and remedial repairs will be performed as needed.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

OPERATION AND MAINTENANCE WORKSHEET

FILTER STRIP

For: Landowner/Operator Edward Gomes

Job Location: T 1S; R 9W; Sec.6

County Tillamook SWCD Tillamook Farm/Tract No. T-197

Prepared By Pedersen Date 03/12

Operation and Maintenance Items

A properly operated and maintained vegetated filter strip is an asset to your farm. This vegetative filter strip was designed and installed to remove sediment and pollutants from runoff. The estimated life span of this practice is at least 10 years. The life of this practice can be assured and usually increased by developing and carrying out a good operation and maintenance program

This practice will require you to perform periodic maintenance and may also require operation items to maintain satisfactory performance. Some recommendations to assist you develop a good operation and maintenance program:

⇒ Maintain vigorous growth of vegetative covering. This includes reseeding, commercial fertilization and application of herbicides when necessary. Periodic mowing or grazing may also be needed to control height.

⇒ Where the filter strip is used to trap nutrients, periodic grazing or mechanical harvesting and removal of vegetation is needed.

⇒ Remove all foreign debris that hinders system operation.

⇒ Limit the traffic and do not use as a roadway.

⇒ Limit livestock usage to vegetative growth periods when they will not damage vegetative root system or compact the soil.

⇒ Immediately repair any vandalism, vehicular, or livestock damage.

⇒ Eradicate or remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

TILLAMOOK COUNTY

SOIL AND WATER CONSERVATION DISTRICT

Spreader Equipment Calibrations (Using Bucket, Pan or Tarp)

Name: Edward Gomes Date 4/2012:

Operator: Same Spreader ID:

Perform the following operations to calibrate the solids spreader equipment:
✓ Place buckets, pans, or tarps in the application area to collect the applied or spread waste material.
✓ Spread waste material over the application area using the spreading pattern normally used in the field. Make sure the spreader is traveling at the speed it typically travels over the collection area. Record engine rpm and gear settings used.
✓ Collect and weigh the waste material and calculate the average application rate. Use this worksheet to record the weights and calculations.
Note: Use Tarps instead of buckets or pans when using dry stack manure or separated solids as the variability in the weight will be less.
Data and Calculations:

Steps	ID of Bucket, Pan or Tarp					
	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 bucket (lb) =						
5. Weight of bucket with waste (lb) =						
6. Weight of Waste (lb) - line 5 – line 4 =						
7. Collection Area (sq ft) - Area of the top of the bucket, pan or tarp used to collect the waste =						
8. Waste Applied (lb/sq ft) - line 6 ÷ line 7 =						
9. Covert to tons per acre - line 8 x 21.78 =						
10. Average Application Rate (tons per acre)- Sum of values in cells A9 through F9 divided by the total number of calibrations completed =						
Additional Notes:						

TILLAMOOK COUNTY

SOIL AND WATER CONSERVATION DISTRICT

Traveling Big Gun Sprinkler Calibration (Using Catch Cans)

Name: Edward Gomes Date: o4/2012

Operator: ______________________ Spreader ID: ______________

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.

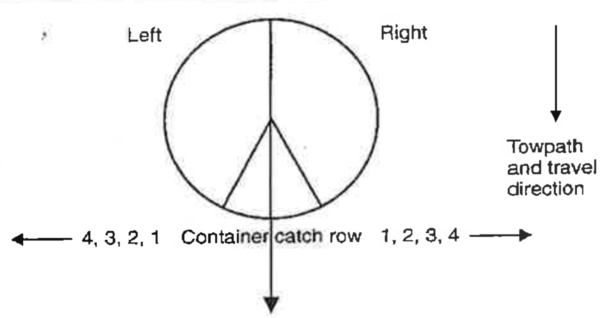
Catch Can Calibration:

Example: 1 inch = 5 Cups

1 cup = 0.2 Inches

Your Catch Cans: 1 inch = ______ Cups

1 cup = ______ Inches



Travel Rate Setting During Test:

Data and Calculations:

Catch Can ID	**Volume of Liquid**						
	Cups	**Inches**	**Cups**	**Inches**	**Cups**	**Inches**	**Cups**
1.							
2.							
3.							
4.							
5.							
6.							
Average							

TILLAMOOK COUNTY

SOIL AND WATER CONSERVATION DISTRICT

Tank Equipment Calibration (Using a Full Tank Load

Name: Edward Gomes Date: 04/2012

Operator: Same Spreader ID:

Perform the following operations to calibrate the tank equipment:
✓ Determine the maximum capacity of the tank equipment from the manufacturer's maintenance manual or the owners manual for the equipment.
✓ Fill the tank and reduce the volume of the tank by the appropriate amount if the tank is not filled to its maximum capacity. Normally a tank spreader is only filled to about 80 percent of its maximum capacity and therefore the maximum rated capacity of the tank should be multiplied by 0.8 to reflect the volume of the loaded tank during the calibration exercise.
✓ Spread the loaded tank on the field using consistent speed and settings to cover the field uniformly. Try to spread in a rectangular pattern so the area calculation will be simple. Record engine rpm and gear settings used.
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. Maximum rated capacity of tank (gallons) =						
5. Volume of filled tank (gallons)- Line 4 x ____ % of tank filled ÷ 100% =						
6. Length of spreading area (ft) =						
7. Width of spreading area (ft) =						
8. Area spread (sq ft)- line 6 x line 7 =						
9. Waste applied (gal/sq ft)- line 5 ÷ line 8 =						
10. Convert to gallons per acre - Line 9 x 43,560 =						
10. Average Application Rate (gallons per acre) – Sum of values in cells A10 through F10 divided by the total number of calibrations completed =						

Additional Notes:

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 3.6

CLIENT: Edward Gomes

ASSISTED BY: Pedersen

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

ANIMAL INVENTORY

Type of Animal	Number of Animals	Average Weight (lbs.)	Animal Units (1,000 lb.)	Milk Production in Pounds/Cow/Day=			55			Manure CF/D/AU	Annual	
				Nutrient Production								
				(lbs./day/1000 lb. Animal Unit)			(lbs./day)				Days Confined	Days Grazed
				N	P	K	N	P	K			
MILKER (Jersey)	305	900	274.5	0.77	0.13	0.45	211.78	35.22	122.66	1.75	187	178
MILKER (DRY)	60	900	54.0	0.30	0.04	0.10	16.20	2.27	5.40	0.92	258	107
HEIFERS (12-24 Months)	30	600	18.0	0.27	0.05	0.12	4.79	0.82	2.16	0.90	258	107
HEIFERS (12-24 Months)	50	300	15.0	0.27	0.05	0.12	3.99	0.68	1.80	0.90	258	107
CALVES (1-12 Months)	40	100	4.0	0.42	0.05	0.11	1.68	0.22	0.44	1.34	365	0
Totals/Averages-	485	560	365.5	0.65	0.11	0.36	238.4	39.2	132.5	1.5		

GRAZING PERIOD

Type of Animal	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AU-YR.
	Percent of Month and Number of Animals Grazing												
MILKER (Jersey)	83%	0%	0%	0%	0%	0%	83%	83%	83%	83%	83%	83%	
	305	305	305	305	305	305	305	305	305	305	305	305	1,595
MILKER (DRY)	50%	0%	0%	0%	0%	0%	50%	50%	50%	50%	50%	50%	
	60	60	60	60	60	60	60	60	60	60	60	60	189
HEIFERS (12-24 Months)	50%	0%	0%	0%	0%	0%	50%	50%	50%	50%	50%	50%	
	30	30	30	30	30	30	30	30	30	30	30	30	63
HEIFERS (12-24 Months)	50%	0%	0%	0%	0%	0%	50%	50%	50%	50%	50%	50%	
	50	50	50	50	50	50	50	50	50	50	50	50	[illegible]
CALVES (1-12 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	40	40	40	40	40	40	40	40	40	40	40	40	0
													0
													0
													0
													0
													0
Total AUM's Available>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total AUM's Needed>>>	271	0	0	0	0	0	271	271	271	271	271	271	1,899
Total AUM's>>>>>>>>>>	-271	0	0	0	0	0	-271	-271	-271	-271	-271	-271	-1,899

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 3.6

4/13/2012

CLIENT: Edward Gomes

ASSISTED BY: Pedersen

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

WEATHER STATION

TILLAMOOK 1 W

Month	25Yr-24Hr	6.00	Lot Runoff Factors as a Percent of Monthly Precipitation	
	Monthly Average in Inches			
	Precipitation	Evaporation	Paved	Unpaved
October	7.16	1.42	50%	20%
November	13.71	0.75	60%	25%
December	13.94	0.60	60%	25%
January	13.09	0.48	60%	25%
February	10.79	0.78	50%	25%
March	9.90	1.26	45%	15%
April	6.81	1.90	40%	15%
May	4.84	3.22	40%	10%
June	3.41	3.40	35%	10%
July	1.64	3.91	30%	0%
August	1.42	3.52	40%	10%
September	3.68	2.54	45%	15%
Annual	90.39	23.78		

AREAS CONTRIBUTING RUNOFF TO LIQUID STORAGE FACILITY

Description of Runoff Area	Area in SF
Paved Lot Area >> Is paved lot scraped daily? (Y/N) NO	0
Unpaved Lot Area >>	0
Roof Area >>	2,800
Surface Area of Silage Storage Facility>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> Does Silage Seepage Drain to Storage Facility? (Y/N) NO	0
Total Runoff Area Contributing to Liquid Storage Facility>>>>>>>>>>>>>>>	2,800

WATER USE THAT ENTERS LIQUID STORAGE FACILITY

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	305.0	2	0.00	0	0.0
Equipment Wash		2	356.00	712	95.2
Flushwater		0	0.00	0	0.0
Miscellaneous		2	25.00	50	6.7
Total>>				762	101.9

CROP DATA

Field Number	Acres	Crop	Percent Dry Matter (DM)	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre: Nitrogen N	Phosphorous P_2O_5	Potassium K_2O
T197 1	21.2	Perennial Hay/Pasture(High Intensity)	30%	Ton	22.00	422	121	318
2	16.4	Perennial Hay/Pasture(High Intensity)	30%	Ton	22.00	422	121	318
3	22.2	Perennial Hay/Pasture(High Intensity)	30%	Ton	22.00	422	121	318
4,7	15.4	Perennial Hay/Pasture(High Intensity)	30%	Ton	22.00	422	121	318
5,6	10.0	Perennial Hay/Pasture(High Intensity)	30%	Ton	22.00	422	121	318
8	30.7	Perennial Hay/Pasture(Med-High Intensity)	30%	Ton	22.00	383	121	318
9	20.4	Perennial Hay/Pasture(High Intensity)	30%	Ton	22.00	422	121	318
Off Farm								

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

4/13/2012

Version 3.6

CLIENT: Edward Gomes

ASSISTED BY: Pedersen

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

BEDDING VOLUME

Type of Animal	Type of Bedding Facility	Bedding Material	Unit Weight Lbs/CF	Amount Needed Lbs/Day/AU	Volume CF/Day/AU	Total Volume CF/Day	Total Weight Lbs/Day
MILKER (Jersey)	Free Stall	~~Loose Straw~~ Separated	2.50	2.60	1.04	285	714
MILKER (DRY)	Free Stall	~~Loose Straw~~ manure	2.50	2.60	1.04	56	140
HEIFERS (12-24 Months)	Free Stall	Loose Straw	2.50	2.04	0.82	15	37
HEIFERS (12-24 Months)	Free Stall	~~Loose Straw~~	2.50	5.40	2.16	32	81
CALVES (1-12 Months)	Loose Housing	~~Loose Straw~~	2.50	9.30	3.72	15	37

SOLIDS SEPARATION FACTOR

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 (Jersey)	Press Type (Screw or Roller)	40%	139	208	456	24	244	36	4,990
MILKER (DRY)	Press Type (Screw or Roller)	40%	25	37	47	2	8	36	892
HEIFERS (12-24 Months)	Press Type (Screw or Roller)	40%	7	10	15	1	5	36	247
HEIFERS (12-24 Months)	Press Type (Screw or Roller)	40%	14	21	13	1	4	36	496
CALVES (1-12 Months)	Press Type (Screw or Roller)	100%	20	0	0	5	0	36	729
Total Solids>>>			204	276	532	34	260		7,354

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)
Version 3.6

CLIENT: Edward Gomes
ASSISTED BY: Pedersen

ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY VOLUMES

	Runoff in Cubic Feet					Manure									
	Roof Area Square Feet	Paved Slab Area Square Feet	Unpaved Lot Area Square Feet	Silage Pit Surface Area, SF	Facility Water Use	Solids	Liquids	Bedding		Solids Separated		Solids in Liquids		Total Solids	Total Liquids
Month	2,800	0	0	0	Cubic Feet	Cubic Feet	Cubic Feet	Cubic Feet	Pounds	Cubic Feet	Pounds	Cubic Feet	Pounds	Cubic Feet	Cubic Feet
October	1,671	0	0	0	3,158	648	3,283	3,566	8,915	2,062	74,229	2,152	77,462	2,062	10,552
November	3,199	0	0	0	3,056	2,301	14,667	12,108	30,271	6,128	220,607	8,281	298,121	6,128	31,019
December	3,253	0	0	0	3,158	2,378	15,155	12,512	31,280	6,332	227,960	8,557	308,058	6,332	31,450
January	3,054	0	0	0	3,158	2,378	15,155	12,512	31,280	6,332	227,960	8,557	308,058	6,332	31,252
February	2,518	0	0	0	2,852	2,147	13,689	11,301	28,253	5,719	205,899	7,729	278,246	5,719	29,581
March	2,310	0	0	0	3,158	2,378	15,155	12,512	31,280	6,332	227,960	8,557	308,058	6,332	30,508
April	1,589	0	0	0	3,056	627	3,177	3,451	8,628	1,995	71,835	2,082	74,963	1,995	10,299
May	1,129	0	0	0	3,158	648	3,283	3,566	8,915	2,062	74,229	2,152	77,462	2,062	10,011
June	796	0	0	0	3,056	627	3,177	3,451	8,628	1,995	71,835	2,082	74,963	1,995	9,506
July	383	0	0	0	3,158	648	3,283	3,566	8,915	2,062	74,229	2,152	77,462	2,062	9,264
August	331	0	0	0	3,158	648	3,283	3,566	8,915	2,062	74,229	2,152	77,462	2,062	9,213
September	859	0	0	0	3,056	627	3,177	3,451	8,628	1,995	71,835	2,082	74,963	1,995	9,569
Annual	**21,091**	**0**	**0**	**0**	**37,183**	**16,051**	**96,485**	**85,562**	**213,906**	**45,078**	**1,622,807**	**56,536**	**2,035,280**	**45,078**	**222,224**

DAILY NUTRIENT PRODUCTION

	Pounds/Day of Nutrients from **LIQUIDS**			Pounds/Day of Nutrients from **SOLIDS**			Pounds/Day of Nutrients from **GRAZING**		
Type of Animal	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
MILKER (Jersey)	127.07	48.41	88.68	84.71	32.27	59.12	211.78	80.69	147.81
MILKER (DRY)	9.72	3.12	3.90	6.48	2.08	2.60	16.20	5.20	6.51
HEIFERS (12-24 Months)	2.87	1.13	1.56	1.92	0.75	1.04	4.79	1.88	2.60
HEIFERS (12-24 Months)	2.39	0.94	1.30	1.60	0.63	0.87	3.99	1.56	2.17
CALVES (1-12 Months)	0.00	0.00	0.00	1.68	0.49	0.53	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 3.6

CLIENT: **Edward Gomes**
ASSISTED BY: **Pedersen**

ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY NUTRIENT PRODUCTION

	Pounds of Nutrients from **LIQUIDS**			Pounds of Nutrients from **SOLIDS**			Pounds of Nutrients from **GRAZING**			Pounds of Nutrients going **OFF-FARM**			Total Pounds of Nutrients from **ALL SOURCES**		
Month	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
October	902	335	572	653	239	398	5,836	2,210	3,978	0	0	0	7,391	2,784	4,948
November	4,262	1,608	2,864	2,891	1,087	1,925	0	0	0	0	0	0	7,153	2,694	4,788
December	4,404	1,661	2,959	2,988	1,123	1,989	0	0	0	0	0	0	7,391	2,784	4,948
January	4,404	1,661	2,959	2,988	1,123	1,989	0	0	0	0	0	0	7,391	2,784	4,948
February	3,977	1,501	2,673	2,699	1,014	1,797	0	0	0	0	0	0	6,676	2,515	4,469
March	4,404	1,661	2,959	2,988	1,123	1,989	0	0	0	0	0	0	7,391	2,784	4,948
April	873	325	554	632	231	385	5,648	2,139	3,850	0	0	0	7,153	2,694	4,788
May	902	335	572	653	239	398	5,836	2,210	3,978	0	0	0	7,391	2,784	4,948
June	873	325	554	632	231	385	5,648	2,139	3,850	0	0	0	7,153	2,694	4,788
July	902	335	572	653	239	398	5,836	2,210	3,978	0	0	0	7,391	2,784	4,948
August	902	335	572	653	239	398	5,836	2,210	3,978	0	0	0	7,391	2,784	4,948
September	873	325	554	632	231	385	5,648	2,139	3,850	0	0	0	7,153	2,694	4,788
Annual	**27,676**	**10,408**	**18,363**	**19,064**	**7,119**	**12,436**	**40,288**	**15,255**	**27,460**	**0**	**0**	**0**	**87,029**	**32,783**	**58,259**

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 3.6

CLIENT: **Edward Gomes**
ASSISTED BY: **Pedersen**

ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

TANK

Tank Parameters	Value
Storage Period, Days=	**94**
Tank Diameter, Feet=	**100**
Existing Storage, Cubic Feet=	**12,358**
Surface Area of Existing Storage, SF=	**0**
25 Year-24 Hour Storm Runoff, CF=	**1,400**
Volume Needed, Cubic Feet=	**129,316**
Design Volume, Cubic Feet=	**116,958**
Is Tank Covered?	NO
Tank Dimensions?	Circular

MONTHLY INFLOWS INTO TANK

Month	Number of days	Rain-Evap on Tank CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Manure CF	Solids CF	Waste to Store CF
October	31	3,755	0	1,671	3,158	3,572	2,152	8,882
November	30	8,478	0	3,199	3,056	15,951	8,281	27,288
December	31	8,727	0	3,253	3,158	16,482	8,557	28,198
January	31	8,249	0	3,054	3,158	16,482	8,557	28,198
February	28	6,548	0	2,518	2,852	14,887	7,729	25,469
March	31	5,652	0	2,310	3,158	16,482	8,557	28,198
April	30	3,212	0	1,589	3,056	3,457	2,082	8,595
May	31	1,060	0	1,129	3,158	3,572	2,152	8,882
June	30	7	0	796	3,056	3,457	2,082	8,595
July	31	-1,485	0	383	3,158	3,572	2,152	8,882
August	31	-1,374	0	331	3,158	3,572	2,152	8,882
September	30	746	0	859	3,056	3,457	2,082	8,595
Annual	365	43,574	0	21,091	37,183	104,942	56,536	198,661

1.0 Feet

Depth = **14.9** Feet

Minimum Freeboard = 1.0 Feet

25Yr-24Hr Storm Precipitation = **6** Inches

25Yr-24Hr Storm Runoff = **1400** Cubic Feet

94 Day Precip - Evap = **40.24** Inches

Runoff from Normal Precipitation = **9841** Cubic Feet

Washwater = **9752** Cubic Feet

Manure = **50900** Cubic Feet

Diameter = **100** Feet

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

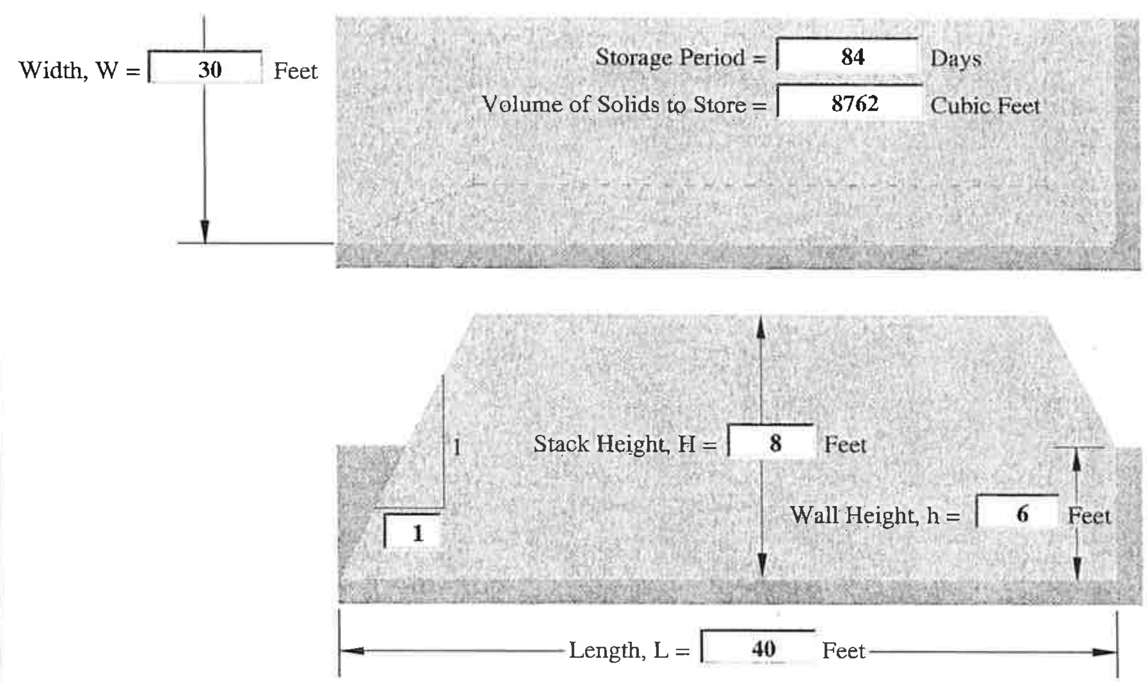
Version 3.6

CLIENT: **Edward Gomes**
ASSISTED BY: **Pedersen**

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=	**84**	October	31	359	1,703	1,031	0
Stacking Width, W in Feet=	**30**	November	30	1017	5,111	3,064	0
Stacking Height, H in Feet=	**8.00**	December	31	1051	5,282	3,166	0
Wall Height, h in Feet=	**6.00**	January	31	1051	5,282	3,166	0
Stack Side Slope (X:1)=	**1.00**	February	28	949	4,770	2,860	0
Existing Storage, Cubic Feet=	**405**	March	31	1051	5,282	3,166	0
Surface Area of Existing Storage, SF=	**0**	April	30	347	1,648	998	0
25 Year-24 Hour Storm Runoff, CF=	**0**	May	31	359	1,703	1,031	0
Volume Needed, Cubic Feet=	**8,762**	June	30	347	1,648	998	0
Design Volume, Cubic Feet=	**8,454**	July	31	359	1,703	1,031	0
Is Facility Covered?	YES	August	31	359	1,703	1,031	0
		September	30	347	1,648	998	0
		Annual	365	7,594	37,484	22,539	0



405 ft^3 is the separated manure returned as bedding to the 304 stalls.

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 3.6

CLIENT: **Edward Gomes**
ASSISTED BY: **Pedersen**

ANIMAL WASTE MANAGEMENT SYSTEM APPLICATION

MANAGEMENT CRITERIA FOR TRACTOR SPREADER APPLICATION OF SOLIDS

To apply **45,078** cubic feet of solids generated from the operation it will take approximately **102** trips annually. Based on applying NITROGEN, N at agronomic rate use the application depths, travel lengths, and loads per acre listed below for each crop.

Field Number	Acres	Crop	Tractor Spreader Capacity Bushels	Tractor Spreader Capacity CF	Spread Width Feet	NITROGEN, N Concentration in Storage Facility PPM	NITROGEN, N Concentration in Storage Facility Lbs/Ton	Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Tons per Acre of Solids to Apply	Travel Length per Load Needed in Feet	Loads per Acre	Assumed Solids Density lbs/CF
T197 1	21.2	Perennial Hay/Pasture(High Intensity)	354	441	15	8,811	17.62	422	1.00	39.4	585	5	36
2	16.4	Perennial Hay/Pasture(High Intensity)	354	441	15	8,811	17.62	422	1.00	39.4	585	5	36
3	22.2	Perennial Hay/Pasture(High Intensity)	354	441	15	8,811	17.62	422	1.00	39.4	585	5	36
4,7	15.4	Perennial Hay/Pasture(High Intensity)	354	441	15	8,811	17.62	422	1.00	39.4	585	5	36
5,6	10	Perennial Hay/Pasture(High Intensity)	354	441	15	8,811	17.62	422	1.00	39.4	585	5	36
8	30.7	Perennial Hay/Pasture(Med-High Intensity)	354	441	15	8,811	17.62	383	1.00	35.7	646	4	36
9	20.4	Perennial Hay/Pasture(High Intensity)	354	441	15	8,811	17.62	422	1.00	39.4	585	5	36

MANAGEMENT CRITERIA FOR BIG GUN SPRINKLER APPLICATION OF LIQUIDS

To apply **1,969,679** gallons of liquids generated from the operation it will take approximately **109** hours of pumping annually. Based on applying NITROGEN, N at agronomic rate use the application depths, set times, and travel rates listed below for each crop.

Field Number	Acres	Crop	Sprinkler Flowrate GPM	Wetted Diameter Feet	Portion of Wetted Diameter Receiving Liquids	NITROGEN, N Concentration in Storage Facility PPM	NITROGEN, N Concentration in Storage Facility Lbs/1000Gal	Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Inches of Liquids to Apply	Application Rate in Inches/Hour	Set Time Needed in Hours	Travel Rate Needed in Feet/Minute
T197 1	21.2	Perennial Hay/Pasture(High Intensity)	300	250	1/2 Circle	141	1.18	422	1.00	20.27	1.45	34.39	0.10
2	16.4	Perennial Hay/Pasture(High Intensity)	300	250	1/2 Circle	141	1.18	422	1.00	20.27	1.45	34.39	0.10
3	22.2	Perennial Hay/Pasture(High Intensity)	300	250	1/2 Circle	141	1.18	422	1.00	20.27	1.45	34.39	0.10
4,7	15.4	Perennial Hay/Pasture(High Intensity)	300	250	1/2 Circle	141	1.18	422	1.00	20.27	1.45	34.39	0.10
5,6	10	Perennial Hay/Pasture(High Intensity)	300	250	1/2 Circle	141	1.18	422	1.00	20.27	1.45	34.39	0.10
8	30.7	Perennial Hay/Pasture(Med-High Intensity)	300	250	1/2 Circle	141	1.18	383	1.00	18.37	1.45	31.17	0.10
9	20.4	Perennial Hay/Pasture(High Intensity)	300	250	1/2 Circle	141	1.18	422	1.00	20.27	1.45	34.39	0.10

CLIENT: Edward Gomes
ASSISTED BY: Pedersen

ANIMAL WASTE MANAGEMENT SYSTEM APPLICATION

MANAGEMENT CRITERIA FOR TANK WAGON APPLICATION OF LIQUIDS

To apply **1,969,679** gallons of liquids generated from the operation it will take approximately **1,159** trips annually. Based on applying NITROGEN, N at agronomic rates use the application depths, travel lengths, and loads per acre listed below for each crop.

Field Number	Acres	Crop	Tank Wagon Capacity Gallons	Spread Width Feet	NITROGEN, N Concentration in Storage Facility PPM	NITROGEN, N Concentration in Storage Facility Lbs/1000Gal	Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Inches of Liquids to Apply	Travel Length per Load Needed in Feet	Loads per Acre
T197 1	21.2	Perennial Hay/Pasture(High Intensity)	**1,700**	**15**	**141**	**1.18**	422	1.00	8.63	21	137.8
2	16.4	Perennial Hay/Pasture(High Intensity)	**1,700**	**15**	**141**	**1.18**	422	1.00	8.63	21	137.8
3	22.2	Perennial Hay/Pasture(High Intensity)	**1,700**	**15**	**141**	**1.18**	**422**	1.00	8.63	21	137.8
4,7	15.4	Perennial Hay/Pasture(High Intensity)	**1,700**	**15**	**141**	**1.18**	**422**	1.00	8.63	21	137.8
5,6	10	Perennial Hay/Pasture(High Intensity)	**1,700**	**15**	**141**	**1.18**	**422**	1.00	8.63	21	137.8
8	30.7	Perennial Hay/Pasture(Med-High Intensity)	**1,700**	**15**	**141**	**1.18**	**383**	1.00	7.82	23	124.9
9	20.4	Perennial Hay/Pasture(High Intensity)	**1,700**	**15**	**141**	**1.18**	**422**	1.00	8.63	21	137.8

COMPUTED NUTRIENT CONCENTRATIONS IN STORAGE

Storage Facility	Annual Volume Production	Units	Concentration of Nutrients in Storage N	P_2O_5	K_2O	Units
Tank (Uncovered)	1,969,679	Gallons	9.84	4.49	7.92	lbs/th Gal
Solids Storage Facility (Roofed)	406	Tons	17.62	7.90	13.79	lbs/Ton

4/13/2012

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)
Version 3.6

CLIENT: **Edward Gomes**
ASSISTED BY: **Pedersen**

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation: Dairy / Type of Storage Facility	Pounds of Nutrients Available N	P2O5	K2O	Percent Nutrients Retained After Storage N	P2O5	K2O	Pounds of Nutrients Retained After Storage N	P2O5	K2O
Liquids	Tank (Uncovered)	27,676	10,408	18,363	**70%**	**85%**	**85%**	19,373	8,847	15,609
Solids	Solids Storage Facility (Roofed)	19,064	7,119	12,436	**75%**	**90%**	**90%**	14,298	6,407	11,192
Grazing	NONE	40,288	15,255	27,460	**100%**	**100%**	**100%**	40,288	15,255	27,460

NUTRIENTS AVAILABLE AFTER APPLICATION

Nutrient Source	Type of Application System	Pounds of Nutrients Available N	P2O5	K2O	Percent Nutrients Retained After Application N	P2O5	K2O	Pounds of Nutrients Retained After Application N	P2O5	K2O
Liquids	Sprinkling	19,373	8,847	15,609	**75%**	**100%**	**100%**	14,530	8,847	15,609
Solids	Broadcast (Incorporated 7 or more days after application)	14,298	6,407	11,192	**70%**	**100%**	**100%**	10,009	6,407	11,192
Grazing	Grazing	40,288	15,255	27,460	**85%**	**100%**	**100%**	34,245	15,255	27,460

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location: Coast / Soil Drainage Class	Pounds of Nutrients Available N	P2O5	K2O	Percent Nutrients Retained After Denitrification N	P2O5	K2O	Pounds of Nutrients Retained After Denitrification N	P2O5	K2O
Liquids	Well Drained	14,530	8,847	15,609	**87%**	**100%**	**100%**	12,641	8,847	15,609
Solids	Well Drained	10,009	6,407	11,192	**87%**	**100%**	**100%**	8,707	6,407	11,192
Grazing	Well Drained	34,245	15,255	27,460	**87%**	**100%**	**100%**	29,793	15,255	27,460
							TOTAL-	***51,142***	***30,510***	***54,261***

PERCENT OF MANURE TO BE APPLIED TO FIELD AND UTILIZATION ACRES NEEDED BASED ON NITROGEN, N

Field Number	Acres	Crop	LIQUIDS Percent to be Applied	LIQUIDS Pounds of Nutrients to be Applied	LIQUIDS Acres Needed for Utilization of Nutrients	SOLIDS Percent to be Applied	SOLIDS Pounds of Nutrients to be Applied	SOLIDS Acres Needed for Utilization of Nutrients	GRAZING Percent to be Applied	GRAZING Pounds of Nutrients to be Applied	GRAZING Acres Needed for Utilization of Nutrients
T197 1	21.2	Perennial Hay/Pasture(High Intensity)	**16%**	2,009	5	**16%**	1,384	3	**16%**	4,734	11
2	16.4	Perennial Hay/Pasture(High Intensity)	**12%**	1,554	4	**12%**	1,070	3	**12%**	3,662	9
3	22.2	Perennial Hay/Pasture(High Intensity)	**17%**	2,103	5	**17%**	1,449	3	**17%**	4,957	12
4,7	15.4	Perennial Hay/Pasture(High Intensity)	**12%**	1,459	3	**12%**	1,005	2	**12%**	3,439	8
5,6	10.0	Perennial Hay/Pasture(High Intensity)	**7%**	947	2	**7%**	653	2	**7%**	2,233	5
8	30.7	Perennial Hay/Pasture(Med-High Intensity)	**21%**	2,636	7	**21%**	1,816	5	**21%**	6,213	16
9	20.4	Perennial Hay/Pasture(High Intensity)	**15%**	1,933	5	**15%**	1,331	3	**15%**	4,555	11
Off Farm			**0%**	0		**0%**	0		**0%**	0	
TOTALS-	**136.3**		**100%**	**12,641**	**31**	**100%**	**8,707**	**21**	**100%**	**29,793**	**72**

CLIENT: Edward Gomes
ASSISTED BY: Pedersen

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENT BALANCE BASED ON AVAILABLE ACRES

			NUTRIENTS APPLIED			- NUTRIENTS REMOVED			= NUTRIENT BALANCE		
Field Number	Acres	Crop	Nitrogen, N Lbs/Acre	Phosphorous, P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre
T197 1	21.2	Perennial Hay/Pasture(High Intensity)	383	229	407	422	121	318	-39	108	89
2	16.4	Perennial Hay/Pasture(High Intensity)	383	229	407	422	121	318	-39	108	89
3	22.2	Perennial Hay/Pasture(High Intensity)	383	229	407	422	121	318	-39	108	89
4,7	15.4	Perennial Hay/Pasture(High Intensity)	383	229	407	422	121	318	-39	108	89
5,6	10.0	Perennial Hay/Pasture(High Intensity)	383	229	407	422	121	318	-39	108	89
8	30.7	Perennial Hay/Pasture(Med-High Intensity)	347	207	369	383	121	318	-35	86	50
9	20.4	Perennial Hay/Pasture(High Intensity)	383	229	407	422	121	318	-39	108	89
Off Farm											

DATE : October 04, 2010
REPORT: S8239 M
CLIENT: GOMES, EDWARD
GROWER:
SAMPLED:

Agri-Check
A Division of AgSource Cooperative Services
323 Sixth St. • P.O. Box 1350 • Umatilla, OR 97882
Ph: 541-922-4894 • 800-537-1129 • Fax: 541-922-5496

SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	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	Base Sat. %	SMP Buf.pH	MOISTURE Total %	Avail. Inches	TKN %	Cl ppm
FIELD: F1																									
7176	1	6.1			93	1664	20.5	8.3	163	222									33.1		6.1				
FIELD: 2																									
7177	1	6.0			85	1704	19.0	7.5	174	222									30.9		6.1				
FIELD: 7																									
7178	1	6.2			60	1687	21.4	8.9	38	132									34.6		6.1				

PHOSPHORUS INDEX WORKSHEET – **WESTERN** OREGON

Producer: Edward Gomes County:Tillamook Tract No. 197 Field No(s). 1 Date: 10-4-2010

Soil Map Unit(s): 170B-Logsden-Nehalem silt loams, 0-5% slopes Soil Test P: 93 ppm Lab. Method: Weak Bray Sample Depth: 1 foot

Crop Rotation: Permanent Pasture Nutrient Application Method(s) Manure gun travel, tank wagon, manure spreader

Planner:Pedersen Notes: ______

		PHOSPHORUS LOSS RATING					Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	0	0
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0.75	0.75
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	1.0	1.0
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	1.5	1.5
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	1.5	0.75
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0
						Transport Factors Subtotal (TFS)	4.75	4.0

Tract **197** Field: 1

SOURCE FACTORS	Factor Weight	PHOSPHORUS LOSS RATING					Weighted Rating Value	
		None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) / 10 (93 - 40) x .10 = 5.3 Soil Test P Assign 0 points if Soil Test P < 40 ppm					5.3	5.3
Commercial P Fertilizer Application Rate	1.00	lbs/ac P_2O_5 x 0.02 ________ x 0.02 = ________ lbs/ac P_2O_5					____	____
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	____	____
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 x 0.02 224 x 0.02 = 4.48 lbs/ac P_2O_5					4.48	4.48
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	2.0	2.0

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	**Low**
13.0 – 25.0	**Medium**
25.1 – 50.0	**High**
> 50.0	**Very High**

	Current	**Planned**
Transport Factors Subtotal (TFS)	4.75	4.0
Source Factors Subtotal (SFS)	11.78	11.78
Total Rating Value (TFS + SFS)	**16.53**	**15.78**
Site Vulnerability Class	**Medium**	**Medium**

DATE : October 04, 2010
REPORT: S8239 M
CLIENT: GOMES, EDWARD
GROWER:
SAMPLED:

Agri-Check
A Division of AgSource Cooperative Services
323 Sixth St. • P.O. Box 1350 • Umatilla, OR 97882
Ph: 541-922-4894 • 800-537-1129 • Fax: 541-922-5496

SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	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	Base Sat. %	SMP Buf.pH	MOISTURE Total %	Avail. Inches	TKN %	Cl ppm
FIELD: F1																									
7176	1	6.1			93	1664	20.5	8.3	163	222									33.1		6.1				
FIELD: 2																									
7177	1	6.0			85	1704	19.0	7.5	174	222									30.9		6.1				
FIELD: 7																									
7178	1	6.2			60	1687	21.4	8.9	38	132									34.6		6.1				

PHOSPHORUS INDEX WORKSHEET – **WESTERN** OREGON

Producer: Edward Gomes County:Tillamook Tract No. 197 Field No(s). 2 Date: 10-4-2010

Soil Map Unit(s): 170B-Logsden-Nehalem silt loams, 0-5% slopes Soil Test P: 85 ppm Lab. Method: Weak Bray Sample Depth: 1 foot

Crop Rotation: Permanent Pasture Nutrient Application Method(s) Manure gun travel, tank wagon, manure spreader

Planner:Pedersen Notes: ______

		PHOSPHORUS LOSS RATING					Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	0	0
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0.75	0.75
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	1.0	1.0
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	1.5	1.5
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	1.5	0.75
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0
						Transport Factors Subtotal (TFS)	4.75	4.0

Tract **197** Field: 2

SOURCE FACTORS	Factor Weight	PHOSPHORUS LOSS RATING					Weighted Rating Value	
		None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) / 10 (85 - 40) x .10 = 4.5 Soil Test P Assign 0 points if Soil Test P < 40 ppm					4.5	4.5
Commercial P Fertilizer Application Rate	1.00	lbs/ac P_2O_5 x 0.02 ________ x 0.02 = ________ lbs/ac P_2O_5					____	____
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	____	____
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 x 0.02 224 x 0.02 = 4.48 lbs/ac P_2O_5					4.48	4.48
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	2.0	2.0

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	**Low**
13.0 – 25.0	**Medium**
25.1 – 50.0	**High**
> 50.0	**Very High**

	Current	Planned
Transport Factors Subtotal (TFS)	4.75	4.0
Source Factors Subtotal (SFS)	10.98	10.98
Total Rating Value (TFS + SFS)	**15.73**	**14.98**
Site Vulnerability Class	**Medium**	**Medium**

PHOSPHORUS INDEX WORKSHEET – **WESTERN** OREGON

Producer: Edward Gomes County:Tillamook Tract No. 197 Field No(s). 2 Date: 10-4-2010

Soil Map Unit(s): 74A Nehalem silt loams, 0-3% slopes Soil Test P: 85 ppm Lab. Method: Weak Bray Sample Depth: 1 foot

Crop Rotation: Permanent Pasture Nutrient Application Method(s) Manure gun travel, tank wagon, manure spreader

Planner:Pedersen Notes: ______

		PHOSPHORUS LOSS RATING					Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	0	0
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0.75	0.75
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	1.0	1.0
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	1.5	1.5
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	1.5	0.75
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0
						Transport Factors Subtotal (TFS)	4.75	4.0

Tract 197 Field: 2

SOURCE FACTORS	Factor Weight	**PHOSPHORUS LOSS RATING** None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Weighted Rating Value** **Current**	**Planned**
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) / 10	(85 - 40) x .10 = 4.5 Soil Test P	Assign 0 points if Soil Test P < 40 ppm			4.5	4.5
Commercial P Fertilizer Application Rate	1.00	lbs/ac P_2O_5 x 0.02	______ x 0.02 = ______ lbs/ac P_2O_5				____	____
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	____	____
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 x 0.02	224 x 0.02 = 4.48 lbs/ac P_2O_5				4.48	4.48
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	2.0	2.0

Total Rating Value TFS + SFS	**Site Vulnerability Class**
< 13.0	**Low**
13.0 – 25.0	**Medium**
25.1 – 50.0	**High**
> 50.0	**Very High**

	Current	**Planned**
Transport Factors Subtotal (TFS)	4.75	4.0
Source Factors Subtotal (SFS)	10.98	10.98
Total Rating Value (TFS + SFS)	**15.73**	**14.98**
Site Vulnerability Class	**Medium**	**Medium**

DATE : October 04, 2010
REPORT: S8239 M
CLIENT: GOMES, EDWARD
GROWER:
SAMPLED:

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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 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 Total %	Avail. Inches	TKN %	Cl ppm
FIELD: F1																									
7176	1	6.1			93	1664	20.5	8.3	163	222									33.1		6.1				
FIELD: 2																									
7177	1	6.0			85	1704	19.0	7.5	174	222									30.9		6.1				
FIELD: 7																									
7178	1	6.2			60	1687	21.4	8.9	38	132									34.6		6.1				

PHOSPHORUS INDEX WORKSHEET – **WESTERN** OREGON

Producer: Edward Gomes County:Tillamook Tract No. 197 Field No(s). 7 Date: 10-4-2010

Soil Map Unit(s): 74A Nehalem silt loams, 0-3% slopes Soil Test P: 60 ppm Lab. Method: Weak Bray Sample Depth: 1 foot

Crop Rotation: Permanent Pasture Nutrient Application Method(s) Manure gun travel, tank wagon, manure spreader

Planner:Pedersen Notes: ______

		PHOSPHORUS LOSS RATING					Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	0	0
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0.75	0.75
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	1.0	1.0
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	1.5	1.5
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	1.5	0.75
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0
						Transport Factors Subtotal (TFS)	4.75	4.0

Tract **197** Field: 7

SOURCE FACTORS	Factor Weight	**PHOSPHORUS LOSS RATING** None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Weighted Rating Value** **Current**	**Planned**
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) / 10	(60 - 40) x .10 = 2.10 Soil Test P		Assign 0 points if Soil Test P < 40 ppm		2.0	2.0
Commercial P Fertilizer Application Rate	1.00	lbs/ac P_2O_5 x 0.02	________ lbs/ac P_2O_5 x 0.02 = ________				____	____
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	____	____
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 x 0.02	224 x 0.02 = 4.48 lbs/ac P_2O_5				4.48	4.48
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	2.0	2.0

Total Rating Value TFS + SFS	**Site Vulnerability Class**
< 13.0	**Low**
13.0 – 25.0	**Medium**
25.1 – 50.0	**High**
> 50.0	**Very High**

	Current	**Planned**
Transport Factors Subtotal (TFS)	4.75	4.0
Source Factors Subtotal (SFS)	8.48	8.48
Total Rating Value (TFS + SFS)	**13.23**	**12.48**
Site Vulnerability Class	**Medium**	**Low**

PHOSPHORUS INDEX WORKSHEET – **WESTERN** OREGON

Producer: Edward Gomes County:Tillamook Tract No. 197 Field No(s). 7 Date: 10-4-2010

Soil Map Unit(s): 170B-Logsden-Nehalem silt loams, 0-5% slopes Soil Test P: 60 ppm Lab. Method: Weak Bray Sample Depth: 1 foot

Crop Rotation: Permanent Pasture Nutrient Application Method(s) Manure gun travel, tank wagon, manure spreader

Planner:Pedersen Notes: ______

		PHOSPHORUS LOSS RATING					Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	0	0
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0.75	0.75
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	1.0	1.0
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	1.5	1.5
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	0.75	0.75
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0
						Transport Factors Subtotal (TFS)	4.0	4.0

Tract **197** Field: 7

SOURCE FACTORS	Factor Weight	PHOSPHORUS LOSS RATING					Weighted Rating Value	
		None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) / 10	(60 - 40) x .10 = 2.0 Soil Test P	Assign 0 points if Soil Test P < 40 ppm			2.0	2.0
Commercial P Fertilizer Application Rate	1.00	lbs/ac P_2O_5 x 0.02	______ lbs/ac P_2O_5 x 0.02 = ______				___	___
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	___	___
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 x 0.02	224 x 0.02 = 4.48 lbs/ac P_2O_5				4.48	4.48
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	2.0	2.0

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	**Low**
13.0 – 25.0	**Medium**
25.1 – 50.0	**High**
> 50.0	**Very High**

	Current	Planned
Transport Factors Subtotal (TFS)	4.0	4.0
Source Factors Subtotal (SFS)	8.48	8.48
Total Rating Value (TFS **+** SFS)	**12.48**	**12.48**
Site Vulnerability Class	**Low**	**Low**

PHOSPHORUS INDEX WORKSHEET – **WESTERN** OREGON

Producer: Edward Gomes County:Tillamook Tract No. 197 Field No(s). 7 Date: 10-4-2010

Soil Map Unit(s): 81B Quillamook complex 0-7% slopes Soil Test P: 60 ppm Lab. Method: Weak Bray Sample Depth: 1 foot

Crop Rotation: Permanent Pasture Nutrient Application Method(s) Manure gun travel, tank wagon, manure spreader

Planner:Pedersen Notes: ______________________________

		PHOSPHORUS LOSS RATING					Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	0	0
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0.75	0.75
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	1.0	1.0
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	0	0
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	0.75	0.75
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0
						Transport Factors Subtotal (TFS)	2.5	2.5

Tract 197	Field: 7	PHOSPHORUS LOSS RATING					Weighted Rating Value	
SOURCE FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) / 10 (60 - 40) x .10 = 2.0 Soil Test P Assign 0 points if Soil Test P < 40 ppm					2.0	2.0
Commercial P Fertilizer Application Rate	1.00	lbs/ac P_2O_5 x 0.02 ________ x 0.02 = ________ lbs/ac P_2O_5					____	____
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	____	____
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 x 0.02 224 x 0.02 = 4.48 lbs/ac P_2O_5					4.48	4.48
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	2.0	2.0

Total Rating Value TFS + SFS	**Site Vulnerability Class**
< 13.0	**Low**
13.0 – 25.0	**Medium**
25.1 – 50.0	**High**
> 50.0	**Very High**

	Current	**Planned**
Transport Factors Subtotal (TFS)	2.5	2.5
Source Factors Subtotal (SFS)	8.48	8.48
Total Rating Value (TFS + SFS)	**10.98**	**10.98**
Site Vulnerability Class	**Low**	**Low**

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

NUTRIENT MANAGEMENT SPECIFICATION SHEET

EXISTING HERD SIZE

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; Sec. 6

County: Tillamook SWCD: Tillamook County Farm/Tract No. 197

Field No. 1-9,

Prepared By: Pedersen Date: 04/2012

Purpose:

☐ To budget and supply nutrients for plant production.

☐ To properly utilize manure and organic by-products as a plant nutrient source.

☐ To minimize agricultural non-point source pollution of surface and ground water resources.

☐ To maintain or improve the physical, chemical and biological condition of soil.

Specifications:

☐ Manure is applied to the surface of permanent pastures in accordance with the enclosed Waste Utilization Specification sheet.

☐ A target yield of 6 tons of dry matter per acre per yield is planned to utilize the nitrogen in the manure and/or commercial applied fertilizer.

☐ Manure and commercial fertilizer is applied in accordance with soil tests.

☐ Manure and/or commercial fertilizer is applied in split applications.

☐ Soil tests are taken at least every 3 years.

☐ Manure test are taken every 3 years. Samples will be collected from the equipment that applies the manure and wastewater to the fields.

☐ No more than 422 lbs. of nitrogen is applied per acre per year in accordance with the below Nutrient Distribution, Soil and forage tests will be used to justify the rates.

Manure Application Equipment to be used:

366-1,000 lb. animal units , Manure Gun Travel, 1,700 Gallon Manure Tank Wagon & 354 Bushel Manure Spreader.

Manure Nutrient Distribution

Edward Gomes

Date: 04/2012

			Grazing		Solids			Liquids (Spreader)			Liquids (Pumping)			
Tract	Field #	Grazing Cycles /YR	# N supplied by grazing/ field/yr	# of N supplied by grazing/ ac/yr	Loads of solid/yr	# of N per field/yr solids	# of N per from solids	Loads of Liquids/yr	# of N per field/yr liquid	# of N per ac/yr from liquid	Hours of Pumping	# of N per field/yr liquid	# of N per ac/yr from liquid	Total # of N per ac/yr
197	1	8	4767	**225**	16	1393	**66**	185	2023	**95**	0	0	**0**	386
197	2	8	3575	**218**	12	1045	**64**	0	0	**0**	13	1517	**92**	374
197	3	8	5065	**228**	17	1480	**67**	197	2149	**97**	0	0	**0**	392
197	4	8	975	**232**	3	285	**68**	0	0	**0**	4	414	**99**	399
197	7	8	2600	**232**	9	760	**68**	0	0	**0**	10	1103	**99**	399
197	5	8	751	**209**	3	219	**61**	0	0	**0**	3	319	**88**	358
197	6	8	1335	**209**	5	390	**61**	0	0	**0**	5	566	**88**	358
197	8	8	6257	**204**	21	1828	**60**	243	2655	**86**	0	0	**0**	350
197	9	8	4469	**219**	15	1306	**64**	174	1896	**93**	0	0	**0**	376
Totals			29793		102	8707		800	8722		34	3919		

NOTE: For Farm Summary of all tracts you must highlight desired cell ranges go to Edit/Copy then click on the Summary Tab and click on Edit/Paste Special/ and under Paste select values/OK

Records are maintained of manure and or/or commmercial fertilizer applications.

Nutrient management plans are reviewed annually and adjustments are made as needed.

Manure is not applied where it is likely to enter an open watercouse. See enclosed Filter Strip Specification Sheet.

DESIGN APPROVAL:

Design approved by: Robert Pedersen Date: 5/30/12

Job Title: CAFO PLANNER

CLIENTS ACKNOWLEGEMENT STATEMENT:

The client acknowledges that:

a. They have received a copy of this specification and under-stands the contents and requirements.

b. The following information must be provided NRCS by the client before this practice can be certified as applied:

☐ Nutrient management application records including soil, water, plant and organic by-product test results.

☐ Documentation showing amount, rate, form and application method of nutrient applied

☐ Annual review of nutrient management including adjustments made.

c. It shall be the responsibility of the client to obtain all necessary permits and/or rights, and to comply with all ordinances and laws pertaining to the application of this practice.

d. Maintain records of nutrient application as required by state and local regulations.

Accepted by:/s/ Date: 5-30-12

CERTIFICATION;

I have completed a review of the nutrient management and the specification's application and certify this practice has been applied.

Certification by:/s/ ______________________ Date: ______________

Job Title: ______________________

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT
WASTE UTILIZATION SPECIFICATION SHEET

Client Edward Gomes.

Location: T 1S; R 9W; Sec. 6

Tillamook SWCD Tract No.T-197

Prepared By Pedersen Date 03/12

Perform the following operations:
❑ Maintain records for all waste applications.
❑ Chemical analysis of soils, plant tissue and waste should be used annually to monitor and adjust amounts of waste applied. Refer to Oregon State University Extension Service publication EC1478, “Soil Test Interpretation Guide” for guidance in getting soil tested and interpreting soil test results. Refer to Oregon State University Extension publication EM8585, “Manure Application Rates for Forage Production” and EM8768, “Calculating Dairy Manure Nutrient Application Rates” for guidance in getting animal waste tested for nutrient concentrations and computing application rates.
❑ To reduce odor problems, apply waste in mid morning when temperatures are warming and air is rising rather than in the afternoon or evening when air is cooling and settling. Avoid applications during periods of fog.
❑ Do not apply waste directly into an open watercourse or where waste is likely to enter an open watercourse. Observe all waste application setbacks identified in the resource management system plan.
❑ Do not apply waste to fields where there is no growing crop. If applications are needed during fall and winter periods due to unforeseen circumstances, such as the storage facilities being full, use the following guidelines for waste applications: a) Only spread waste on fields that are growing a crop, preferably grass. b) Increase all waste application setbacks identified in the resource management system plan by at least 15 feet. c) Don’t apply waste during any rainfall event that will cause runoff. d) Use maximum travel rates for the traveling big gun sprinkler and solids spreader. e) Use soil tests, such as the Pre-side dress Soil Nitrate test, to determine if additional applications of waste are needed on those fields receiving emergency winter applications.
❑ Do not apply waste to fields with frozen or snow covered soil conditions unless provisions are made to control runoff.
❑ Do not spread waste on fields where soils are saturated, ponded, flooded and/or during times when waste is likely to runoff into open watercourses.
❑ Be aware of the location of sensitive areas, concerns of neighbors or concerns of the public which require special application procedures
❑ Handle all waste material with caution. Wear appropriate protective clothing.
❑ Clean up residual materials from equipment and dispose of properly.
❑ Equipment used in waste utilization should be regularly inspected and maintained as needed in accordance with equipment operation and maintenance guidelines from the manufacturer or provided by NRCS.
Additional Guidance and Notes: Any manure discharge into an open water course will be reported to Oregon
Department of Agriculture (ODA) within 24 hours. Within 5 days a written statement describing the manure
discharge will be submitted to ODA. Annual CAFO permit reports will be submitted on time
When applying waste during the irrigation season, use the enclosed “Estimating Soil Moisture by Feel
and Appearance” to monitor the soil moisture to prevent over application of irrigation water and/or
manure that may leach nitrates below the root zone.

DESIGN APPROVAL:

Design Approved by: /s/ Robert A. Pedersen Date: 5/30/12

Job title: CAFO PLANNER

CLIENTS ACKNOWLEDGEMENT STATEMENT:

The Client acknowledges that:

a. They have received a copy of the specification and understand the contents and requirements.

b. The following information must be provided to SWCD by the client before this practice can be certified as applied:
   - ☐ Waste application records which include the date, crop, type of waste applied, and amount of waste applied.
   - ☐ Calibration records for waste application equipment.
   - ☐ Analysis of nutrient concentrations in solid and liquid wastes.

c. It shall be the responsibility of the client to obtain all necessary permits and/or rights, and to comply with all ordinances and laws pertaining to the application of this practice.

Accepted by: /s/ Edward Jones Date: 5-30-12

CERTIFICATION:

I HAVE COMPLETED A REVIEW OF THE INFORMATION PROVIDED BY THE CLIENT AND CERTIFY THIS PRACTICE HAS BEEN APPLIED.

Certification by: /s/________ Date:________

Job title:________

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	**1-503-986-4700**
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	
Address	
Farm Phone	
Permit #	
DIRECTIONS TO FARM	
Emergency Phone Numbers:	
Alan Wachlin home	
Alan Wachlin cell	
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:

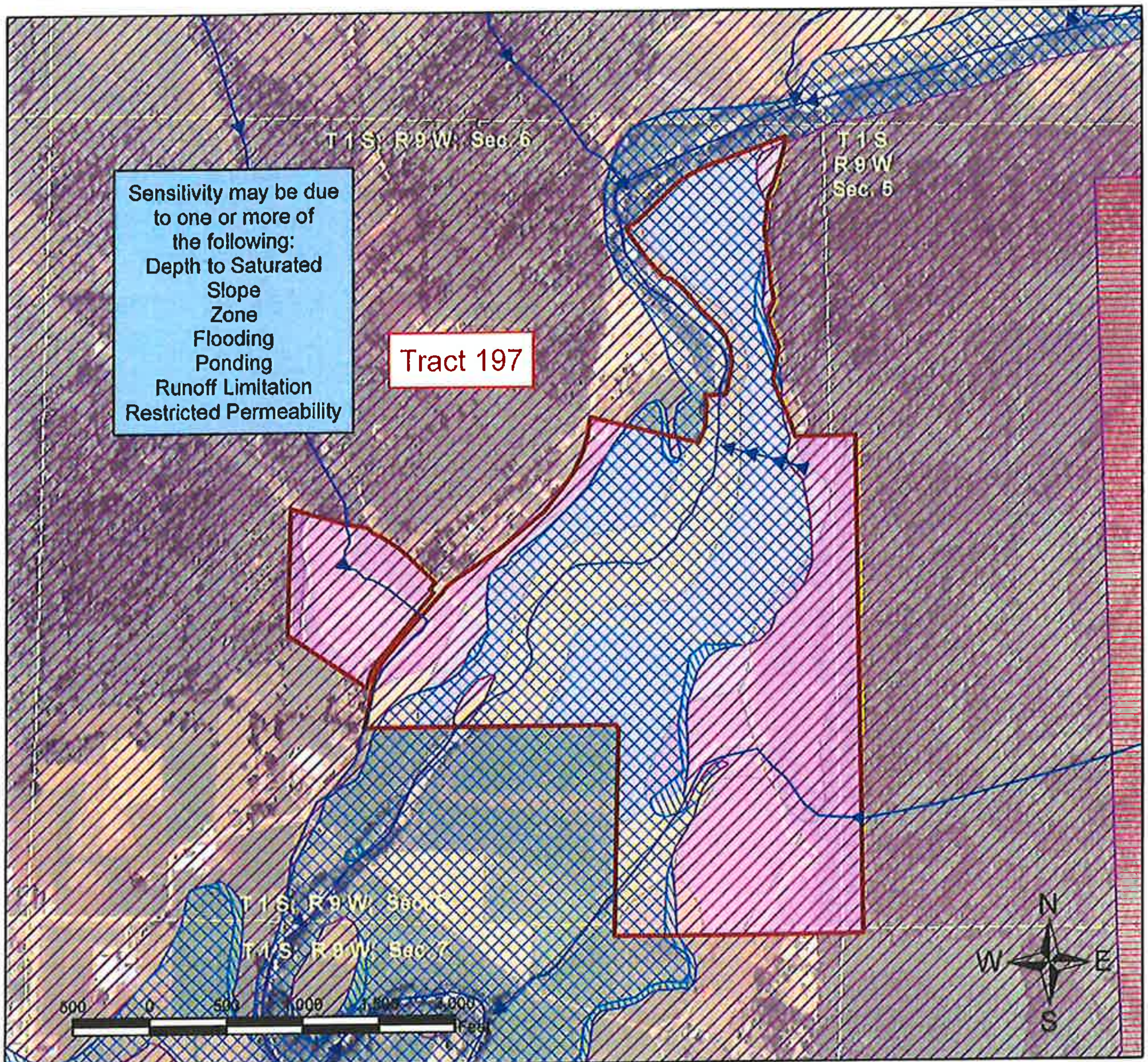
a. A description and cause of the discharge.
b. The period of discharge including exact dates, times and duration of discharge.
c. An estimate of discharge volume.
d. Name or location of receiving water.
e. Corrective steps taken, if appropriate, to reduce, eliminate or prevent reoccurrence of the discharge.

EDWARD GOMES
KI006

TILLAMOOK SERVICE CENTER
Tillamook County SWCD
TILLAMOOK COUNTY, OREGON

Tillamook County SWCD
Approximate Acres: 203.4
Date: 11/7/2008

Flood Boundary Map
Sensitive Manure Application Area



Legend	FEMA Classification	Flood Frequency Classification
Tract Boundary	Sensitive Manure Application Area (100 Yr. Flood Plain)	Frequent
Planned Land Units	Winter Manure Application Area (Outside 500 Yr. Flood)	None
Public Land Survey	500 Yr. Flood Plain	Occasional
Open Water Course	Undetermined Flood Plain	Rare

Flooding Frequency Class - **Edward Gomes**

Month Range: January to December
Aggregation Method: Dominant Condition
Tie-break Rule: More Frequent

Tillamook County, Oregon
Survey Area Version and Date: 1 - 09/21/2006

Map symbol	Map unit name	Rating
1A	Brenner silt loam, 0 to 1 percent slopes	Frequent
20E	Klootchie-Necanicum complex, 30 to 60 percent slopes	None
21F	Necanicum-Ascar-Klootchie complex, 60 to 90 percent slopes	None
24D	Lebam medial silt loam, 5 to 30 percent slopes	None
31E	Tolovana-Templeton medial silt loams, 30 to 60 percent slopes	None
51C	Walluski-Chitwood medial silt loams, 3 to 15 percent slopes	None
57B	Condorbridge gravelly medial loam, 0 to 7 percent slopes	None
59B	Chitwood-Knappa medial silt loams, 0 to 7 percent slopes	None
74A	Nehalem silt loam, 0 to 3 percent slopes	Occasional
81B	Quillamook complex, 0 to 7 percent slopes	None
92A	Yachats-Gauldy complex, 0 to 3 percent slopes	Frequent
170B	Logsden-Nehalem silt loams, 0 to 5 percent slopes	Rare

Flooding Frequency Class

Rating Options

Attribute Name: Flooding Frequency Class

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Flooding frequency class is the number of times flooding occurs over a period of time and is expressed as a class. Flooding Frequency Classes are based on the interpretation of soil properties and other evidence gathered during soil survey field work.

The classes are:

NONE: Flooding is not probable, near 0 percent chance of flooding in any year or less than 1 time in 500 years.

VERY RARE: Flooding is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year).

RARE: Flooding is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year).

OCCASIONAL: Flooding occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year).

FREQUENT: Flooding is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year).

VERY FREQUENT: Flooding is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

Month Range: January to December

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value to represent the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. The components in the map unit name represent the major soils within a map unit delineation. Minor components make up the balance of the map unit. Great differences in soil properties can occur between map unit components and within short distances. Minor components may be very different from the major components. Such differences could significantly affect use and management of the map unit. Minor components may or may not be documented in the database. The results of aggregation do not reflect the presence or absence of limitations of the components which are not listed in the database. An on-site investigation is required to identify the location of individual map unit components.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be generated. Aggregation must be done because, on any soil map, map units are delineated but components are not.The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Tie-break Rule: More Frequent

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

PRESCRIBED GRAZING SPECIFICATION SHEET

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; Sec. 6

County: Tillamook SWCD Tillamook County Farm/Tract No. T-197

Field No.: 12,3,4,5,6,7,8,9,10

Prepared By: Pedersen Date: 03/12

⇒ Purpose:

⇒ Improve or maintain the health and vigor of the forage stand

⇒ Maintain and improve water quality

⇒ Maintain or improve animal health and productivity.

⇒ Attain grazing and management efficiency to promote economic stability.

Specifications:

⇒ Pastures are managed to assure at least 6 tons of dry matter is produced per acre per year.

⇒ Pastures are reestablished when forage yields fall below 4 tons of dry matter per acre per year.

⇒ A rotational grazing system is used. A 21 day re-growth period is used during the normal years. During low rainfall years, the re-growth period various between 30 to 35 days.

⇒ Noxious weeds such as Tansy Ragwort and Canada thistle are controlled in accordance with an Integrated Pesticide Management Plan.

⇒ Pastures are clipped and dragged at least twice during the growing season.

⇒ Manure and commercial fertilizer applications are based on soil tests. Soil tests will be taken at least every 3 years. Nitrogen applications will not exceed 422 lbs. of nitrogen per acre per year unless soil tests and forage production justifies higher application rates.

⇒ Manure is applied to pastures in accordance with the enclosed Waste Utilization Specification Sheet.

⇒ Spring grazing is delayed until the grasses have at least 6 inches of growth and the soil is firm.

⇒ Pastures are not grazed below 2 inches any time during the growing season.

⇒ Excess forage will be cut for silage.

⇒ Livestock are removed from the pastures in the fall when the ground becomes wet and the grasses have at least 3 inches of growth going into the winter.

DESIGN APPROVAL:

Design approved by: /s/ Robert A. Pedersen Date: 5/30/12

Job Title: CAFO PLANNER

CLIENTS ACKNOWLEGEMENT STATEMENT:

The client acknowledges that:

a. They have received a copy of this specification and understands the contents and requirements.

b. It shall be the responsibility of the client to obtain all necessary permits and/or rights, and to comply with all ordinances and laws pertaining to the application of this practice.

Accepted by: /s/ Harold Jones Date: 5-30-12

CERTIFICATION;

I have completed a review of the prescribed grazing practice and the specification's application and certify this practice has been applied.

Certification by: /s/____________________ Date: ____________

Job Title: ____________________

TILLAMOOK COUNTY
SOIL AND WATER CONSERVATION DISTRICT

FILTER STRIP SPECIFICATION SHEET

Landowner/Operator: Edward Gomes

Job Location: T 1S; R 9W; Sec. 6

County: Tillamook SWCD Tillamook Farm/Tract No. T-197

Field No. 1,2,3,4,5,6,7,8,9

Prepared By: Pedersen Date 03/12

Purpose: To reduce manure runoff into an adjacent open watercourse and the resulting fecal and organic contamination in the watercourse.

Specifications:

⇒ A grass filter strip will be maintained adjacent to all open water courses that flow through the farm. From April to October, a five foot wide grass buffer strip will be maintained for sold manure applied with a manure spreader or liquid manure spread with a tank wagon. A 20 foot wide grass filter strip will be maintained when applying liquid manure with a manure sprinkler system. During the winter months, a 10 foot wide grass filter strip will be maintained when solid manure is applied with a manure spreader or liquid manure is applied with a tank wagon. If liquid manure is applied during the winter months with a manure sprinkler system a 30 foot wide grass filter strip will be maintained.

⇒ No manure will be applied to the filter strip area.

⇒ Noxious weeds such as Tansy Ragwort and Canada thistle are controlled in accordance with an Integrated Pesticide Management Plan.

⇒ Excessive accumulation of sediment and/or manure will be removed. The filter strip will be harrowed at least once each year prior to May 1st to shape and maintain at least a 1 % grade sloping away from the existing open water courses. Filter strip grade will be maintained to allow the runoff to occur along the entire length of the filter strip and not occur in only certain areas of the filter strip.

⇒ Depressions will be prevented from forming in the filter strip area where manure and sediment can be trapped.

⇒ Debris will not be allowed to accumulate in the filter strip.

⇒ Filter strips will be clipped, dragged, and or grazed at least twice during the growing season.

⇒ Grass will be at least 3 inches high by October 15th.

DESIGN APPROVAL

Design approved by: Robert A. Pedersen Date: 5/30/12

Job Title: CAFO PLANNER

Client Acknowledgement Statement:

The client acknowledges that:

a. They have received a copy of this specification and under-stands the contents and requirements.

b. It shall be the responsibility of the client to obtain all necessary permits and/or rights, and to comply with all ordinances and laws pertaining to the application of this practice.

Accepted by: /s/ Date: 5-30-12

Certification:

I have completed a review and checked out the filter strip practice specifications and certify that the practice has been applied in accordance with specifications.

Certified by: /s/__________ Date:__________

Job Title:__________

SOIL AND MANURE SAMPLING INSTRUCTIONS FOR ANIMAL WASTE MANAGEMENT SYSTEMS

SOIL SAMPLES Job Sheet 5

Spring Soil Samples

- Spring soil samples are to be collected the last 2 weeks of March or the first 2 weeks in April when soils are not saturated.
- Soil samples are to be collected on fields that have not received manure applications within the last 30 days.
- Collect several samples (about 10 one-fourth cup samples) of soils from just below the thin sod layer to a depth of 6 to 9 inches and add to bucket.
- Mix the samples in the bucket and remove about 1 cup from the mixture and place into a sample bag.
- The bag should be labeled with ;
  farm or operator name
  sample date
  field and tract (see NRCS plan map)
  sample depth (0 to 9 inches)
  soil type if determined
- Keep soil sample cool (small cooler with some ice) in the field until sample can be put in refrigerator or into freezer. Soil can be stored in refrigerator for up to 1 week or can be stored in a freezer for longer periods.
- Ship samples to lab (see shipping instructions below).

Fall Soil Samples

- Fall soil samples are to be collected during the last 2 weeks in September or the first 2 weeks in October on soils that are not saturated.
- Soil samples are to be collected on fields that have received normal manure applications during the current year.
- Sample soils and ship as outlined in the spring soil sample section above.

MANURE SAMPLES

Liquid Manure Samples

- Liquid manure samples should be sampled after agitating the storage facility for the first application made in the spring (March-April) and for the last application in the fall (September-October).
- Put a bucket in the path of the gun or carefully take bucket sample of liquid manure from the liquid manure tank wagon .
- Fill a sample bottle with some of the liquid manure from the bucket and keep cool while in the field. (you can put the sample in a small cooler with some ice)
- Label the sample with the farm or operator name, date, and liquid manure sample.
- Freeze the sample until ready to ship to the lab.

MANURE SAMPLES

Solid Manure Samples

- Solid manure samples should be sampled during the first application made in the spring(March-April).
- Lay a piece of tarp or plastic on the pasture and make a pass over or next to it to obtain a representative sample from the spreader.
- Scoop up enough material to fill the sample bag about half full.
- Label the sample with the farm or operator name, date, and solid manure sample.
- Keep the sample cool while in the field. (You can put the sample in a small cooler with some ice.)
- Freeze the sample until ready to ship to the lab.

SHIPPING INSTRUCTIONS

- Nitrogen is heat sensitive. Keeping the samples cool in shipping helps to improve reliability of data.
- Ship frozen soil samples in small cooler.
- If shipping refrigerated soil samples, it is recommended that these be shipped in a small cooler with ice.
- Ship frozen liquid or solid manure samples in a small cooler.
- Ship frozen soil samples or refrigerated soil samples with frozen liquid and/or solid samples in a small cooler. Lab should send cooler back to you if request them to do so.
- Ship any or all samples on Monday, Tuesday, or Wednesday using any parcel post service.
- Include a note with the samples for the analysis needed.

Soils Analysis Needed;

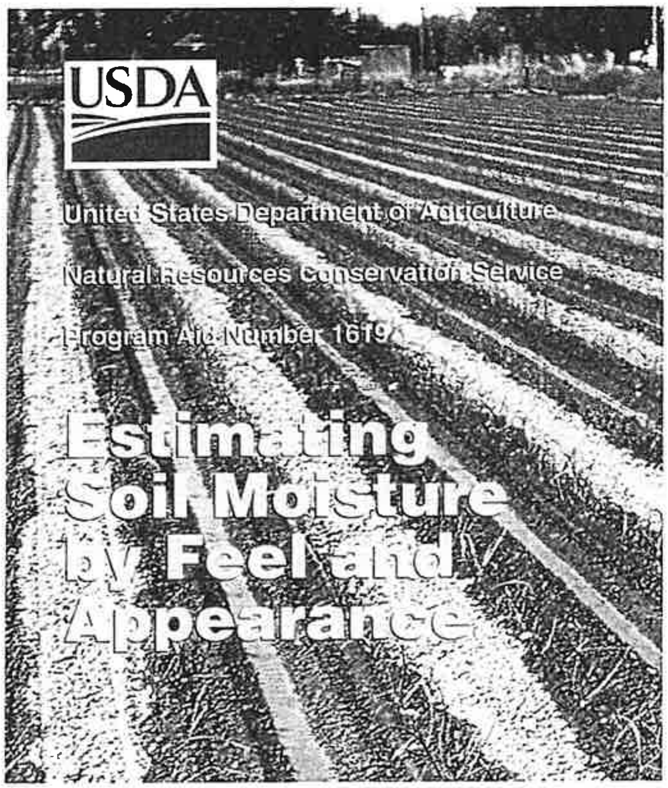
pH
P---Phosphorus (Weak Bray)
K---Potassium
NH_4-N---Ammonium
NO_3-N---Nitrate

Liquid and Solid Manure Analysis Needed;

Total Nitrogen, Phosphorus, & Potassium plus Ammonium and Solids

Estimating Soil Moisture by Feel and Appearance

Irrigation Water Management (IWM) is applying water according to crop needs in an amount that can be stored in the plant root zone of the soil.



The "feel and appearance method" is one of several irrigation scheduling methods used in IWM. It is a way of monitoring soil moisture to determine when to irrigate and how much water to apply. Applying too much water causes excessive runoff and/or deep percolation. As a result, valuable water is lost along with nutrients and chemicals, which may leach into the ground water.

The feel and appearance of soil vary with texture and moisture content. Soil moisture conditions can be estimated, with experience, to an accuracy of about 5 percent. Soil moisture is typically sampled in l-foot increments to the root depth of the crop at three or more sites per field. It is best to vary the number of sample sites and depths according to crop, field size, soil texture, and soil stratification. For each sample the "feel and appearance method" involves:

1. Obtaining a soil sample at the selected depth using a probe, auger, or shovel;
2. Squeezing the soil sample firmly in your hand several times to form an irregularly shaped "ball";
3. Squeezing the soil sample out of your hand between thumb and forefinger to form a ribbon;
4. Observing soil texture, ability to ribbon, firmness and surface roughness of ball, water glistening, loose soil particles, soil/water staining on fingers, and soil color. [Note: A very weak ball will disintegrate with one bounce of the hand. A weak ball disintegrates with two to three bounces;
5. Comparing observations with photographs and/or charts to estimate percent water available and the inches depleted below field capacity.

Example:

Sample Depth	Zone	USDA Texture	AWC*for Zone	Soil Moisture Delpetion**	Percent Depletion
6"	0-12"	sandy loam	1.4"	1.0"	70
18"	12-24"	sandy loam	1.4"	.8"	55
30"	24-36"	loam	2.0"	.8"	40
42"	36-48"	loam	2.0"	.5"	25
			6.8"	3.1"	

Result: A 3.1" net irrigation will refill the root zone.
** Available Water Capacity*
*** Determined by "feel and appearance method"*

Available Water Capacity (AWC) is the portion of water in a soil that can be readily absorbed by plant roots of most crops.

Soil Moisture Deficit (SMD) or Depletion is the amount of water required to raise the soil-water content of the crop root zone to field capacity.

Appearance of sandy clay loam, loam, and silt loam soils at various soil moisture conditions.

Available WaterCapacity 1.5-2.1 inches/foot

Percent Available: Currently available soil moisture as a percent of available water capacity.

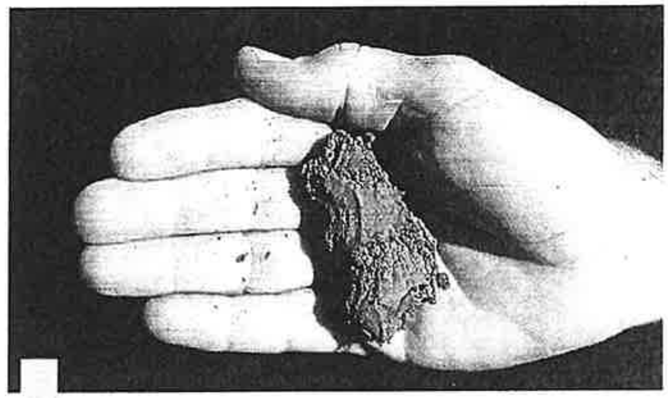
In/ft. Depleted: Inches of water currently needed to refill a foot of soil to field capacity.

0-25 percent available
2.1-1.1 in./ft. depleted

Dry, soil aggregations break away easily, no staining on fingers, clods crumble with applied pressure. (Not pictured)

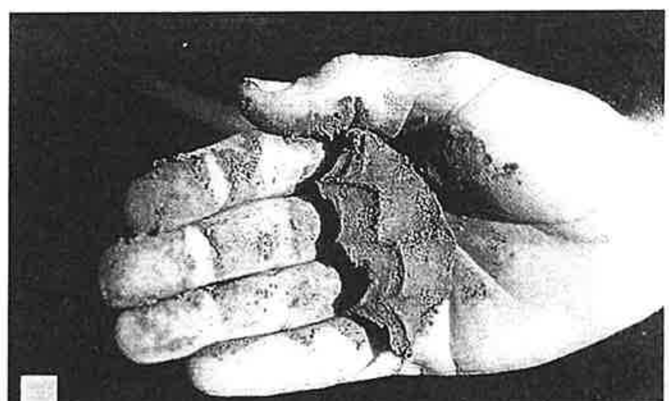
25-50 percent available
1.6-0.8 in./ft. depleted

Slightly moist, forms a weak ball with rough surfaces, no water staining on fingers, few aggregated soil grains break away.



50-75 percent available
1.1-0.4 in./ft. depleted

Moist, forms a ball, very light staining on fingers, darkened color, pliable, forms a weak ribbon between the thumb and forefinger.



75-100 percent available
0.5-0.0 in/ft. depleted

Wet, forms a ball with well-defined finger marks, light to heavy soil/water coating on fingers, ribbons between thumb and forefinger.

100 percent available
0.0 in/ft. depleted (field capacity)

Wet, forms a soft ball, free water appears briefly on soil surface after squeezing or shaking, medium to heavy soil/water coating on fingers. (Not pictured)

Guidelines for Estimating Soil Moisture Conditions

	Coarse Texture- Fine Sand and Loamy Fine Sand	Moderately Coarse Texture Sandy Loam and Fine Sandy Loam	Medium Texture - Sandy Clay Loam, Loam, and Silt Loam	Fine Texture- Clay, Clay Loam, or Silty Clay Loam
Available Water Capacity (Inches/Foot)				
	0.6-1.2	1.3-1.7	1.5-2.1	1.6-2.4
Available Soil Moisturre Percent	Soil Moisture Deficit (SMD) in inches per foot when the feel and appearance of the soil are as described.			
0-25	Dry, loose, will hold together if not disturbed, loose sand grains on fingers with applied pressure. SMD 1.2-0.5	Dry, forms a very weak ball, aggregated soil grains break away easily from ball. SMD 1.7 -1.0	Dry. Soil aggregations break away easily. no moisture staining on fingers, clods crumble with applied pressure. SMD 2.1-1.1	Dry, soil aggregations easily separate, clods are hard to crumble with applied pressure SMD 2.4-1.2
25-50	Slightly moist, forms a very weak ball with well-defined finger marks, light coating of loose and aggregated sand grains remain on fingers. SMD O.9-0.3	Slightly moist, forms a weak ball with defined finger marks, darkened color, no water staining on fingers, grains break away. SMD 1.3-0.7	Slightly moist, forms a weak ball with rough surfaces, no water staining on fingers, few aggregated soil grains break away. SMD1.6-0.8	Slightly moist, forms a weak ball, very few soil aggrega-tions break away, no water stains, clods flatten with applied pressure SMD 1.8-0.8
50-75	Moist, forms a weak ball with loose and aggregated sand grains on fingers, darkened color, moderate water staining on fingers, will not ribbon. SMD O.6-0.2	Moist, forms a ball with defined finger marks. very light soil/water staining on fingers. darkened color, will not slick. SMD O.9-0.3	Moist, forms a ball, very light water staining on fingers, darkened color, pliable, forms a weak ribbon between thumb and forefinger. SMD 1.1- 0.4	Moist. forms a smooth ball with defined finger marks, light soil/water staining on fingers, ribbons between thumb and forefinger. SMD I.2-0.4
75-100	Wet, forms a weak ball, loose and aggregated sand grains remain on fingers, darkened color, heavy water staining on fingers, will not ribbon. SMD O.3-0.0	Wet, forms a ball with wet outline left on hand, light to medium water staining on fingers, makes a weak ribbon between thumb and forefinger. SMD O.4-0.0	Wet, forms a ball with well defined finger marks, light to heavy soil/water coating on fingers, ribbons between , thumb and forefinger. SMD O.5 -0.0	Wet, forms a ball, uneven medium to heavy soil/water coating on fingers, ribbons easily between thumb and forefinger. SMD O.6-0.0
Field Capacity (100 %)	Wet, forms a weak ball, moderate to heavy soil/ water coating on fingers, wet outline of soft ball remains on hand. SMD 0.0	Wet, forms a soft ball, free water appears briefly on soil surface after squeezing or shaking,medium to heavy soil/water coating on fingers. SMD 0.0	Wet, forms a soft ball, free water appears briefly on soil surface after squeezing or shaking, medium to heavy soil/water coating on fingers. SMD 0.0	Wet, forms a soft ball, free water appears on soil surface after squeezing or shaking, thick soil/water coating on fingers, slick and sticky. SMD 0.0

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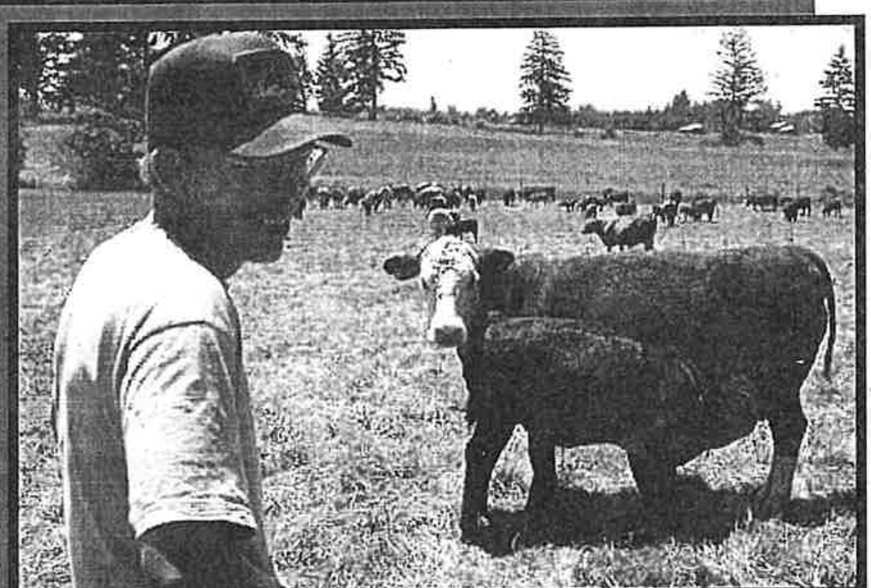
Estimating Plant-available Nitrogen from Manure



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Prepared by Dan M. Sullivan, Extension soil scientist, Oregon State University.

Nutrient management plans for crops require estimates of plant-available nitrogen (PAN) provided by application of manure or compost. Recent developments have stimulated interest in utilizing manure nitrogen (N) as a resource. These factors include the following:

- Increased cost of N fertilizers
- Increased value of PAN from manure on farms using certified organic methods to produce crops or animal products
- Greater concern for the environmental effects of ammonia and nitrate loss
- Development of manure application equipment that can reduce ammonia loss (increase retention of PAN)
- Federal cost-share programs (usually administered by the Natural Resources Conservation Service) that pay producers to adopt practices that reduce N loss to the environment
- Efforts to reduce phosphorus buildup in manure-fertilized soils (when manure N is used more efficiently, the manure application rate to meet P needs can be reduced)

How to Use This Publication

This publication focuses on how to estimate PAN provided by manure. We do not address management of other nutrients or other aspects of manure management, such as manure sampling, calibration of application equipment, record-keeping, or post-application monitoring. See "For More Information" (page 19) for resources on these topics.

This publication is primarily designed for use by planners (agricultural professionals that assist farmers with nutrient management). We focus primarily on cropping systems west of the Cascades in Oregon and Washington.

This publication has two main parts:

1. Worksheet for calculating available nutrients supplied by manure application
2. Management practices that increase crop N utilization

The Worksheet can be used to do the following:

- Determine the manure application rate needed to supply a target amount of PAN
- Estimate the dollar value of PAN from the current year's manure application
- Estimate the value of additional PAN retained by immediate tillage or direct application (injection, banding, etc.)
- Assess the balance between PAN, P, and K supplied by manure
- Get a rough, long-term (10-year) estimate of PAN availability from manure
- Evaluate management options to increase crop N utilization

Management practices discussed in the second section of this publication can help farmers reduce N loss to the environment (water and air) and may provide economic benefit to some farmers.

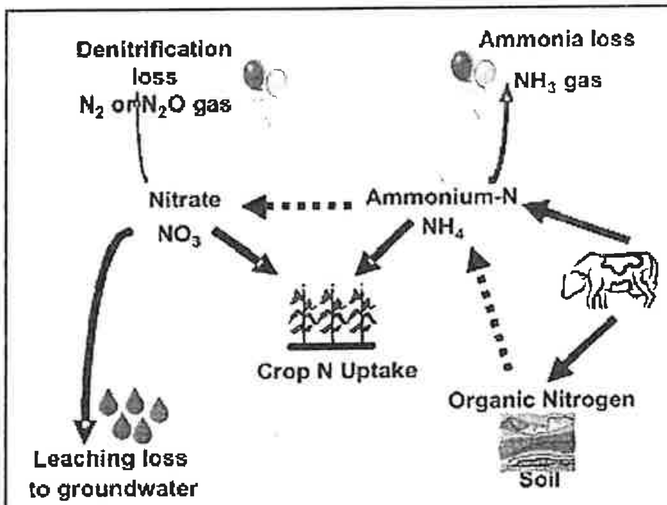


Figure 1. Where does manure N go? It can be taken up by the crop (green arrows) or lost to air or water (blue arrows). Organic N in the soil is converted to different forms by microbial activity (dotted arrows).

Nitrogen Forms and Cycling

The goal of N management is to efficiently deliver plant-available N (PAN) to a crop by maximizing crop utilization and minimizing losses to the environment. Plant roots take up nitrate and ammonium-N. Major losses of N to the environment occur when ammonia gas (NH_3) is lost to the air or nitrate (NO_3) is leached to groundwater. Losses of N via denitrification as N_2 or N_2O gas can be important under some conditions, but are generally small enough to be ignored in estimating PAN from manure.

Manures that contain mostly ammonium-N contain much PAN that is subject to volatilization (loss to the atmosphere) shortly after manure application. Manures that contain mostly organic N release much less PAN in the short term, and must be managed as a long-term investment in soil building.

Efficient manure N management matches N supply to crop needs. Management can reduce ammonia loss to the atmosphere and nitrate leached to groundwater.

Introduction to the Worksheet

The Worksheet estimates:

- Nutrients supplied this year and their dollar value
- Ammonia-N lost and its value
- Amount of organic N stored in the soil from this year's manure application

The Worksheet uses manure N analyses for ammonium-N (NH_4-N) and organic N as starting points for calculations (instead of a "total N" book value). This approach allows site-specific adaptation of calculations.

To use the Worksheet, you will need:

- This year's manure analysis
- Planned manure application rate for this year
- Manure application rate and manure N analyses from previous years

If you don't have manure analysis data, you can still use the Worksheet, but the results will not be customized for your farm.

The Worksheet does have some limitations.

- It is not a complete planning tool for long-term nutrient management. The Worksheet is most useful for quick, "ballpark" estimates. It can be used by farm managers to adjust in-season application rates based on manure analyses.
- It is not a nitrogen recommendation or nitrogen budget (N budgets are used to estimate crop N need). You need to know how much PAN the crop needs before using the Worksheet.
- It allows input for only one kind of manure for the current year. If two types of significantly different manure will be applied, you can use the Worksheet twice and add the results together. (Take credit for manure applied in previous years only one time.) For complicated scenarios, the calculation method presented here is compatible with several software packages that are available for nutrient management planning.
- Worksheet estimates of PAN from manure should be regarded as rough estimates. Post-application monitoring (crop yield, plant tissue tests, soil tests) are needed before adjusting manure management practices to fit site-specific conditions.

Nutrient Analysis of Manure

Typical values for manure nutrient content (book values) can be used for a general comparison of the nutrient content of different manure sources (e.g., chicken vs. horse manure). Manure nutrient composition depends on management practices, such as:

- Source and quality of livestock feed
- Water added to manure
- Type and amount of livestock bedding
- Manure storage method and length of storage

Because management practices vary substantially among farms, it is important to sample and test manure to determine its nutrient content.

For livestock farms that utilize manure on their own acreage, we recommend that you sample and analyze manure several times a year to develop a "running average" of manure nutrient content. Usually, it takes 2 to 4 years to develop a reliable estimate of average manure nutrient content and of the variability of nutrient content during the year. Several "quick test" meters can be used for on-farm monitoring of manure NH_4-N. The "Agros Meter" has been used in western Oregon and has accurately determined NH_4-N in dairy manure. See "On-Farm Quick Tests" in the "For More Information" section for details.

The best time to sample manure is at the time of field application, because:

- Manure is well-mixed, so the sample is representative.
- The analysis will reflect changes in manure N concentration that occur during storage (volatilization) or in preparation for field application (agitation, mixing, and dilution with water).

For Worksheet input, you may choose to separate manure test results into two or more different groups (instead of averaging test results over the entire year). For example, you may want to average early-spring manure tests separately from midsummer tests.

To locate a suitable analytical laboratory, see *Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis*, EM 8677 (listed in "For More Information").

Ask the laboratory to perform these analyses:

1. **Nitrogen:** total N and ammonium-N (NH_4-N). For compost only, also request an analysis for nitrate-N (NO_3-N). Other manures contain insignificant amounts of NO_3-N. To obtain an accurate value for manure NH_4-N, make sure the laboratory determines NH_4-N on a fresh sample (not a dried sample). Most of the manure NH_4-N is lost when samples are oven-dried.
2. **Phosphate and potash:** total P and total K. You will need analyses of P_2O_5 and K_2O for the Worksheet. Some labs report values in these units. If the lab reports only P, multiply P x 2.29 to calculate P_2O_5. If the lab reports only K, multiply by 1.2 to calculate K_2O.
3. **Manure dry matter (DM) or total solids.** The laboratory determines this value by oven-drying manure. This value enables you to express manure nutrient content on a dry weight or wet weight basis. Also, if manure analyses using wet weight fluctuate over time, manure DM can be used to determine whether the variation is due to changes in moisture or changes in nutrient content.

Manure N Availability Values

The worksheet estimates plant-available N (PAN) as:

PAN = NH_4-N retained after application
+ N mineralized from manure organic N in soil

The amount of manure NH_4-N retained is determined within the first week after application. In contrast, PAN is released from mineralization of manure organic N over a much longer period (Figure 2, page 7).

Estimating PAN from manure NH4-N

Under some conditions, ammonium (NH_4) is readily transformed to ammonia (NH_3) and is lost as a gas (Figure 1, page 3). Nitrogen lost as ammonia reduces PAN supplied by manure.

Management practices affect the amount of ammonium-N retained after manure application (Table 1):

- **Time to manure incorporation.** The sooner manure is incorporated into soil, the more ammonium-N is retained. After manure is in contact with soil, it is held as non-volatile ammonium-N (NH_4-N).
- **Manure dry matter (DM).** When manure is not incorporated or injected, the proportion of dry matter in manure determines the amount of ammonium-N retained. Solid manures remain on the soil surface, where most of the NH_4-N is lost to the atmosphere. Lagoon water, on the other hand, infiltrates soil rapidly, retaining almost all of its manure NH_4-N. With slurries, some of the NH_4-N infiltrates into the soil, and some remains with manure solids on the soil surface. The thicker the slurry, the less ammonium-N is retained.

  Composting. The pH value of finished compost is near 7 (usually 6.5 to 7.5). At pH values below 7.5, N remains in the ammonium form and is not subject to loss as ammonia gas.

Table 1 estimates the amount of ammonium-N retained after field application. To use this table, you will need information on:

- Manure dry matter
- Method of application
- Number of days before manure is incorporated

To use Table 1, find the column representing the kind of manure (lagoon water, slurry, solid, or compost) you will apply. Use the "lagoon water" column for water pumped from secondary lagoons, even if the dry matter content is above 1 percent. Use the "thick slurry" column if manure has greater than 5 percent dry matter, but can still be pumped as a liquid. Use the "solid" or "solid poultry" column for manures that are applied with a solid manure spreader. Use the "compost" column for well-composted materials that have an earthy odor with no discernable ammonia odor. If you smell ammonia in a material sold as compost, use the "solid" manure column in Table 1.

Next, find the "time to incorporation" (left column in Table 1) that best describes the typical time elapsed between manure application and tillage. Because ammonia is lost rapidly after application, immediate shallow incorporation often conserves NH_4-N more effectively than more intensive tillage the next day. When manure is broadcast, subsequent application of a half-inch of water via sprinkler irrigation or rainfall is considered as effective as tillage for moving NH_4-N into soil (provided the soil is not saturated).

If you use a directed application method (injection or banding), choose one of the application options at the bottom of Table 1. See "Conserve NH_4-N at application" (page 13) for additional information on directed incorporation methods.

Table 1. Estimated fraction of manure ammonium-N retained after application.
Use the appropriate value from this table in Worksheet Step 3, "PAN from NH_4-N."

	Manure type and dry matter (DM) content					
Time to incorporation[a]	Lagoon water (< 1% DM)	Thin slurry (1–5 % DM)	Thick slurry (5–10% DM)	Solid (> 10% DM)	Compost	Solid poultry (> 10% DM)
	---Fraction of manure NH_4-N retained[b]---					
Immediate incorporation (1 hr)	0.95	0.95	0.95	0.95	1.00	0.95
Incorporation 1 day after	0.95	0.70	0.60	0.50	1.00	0.70
Incorporation 2 days after	0.95	0.60	0.45	0.30	1.00	0.50
Incorporation 7 days after	0.95	0.55	0.40	0.20	1.00	0.40
Directed application methods:						
Subsurface injection		0.95	0.95			
Surface band (partial incorporation)		0.85	0.70			
Surface band (no incorporation)		0.75	0.60			

[a] Tillage with harrow, cultivator, plow, etc. to incorporate manure, or overhead sprinkler irrigation (0.5 inch) after manure application.

[b] Ammonium-N retention estimates for lagoon water, slurry, solid manure, and compost apply to all livestock manures except solid poultry.

Table 2. Estimating PAN from manure organic N. Use the appropriate value in Worksheet Step 3, "PAN from organic N."

			Organic N applied in previous years			
Manure	Manure dry matter (as applied)	Organic N applied this year	1 year ago	2 years ago	3 years ago	4 to 9 years ago
		---Fraction mineralized to PAN---				
Dairy cattle or other livestock						
Lagoon water	< 1% DM	0.40	0.15	0.07	0.03	0.02 per year
Thin slurry	1 to 5 % DM	0.40	0.15	0.07	0.03	0.02 per year
Thick slurry	5 to 10% DM	0.30	0.15	0.07	0.03	0.02 per year
Solid	> 10% DM	0.30	0.15	0.07	0.03	0.02 per year
Separated dairy solids or horse manure[a]		0.10	0.05	0.05	0.03	0.02 per year
Compost[b]		0.10	0.05	0.05	0.03	0.02 per year
Solid poultry	> 10% DM	0.50	0.15	0.07	0.03	0.02 per year

[a] PAN for dairy solids from a mechanical separator. If separated solids come from gravity separation (settling basin or evaporation basin), use PAN values for the type of manure (lagoon water or slurry) that flows into the settling basin.

[b] Stable or finished compost. A finished compost does not smell like ammonia, has a pile temperature less than 95°F (35°C), and often contains significant amounts of nitrate-N. Not all materials sold as compost meet these criteria.

Estimating PAN from mineralization of manure organic N

PAN is released from manure organic N through microbial activity in soil in a process called mineralization. This process is more rapid in soils that are warm and moist, and it is slower in soils that are cold or dry. Table 2 estimates the fraction of manure organic N that is released as PAN by mineralization.

Organic N mineralizes most rapidly during the first months after manure application. With time, the manure N mineralization rate slows. Figure 2 shows cumulative N mineralization for a variety of manures. The amount of N mineralized during the first year is strongly affected by the composition of manure (see "How Manure Composition Affects N Mineralization"). Mineralization rates for residual organic N (1 or more years after application) from many manures and composts are similar. However, it takes much longer for all of the manure organic N to mineralize from compost than from other manures.

The Worksheet (pages 11–12) tracks PAN from manure organic N over a 10-year period (Table 2). For the current year and for 1, 2, and 3 years ago, annual mineralization estimates are given. Long-term mineralization (4 to 9 years ago) is estimated at 2 percent per year and summed over the number of years (years manure applied x 0.02 per year). Table 3 shows examples of estimated N mineralization for manure (page 8) applied 4 to 9 years ago.

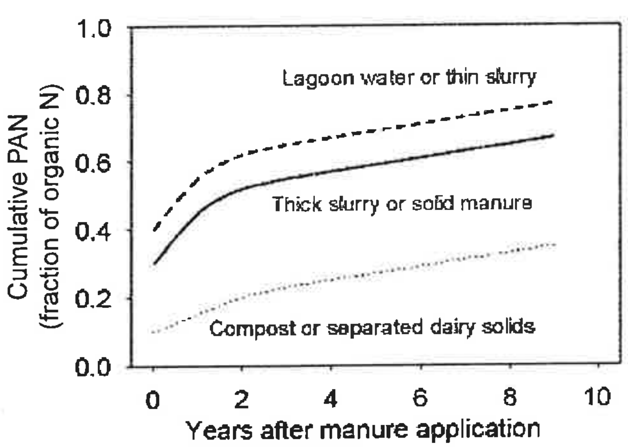


Figure 2. Cumulative PAN supplied by manure organic N, using the mineralization factors presented in Table 2. For this example, manure was applied in Year 0, with no subsequent manure applications. Slow release of PAN from mineralization continues beyond the 10-year period shown in the graph.

How Manure Composition Affects N Mineralization

The rate of mineralization in soil depends upon the "digestibility" of manure organic matter and its carbon:nitrogen (C:N) ratio. Separation of whole manure into liquids and solids segregates coarse and fine manure particles that have different organic composition and different mineralization rates. Fine particles in manure contain organic compounds with low C:N ratios (high protein) and are rapidly decomposed in soil. Coarse particles have higher C:N ratios (lower protein) and are more slowly decomposed in soil.

Because thin slurry and lagoon water contain the finest organic particles, these materials have the most rapid N mineralization rate. Thick slurry and solid manures contain a mixture of fine and coarse particles, so they have a lower N mineralization rate.

Solids separated from liquid manure by a mechanical separator (separated dairy solids) contain mostly coarse particles (bedding plus undigested feed). These solids have a unique pattern of mineralization over time in soil. Separated solids typically have negative N mineralization rates (PAN in soil decreases) for 4 to 8 weeks after application. After that, PAN is mineralized very slowly. Cumulative PAN from separated solids is much lower than for other fresh manures. The timing and amount of PAN release from horse manure is similar to that from separated dairy solids.

Separation of solids from liquid manure by gravity separation (settling basin or evaporation basin) does not change PAN, because the fine organic particles in the manure are recovered from the basin.

Composting manure reduces manure volume by 50 percent or more. During composting, some of the manure N is lost as ammonia gas, and some is transformed to more stable organic compounds. Compost organic matter decomposes very slowly in soil. Cumulative PAN for compost organic matter is similar to that of separated dairy solids.

Fresh poultry manure or broiler litter contains some organic N in the form of uric acid (similar to urea). In soil, uric acid is converted to PAN in 1 to 2 weeks. Most broiler litter sold as "compost" in western Oregon contains uric acid and behaves more like fresh litter than compost in terms of N availability. If you can smell ammonia in broiler litter, it probably is not thoroughly composted. Dry-stacking of broiler litter does not provide adequate moisture for composting.

Table 3. Examples: Mineralization factors for estimating PAN from manure applied 4 to 9 years ago.

Manure application frequency	**Calculation**	**Mineralization factor to use for "4 to 9 years ago" in Worksheet**
Annual (6 out of 6 years)	0.02 per year x 6 years	0.12
5 out of 6 years	0.02 per year x 5 years	0.10
3 out of 6 years	0.02 per year x 3 years	0.06
1 out of 6 years	0.02 per year x 1 year	0.02

Worksheet Instructions and Example Data Inputs

Input your data in the yellow worksheet cells. The Worksheet automatically calculates the values in the green cells.

The Worksheet shows "example" calculations for dairy slurry. The example is provided to help you follow the steps in the calculation. It is **not** a recommendation for manure application rate.

The mini-worksheets below include only the input data. You can use these mini-worksheets to assemble your manure and field management data before using the Worksheet. **The Worksheet has six steps.**

Step 1. Enter manure data.

Instructions

- Enter the kind of manure and the measurement units used for manure application. The Worksheet is not designed for use with more than one kind of manure for "this year." If you will apply more than one kind of manure this year, repeat the process with additional blank Worksheets.
- Enter analysis values for manure on an "as-is" or wet weight basis. If laboratory analysis units are different than field application units, see Table 5 (page 18) for conversion factors. For compost only: enter the compost NH_4-N + NO_3-N analysis value in the Worksheet "NH_4-N" box.
- Enter solids fraction in manure: 5% DM (dry matter) = Solids fraction of 0.05

Example input data (Step 1)

	Example	**Your information**
Kind of manure	Thin dairy slurry	
Field application units (choose one)		
Per ton (solid or semi-solid manure)		
Per 1,000 gallons (slurry)	X	
Per acre-inch (lagoon or holding pond effluent)		
This year's manure analysis [a, b, c]		
Total N	10 lb/1,000 gal	
Ammonium-N (NH_4-N)	6 lb/1,000 gal	
Phosphate (P_2O_5)	7 lb/1,000 gal	
Potash (K_2O)	16 lb/1,000 gal	
Manure solids fraction (dry matter percentage ÷ 100)	0.03	

[a] Input "as-is" or wet weight manure analysis data.

[b] Enter only "lb nutrient" if the manure analysis is in units of "lb nutrient per 1,000 gallons." For example, you would enter total N of "8" for a manure analysis of "8 lb/1,000 gallons."

[c] If laboratory analysis units are different than field application units, see Table 5 for conversion factors.

[d] The Worksheet calculates this figure automatically for this year's manure application.

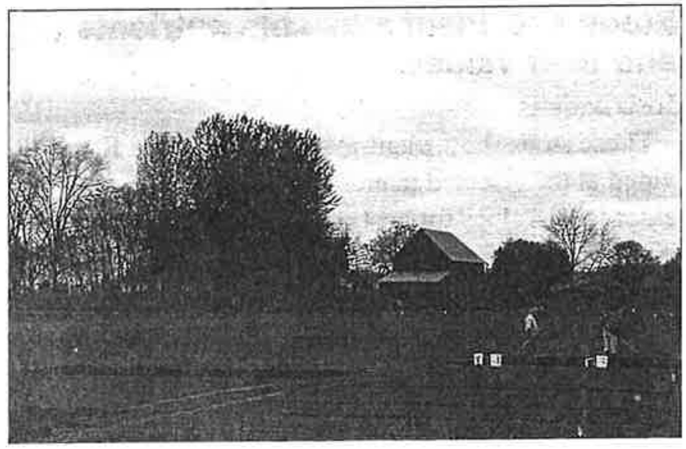
Step 2. Calculate manure N applied.

Instructions

- Enter the manure application rate planned for this year and this year's manure organic N analysis.
- Enter manure application rate and organic N analyses for manure applied in previous years.

Example input data (Step 2)

This year's manure application:
Rate = 20,000 gal/acre
Manure organic N applied in previous years:



	Example	Example	Your information	Your information
	Manure application rate	Manure organic N analysis[a]	Manure application rate	Manure organic N analysis
Year	(units/acre)	(lb/unit)	(units/acre)	(lb/unit)
1 year ago	25,000 gal/acre	9 lb/1,000 gal		
2 years ago	15,000 gal/acre	5 lb/1,000 gal		
3 years ago	10,000 gal/acre	7 lb/1,000 gal		
4 to 9 years ago	15,000 gal/acre	6 lb/1,000 gal		

[a]Estimate from past manure analyses. Organic N = total N - NH_4-N.

Step 3. Estimate plant-available N (PAN) supplied by manure.

Instructions

Enter appropriate fractions for NH_4-N retention (Table 1, page 6) and fraction of organic N mineralized (Table 2, page 6).

Example input data (Step 3)

- Method of manure application: surface broadcast (splash plate)
- Time to incorporation by tillage or by 0.5 inch overhead sprinkler application: no incorporation within 7 days
- Fraction NH4-N retained at application (Table 1) = 0.55
- Fraction of organic N mineralized (Table 2)

Fraction of NH_4-N retained at application	
Example	**Your information**
0.55	

	Fraction of organic N mineralized	
Year	**Example**	**Your information**
This year	0.40	
1 year ago	0.15	
2 years ago	0.07	
3 years ago	0.03	
4 to 9 years ago (application every year)	0.02 per year x every year (6 years) = 0.12	

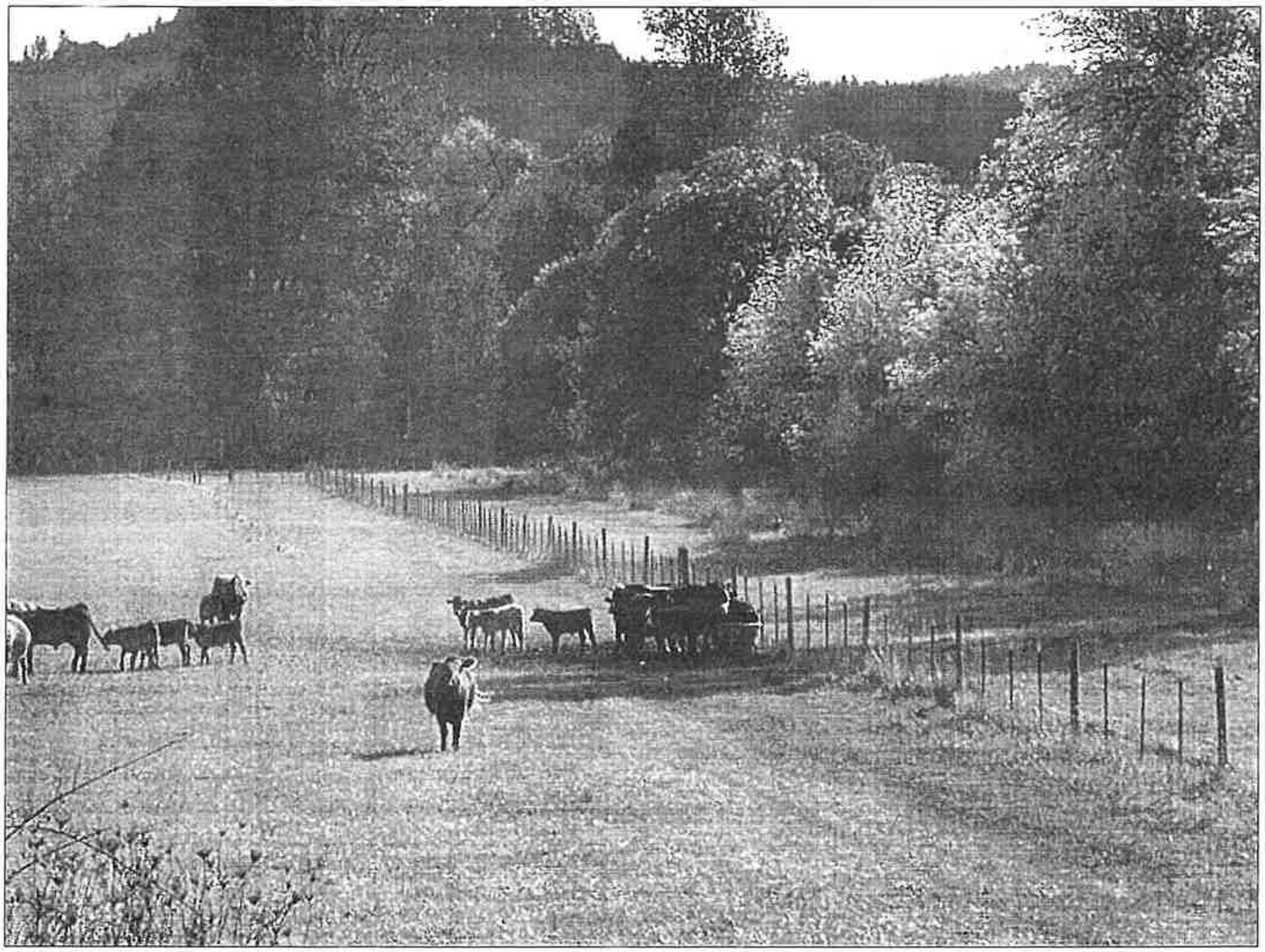
Steps 4–6. Plant available nutrients and their values.

Instructions

These steps show plant-available N, P, and K provided at the selected manure application rate. You can enter local values for cost of nutrients from commercial fertilizer to get an estimate of the value of manure nutrients. Because manure is an excellent source of P and K, it has the greatest value when applied to soils that test "low" or "medium" in plant-available P and K. If your soil test values are "high" or "excess," adding additional P or K will not have economic benefit.

Example input data

	Example	Your information
Nutrient	Nutrient price ($/lb nutrient)	Nutrient price ($/ lb nutrient)
Phosphate (P_2O_5)	$0.40/lb	
Potash (K_2O)	$0.24/lb	
Nitrogen (N)	$0.50/lb	



Worksheet: Estimating plant-available N from manure

Input cells are yellow.
Calculations are done for you in green boxes. (These cells contain equations.)
Final results for total PAN, P_2O_5, and K_2O are highlighted in blue text.

Note: The yellow cells contain example data. Replace the information in these cells with your own data. Before entering your data in the yellow cells, we recommend entering "0" in all yellow cells (to make sure you don't accidentally use the "example" data).

Note: We recommend turning off the following options in Acrobat Reader:
- Show border hover color for fields
- Auto-complete

To turn off these options, choose Preferences from the Edit menu (PC) or File menu (Mac). In the Preferences dialog box, chose Forms from the left-hand menu. Then make sure the buttons for these options are clicked OFF.

Step 1. Enter manure data

Instructions: Choose the manure application units that will be used througout this worksheet.

	Your information	Example
Kind of manure	thin dairy slurry	Thin dairy slurry

Choose manure application unit

Is wet manure measured in :

- ○ ton (solid or semisolid manure)?
- ◉ 1000 gallons (slurry or liquid)?
- ○ acre-inches (lagoon or holding pond effluent)?

Instructions: Enter "as-is" or "wet weight" manure analysis. If units are "lb nutrient/1000 gal," enter only "lb nutrient" in the boxes below.

This year's manure analysis
Nitrogen (N), lb/unit

	Your values	Example
Total N	10	10 lb/1000 gal
NH_4-N	6	6
Organic N	4	4

This year's manure analysis
Phosphate (P_2O_5) and potash (K_2O), lb/unit

	Your values	Example
P_2O_5	7	7 lb/1000 gal
K_2O	16	16

This year's manure analysis
Manure solids and moisture

Fraction	Your values	Example
Solids or DM	0.03	0.03
Moisture	0.97	0.97
Total	1.00	1.00

Step 2. Calculate manure N applied.

Instructions: Enter manure application rate for this year. Use application units chosen in Step 1.

	Your value units/acre	Example
Application rate selected	20	20,000 gallons

Ammonium-N applied this year

Manure rate (units/ac)		NH_4-N analysis (lb/unit)		NH_4-N applied (lb/acre)
20,000 gal	×	6 lb/1000 gal	=	120
20		6		120

From manure analysis (this year):

6 lb NH_4-N per 1000 gallons

Organic N applied this year

Manure rate (units/ac)		Organic-N analysis (lb/unit)		Organic-N applied (lb/acre)
20,000 gal	×	4 lb/1000 gal	=	80
20		4		80

From manure analysis (this year):
4 lb organic N/1000 gal

Instructions: Enter manure rate and manure analysis for 1–9 years ago.

Organic N applied in previous years

Year	Manure rate (units/ac)		Organic N analysis (lb/unit)		Organic N residual (lb/acre)
1 year ago	25,000 gal	×	9 lb/1000 gal	=	225
	25		9		225
2 years ago	15,000 gal	×	5 lb/1000 gal	=	75
	15		5		75
3 years ago	10,000 gal	×	7 lb/1000 gal	=	70
	10		7		70
4 to 9 years ago	15,000 gal	×	6 lb/1000 gal	=	90
	15		6		90

Manure organic N analysis (lb/1000 gal):
9 (1 year ago), 5 (2 year ago), 7 (3 year ago)
Estimated manure organic N 4 to 9 years ago = 6 lb/1000 gal

Step 3. Estimate plant-available N (PAN) supplied by manure

Instructions: Consult Tables 1 and 2, and choose appropriate values for manure NH_4-N retained and organic-N mineralized.

PAN (from NH_4-N)

NH_4-N applied (lb/acre)		Fraction retained (Table 1)		PAN (lb/acre)
120	×	0.55	=	66
120		0.55		66

Surface applied

not incorporated

PAN (from organic N applied this year)

Organic N applied (lb/acre)		Fraction mineralized to PAN (Table 2)		PAN (lb/acre)
80	×	0.4	=	32
80		0.40		32

Thin dairy slurry

PAN (from residual organic N)

Year	Organic N residual (lb/acre)		Fraction mineralized to PAN (Table 2)		PAN (lb/acre)
1 year ago	225	×	0.15	=	34
	225		0.15		34
2 years ago	75	×	0.07	=	5
	75		0.07		5
3 years ago	70	×	0.03	=	2
	70		0.03		2
4 to 9 years ago	90	×	0.12	=	11
	90		0.12		11

4 to 9 years ago: manure applied annually

Years 4 to 9, fraction mineralized = 0.02/year x 6 years = 0.12

Step 4. Sum plant-available N (PAN) supplied by manure application

(PAN from this year + PAN from residual manure organic N)

PAN from NH_4-N (lb/acre)		PAN from this year's organic-N (lb/acre)		PAN from residual organic N (lb/acre)		Total PAN (lb/acre)
66	+	32	+	52	=	150
66	+	32	+	52	=	150

Step 5. Phosphate (P_2O_5) and potash (K_2O) supplied by this year's manure application, and its fertilizer value

Instructions: Enter local $ value for phosphate (P_2O_5) and potash (K_2O).

Note: Manure P and K have value when soil test values are "low" or "medium." When P and K soil test values are "high" or "excess," value of P and K is zero or negative.

Phosphate (P_2O_5)

Manure rate (?/ac)		P_2O_5 analysis (lb/unit)		P_2O_5 applied (lb/acre)		Phosphate fertilizer price ($/lb P_2O_5)		Manure P_2O_5 value ($/acre)
20,000 gal	×	7 lb/1000 gal	=	140	×	$0.40	=	$56
20		7		140		$0.40		$56

Potash (K2O)

Manure rate (?/ac)		K_2O analysis (lb/unit)		K_2O applied (lb/acre)		Potash fertilizer price ($/lb K_2O)		
20000 gal	×	16 lb/1000 gal	=	320	×	$0.24	=	$77
20		16		320		$0.24		$77

Step 6. Estimated fate of this year's manure N, and its fertilizer value

Instructions: Enter local $ value for fertilizer N.

PAN this year, and its value

Total N applied (lb/acre)	PAN (lb/acre)		Nitrogen Fertilizer price ($/lb N)		Manure PAN value ($/acre)
200	98	×	$0.50	=	$49
200	98		$0.50		$49

NH_4-N lost, and its value

Manure NH_4-N lost at application (lb/acre)		Fertilizer N price ($/lb N)		Value of Manure NH_4-N lost ($)
54	×	$0.50	=	$27
54		$0.50		$27

N stored in soil

Residual soil organic N from this year's manure (lb/acre)
48
48

Management to Increase Crop N Utilization

Conserve manure NH_4-N at application

Directed application methods reduce exposure of slurry to the atmosphere, which reduces ammonia loss. When properly done, directed application increases NH_4-N retention, reduces odor, decreases the risk of manure runoff from the field, and allows for greater manure application uniformity. Directed application methods do not require a separate tractor trip across the field for slurry incorporation. Directed application methods (Figures 3 and 4) include:

- Injection below the soil surface
- Surface banding; placement of slurry in a line (band) on the soil surface
- Surface banding with partial incorporation of slurry into soil with a tillage implement

Many equipment configurations are available. Slurry is supplied to tractor-mounted application equipment through a drag hose or from a tanker. Many directed application methods are suitable for use with no-till or reduced tillage cropping systems.

Because surface banding does not completely cover slurry with soil, it does not increase NH_4-N retention as much as does injection (Table 1). However, surface banding methods require less power, are faster, and cause less damage to established grass than injection. An excellent discussion of advantages and limitations of various directed application systems (with photos) is provided in *Advanced Silage Corn Management* (Bittman and Kowelenko, 2004).

Equipment alternatives are discussed below and illustrated in Figures 3 and 4.

Preplant or side-dress for row crops (Figure 3). With this kind of equipment, one injection slot is made for each crop row. Options include:

- Deep injection (4 to 8 inches) into soil with a hose mounted on a knife or chisel (Figure 3a).

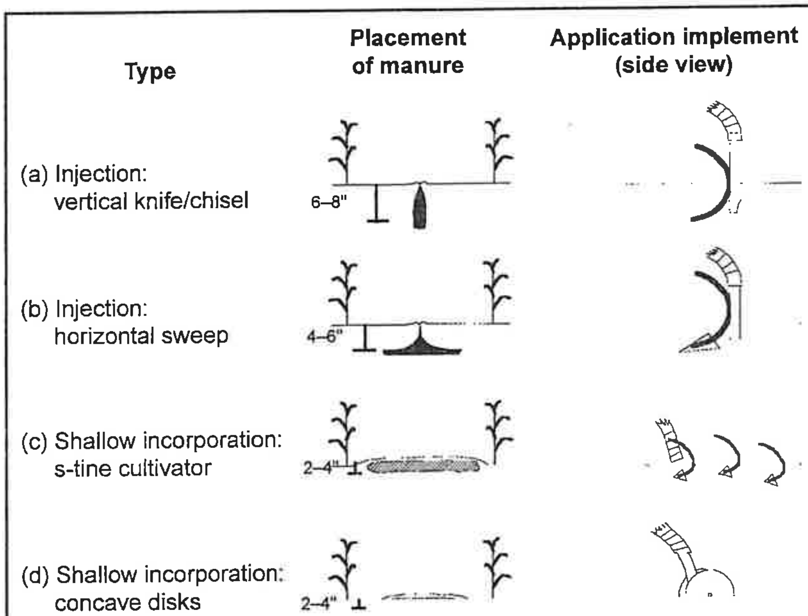


Figure 3. Directed application methods for row crops. Source: Jokela, W.E. and D. Côté. 1994. In NRAES-79. Natural Resource, Agriculture, and Engineering Service (NRAES), Ithaca, NY. www.nraes.org

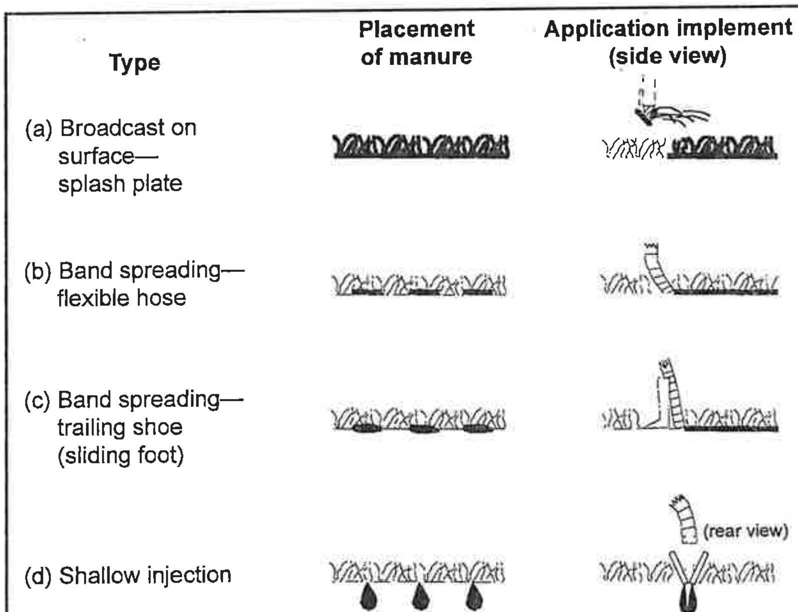


Figure 4. Directed application methods (b, c, d) for grasses or cereal crops vs. traditional broadcast manure application (a). Source: Jokela, W.E. and D. Côté. 1994. In NRAES-79. Natural Resource, Agriculture, and Engineering Service (NRAES), Ithaca, NY. www.nraes.org

- Injection with a sweep (4 to 6 inches depth)—this kind of injection has a wider application zone (Figure 3b).
- Shallow injection (2 to 4 inches) into soil, followed by shallow tillage with tines or discs (Figure 3c and 3d).

Surface band application in established grass (Figure 4). Slurry is placed in a line (band) on the soil surface. For best results, surface bands need to be close together (3 to 6 inches apart) and placed under crop residues. A "sleigh foot applicator" is one type of surface banding implement that has been tested extensively in coastal British Columbia. (The "sleigh" is pulled across the soil surface like Santa in his sleigh.) The "sleigh foot" applicator is similar to a "trailing shoe" or "sliding foot" applicator (Figure 4c). A recent innovation has combined aerator tines with sleigh foot application (Bittman and Kowelenko, 2004). The aerator tines make small holes or slots that encourage rapid slurry infiltration and improve NH_4-N retention.

Limitations of directed application methods include:

- More labor, fuel, equipment, and expertise are required than for broadcast surface application.
- Requires driving on the field, which may be impractical during wet spring months.
- When manure is supplied by a tanker, row length must be matched to tanker volume to avoid "driving empty."
- Requires closely spaced bands (3 to 6 inches between bands) when application is made to grass.
- When injection slots are spaced far apart, injected slurry may move deeper than desired, or may move to the soil surface. This problem can be overcome by limiting the slurry application rate.
- If manure is supplied by a tanker, an equipment turn-around area usually is needed at the top and bottom of the field.
- Injection may increase N loss from leaching and denitrification in some situations.
- Injection slots may channel runoff, causing increased erosion.

Schedule manure applications to minimize N leaching loss

The manure application date affects the efficiency of crop uptake of PAN supplied by manure (Table 4, page 15). The PAN values estimated in the Worksheet (pages 11–12) assume that manure is applied during months when crop N utilization is "medium" to "high." When crop utilization is "low" or "very low" (Table 4), a substantial portion of PAN is likely to be lost by leaching before it can be utilized by the crop. Crop N utilization estimates given in Table 4 assume that:

- Manure application rate is not excessive.
- Manure application does not cause significant damage to soil (compaction) or crop (smothering).

Most crops have the greatest ability to take up N before it can be lost by leaching below the root zone when manure is applied in spring or summer. Nitrate-N already present in the soil in the fall usually is sufficient to support winter cover crop establishment, so applying manure to cover crops in the fall generally is not an efficient use of manure N. However, winter crops often can utilize manure N applied in early spring (February–March). Crop utilization of manure PAN is lowest when manure is applied in fall to fallow ground or corn stubble.

Crop N utilization values given in Table 4 do not apply to well-composted manures or to dairy solids removed by a mechanical separator. These materials release PAN slowly and in small amounts, reducing the importance of season of application.

Although crop N utilization is "medium" for fall or winter application to grass, manure or compost application may cause excessive runoff of phosphorus or bacteria from the field. Consider contacting a crop consultant or the Natural Resources Conservation Service for help in identifying grass fields that are suitable for winter manure application.

Table 4 does not specify a method of manure application. At times of the year when crop N utilization is "medium," "high," or "very high," you can gain the most benefit from manure application methods that conserve NH_4-N. When crop N utilization is "low" or "very low" (Table 4), changing the manure application method will **not** improve crop N utilization.

Table 4. Effect of the timing of manure application on crop N utilization for crops grown west of the Cascades.[a] Best utilization of manure N = "high."

	Manure application date				
	March	April–June	July	August	September–February[b]
Crop	Crop N uptake utilization of first-year PAN[c, d]				
Corn for silage	Medium	High	Medium	Low	Very low
Grass pasture or grass for silage	High	High	High	Medium	Medium
Cereal or grass winter cover crop	High	Medium (April), very low (May–June)			Low
Grass seed crop	High	Medium (April), very low (May–June)	Medium (postharvest)	Medium	Medium
Summer annual forage crop (e.g., sudangrass)	Medium	High	High	Medium	Very low

[a] Excludes mechanically separated dairy solids and composts. These materials have "medium" or "high" crop N utilization because they release PAN slowly and in small amounts.

[b] September–February applications are not recommended where significant surface runoff is expected.

[c] PAN = First-year plant-available N from manure application.

[d] PAN utilization estimate given assumes that manure application rate is adequate, but not excessive, and that manure application does not cause significant damage to soil (compaction) or crop (smothering).

Take advantage of increased soil N mineralization rates

Repeated manure applications gradually increase the amount of PAN supplied from mineralization of residual organic N (manure organic N applied 1 or more years ago). This process is part of "soil building." The annual quantity of N mineralized from manured soils (in the absence of current-season manure application) typically is 1.5–2 times greater than from unmanured soils with similar soil and crop management regimes. This boost in soil N mineralization is accounted for in the Worksheet (pages 11–12) as "PAN from residual organic N."

Studies of soil biota (soil animals, nematodes, fungi, bacteria, etc.) show adaptation to repeated manure application. Biota communities adapted to manured soil typically have greater capacity to break down organic N compounds in manure that generally are resistant to decomposition. The proliferation of soil biota in manured soils also often improves soil tilth, which can increase root growth and crop N utilization. These changes in soil biota and tilth also contribute to "residual" manure effects (increasing PAN supply for the crop).

The rate of PAN release from residual organic N (1 or more years after manure application) is strongly affected by soil moisture and soil temperature, but it is not affected much by the kind of manure or compost applied the previous year. With irrigation, N mineralization rates are 2 to 4 times faster during the summer than during the cool season (October–March). Because soil is moist but not frozen for most of the winter at sites west of the Cascades, a small, but significant, amount of N mineralizes between October and March.

To take full advantage of PAN from soil organic matter mineralization, the field must have vegetative cover during the October–March period. Otherwise, nitrate-N released via mineralization during this period is likely to be lost by leaching. On fields with a history of frequent manure application, perennial grass growth typically continues for several weeks longer in the fall, and begins earlier in the spring, than on unmanured fields (even if manure was not reapplied in the early spring). The most significant long-term impact of manure application is evident in early spring (February and March) grass growth.

Crop rotation strongly affects PAN release from residual organic N. When rotating from perennial

The Environment and N Loss from Manures—Why Do We Care?

Plant-available N (PAN) losses from the soil represent lost fertilizer value. Nitrogen can be lost as ammonia, nitrate, or nitrous oxides (Figure 1, page 3). Besides losing a valuable resource, the lost PAN can contribute to off-site problems.

Ammonia lost to the atmosphere is an air pollution problem in some areas of the western U.S., particularly in winter when atmospheric inversions prevent air mixing. In the atmosphere, ammonia can react with dust and other compounds to reduce visibility and to acidify rain or fog. Ammonia emissions may contribute to:

- Human health problems (inhalation hazard)
- Changes in natural plant communities in forests and rangeland. (Nitrogen deposited in N-poor ecosystems can alter the balance between adapted species and N-loving invasive species.)
- Acid fog or rain damage to limestone buildings or cultural artifacts (for example, petroglyphs on limestone)
- Reduction in visibility (haze)

Nitrate moves with soil water. Nitrate lost from soil enriches groundwater or surface water and can contribute to:

- Human health problems (blue baby syndrome, elevated cancer risk)
- Algae blooms in lakes or other slow-moving bodies of water
- Reduced survival and reproduction of some amphibians

Nitrous oxides lost to the atmosphere through denitrification can contribute to:

- Human health problems (inhalation hazard)
- Global warming (A molecule of nitrous oxide (N_2O) traps approximately 300 times more heat than a molecule of carbon dioxide.)
- Increased N deposits in sensitive ecosystems, resulting in soil acidification or change in plant communities
- Reduction in visibility (haze)

grass or alfalfa to a row crop, a large amount of PAN is mineralized during the first 6 months following tillage. Tillage aerates the soil and breaks up soil aggregates that protect organic N from soil biota. Lower rates of PAN addition are required for most row crops following plow-down of a perennial grass sod. When grass sod is plowed down in the fall, a substantial amount of N is lost over the winter through leaching.

Supply only a portion of crop N need from manure

One of the most efficient N management strategies for row crops is to supply only 50 to 70 percent of planned crop N need with manure. Then, side-dress with N fertilizer at midseason if needed (based on soil nitrate test results). This practice improves crop N utilization by:

- Supplying PAN when the crop needs it
- Minimizing the accumulation of PAN at the end of the growing season
- Allowing some margin for error in estimating PAN release from manure

Because less manure is applied, this practice will also reduce accumulation of manure P and K in soil. See OSU Extension publication EM 8832 (listed in "For More Information") to learn how to collect and interpret data from a midseason soil nitrate test.

Questions and Answers

Is the calculation method used for PAN in this publication different from that used in the "Organic Fertilizer Calculator"?

The Organic Fertilizer Calculator (OSU Extension publication EM 8936-E) is primarily designed to assist organic farmers who are purchasing manure or other organic fertilizers. The Calculator provides an estimate of first-season N availability, assuming all of the manure NH_4-N is retained after application. The Calculator is based on a linear regression equation (generated from local research) between manure total N (organic + ammonium-N) and first-season PAN.

Because the Calculator uses a different approach to PAN estimates, the PAN values from the Calculator and from this publication are not directly comparable. PAN estimates from this publication's Worksheet and from the Organic Fertilizer Calculator are most similar for manures that contain mostly organic N.

Should denitrification loss estimates be included in N budgets for manure utilization?

The denitrification process (Figure 1, page 3) requires:

- Anaerobic soil conditions (lack of oxygen)
- Microbial activity
- Soil nitrogen in the nitrate form

Research conducted west of the Cascades has demonstrated that N loss via denitrification is typically less than 10 percent of N applied. Nitrate-N loss in the fall and winter is caused mainly by leaching. In spring, denitrification is limited by low concentrations of soil nitrate. In western Oregon and Washington, denitrification loss is not necessarily related to soil drainage class because seasonal high water tables usually occur in winter and spring when soil nitrate-N is low (e.g., it has already been leached out).

Because the amount of PAN lost by denitrification is generally small relative to other processes that affect PAN (timing and rate of manure application, NH_4-N retained at application, organic-N mineralized, nitrate-N leached) it is ignored in the Worksheet.

What can be done to conserve N on a whole-farm basis?

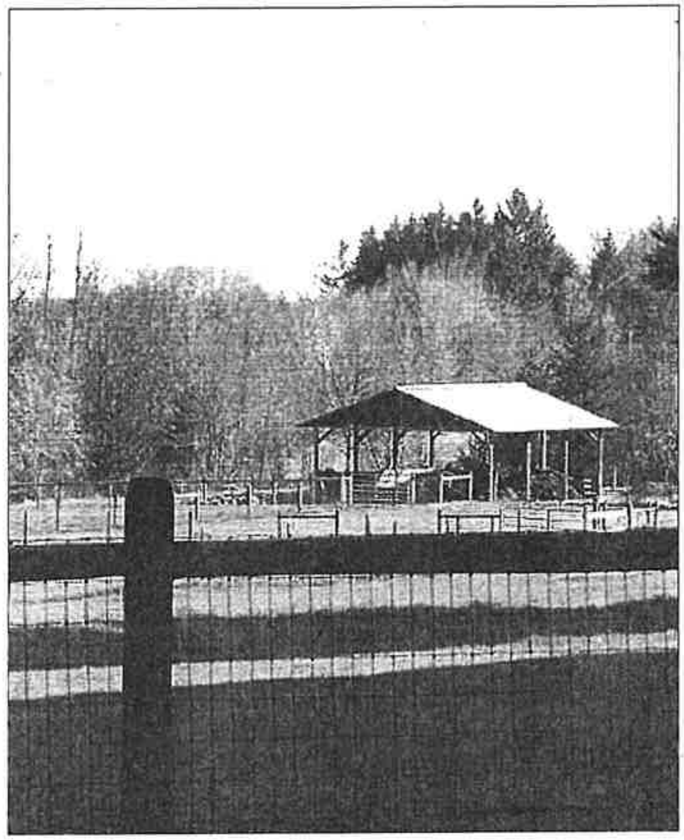
Much of the N lost from manure occurs prior to field application. An N-efficient whole-farm system includes:

- Feeding practices that maximize animal utilization of N
- Minimizing N loss in the barn
- Minimizing N loss in manure storage

Resources for improving whole-farm N utilization are available from the Livestock Poultry Environmental Stewardship program at: www.lpes.org

If manure is applied in fall, does it count as manure applied "this year" in the Worksheet?

The Worksheet allows you to define a "year" any way you wish. If you apply manure in the fall to perennial grasses, you may want to begin your "manure application year" after the last forage cut in the fall, since this manure N will be utilized by grass the following spring.



For crops other than perennial grasses, it is best to avoid fall application of manure because crop N utilization is low (Table 4, page 15). Most of the first-year PAN is lost from manure applied in the fall when crop N utilization is "low" or "very low" (Table 4).

Is the Worksheet a nitrogen budget or nitrogen recommendation?

The Worksheet provided in this publication is **not** a complete nitrogen budget or recommendation. The Worksheet focuses only on N supplied by manure application. A nitrogen recommendation considers other factors, including:

- N uptake/removal by crops
- N supplied from other sources (irrigation water, fertilizer, legumes)
- Typical mineralization rate for soil organic matter (unmanured soil)

Conversion Factors

Nutrient concentrations in manure can be expressed in different units or in different chemical forms. Use the unit conversion table on the next page to convert laboratory analysis units to field application units.

Carefully examine your laboratory report to determine whether nutrient concentration is expressed on an "as-is" basis (moist manure) or on a dry matter basis (no moisture).

Table 5. Conversion factors. To convert from units in column 2 (blue) to those in column 5 (orange), multiply by the conversion factor in column 4. To convert from units in column 5 to units in column 2, divide by the conversion factor. For example, to convert P2O5 to P, divide by 2.29.

Measurement	Unit	Symbol	Multiply by	To obtain	Symbol
Volume	acre-inch	ac-in	27000	gallon	gal
	gallon	gal	8.35	pound	lb
Concentration	parts per million	ppm or mg/kg	0.002	pound/ton	lb/t
	parts per million	ppm or mg/L	0.00835	pound/1,000 gallon	lb/1,000 gal
	parts per million	ppm or mg/L	0.227	pound/acre-inch	lb/ac-in
	percent	%	20	pound/ton	lb/t
	percent	%	83.5	pound/1,000 gallon	lb/1,000 gal
	percent	%	2,266	pound/acre-inch	lb/ac-in
	percent	%	10,000	parts per million	ppm
	pound/1,000 gallon	lb/1000 gal	27	pound/acre-inch	lb/ac-in
Dry or wet	percent dry matter (total solids)	% DM	0.01	solids fraction	DM
	percent moisture	% moisture	0.01	moisture fraction	MF
	manure, dry wt. basis		100/(%DM)	manure, "as-is" basis	
Nutrients	phosphorus	P	2.29	phosphate	P_2O_5
	potassium	K	1.20	potash	K_2O
	nitrogen in nitrate form	NO_3-N	1	nitrogen	N
	nitrogen in ammonium form	NH_4-N	1	nitrogen	N
	nitrogen in organic form	org-N	1	nitrogen	N

For More Information

OSU Extension publications

Manure management

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

Downing T., D. Sullivan, J. Hart, and M. Gamroth. 2007. *Manure Application Rates for Forage Production*. EM 8585-E.

Laboratories

Hart, J. 2006. *Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis*. EM 8677.

Tracking nutrients on the farm

Downing, T. 2000. *Calculating Dairy Manure Nutrient Application Rates*. EM 8768.

Gamroth, M., T. Downing, and P. French. 2006. *Feed Management: A Tool for Balancing Nutrients on Dairies and Other Livestock Operations*. EM 8913-E.

Marx, E.S., N.W. Christensen, J. Hart, M. Gangwer, C.G. Cogger, and A.I. Bary. 1997. *Nutrient Management for Dairy Production: The Pre-sidedress Soil Nitrate Test (PSNT) for Western Oregon and Western Washington*. EM 8650.

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Sullivan, D.M., C.G. Cogger, and A.I. Bary. 1997. *Date, Rate, and Place: the Field Book for Dairy Manure Applicators*. PNW 506.

Sullivan, D.M and R.G. Stevens. 2003. *Agricultural Phosphorus Management Using the Oregon/Washington Phosphorus Indexes*. EM 8848-E.

Additional Extension publications on manure and nutrient management are available at http://extension.oregonstate.edu/catalog/

Other resources

On-Farm quick tests for manure

Chadwick, D.R., S.K.E. Brookman, J. Williams, K.A. Smith, B.J. Chambers, I.M. Scotford, and T.R. Cumby. 2004. On-Farm Quick Tests for Manure. In: *Advanced Silage Corn Management*. http://www.farmwest.com

Manure application methods to reduce ammonia loss

Bittman, S. and C.G. Kowalenko, eds. 2004. *Advanced Silage Corn Management: a Production Guide for Coastal British Columbia and the Pacific Northwest*. Pacific Field Corn Association, Agassiz, BC.

Effects of weather and direct application methods on ammonia loss

An online calculator, Ammonia Loss from Applied Slurry Manure, is available at www.farmwest.com

Organic fertilizer calculator

Andrews, N. and J. Foster. 2007. *Organic Fertilizer Calculator: A Tool for Comparing the Cost, Nutrient Value, and Nitrogen Availability of Organic Materials*. Oregon State University Extension Service publication EM 8936-E, available at http://smallfarms.oregonstate.edu/organic-fertilizer-calculator

Whole-farm nutrient management

Livestock and Poultry Environmental Stewardship Curriculum, available at http://www.lpes.org

National Livestock and Poultry Environmental Learning Center, available online at http://lpe.unl.edu

Research references

The references listed below were consulted by the author in preparation of this publication. Much of the field research cited below was conducted in western Oregon, Washington, and British Columbia (the target region for this publication). Where local research was not available, best professional judgment was used to select applicable research from other regions. To determine the rationale behind existing Extension recommendations, the author also interviewed authors of state Extension publications that utilize a similar calculation method for PAN (PAN = NH_4-N retained at application + organic N mineralized after application).

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Bitzer, C.C. and J.T. Sims. 1988. Estimating the availability of nitrogen in poultry manure through laboratory and field studies. J. Environ. Qual. 17:47–54.

Pote, J.W., J.R. Miner, and J.R. Koelliker. 1980. Ammonia loss during sprinkler application of animal wastes. Transactions of the ASAE, p. 1202–1206.

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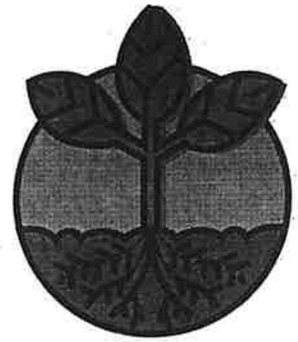
Soil Test Interpretation Guide



D.A. Horneck, D.M. Sullivan, J.S. Owen, and J.M. Hart

EC 1478 • Revised July 2011

Regular soil testing is an important element in nutrient management. You can use soil tests as a diagnostic tool or to identify trends through time. To obtain meaningful test results, you must sample soil correctly, at the same time each year, and you must maintain records.

> For more information, see the following in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/): *Soil Sampling for Home Gardens and Small Acreages* (EC 628); *Monitoring Soil Nutrients Using a Management Unit Approach* (PNW 570); *Monitoring Soil Nutrients in Dryland Systems Using Management Units* (EM 8920).

Soil testing laboratory methods vary, which may influence results and sufficiency ranges. Therefore, the sufficiency ranges in this publication are accurate only for the test methods listed.

Soil tests are used to measure soil nutrients that are expected to become plant-available. They do not measure the total amounts of nutrients in soil. Measurements of total nutrient content are not useful indicators of sufficiency for plant growth, because only a small portion of the nutrients are plant-available. Roots take up plant-available nutrients as positively or negatively charged ions from the soil (table 1).

Soil test results (see figure 1) can be viewed in three categories: (1) low or yes, a fertilizer addition *will* likely increase growth and yield; (2) high or no, a fertilizer addition will *not* likely increase growth or yield; and (3) intermediate or maybe, a fertilizer addition *may* increase growth or yield. Categorization of soil test results into "yes," "no," and "maybe" assists understanding the limits and benefits of using soil test results for making nutrient recommendations.

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Table 1. Plant-available nutrient forms.

Nutrient	Form used by plant
Cations (+):	
Nitrogen	NH_4^+
Potassium	K^+
Calcium	Ca^{2+}
Magnesium	Mg^{2+}
Manganese	Mn^{2+}
Copper	Cu^{2+}
Zinc	Zn^{2+}
Anions (–):	
Nitrogen	NO_3^-
Phosphorus	$H_2PO_4^-$ and HPO_4^{2-}
Sulfur	SO_4^{2-}
Boron	H_3BO_3 and $H_2BO_3^-$
Molybdenum	$HMoO_4^-$ and MoO_4^{2-}
Chloride	Cl^-

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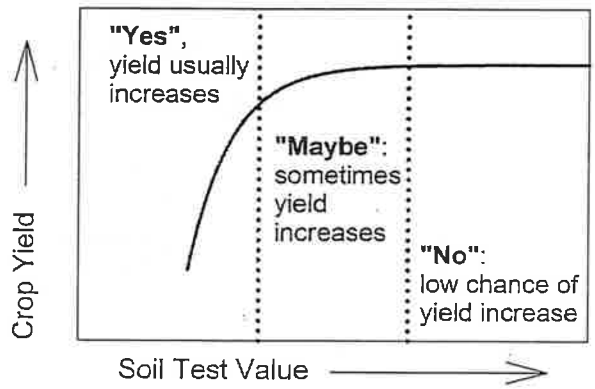

Figure 1. Soil test value vs. probability of crop yield response to nutrient addition. Crop yield increase due to nutrient addition is likely at low soil test values and unlikely at high soil test values. (Chart © Oregon State University. Prepared by Dan M. Sullivan.)

Differing fertilizer recommendation philosophies can provide multiple recommendations from the same soil test results. For example, nutrient application recommendations of land-grant university Extension services in the western United States are based on the philosophy that nutrients should only be applied when an economic yield increase is likely. In contrast, another philosophy for nutrient application is soil test level maintenance, commonly used in the midwestern United States. Soil test level maintenance is accomplished by fertilizing nutrients removed by crop harvest. Nutrients are applied even though the soil test level for these nutrients may be sufficient.

Nutrient concentrations vary with soil depth, which affects soil test results. To determine the proper sampling depth, you must consider the purpose of the soil test. To estimate fertilizer requirement prior to planting, sample soil to the depth where most root activity will occur, usually a depth of 6 to 12 inches. Shallow sampling, 2 to 3 inches, is sometimes used to evaluate fertilizer need in perennial crops where fertilizers have repeatedly been applied to the soil surface. A combination of sampling depths may be necessary to diagnose problems in orchards.

> For more information, see the following in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/): *Evaluating Soil Nutrients and pH by Depth in Situation of Limited or No Tillage in Western Oregon* (EM 9014).

Most soil test values do not vary greatly from year to year. However, some soil and environmental conditions cause fluctuations in measurements such as pH and nitrate-nitrogen. Drastic changes in test values year to year may indicate an unrepresentative soil sample or a laboratory error. When in doubt, submit a new sample or ask the lab to repeat the analysis.

Quality control programs for agricultural soil testing laboratories include North American Proficiency Testing (NAPT, http://www.naptprogram.org). This program is overseen by the Soil Science Society of America and is designed to promote quality, reproducible soil testing methods.

This publication provides general guidelines for interpreting soil test results. Guidelines for specific crops are available in many other publications. If a nutrient management/fertilizer guide for the crop in which you are interested is available, use it instead of the general information in this guide. Nutrient management/fertilizer guides for Christmas trees, wheat, sweet corn, silage or field corn, peppermint, blueberries, caneberries, several grasses grown for seed, carrots grown for seed, cranberries, hops, pastures, tree fruits and nuts, alfalfa, and onions are available from OSU and PNW Extension Publishing through the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/). For potato nutrient management recommendations in Oregon, use Washington State University's *Nutrient Management Guide: Central Washington Irrigated Potatoes* (EB1882, http://potatoes.wsu.edu/research/images/nutrient-central-wa.pdf.)

Nitrogen (N)

Plant-available nitrogen (nitrate and ammonium)

The plant-available forms of nitrogen are ammonium-N (NH_4-N) and nitrate-N (NO_3-N). The abbreviation NH_4-N means nitrogen in the ammonium form, and NO_3-N means nitrogen in the nitrate form. Soil concentrations of NO_3-N and NH_4-N depend on biological activity and therefore fluctuate with changes in conditions such as temperature and moisture. Nitrate is easily leached from the soil with high rainfall or excessive irrigation. Soil tests can determine NO_3-N and NH_4-N concentrations at the time of sampling but do not reflect future conditions.

The nitrogen mineralization test estimates seasonal N supply from a sample collected for wheat during late January. This test is only used for soft white winter wheat production in western Oregon.

> For more information, see the following in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/): *Using the Nitrogen Mineralization Soil Test to Predict Spring Fertilizer N Rate for Soft White Winter Wheat Grown in Western Oregon* (EM 9020).

Failure to account for NO_3-N in the soil or from irrigation water can lead to over-application of nitrogen fertilizers. Proper irrigation increases N use efficiency and reduces nitrate leaching.

Keep samples for N analysis cool and deliver them to the laboratory the day they are collected or send them using next-day delivery. If sample results are not needed immediately, samples can be frozen and shipped later.

Ammonium-nitrogen (NH_4-N)

Ammonium-nitrogen usually does not accumulate in the soil, as soil temperature and moisture conditions suitable for plant growth also are ideal for conversion of NH_4-N to NO_3-N. Ammonium-nitrogen concentrations of 2–10 ppm are typical. Soil NH_4-N levels above 10 ppm may occur in cold or extremely wet soils, when the soil contains fertilizer from a recent application when soil pH is very high or low, and when soluble salts (measured by electrical conductivity) are high.

Nitrate-nitrogen (NO_3-N)—West of the Cascade Mountain Range

Nitrate-N is mobile in H_2O and is a difficult test to interpret in western Oregon. Nitrate moves with the water when rainfall exceeds evaporation, usually November through April. Consequently, nitrate remaining in the soil after harvest can leach during winter rains, contaminating surface and groundwater. Situations for which nitrate-N can be used for management decisions are limited. They must be selected carefully to match crop growth and likelihood of sufficient nitrate to reduce fertilizer need. For example, midseason measurement of soil nitrate is used for silage and sweet corn production.

> For more information, see the following in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/): *Silage Corn Production Nutrient Management Guide (Western Oregon)* (EM 8978); *Sweet Corn Nutrient Management Guide (Western Oregon)* (EM 9010).

Post-harvest soil nitrate testing can be used in some cropping systems to determine whether N supplied from all sources (fertilizer, irrigation water, organic amendments) was excessive. Interpretation of post-harvest soil nitrate analyses is crop specific. If post-harvest nitrate levels are consistently high, reduce fertilizer N inputs in future growing seasons.

> For more information, see the following in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/): *Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascade Mountain Range* (EM 8832).

Nitrate-nitrogen (NO_3-N)—East of the Cascade Mountain Range

In arid regions, soil nitrate is evaluated by measuring NO_3-N, usually in one-foot depth increments, to a depth of 2 to 5 feet. The nitrogen measured with this test is used to determine the N fertilizer application rate. Consult the nutrient management guide for an individual crop to determine sampling depth and method for crediting soil nitrate-N. If test results are reported in ppm, convert to lb/acre using table 13.

Total nitrogen

Total nitrogen analysis measures N in all organic and inorganic forms. Total nitrogen does *not* indicate plant-available N and is not the sum of NH_4-N + NO_3-N. Total N is not used for fertilizer recommendations.

A typical agricultural soil in the Willamette Valley contains about 0.10 to 0.15 percent N, or approximately 5,000 lb N/acre in the surface foot. Only 1 to 4 percent of this total N becomes plant-available (converts via microbial activity from organic form to inorganic form) during a growing season. East of the Cascade Mountain Range, soils usually have half or less this amount of total N.

Phosphorus (P)

Phosphorus fertilizer recommendations are based on a documented relationship between crop yield and extractable soil test phosphorus. Historical soil test calibration data in Oregon have been developed in relation to two specific phosphorus extractions methods: the Bray P1 test and the Olsen or sodium bicarbonate test (table 2). The Bray P1 extraction method is used for soils west of the Cascade Mountain Range, and the Olsen sodium bicarbonate ($NaHCO_3$) extraction method is used for soils east of the Cascade Mountain Range. Soil testing laboratories also use several other extraction methods. For interpretation of results from other extraction methods, contact the laboratory that performed the analysis. Soil test P extraction methods other than Bray P1 and Olsen often have little or no field calibration studies performed to document their utility in Oregon.

Phosphorus soil tests are an index of P availability (low, medium, high, excess). When interpreting a P soil test, you must be aware of previous P management practices. Phosphorus is relatively immobile in soil. If phosphorus has been applied in a fertilizer band, concentrations of P may persist where the band was placed, making interpretation of soil test data difficult.

The phosphorus application rate necessary to correct P deficiencies varies depending on soil properties and crop grown. Phosphorus availability decreases in cool, wet soils. In many situations, banded phosphorus applications are more effective than broadcast applications, especially when soil test P values are low.

Phosphorus applications generally are not recommended when test results are high or excessive. High soil phosphorus combined with P movement from soil into surface waters can cause excessive growth of vegetation, damaging aquatic ecosystems.

Table 2. Phosphorus (P) soil test categories and suggested fertilizer rate recommendations.

	West of Cascades Bray P1 test P (ppm)	East of Cascades Olsen test P (ppm)	Recommendation (lb P_2O_5/acre)
Low	<20	<10	0–300
Medium	20–40	10–25	0–200
High	40–100	25–50	0–30
Excessive	>100	>50	0

Cations: potassium, calcium, and magnesium

Of the three primary cations (potassium, calcium, and magnesium), potassium requires the most management attention. Few crops have increased growth or yield from calcium and magnesium additions in the Pacific Northwest.

The soil test ranges in tables 3 and 4 are for the ammonium acetate or the sodium bicarbonate ($NaHCO_3$) extraction method.

Potassium (K)

Excessive soil potassium levels can result in elevated K levels in grass forage crops, which may be detrimental to animal health. Conversely, very low soil test K levels can reduce plant growth. K applications in table 3 are applied as a broadcast application.

Table 3. Extractable potassium (K) soil test categories and suggested fertilizer rate recommendations.

	Extractable or soil test K	Recommendation (lb K_2O/acre)
Low	<150 ppm* <0.4 meq/100 g soil	100–300
Medium	150–250 ppm 0.4–0.6 meq/100 g soil	60–250
High	250–800 ppm 0.6–2.0 meq/100 g soil	0
Excessive	>800 ppm >2.0 meq/100 g soil	0†

* For ammonium acetate or sodium bicarbonate extraction method.
† When extractable K is excessive, determine soil and irrigation water electrical conductivity.

Calcium (Ca)

Calcium deficiencies usually are found only on very acidic soils. They can be corrected by liming with calcium carbonate ($CaCO_3$). Calcium is rarely deficient when soil pH is adequate. Calcium deficiency can occur at otherwise adequate soil pH values in serpentine soil (high Mg). These soils are found in the Siskiyou Mountains and other parts of southwest Oregon.

Magnesium (Mg)

Magnesium deficiencies on acidic soils can be corrected by liming with dolomitic lime (calcium-magnesium carbonate [$CaCO_3$-$MgCO_3$]). If the soil pH is sufficient, Mg can be supplied with Epsom salts ($MgSO_4$) or potassium-magnesium sulfate ($K_2SO_4 \cdot 2MgSO_4$). Excess magnesium can occur on serpentine soils in southwest Oregon. Agricultural production on serpentine soil requires management not addressed in this publication.

Table 4. Extractable magnesium (Mg) soil test categories and suggested fertilizer rate recommendations.

	Extractable or soil test Mg	Recommendation (lb Mg/acre)
Low	<60 ppm	10–100
	<0.5 meq/100 g soil	
Medium	60–300 ppm	0–60
	0.5–2.5 meq/100 g soil	
High	>300 ppm	0
	>2.5 meq/100 g soil	

Sulfate-sulfur (SO_4^--S)

Plants absorb sulfur in the sulfate form. In high-rainfall areas west of the Cascade Mountain Range, sulfate is readily leached, and soil tests are not well correlated with plant growth. In arid regions east of the Cascades, soil test information may be useful. Irrigation water may contain significant amounts of sulfate-sulfur. Plant analysis, especially a nitrogen-sulfur (N:S) ratio, is useful for diagnosing a sulfur deficiency.

Table 5. Sulfate-sulfur soil test categories and suggested fertilizer rate recommendations, east of the Cascade Mountain Range.

	Soil test sulfate-S (ppm)	Recommendation (lb S/acre)
Very low	<2	30–60
Low	2–5	10–30
Medium	5–20	0–20
High	>20*	0

* When sulfate-S soil test values are high, determine soil and irrigation water electrical conductivity.

Micronutrients

Deficiencies of micronutrients other than boron and zinc are uncommon. The availability of most micronutrients decreases as pH increases (except for molybdenum, which becomes more available as pH increases). Micronutrient deficiencies rarely occur when the soil pH is below 6.5.

Soil testing for micronutrients other than boron and zinc is recommended only when a deficiency is suspected. If you suspect a micronutrient deficiency, plant tissue testing may be a better diagnostic tool than soil testing. Soil testing will help determine what rate to apply.

Boron (B)

Crops such as alfalfa, table beets, brassica crops, caneberries, and root crops have responded to boron fertilization on B-deficient soils in western Oregon. Tree fruits and alfalfa are examples of crops sensitive to low boron levels east of the Cascade Mountain Range.

While low levels of boron may limit plant growth, high concentrations can be toxic. When applying boron, apply it uniformly as a broadcast application and mix it thoroughly with the soil.

Table 6. Extractable boron (B) soil test categories and suggested fertilizer rate recommendations.

	Soil test B (ppm)	Recommendation (lb B/acre)*
Very low	<0.2	1–3
Low	0.2–0.5	0–3
Medium	0.5–1	0–1
High	1–2	0
Excessive	>2†	0

* Do not apply B in a concentrated area such as a fertilizer band.

† When soil test B is excessive, determine soil and irrigation water electrical conductivity and B in irrigation water.

Zinc (Zn)

A zinc soil test above 1.5 ppm using the DTPA extraction method is sufficient for most crops. Corn, beans, grapes, hops, onions, and deciduous fruit trees are especially sensitive to low levels of soil test Zn. Fertilizer applications with zinc sulfate are typically 5 to 15 lb Zn per acre.

Copper (Cu)

Copper values above 0.6 ppm using the DTPA extraction method are sufficient. Copper deficiencies are extremely rare, regardless of soil test results. The only deficiencies that have been identified are on muck soils such as those in the Klamath and Salem (Lake Labish) areas in Oregon and the Colville area in Washington. Routine copper application to mineral soil can cause copper toxicity.

Manganese (Mn)

Adequate soil test Mn varies with crop. Soil test values between 1 and 5 ppm using the DTPA extraction method are usually sufficient. Manganese deficiencies generally occur only when soil pH is 8.0 or above.

> Details of Mn deficiency, Mn application, and soil pH adjustment can be found in the following publication in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/): *Managing Manganese Deficiency in Nursery Production of Red Maple* (EM 8905).

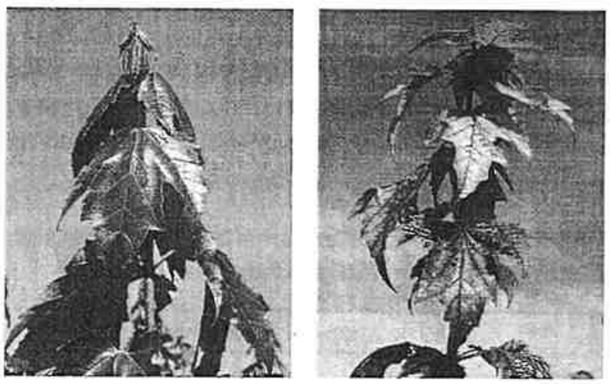

Figure 2. Left: Healthy red maple. Right: Red maple with chlorosis from manganese deficiency. To ensure adequate manganese is available for red maple, the soil pH should be below 5.6 and soil test manganese values should be above 20 ppm. (Photos © Oregon State University. From: Altland, J. 2006. *Managing Manganese Deficiency in Nursery Production of Red Maple*. EM 8905. Corvallis, OR: Oregon State University Extension Service.)

Manganese toxicity is more common in acidic soil than Mn deficiency. Garlic and onions are the most sensitive crops grown in Oregon. Manganese toxicity causes incomplete filling of garlic bulbs when the soil pH is below 6.5. In contrast, wheat growth and yield is not limited by Mn until soil pH is below 5.2.

Diagnosis of either Mn deficiency or toxicity should use soil pH and tissue Mn concentration in combination with soil test Mn.

For alkaline soils east of the Cascade Mountain Range, acidified microzones, such as the area around fertilizer bands or granules, can increase Mn availability. These acidified microzones can alleviate the Mn deficiency sometimes encountered on soil with high pH.

Iron (Fe)

Soil testing for iron is not recommended. Most test methods do not discern between forms of iron and therefore have little meaning for plant nutrition.

Iron deficiencies are uncommon on acidic soils in the Pacific Northwest. Where deficiencies occur, they often are associated with plants adapted to acidic soil, such as blueberries, azaleas, or rhododendrons, growing on soil with an unsuitably high pH. Acidifying the soil with elemental sulfur usually will correct Fe deficiency for these plants.

> Guidance on soil acidification for home gardens and small acreages in western Oregon is provided in the following: *Acidifying Soil for Blueberries and Ornamental Plants in the Yard and Garden West of the Cascade Mountain Range in Oregon and Washington* (EC 1560); *Acidifying Soil in Landscapes and Gardens East of the Cascades* (EC 1585). For large scale agricultural production, guidance about soil acidification can be found in the following: *Acidifying Soil for Crop Production West of the Cascade Mountains* (EM 8857); *Acidifying Soil for Crop Production: Inland Pacific Northwest* (PNW 599). All available in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/).

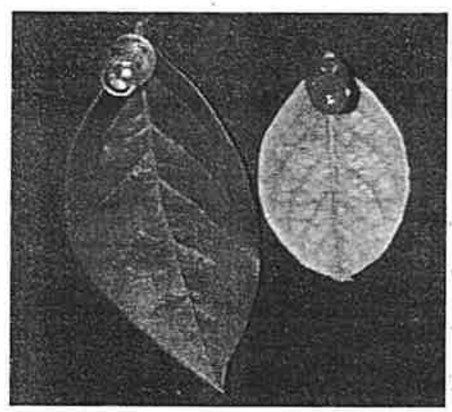

Figure 3. Left: Healthy blueberry leaf. Right: Iron-deficient blueberry leaf. Note the pale green leaf area and contrasting green veins on the iron-deficient leaf. (Photo © Oregon State University. From: Hart, J., D. Horneck, R. Stevens, N. Bell, and C. Cogger. 2003. *Acidifying Soil for Blueberries and Ornamental Plants in the Yard and Garden West of the Cascade Mountain Range in Oregon and Washington*. EC 1560. Corvallis, OR: Oregon State University Extension Service.)

Iron salts (such as iron sulfate) applied to alkaline soil do not remain plant-available for long enough to be an effective plant nutrient source. Chelated iron fertilizers are more effective in alkaline soils than inorganic fertilizer materials, but they are very expensive. The cost usually prohibits use. Lowering soil pH to increase iron availability on a field scale is not economical. However, adding acidifying materials such as elemental sulfur to fertilizer mixtures can acidify microzones around the fertilizer material and increase Fe availability.

Turf often will become darker green when a complete fertilizer containing Fe is applied. The change in color is in spite of adequate soil test iron values.

Molybdenum (Mo)

Soil Mo concentrations are too low for most labs to evaluate. Molybdenum deficiencies are rare. Molybdenum-deficient legumes produced on acidic soil appear chlorotic or nitrogen deficient. In this situation, applying lime usually increases soil pH and alleviates the chlorosis.

Livestock producers desiring information about molybdenum in forage should have the Mo content of forage determined.

Chloride (Cl^-)

Soil testing for chloride is not a common practice, and little data exist for interpretation of test results. Wheat sometimes benefits from a chloride application. Little information exists on chloride soil test values and recommended rates in Washington and Oregon. Chloride is supplied with irrigation water and from organic sources such as manure and compost. Chloride fertilizer application may occur incidentally when Cl salts are used to supply potassium or magnesium. For example, a 100 lb application of muriate of potash (potassium chloride [0-0-60]) contains 60 lb K_2O and 45 lb Cl.

Table 7. Chloride (Cl) soil test categories and suggested fertilizer rate recommendations.

	Soil test Cl (ppm)	Recommendation (lb potassium chloride [0-0-60]/acre)
Very low	0–5	0–150
Low	5–10	0–150
Medium	10–20	0–50
High	20–50	0
Excessive	>50*	0

* When soil test Cl is excessive, determine soil and irrigation water electrical conductivity and B in irrigation water.

pH, lime requirement (LR)

Soil pH expresses soil acidity. Most crops grow best when the soil pH is between 6.0 and 8.2.

Table 8. Soil pH ranges.

	pH
Strongly acidic	<5.1
Moderately acidic	5.2–6.0
Slightly acidic	6.1–6.5
Neutral	6.6–7.3
Moderately alkaline	7.4–8.4
Strongly alkaline	>8.5

Soil pH can be increased by liming, the application of calcium carbonate (limestone). The soil pH test indicates *if* lime is needed. The lime requirement test determines *how much* lime is needed.

Lime rates in eastern Oregon are much lower than in western Oregon, typically 500 to 1,500 lb/acre compared to 2,000 to 6,000 lb/acre. The lower rates reflect sandy soil or a low cation exchange capacity (CEC). The low lime rates in eastern Oregon are applied with greater frequency than lime in western Oregon, making the long-term rates for the same crop comparable.

SMP lime requirement test

Refer to individual crop nutrient management or fertilizer guides for lime application rate. The information provided here is very general. SMP stands for Shoemaker, MacLean, and Pratt—the people who developed the test.

Accurate lime recommendations cannot be made solely on the basis of soil pH. The SMP test is used to estimate the lime required to raise the pH of 6 inches of soil. The SMP test is performed by mixing soil with a solution buffered at pH 7.5 and determining the resulting pH. The soil's exchangeable hydrogen or "reserve acidity" lowers the pH of the SMP solution. Soils with low SMP values have high reserve acidity and high lime requirements. Conversely, soils that are acidic and have a high SMP buffer have a low lime requirement.

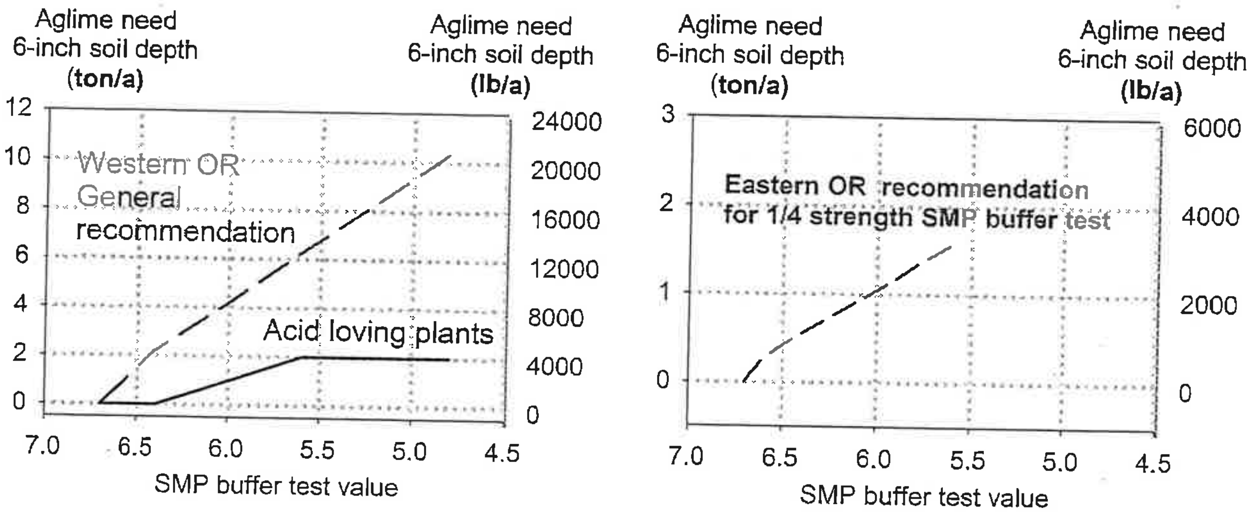

Figure 4. Lime rate increases as SMP test value decreases. Left: Western Oregon (full-strength SMP test). Right: Eastern Oregon (1/4-strength SMP test). (Charts © Oregon State University. Prepared by Dan M. Sullivan.)

Figure 4 shows the relationship between SMP test and lime recommendation. Lime rate increases as the SMP test value decreases.

Table 9 is used to determine the amount of lime required, based on the SMP test, to raise soil pH to a desired level. The target pH is determined by the crop to be grown and possibly by other factors such as disease management. For example, when the SMP test value is 6 (left column), the recommended rate of lime for most crops in western Oregon is 8,400 lb/acre. For the same SMP test value, only 1,000 lb aglime/acre is recommended for acid loving crops like blueberries. The recommendations in table 9 assume that lime is incorporated by tillage to a depth of 6 inches.

Some soils may have a low pH (below 5.3) and a fairly high SMP test value (above 6.2). This condition can be caused by the application of fertilizer. In this case, the low pH value is temporary, and the pH of the soil will increase as the fertilizer completes its reaction with the soil.

In western Oregon, sandy soils also may have a low pH and high SMP buffer value. This condition occurs because sandy soils have low amounts of reserve acidity due to low CEC. In such cases, a light application of lime (2,000 to 4,000 lb/acre) should suffice to neutralize soil acidity. This amount of lime should be applied regardless of the SMP test value.

Table 9. Rates of 100 score aglime to raise soil pH determined by use of SMP test.*

SMP test result	Lime rate recommendation (lb/acre)		
	Acid-loving plants (blueberry, rhododendron, etc.)	Western Oregon field crops, horticultural production and pasture	Eastern Oregon field crops, horticultural production and pasture
6.7	0	0	0
6.4	0	4,400	1,100
6.0	1,000	8,400	2,100
5.6	2,000	12,600	3,150
5.2	2,000	16,600	
4.8	2,000	20,800	

* For specific recommendations, refer to individual crop nutrient management or fertilizer guides.

Table 10. Lime requirement for gardens in western Oregon based on the SMP test.

When the SMP test result is ...	Apply this amount of lime (lb/1,000 ft^2):
<5.5	250
5.5–6.0	150–250
6.0–6.5	100–150
>6.5	0

Sodium (Na)

Sodium is not a plant nutrient and therefore is not necessary for plant growth. High levels of sodium are detrimental to soil structure, soil permeability, and plant growth, a problem encountered east of the Cascade Mountain Range.

Sodium levels are evaluated based on exchangeable sodium percentage (ESP). The ESP is the percent of the CEC occupied by Na.

ESP values above 10 percent are of concern. Excessive sodium levels can occur naturally or can result from irrigation with high-sodium water. Reclamation involves establishment of drainage followed by gypsum application and leaching with low-sodium water.

Soluble salts

Soluble salt problems usually are associated with arid regions in eastern Oregon and Washington. Soils with high levels of soluble salts are called saline soils. Soils high in sodium are called sodic soils (see "Sodium" section). Saline-sodic soils are high in both soluble salts and sodium. Soluble salts are measured by electrical conductivity (EC) of a saturated paste soil extract.

Table 11. Soluble salts determined from a saturated paste extract.

	EC (mmhos/cm)*	ppm salt†	Suitability for crop production
Low	<1.0	<640	Suitable
Medium	1.0–2.5	640–1,600	Marginal
High	>2.5	>1,600	Poor, unsuitable for many crops

Note: Some laboratories determine EC using a 1:1 or 2:1 ratio of water to soil, which provides a substantially lower value than the saturated paste extract. No relationship has been established for converting 1:1 or 2:1 EC to saturated paste EC.

* mmhos/cm is equivalent to deci-siemen/m (dS/m) and milli-siemen/cm (mS/cm).

† Multiply mmhos/cm by 640 to estimate ppm salt.

Because salts move readily with water, salt problems can be transient. Salt toxicity can occur, and salts may leach before soil is tested. Low salt values, therefore, do not always rule out salt toxicity as a cause of problems.

Salt tolerance varies greatly among plant species. Seedlings are especially sensitive to high salt concentrations. Excessive salts may inhibit seed germination. Excessive fertilization and poor irrigation water quality are sources of salts.

> For more information, see the following in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/): *Managing Salt-affected Soils for Crop Production* (PNW 601).

Organic matter or soil carbon

Interpretation

Soil organic matter (OM) is a surrogate for soil carbon and is measured as a reflection of overall soil health. When monitored for several years, it gives an indication whether soil quality is improving or degrading. Soil OM is important to a wide variety of soil chemical, physical, and biological properties. As soil OM increases, so does CEC, soil total N content, and other soil properties such as water-holding capacity and microbiological activity. As OM increases, so does the ability to adsorb and reduce effectiveness of many soil-applied herbicides.

Soil OM is in equilibrium with climate, soil mineralogy, and environment, providing limited capacity to accumulate organic matter. A soil with 2 percent OM will not increase to 10 percent under normal farming or gardening practices. A 2 percent increase in soil OM (e.g., from 1 to 3 percent or from 4 to 6 percent) would be considered a large change and the maximum likely for most situations in Oregon. Soil OM could increase more than 2 percent in a garden or area receiving large amounts of compost or other organic residue.

Soil OM content is not a quantitative indicator of the capacity of soil to supply plant-available nitrogen (PAN) for plant growth even though a soil with more OM contains more total N. The timing and amount of PAN released from soil organic matter is dependent on soil temperature, moisture, and many other soil management factors. Laboratories that estimate plant-available N release based on soil OM typically do not have calibration data to support their estimates.

Methods for determining soil organic matter

Soil OM values vary with method used for the analysis. Utility of soil OM data is dependent upon analytical method. Before soil OM is determined, determine the analytical method to be used. If you are monitoring OM, use the same analytical laboratory and analytical method. Diffcrences in results from varying methods can mask changes in OM from management.

Laboratory methods used to determine OM include the following:

- **Loss On Ignition (LOI) method**—sample weight loss on ignition at 360°C–400°C
- **Combustion method**—combustion of sample at 900°C–1800°C and direct measurement of C lost in gas
- **Walkley-Black method**—wet chemistry reaction of soil C with an oxidizing agent (potassium dichromate)

Choosing one of these methods for organic matter determination involves consideration of factors outlined in table 12.

What method is preferred?

The LOI method is the least expensive. The Combustion and Walkley-Black methods are both moderate to high cost. When only an approximate value for soil organic matter is needed, the less expensive LOI test is probably adequate.

The Combustion and Walkley-Black methods both provide high accuracy and high reproducibility; the LOI method is less accurate and less reproducible. The Combustion method is more accurate and reproducible than the LOI method because it directly measures the central component of organic matter (carbon), while LOI measures weight loss (includes organic matter plus some water adhering to soil minerals). For monitoring soil OM, the Combustion method is the most suitable test.

Cation exchange capacity (CEC)

CEC is a measure of a soil's capacity to retain and release elements such as K, Ca, Mg, and Na. Soils with high clay and/or organic matter content have high CEC. Sandy, low organic matter soils have low CEC. Soil CEC is relatively constant, so no need exists for repeated analyses.

Some laboratories estimate CEC based on soil texture, organic matter content, cations, SMP, and pH. Such estimates can be inaccurate. The "sum of bases" method for calculating CEC can give inaccurate results, especially in high pH soils containing lime.

CEC is used to estimate the amount of elemental sulfur required for soil acidification in western Oregon and Washington. Acidifying soil is sometimes necessary for production of blueberries or nursery stock such as rhododendrons and red maple.

> For more information, see the following in the OSU Extension Catalog (http://extension.oregonstate.edu/catalog/): *Acidifying Soil for Crop Production West of the Cascade Mountains* (EM 8857); *Acidifying Soil for Crop Production: Inland Pacific Northwest* (PNW 599).

Table 12. Factors to consider in choosing soil organic matter laboratory method.

Method	Test cost and availability	Suitability for soil with carbonate	Accuracy and reproducibility	Comments
Loss on Ignition	Low cost; often included in routine soil test "package"	Suitable	Low to medium; results inconsistent	LOI value can be higher or lower than "true" value determined by direct measurement
Combustion*	Moderate to high cost; available as additional test upon request at many labs	Suitable after sample pretreatment to remove carbonates	High	Preferred test
Walkley-Black*	Moderate to high cost; not offered at many labs	Suitable	High	Test generates a toxic waste (chromium)

*Soil C determined via Combustion or Walkley-Black method is expressed as OM via the following equation: $OM = C \times 1.7$.

Base saturation

Base saturation is the percentage of the soil CEC that is occupied by basic cations (calcium, magnesium, potassium, sodium) at the current soil pH value. Base saturation and CEC are nearly equivalent (base saturation is 100 percent) when soil pH is near 7. An acidic soil has a base saturation of about 50 percent when the soil pH is about 5.

Since base saturation is simply an indirect expression of soil pH, it is not required for making fertilizer or lime recommendations. In acidic soils, base saturation and soil pH change simultaneously. Liming increases base saturation and soil pH. Sulfur application will reduce base saturation and pH. Base saturation is not a useful concept in alkaline soils, where base saturation equals or exceeds 100 percent.

Table 13. Unit conversions.*

To convert column 1 into column 2, divide by	Column 1	Column 2	To convert column 2 into column 1, multiply by
390	ppm K	meq K/100 g soil	390
200	ppm Ca	meq Ca/100 g soil	200
121	ppm Mg	meq Mg/100 g soil	121
230	ppm Na	meq Na/100 g soil	230
1	meq/100 g soil	cmol/kg soil	1
3.5†	lb/acre (1 ft depth)	ppm	3.5†
43.56	lb/acre	lb/1,000 ft^2	43.56
43,560	ft^2	acres	43,560
2.471	acres	hectares	2.471
2.3	P_2O_5	P	2.3
1.2	K_2O	K	1.2

* Units used in analytical reports vary. For example, 1 ppm (w/w) = 1 mg/kg or 1 ug/g. Use the conversions in this table to change a unit into a term familiar to you.

† This factor depends on soil bulk density. 3.5 x ppm = lb/acre-ft when soil bulk density is 1.3 grams per cm^3 (81 lb/ft^3). These soils typically have a medium to fine texture. Use 4 when the soil is "sandy," more than 60 percent sand.

Acknowledgements

This publication was adapted and updated from the following: Marx, E.S., J. Hart, and R.G. Stevens. 1996. *Soil Test Interpretation Guide*. EC 1478. Corvallis, OR: Oregon State University Extension Service.

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For more information

The following publications and nutrient management guides/fertilizer guides for many individual crops are available through the Oregon State University Extension Service Publications and Multimedia Catalog (http://extension.oregonstate.edu/catalog/):

Altland, J. 2006. *Managing Manganese Deficiency in Nursery Production of Red Maple*. EM 8905. Corvallis, OR: Oregon State University Extension Service.

Anderson, Nicole P., John M. Hart, Neil W. Christensen, Mark E. Mellbye, and Michael D. Flowers. 2010. *Using the Nitrogen Mineralization Soil Test to Predict Spring Fertilizer N Rate for Soft White Winter Wheat Grown in Western Oregon*. EM 9020. Corvallis, OR: Oregon State University Extension Service.

Anderson, Nicole P., John M. Hart, Donald A. Horneck, Dan M. Sullivan, Neil W. Christensen, and Gene J. Pirelli. 2010. *Evaluating Soil Nutrients and pH by Depth in Situations of Limited or No Tillage in Western Oregon*. EM 9014. Corvallis, OR: Oregon State University Extension Service.

Corp, M.K., D.A. Horneck, D. Wysocki, and L. Lutcher. 2006. *Monitoring Soil Nutrients in Dryland Systems Using Management Units*. EM 8920. Corvallis, OR: Oregon State University Extension Service.

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Sullivan, D.M., and C.G. Cogger. 2003. *Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascade Mountain Range*. EM 8832. Corvallis, OR: Oregon State University Extension Service.

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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)

Dan M. Sullivan, Extension soil scientist, Oregon State University, and Craig G. Cogger, Extension soil scientist, Washington State University.

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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.

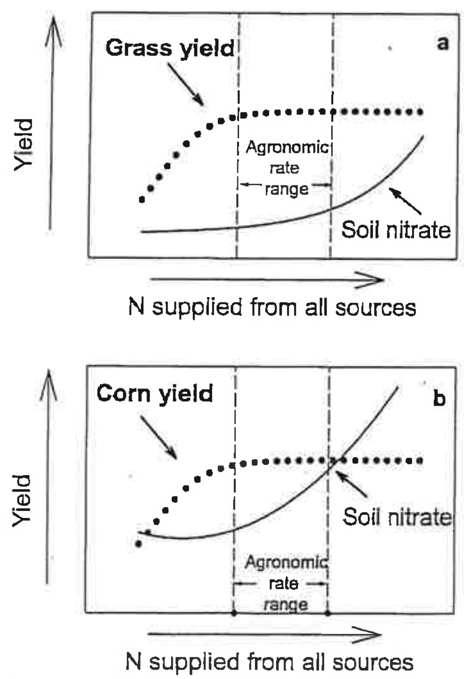

Figure 1.—Crop yield and soil nitrate response to increased N supply. Agronomic rate range = range of N supplied from all sources that results in near-maximum crop yield with acceptable post-harvest nitrate accumulation. Above the agronomic rate range, excess N accumulates as nitrate in soil. More nitrate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

Cumulative rainfall after Sept. 1	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)
(inches)								
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

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

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)

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.

[a]The 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.

[a] The 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 (ppm x 3.5 = 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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Marx, E.S., J. Hart, and R.G. Stevens. 1996. Soil Test Interpretation Guide, EC 1478.

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Sullivan, D.M., C.G. Cogger, and A.I. Bary. 1997. Date, Rate, and Place: The Field Book for Dairy Manure Applicators, PNW 506.

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

Other resources

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North American Proficiency Testing Program. Standard Reference Soil Samples (Soil Science Society of America, 677 S. Segoe Rd., Madison, WI 53711; phone: 608-273-8080; Web: http://www.soils.org).

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NUTRIENT MANAGEMENT
FOR DAIRY PRODUCTION

Manure application rates for forage production

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Most dairies can supply all the nitrogen, phosphorus, potassium, and other nutrients needed for forage production by applying manure to forage crops. As a manager, your goal is to match nutrient supply with crop needs by deciding when and how much manure to apply.

This publication explains how to estimate the amount of manure to apply for forage production. To do so, you need:

- A current manure analysis for your dairy (see *Dairy Manure as a Fertilizer Source*, EM 8586)
- A list of forage crops to be produced
- A soil test for phosphorus and potassium from each field where manure will be applied

Applying too much manure leads to several problems. First, plants take up excess amounts of nutrients such as potassium. High-potassium grass forages can lead to health problems, especially in dry cows. Second, excess manure can add nutrients and microorganisms to runoff or surface water, and can provide nitrogen that can leach into groundwater.

Application rates in this publication are based on soil tests and growing conditions in western Oregon.

Manure analysis

Analyzing manure is critical to determining the correct application rate. If you don't test your dairy's manure, you can only guess its nutrient value.

Manure testing in western Oregon has shown more variation among dairies than within one dairy. Develop a manure nutrient history for your dairy by testing manure two or three times a year for 2 or 3 years. These records will help you manage nutrient resources.

Have manure analyzed for total nitrogen (N), ammonium nitrogen (NH_4-N), phosphorus (P), and potassium (K). Laboratories often perform these as a standard analysis package.

Call your county office of the OSU Extension Service or your local USDA Natural Resources Conservation Service office for sampling directions. *Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis* (EM 8677) lists laboratories that test manure.

Crop nitrogen requirements

Nitrogen (N) typically is the limiting nutrient for crop production on dairies. Table 1, page 3, shows the estimated nitrogen removal rate (or uptake) for average yields of the most common forage crops grown on dairies. Values in the upper part of the table are on a dry matter (DM) basis; in the lower part, as-harvested values are adjusted for moisture. For example, 1 ton of forage dry matter is equivalent to 4 tons of harvested forage if the silage is 25 percent DM. When discussing nutrient removal, you need to know whether you are dealing with as-harvested or dry-matter values so that you can interpret values correctly.

Troy Downing, Extension agriculture faculty (dairy), Tillamook County; Dan Sullivan, Extension soil scientist; John Hart, Extension soil scientist; and Mike Gamroth, Extension dairy specialist; all of Oregon State University. This publication replaces EC 1094, *Calculating the Fertilizer Value of Manure from Livestock Operations*.

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Determining manure application rate

Your goal is to match manure nutrient application rates with crop removal rates. Table 1 and Figures 1 and 2 provide the information you need to determine nutrient removal for many annual and perennial crops. Instructions for using the table and figures follow.

1. In Table 1, find the crop you will grow. Let's assume it's perennial ryegrass. The table is arranged to help you separate different levels of intensity. For example, low-intensity harvesting might be only one or two cuttings per year, medium will be three to five cuttings, and high intensity is six to seven cuttings per year.
2. For our example, let's assume you harvest four times a year, and your ryegrass averages 15 percent protein. That is equivalent to 48 lb of nitrogen per ton of dry matter, yielding around 5 tons of dry matter (240 lb N) per year.
3. You need to replace 240 lb N/a/year from the four cuttings. This is equivalent to 60 lb/a of nitrogen per cutting.
4. Find the figure below (Figure 1 or 2) that represents the type of manure you want to apply. Let's assume you want to apply lagoon effluent, so you'll use Figure 2.
5. Figure 2 contains three lines representing N application rates of 50, 100, and 150 lb N/a. Find the line closest to the rate you need to apply. In this example, you'll use the line for 50 lb/a.
6. Select the manure analysis from your dairy for nitrogen on the left side of the graph. Assume a manure test shows that the effluent contains 6 lb/1,000 gal or 750 ppm N. Move to the right across the graph until you meet the line for the application rate you have chosen (50 lb N/a).
7. Now move straight down to the line labeled "effluent acre-inches to apply" and estimate the number of acre-inches of effluent to apply (in this case, about 0.3 acre-inch). Remember that you will need about 20 percent more nitrogen because no line exists for 60 lb N/a. Your final result will be about 0.4 acre-inch.

Testing your soil for P and K

Test your soil for phosphorus (P) and potassium (K) before applying manure. Table 2 (back page) provides interpretations of P and K soil tests.

If you've applied manure for more than 5 years, additions of P and K usually are not needed. For example, potassium usually is not deficient in soils

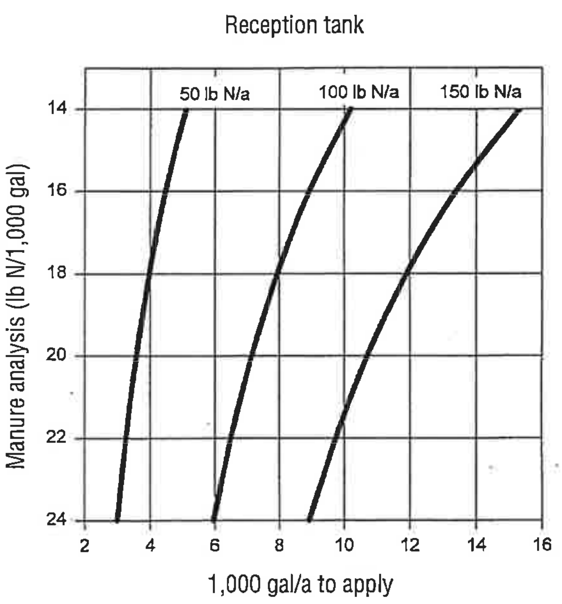

Figure 1.—Determining application rate for reception tank manure.

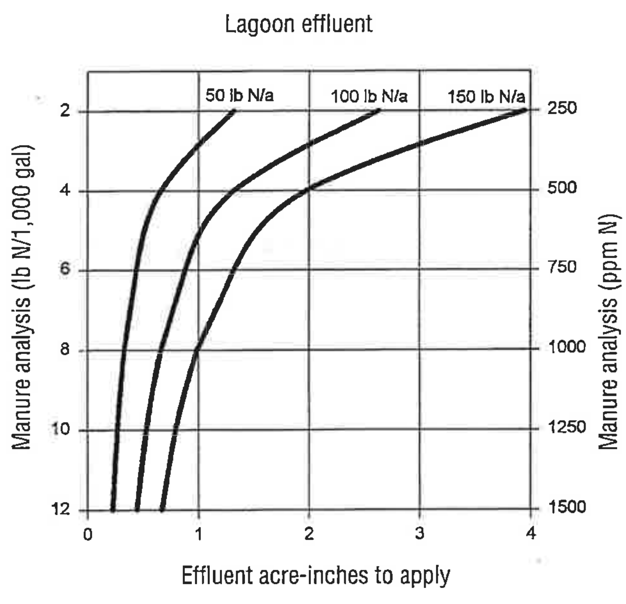

Figure 2.—Determining application rate for lagoon effluent.

Note: For reception-tank manure, approximately 70 percent of the total N is considered available. For lagoon effluent, 100 percent of the total N is considered available.

Table 1.—Nitrogen, phosphorus, and potassium removal of common perennial and annual forage crops.

Crop (dry matter)	Cuttings (no.)	DM[1] (%)	CP[1] (%)	N (lb/t)	P (lb/t)	K (lb/t)	DM (t/a)	N used (lb/a)
Red clover	1	100	18	58	8	48	4	232
Alfalfa hay	3	100	20	64	8	42	5	320
Perennial grass (low intensity)	1–2	100	10	32	6	38	4	128
Perennial grass (medium to low intensity)	2–3	100	12	38	6	38	4.5	171
Perennial grass (medium intensity)	4–5	100	15	48	7	38	5	240
Perennial grass (medium to high intensity)	5–6	100	18	58	8	40	6	348
Perennial grass (high intensity)	6–8	100	20	64	8	40	7	448
Annual ryegrass	1	100	12	38	6	38	4	152
Annual ryegrass	2	100	15	48	7	40	5	240
Corn silage	1	100	8	25	4	20	8	200
Small grains (boot stage)	2	100	12	38	5	32	5	190
Small grains (soft dough)	1	100	8	25	5	30	4	100
Crop (as harvested)	**Cuttings (no.)**	**DM[1] (%)**	**CP[1] (%)**	**N (lb/t)**	**P (lb/t)**	**K (lb/t)**	**AH[1] (t/a)**	**N used (lb/a)**
Red clover	1	25	5	14	2	12	16	232
Alfalfa	3	30	6	19	2	12	16	320
Perennial grass (low intensity)	1–2	30	3	10	2	11	13	128
Perennial grass (medium to low intensity)	2–3	30	4	11	2	11	15	171
Perennial grass (medium intensity)	4–5	30	5	14	2.1	11	17	240
Perennial grass (medium to high intensity)	5–6	30	5	17	2.4	12	20	348
Perennial grass (high intensity)	6–8	30	6	19	2.4	12	23	448
Annual ryegrass	1	30	4	11	1.8	11	13	152
Annual ryegrass	2	25	4	12	1.8	10	20	240
Corn silage	1	25	2	6.7	1	5	30	200
Small grains (boot stage)	2	30	4	11	1.5	10	16	190
Small grains (soft dough)	1	30	2	8	1.5	9	13	100

[1]DM=dry matter; CP=crude protein; AH=as harvested

where manure has been applied unless the applications were light and a high yield of grass hay was removed. A manure application that meets crop N needs usually supplies sufficient amounts of P and K. Manure contains as much, if not more, K than N. For more information, see *Dairy Manure as a Fertilizer Source* (EM 8586).

In fact, fields that have received manure for a decade or more often have high soil test values for P and K. Fields with soil test K above 1,000 ppm can produce grass forage with a high K concentration. Dry cows fed grass forage containing more than 3 percent K may become seriously ill or die.

In some cases, a soil test shows excessive K, but N is needed. In this case, if another area is available for manure application, apply manure there and buy N fertilizer for the area that has excess K.

Contact your county office of the OSU Extension Service for additional information.

Soil and plant tissue testing for N

The tables and figures in this publication only estimate manure application rates. A soil test for nitrate nitrogen or a stalk nitrate test for silage corn can aid in adjusting manure application rates.

Table 2.—Interpretation of soil tests for P and K.

Soil status	Nutrient (ppm) Phosphorus (P)	Potassium (K)
Deficient	below 25	below 150
Sufficient	25–50	150–500
High	50–75	500–1,000
Excess	above 75	above 1,000

For more information, see *The Presidedress Soil Nitrate Test* (EM 8650) and *Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascades* (EM 8832).

For more information

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