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AWMP # 12060

MA # 62912

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FOR Salem

Animal Waste Management Plan
December 2011

Vogel Dairy

Operated by:

David W. Wolf
4232 Scenic Drive
Central Point, Oregon 97502

Facillity:
5325 Tolo Road
Central Point, Oregon 97502
(541) 664-2628
County Jackson

Operation:

Holstein Dairy
State CAFO

As owner and operator of Vogel Dairy, I intend to manage in accordance with the practices described in this Animal Waste Management Plan.

Operator/Owner

Signature David L Wolf Date 3-5-12

RECEIVED

MAR 08 2012

NATURAL RESOURCES
DIVISION

GENERAL NARRATIVE DESCRIPTION

Vogel Dairy is located at 5325 Tolo Road near Central Point, Oregon and is owned and operated by David W. Wolff. The operation is a State CAFO facility in Jackson County. This Holstein dairy facility is in operation year round. The operation is made up of 115 acres of range ground and 10 acres of riparian pasture where all grazing occurs, and 149 acres of hay/crop ground.

Manure Collection Methods

The animals are in the main facility for milking and winter confinement. All facilities are dry scraped and manure is handled both as a liquid and as a solid. Contaminated runoff and any liquid wastes drain by gravity to the collection tank. Manure Liquids are transferred by 4 inch buried transfer line but can be moved by tank wagon or tractor, from the collection tank to the storage pond.

Manure Storage Facilities and Transfer

The manure generated at the facility is handled both as a liquid and as a solid. Manure is collected in a 20'x16'x6' rectangular collection sump, that alows liquids to flow by gravity to the storage pond. By itself the reception tank provides about ten days worth of storage while still providing storage for the 25 year 24 hour event. Manure can also be moved by tanker or tractor to the storage pond. Manure is stored in a 50'x100'x3' manure storage pond. Between the pond and the reception tank the operation has aproximately 180 days worth of storage. All manure is applied to Range,Pasture, and crop ground owned by Vogel Dairy. Manure is either hauled in a solid spreader or a tank wagon. Solid material may be hauled to the field in a dumptruck and spread by tillage equipment.

Manure Utilization

All manure is spread to hay/pasture and crop ground. Manure is applied year round as weather and soil conditions permit and as the crops can use the nutrients.

SPECIFIC DESCRIPTIONS AND CALCULATIONS

Land Application Areas

Aerial photos showing field locations for all manure application acreage, surface water features and headquarters are included in this Animal Waste Management Plan.

All fields are available for manure applications on the farm. The Riparian pasture surrounds Willow Creek and will not receive manure applications except from grazing animals. The riparian pasture provide a greater than 35 foot setback where manure applicationwill not occur. Vogel dairy will observ a 35 foot setback from surface waters for all mecanical manure applications.

Nine different soil types make up the manure application acreage. Soil Types include barron coarse sandy loam (10B), Camas sandy loam (21A), Central point sandy loam (31A), Coleman loam (34B), Gregory silty clay loam (76A), Kubli loam (100A), Medford silty clay loam (127A), Ruch silt loam (157B), and Vannoy silt loam (196E) Map unit descriptions are included with this plan.

Manure and Waste Volumes

Calculated volumes of all manure, bedding, have been completed using the Oregon Animal Waste Management Worksheet (ORAWM) based from the NRCS Agricultural Waste Field Handbook. The worksheet is included in this Animal Waste Management Plan.

Nutrient Content of Manure, Litter and Process Waste Water

Oregon Animal Waste Management Worksheet was used to estimate volume of manure.

Farm Nutrient Balance

The amount of nutrients (N, P, K) generated, lost in storage, lost during application, used by crops and exported off of the farm is supplied for this plan using the Oregon Animal Waste Management Worksheet, included with this Animal Waste Management Plan. Vogel Dairy is balancing for nitrogen, which is the most limiting nutrient as determined by the NRCS Phosphorus Index. The index shows that fields have a Site Vulnerability Class of LOW.

Application Schedule and Limitations

Manure that is applied to the 149 acres of hay/crop ground on the farm is applied as weather permits and the hay can use the nutrients. Applications are typically made year round. All manure is applied to permanent grass, alfalfa and cereal crops. A dump truck and tillage equipment, a tanker, and/or a manure spreader are used to apply manure.

There is a no-spread area along Willow creek. A thirty-five foot setback where no mecanical manure applications will occur, will be observed in this area.

Animal Mortality Management

Animal mortalities are taken to a local landfill or buried according to state and local law on the operations property.

Record Keeping and Reporting

Soil sample test results are supplied by A&L laboratories. Vogel Dairy records date and amount of manure exported to their customers and records date, field, and amount of manure for manure applied to their own crop ground. Application records showing the amount of Nitrogen and Phosphorus applied will be kept.

Vogel Dairy will report any discharge within 24 hours to the Oregon Department of Agriculture. Annual reports including amount of manure applied and exported will be submitted each year.

Operation and Maintenance

Above and/or Below Ground Liquid Tank

The tank serves as a collection point for effluent to drain to or be scraped from the animal feeding areas. If the tank will provide storage capacity to the waste management system it shall be completely emptied at the beginning of the storage period and the contents applied to cropland as weather and crop conditions permit. A 1-foot free board will be maintained to prevent spillage. Continually maintain all pumps, agitators, piping valves and all other electrical and mechanical equipment in good operating condition by following manufacturer's recommendations. Float valves will be maintained in good working order. Perform daily inspections of waterlines including drinking water or cooling water lines. Repair leaking lines immediately to prevent excess water from entering the waste storage system. Depth markers are installed to assure maximum volume will be maintained and checked weekly. At least once every 5 years, the tank shall be emptied and inspected for structural damage and leakage. Any damage found shall be corrected before putting the tank back in service. Remove all foreign debris within the structure that may cause damage to pumps and agitator. If below ground, the tank lid will not be subjected to more than two, 8,000 pound wheel loads. Before entering a tank, for any reason whatever, proper ventilation shall be provided, and self-contained breathing

apparatus shall be used, if required, when entering a covered tank. No one shall enter the tank unless safety ropes are used and someone else capable of providing assistance is outside of the tank. Warning: Entering Unventilated Tanks Is Extremely Dangerous.

Animal Access Lanes or Walkways

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

Agitator

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

Concrete Gutters

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

Curbs

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

Culverts

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

Fencing

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

Filter Strips

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

Gutters and Downspouts

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

Manure Application Equipment

All manure application equipment (including but not limited to sprinklers, big gun irrigators, spreaders and/or tank wagons) will be operated and maintained according to the manufacturer's manual. Equipment found to be broken or worn

will be replaced. Equipment will be calibrated to ensure recommended rates are applied. Liquids will be drained from sprinklers or big guns prior to freezing weather. When system is flushed, rinse water is used following waste, and liquid and sediment is applied agronomically. Nozzles will be checked periodically and if worn, nozzles will be replaced. Minimize exposure to animal and organic waters and manure gasses. Wear protective clothing when appropriate. When cleaning equipment after nutrient application, remove and save wastes in an appropriate manner. Avoid applying manure near surface water and use extreme care to avoid contaminating ground water.

Manure Effluent and Irrigation Transfer Lines.

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

Pumps

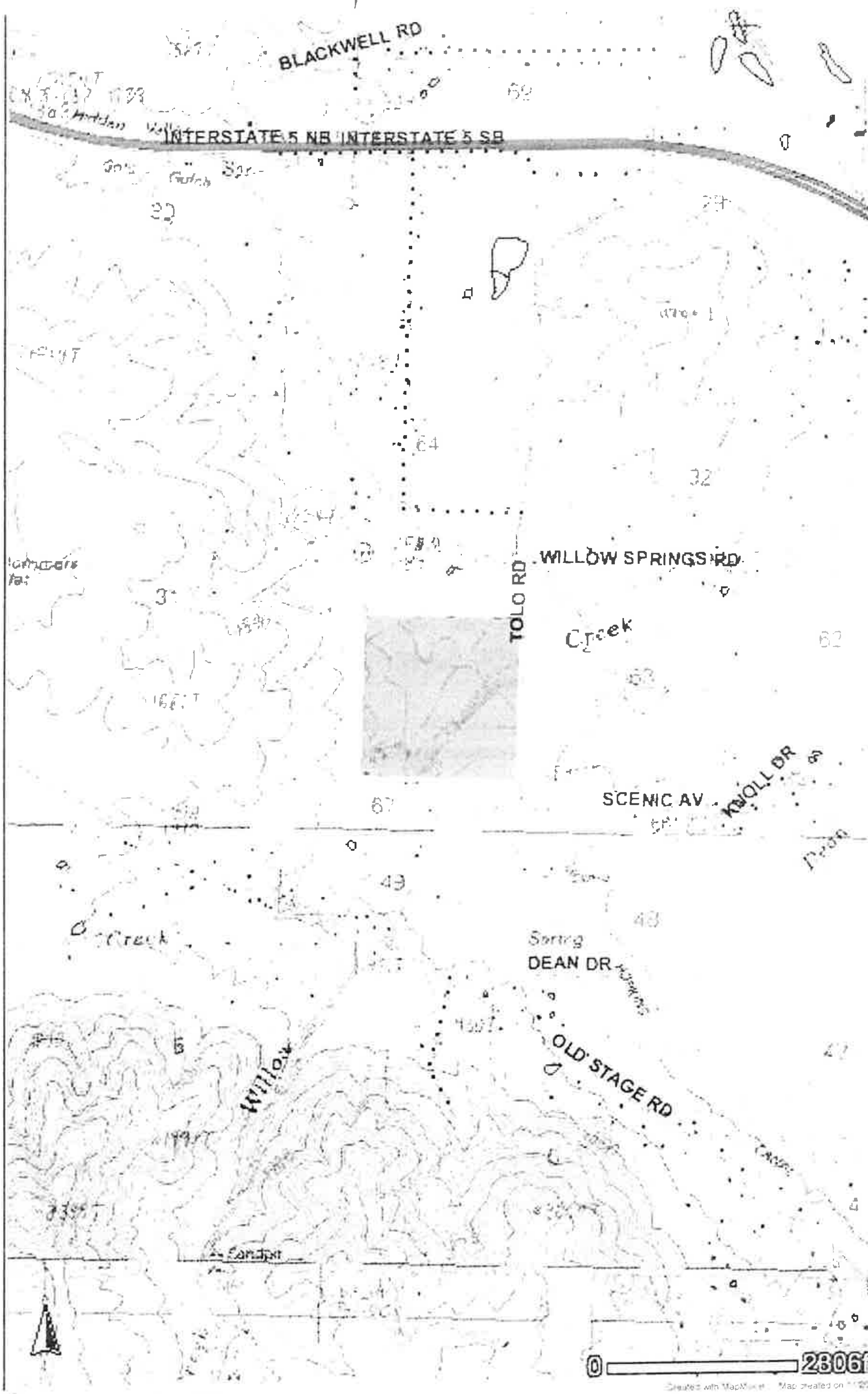
Pumps will be maintained in accordance with manufacturer's operation and maintenance manual. Effluent will be drained from pumps prior to freezing weather. Pumps will be inspected periodically to identify and remove debris wrapped around impeller or worn parts. Appropriate action will be taken to repair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

Roofs

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

Trough or Tank

Watering facility will be inspected periodically. Damaged tank/trough will be repaired or replaced. Float valves will be maintained in good working order. Area immediately surrounding the trough/tank will be maintained in a stable condition.



JACKSON COUNTY
INFORMATION TECHNOLOGY

Vogel Dairy topo map

Front Counter Legend

Highlighted Feature

Wetlands

wetland

upland

Streams and Ditches

Streams

Canal

Siphon / Underground

City Limits

Ashland

Butte Falls

Central Point

Eagle Point

Gold Hill

Jacksonville

Medford

Phoenix

Rogue River

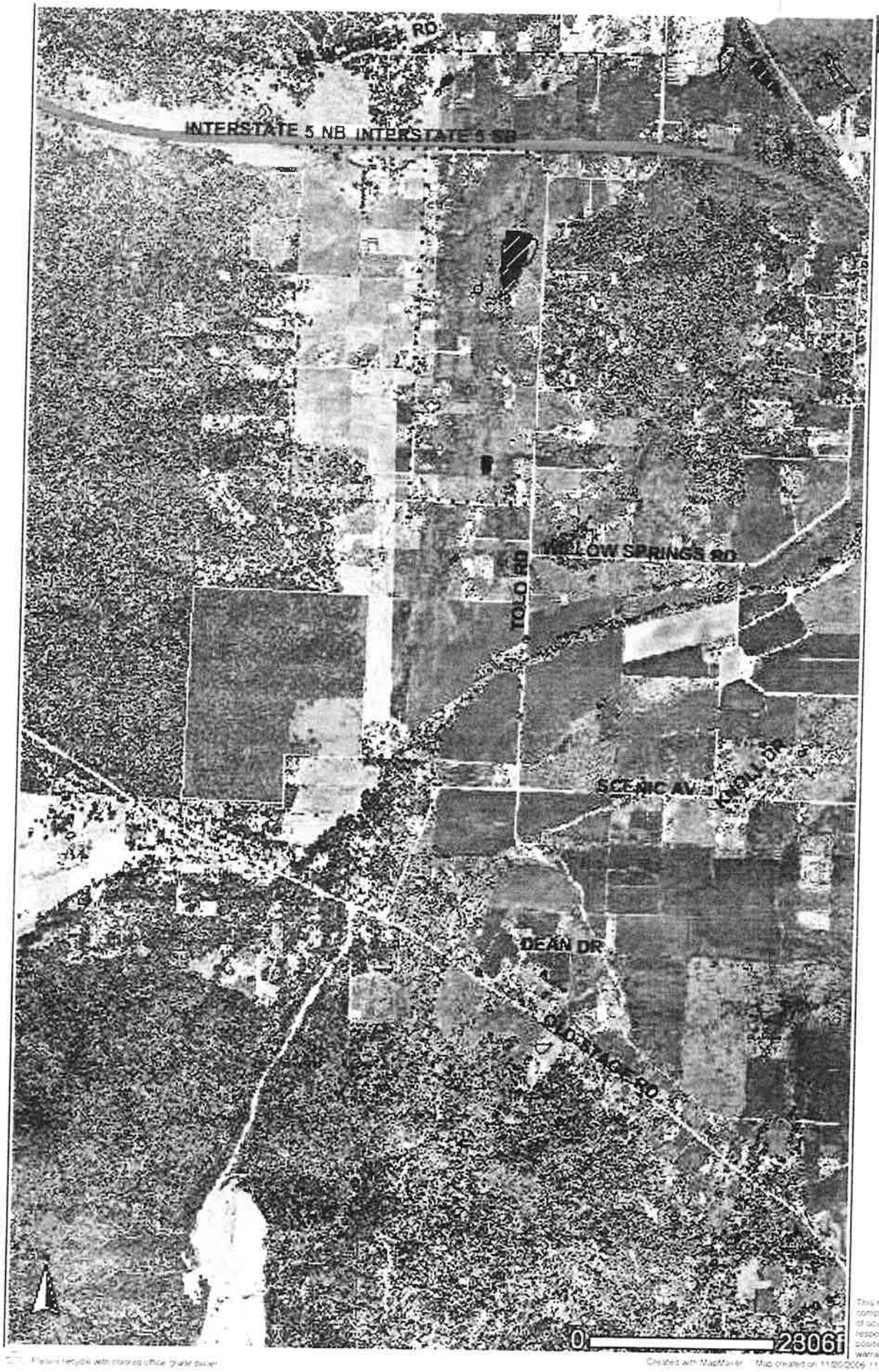
Shady Cove

Talent

USGS 7 1/2 Minute Quad Maps

Rogue Valley Sewer Service Sewer Lines

JACKSON COUNTY
Oregon



JACKSON COUNTY

INFORMATION TECHNOLOGY

vogel dairy range

Front Counter Legend

Highlighted Feature

Wetlands

Streams and Ditches

Streams

City Limits

Ashland

Butte Falls

Central Point

Eagle Point

Gold Hill

Jacksonville

Medford

Phoenix

Rogue River

Shady Cove

Talent

Rogue Valley Sewer Service Sewer Lines

JACKSON COUNTY
Oregon

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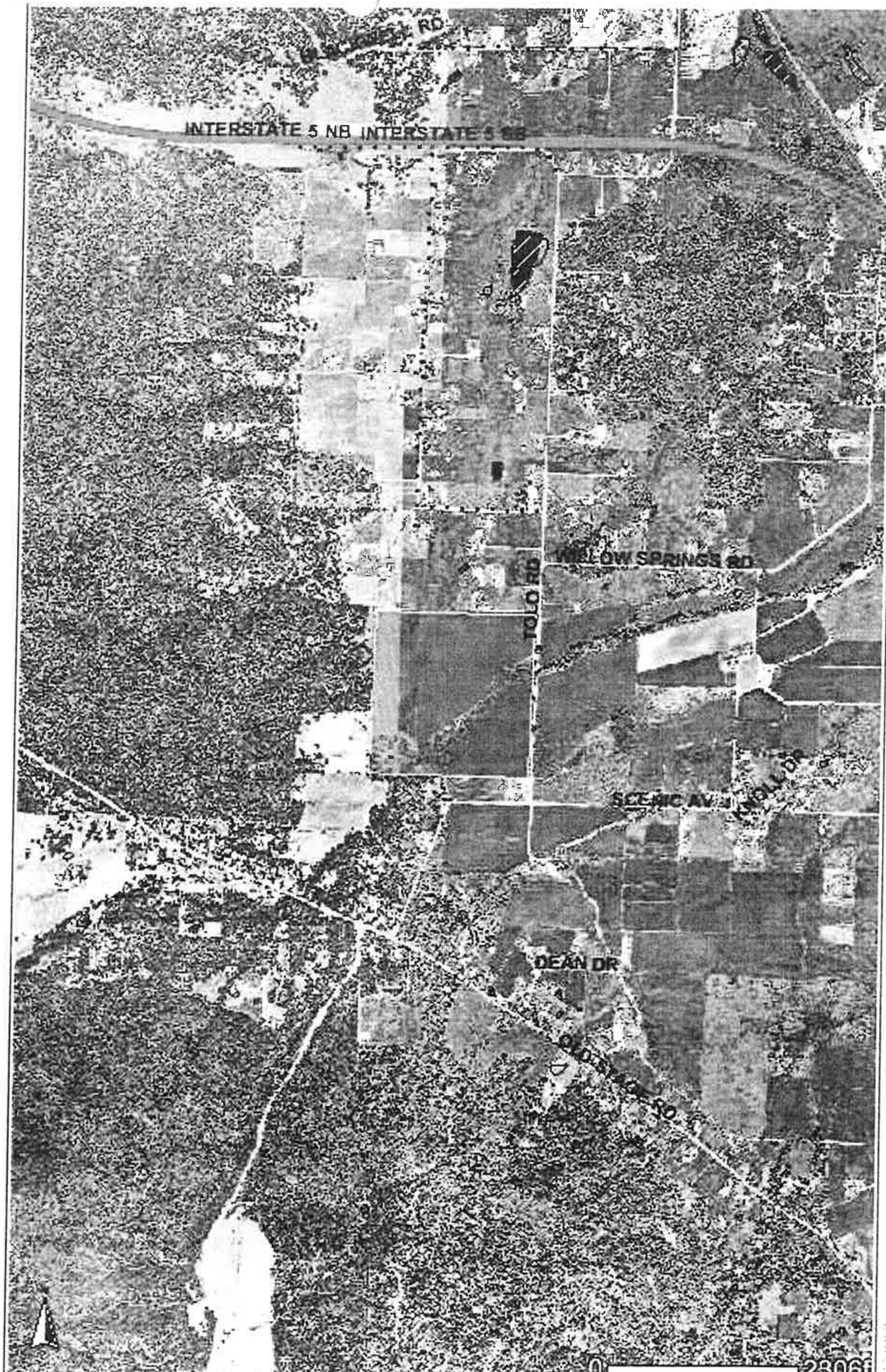


JACKSON COUNTY

INFORMATION TECHNOLOGY

Vogel dairy Main fields

Front Counter Legend

Highlighted Feature

Wetlands

Wetland

Upland

Streams and Ditches

Streams

Canal

Siphon / Underground

City Limits

Ashland

Butte Falls

Central Point

Eagle Point

Gold Hill

Jacksonville

Medford

Phoenix

Rogue River

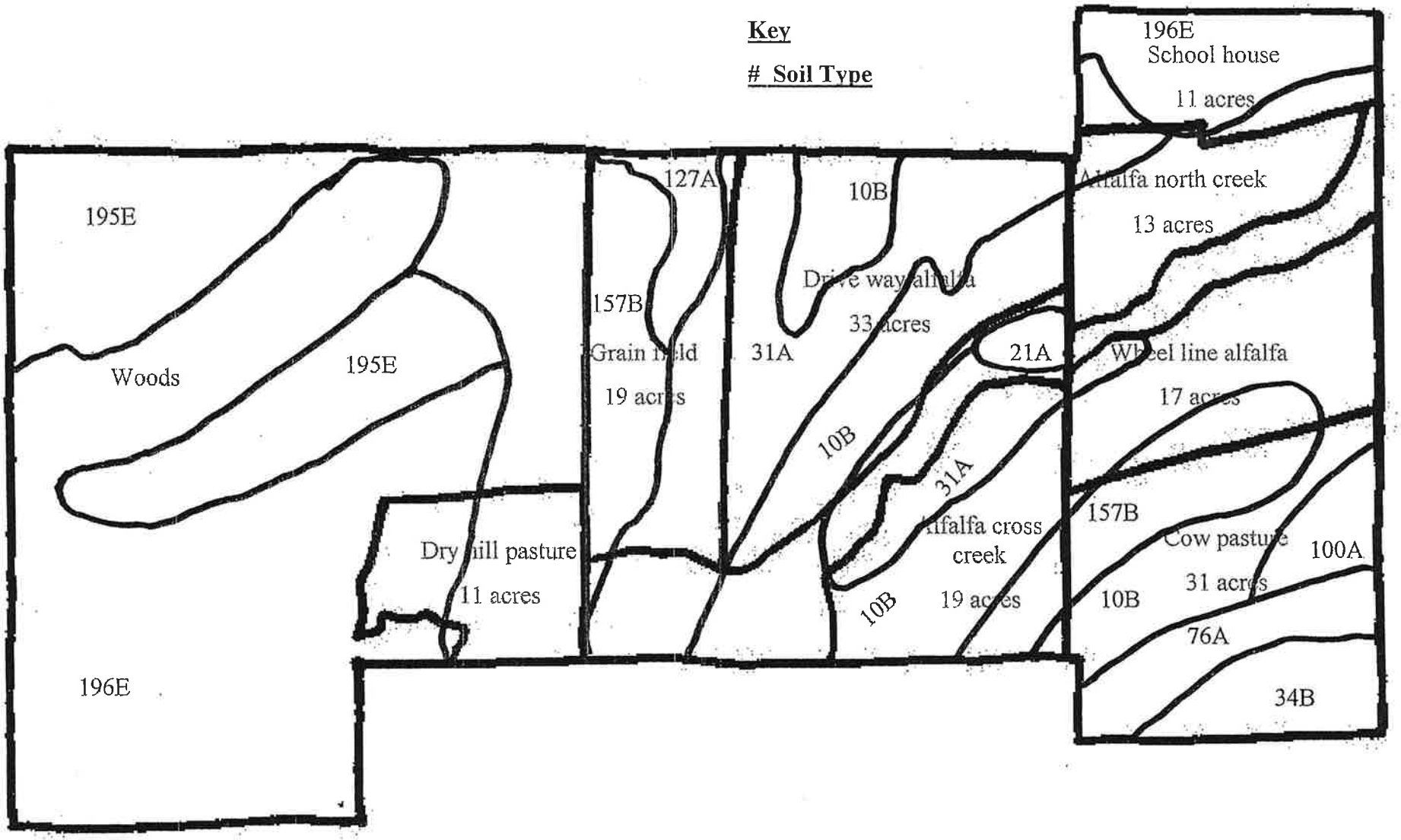
Shady Cove

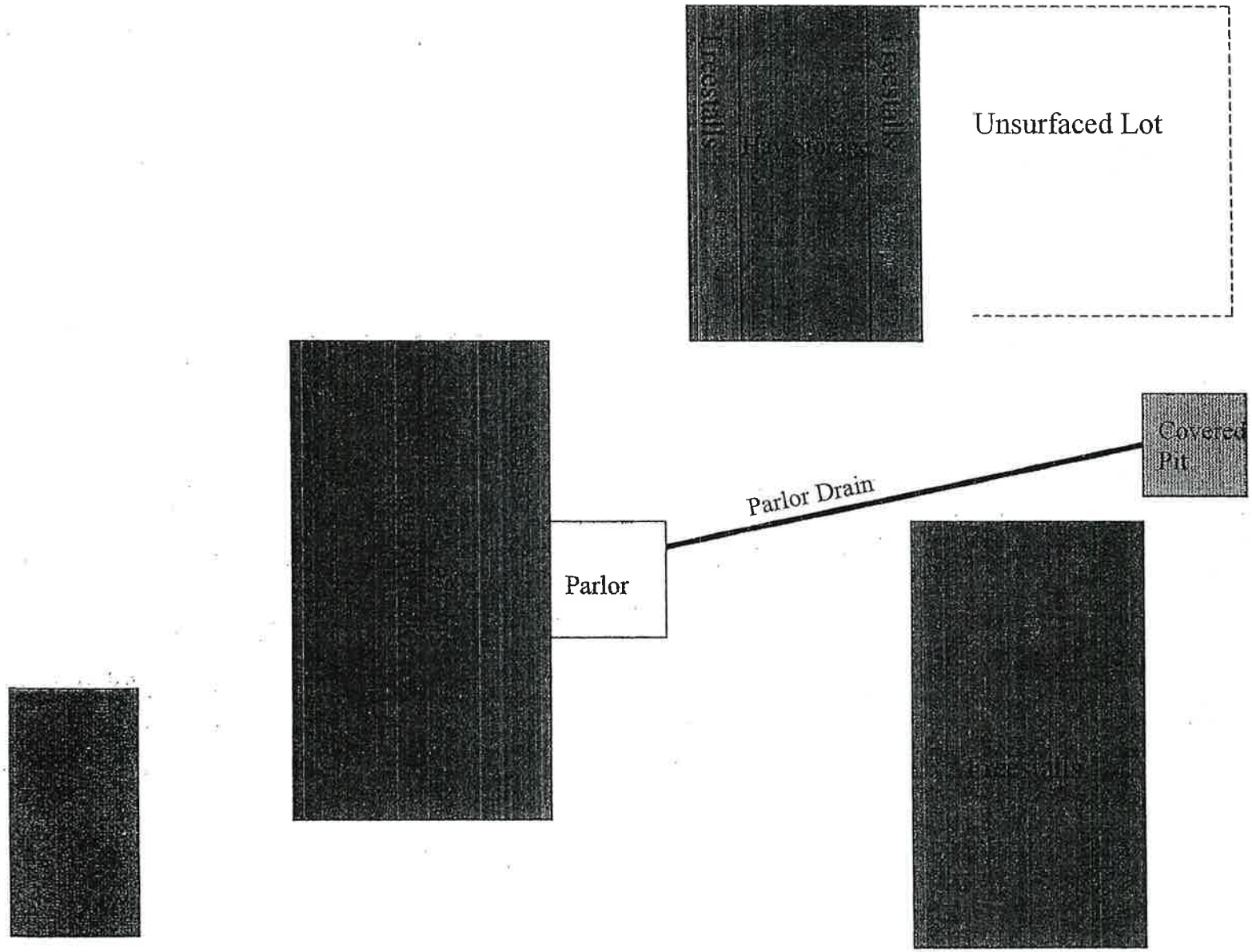
Talent

Rogue Valley Sewer Service Sewer Lines

JACKSON COUNTY
Oregon

Created with MapMaker


Key
Soil Type
196E
School house
11 acres
195E
127A
10B
Alfalfa north creek
13 acres
Drive way alfalfa
33 acres
157B
Grain field
19 acres
31A
21A
Wheel line alfalfa
17 acres
Woods
195E
10B
31A
Alfalfa cross creek
19 acres
157B
Cow pasture
31 acres
100A
Dry hill pasture
11 acres
10B
10B
76A
196E
34B

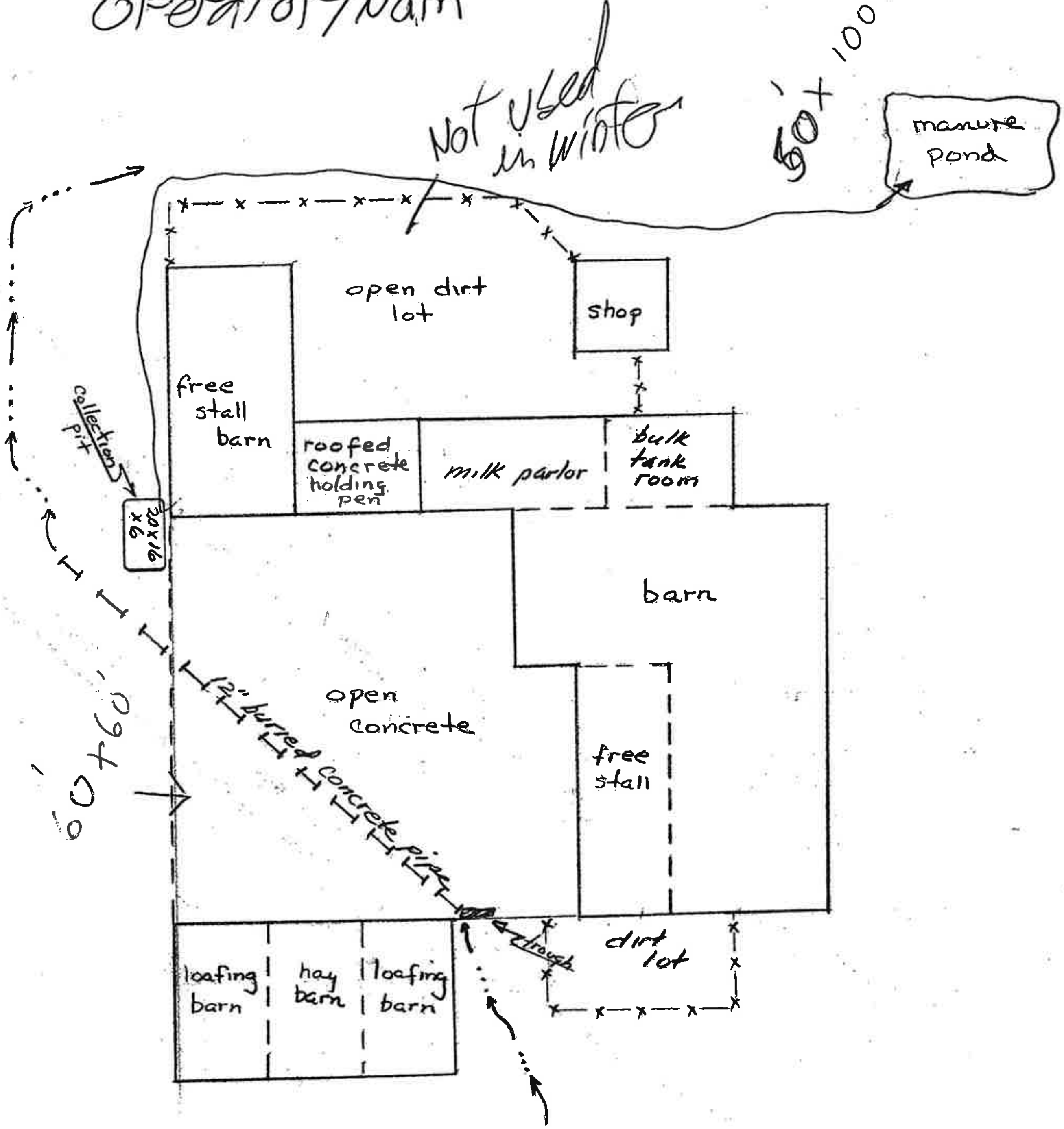

Freestalls
Hay Storage
Freestalls
Unsurfaced Lot
Covered
Pit
Parlor Drain
Parlor

COMPUTATION SHEET
SCS–ENG–523 Rev. 8–69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE OREGON		PROJECT	
BY R. Edwards	DATE 5/00	CHECKED BY	DATE	JOB NO.
SUBJECT [illegible] Vogel Dairy				SHEET 1 OF 1

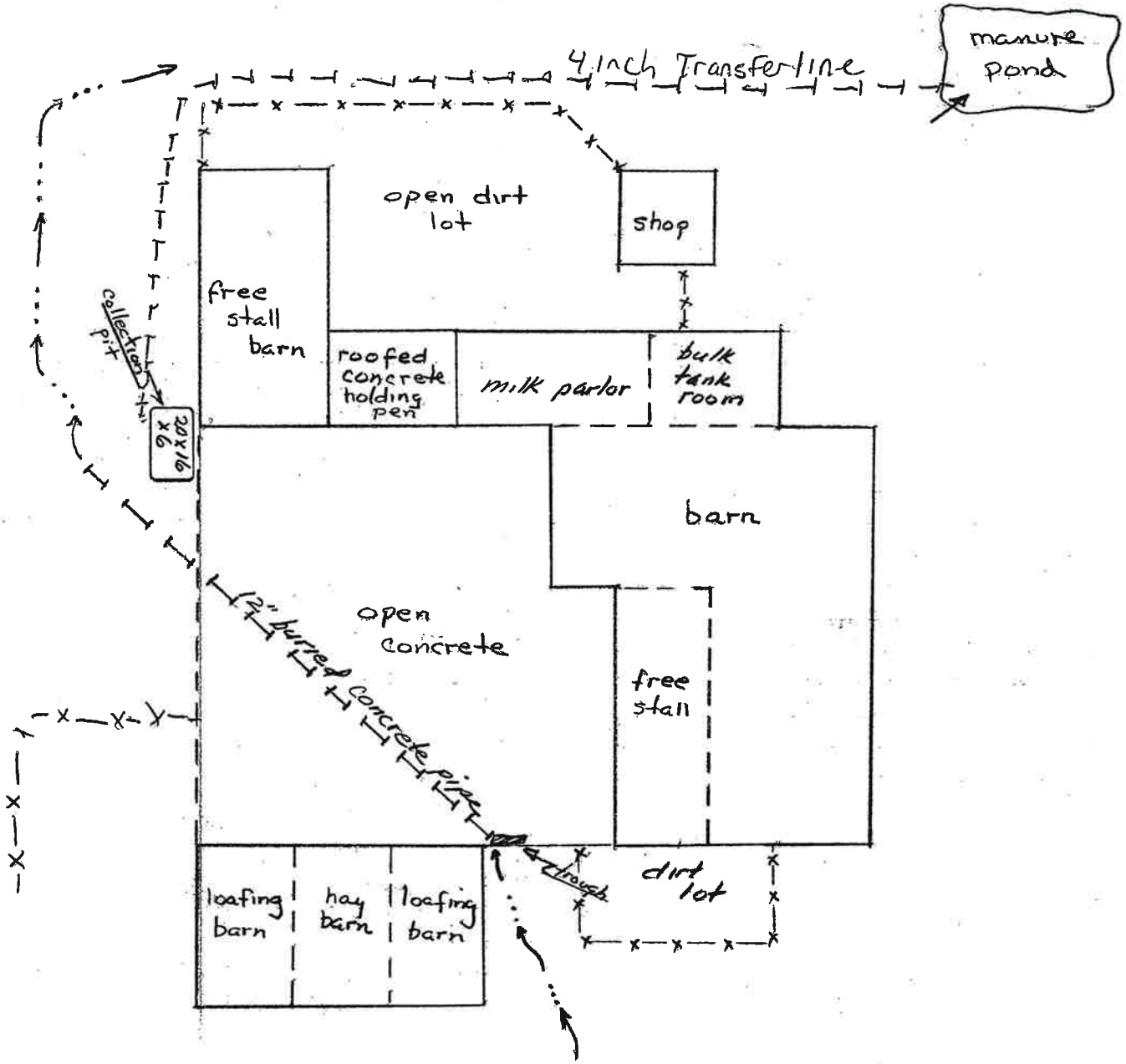
(David W. Wolff)
send atr for
operator/nam



COMPUTATION SHEET
SCS–ENG–523 Rev. 8–69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE OREGON		PROJECT		
BY R. Edwards	DATE 5/00	CHECKED BY	DATE	JOB NO.
SUBJECT Ray Vogel Dairy				SHEET 1 OF 1



PHOSPHORUS INDEX WORKSHEET – **WESTERN** OREGON

Tract _____ Fields _____

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) x 0.10	(21 (Soil Test P) - 40) x 0.10 = _____			Assign 0 points if Soil Test P < 40 ppm	0	
Commercial P Fertilizer Application Rate	1.00	lbs/ac P_2O_5 x 0.02	0 (lbs/ac P_2O_5) x 0.02 = _____				0	
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)	0	
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 x 0.02	61 (lbs/ac P_2O_5) x 0.02 = 1.22				1.22	
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)	8	

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	Low
13.0 – 25.0	Medium

	Current	Planned
Transport Factors Subtotal (TFS)	7.25	
Source Factors Subtotal (SFS)	9.22	
Total Rating Value (TFS + SFS)	16.47	

October 2001

PHOSPHORUS INDEX WORKSHEET – **WESTERN** OREGON

Producer: David Wolff Vogel Dairy County: Jackson Tract No. _____ Field No(s). All Date: 12-20-11

Soil Map Unit(s): 10B 21A 31A 34B 76A 100A 121A 157B Soil Test P: 21 ppm Lab. Method: Brey Sample Depth: 12"

Crop Rotation: Grass or Grass/Afalfa or Grass/Cereal Nutrient Application Method(s) Tank Wagon - Solid Spreader - Truck and Spread

Planner: ODA Notes: Worst Case Scenario

TRANSPORT FACTORS	Factor Weight	PHOSPHORUS LOSS RATING					Weighted Rating Value	
		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)	3	
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)	.75	
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	2	
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	
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)		
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)		

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET

Version HRv3.0

12/22/11
STATE: OREGON

CLIENT: Vogel Dairy
ASSISTED BY: ODA
CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

ANIMAL INVENTORY

Milk Production in Pounds/Cow/Day= 60

Type of Animal	Number of Animals	Average Weight (lbs.)	Animal Units (1,000 lb.)	Nutrient Production (lbs./day/1000 lb. Animal Unit) N	P	K	Nutrient Production (lbs./day) N	P	K	Manure CF/D/AU	Annual Days Confined	Annual Days Grazed
MILKER (Holstein)	55	1,300	71.5	0.68	0.11	0.31	48.62	8.19	22.27	1.63	365	0
MILKER (DRY)	5	1,400	7.0	0.33	0.07	0.17	2.31	0.49	1.19	0.92	203	162
HEIFERS (12-24 Months)	25	700	17.5	0.27	0.05	0.12	4.66	0.80	2.10	0.90	203	162
CALVES (1-12 Months)	10	150	1.5	0.42	0.05	0.11	0.63	0.08	0.17	1.34	365	0
Totals/Averages-	95	888	97.5	0.58	0.10	0.26	56.2	9.6	25.7	1.4		

GRAZING PERIOD

Type of Animal	Percent of Month and Number of Animals Grazing OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AU-YR.
MILKER (Holstein)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	55	55	55	55	55	55	55	55	55	55	55	55	0
MILKER (DRY)	60%	0%	0%	0%	0%	0%	10%	60%	100%	100%	100%	100%	
	5	5	5	5	5	5	5	5	5	5	5	5	3
HEIFERS (12-24 Months)	60%	0%	0%	0%	0%	0%	10%	60%	100%	100%	100%	100%	
	25	25	25	25	25	25	25	25	25	25	25	25	93
CALVES (1-12 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	10	10	10	10	10	10	10	10	10	10	10	10	0
													0
													0
													0
													0
													0
Total AUM's Available>	0	0	0	0	0	0	0	0	0	0	0	0	
Total AUM's Needed>>>	15	0	0	0	0	0	0	0	0	0	0	0	0
Total AUM's>>>>>>>>>>	-15	0	0	0	0	0	2	15	25	25	25	25	130
							-2	-15	-25	-25	-25	-25	-130

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET

Version HRv3.0

12/22/11
STATE: OREGON

CLIENT: Vogel Dairy
ASSISTED BY: ODA
CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

WEATHER STATION

MEDFORD EXP STA

Month	Precipitation	Evaporation	Paved	Unpaved
	25Yr-24Hr	4.00	Lot Runoff Factors as a Percent of Monthly Precipitation	
	Monthly Average in Inches			
October	1.39	1.38	50%	10%
November	3.06	0.56	50%	15%
December	2.85	0.33	50%	15%
January	2.45	0.39	55%	20%
February	2.09	0.95	45%	10%
March	2.25	1.67	40%	10%
April	1.43	2.68	30%	10%
May	1.30	3.98	35%	10%
June	0.76	4.96	35%	10%
July	0.49	6.22	30%	0%
August	0.54	5.11	30%	10%
September	0.97	3.08	40%	10%
Annual	19.58	31.31		

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	3,600
Unpaved Lot Area >>>	0
Roof Area >>	0
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>>>>>>>>>>>>>>>>>	3,600

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	55.0	2	0.25	28	3.7
Equipment Wash		2	100.00	200	26.7
Flushwater		2	0.00	0	0.0
Miscellaneous		2	10.00	20	2.7
Total>>>				248	33.1

CROP DATA

Field Number	Acres	Crop	Condition	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre: Nitrogen N	Phosphorous P_2O_5	Potassium K_2O
range	115.0	Fescue Hay/Pasture	DHM	Ton	1.00	29	14	40
driveway field	50.0	Alfalfa Hay	DHM	Ton	6.00	270	60	270
across creek	19.0	Alfalfa Hay	DHM	Ton	6.00	270	60	270
across road	80.0	Hay/Pasture Mix 16 % Protein	DHM	Ton	4.00	205	57	157
creek pasture	10.0	Fescue Hay/Pasture	DHM	Ton	2.00	59	28	80
Off-Farm								

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET

Version HRv3.0

12/22/11
STATE: OREGON

CLIENT: **Vogel Dairy**
ASSISTED BY: **ODA**
CHECKED BY:

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 (Holstein)	Free Stall	Sawdust	**12.00**	**3.00**	**0.25**	18	215
MILKER (DRY)	Free Stall	Sawdust	**12.00**	**3.00**	**0.25**	2	21
HEIFERS (12-24 Months)	Loose Housing	Loose Straw	**2.50**	**2.04**	**0.25**	4	36
CALVES (1-12 Months)	Loose Housing	Loose Straw	**2.50**	**25.00**	**0.25**	0	38

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 (Holstein)	Dry Scrape System								
MILKER (DRY)	Dry Scrape System	**98%**	132	3	2	114	1	**36**	4,747
HEIFERS (12-24 Months)	Dry Scrape System	**98%**	8	0	0	6	0	**36**	289
CALVES (1-12 Months)	Dry Scrape System	**98%**	20	0	0	15	0	**36**	710
		98%	2	0	0	2	0	**36**	84
Total Solids>>			162	3	3	138	2		5,830

U.S. Department of Agriculture
Natural Resources Conservation Service

CLIENT: Vogel Dairy
ASSISTED BY: ODA

ANIMAL WASTE MANAGEMENT WORKSHEET
Version HRv3.0

CHECKED BY:

12/15/11
STATE: OREGON

ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY VOLUMES

Month	Runoff in Cubic Feet: Roof Area Square Feet 0	Paved Slab Area Square Feet 3,600	Unpaved Lot Area Square Feet 0	Silage Pit Surface Area, SF 0	Facility Water Use Cubic Feet	Manure Solids Cubic Feet	Manure Liquids Cubic Feet	Bedding Cubic Feet	Bedding Pounds	Solids Separated Cubic Feet	Solids Separated Pounds	Solids in Liquids Cubic Feet	Solids in Liquids Pounds	Total Solids Cubic Feet	Total Liquids Cubic Feet
October	0	209	0	0	1,026	503	3,452	642	8,515	4,505	162,164	92	3,309	4,505	1,405
November	0	459	0	0	993	544	3,683	731	9,261	4,859	174,914	99	3,570	4,859	1,638
December	0	428	0	0	1,026	562	3,806	756	9,570	5,021	180,745	102	3,689	5,021	1,643
January	0	404	0	0	1,026	562	3,806	756	9,570	5,021	180,745	102	3,689	5,021	1,620
February	0	282	0	0	926	508	3,437	683	8,644	4,535	163,253	93	3,332	4,535	1,389
March	0	270	0	0	1,026	562	3,806	756	9,570	5,021	180,745	102	3,689	5,021	1,486
April	0	129	0	0	993	534	3,626	713	9,091	4,775	171,917	97	3,509	4,775	1,305
May	0	137	0	0	1,026	503	3,452	642	8,515	4,505	162,164	92	3,309	4,505	1,333
June	0	80	0	0	993	449	3,112	548	7,560	4,026	144,946	82	2,958	4,026	1,228
July	0	44	0	0	1,026	464	3,215	566	7,812	4,160	149,777	85	3,057	4,160	1,228
August	0	49	0	0	1,026	464	3,215	566	7,812	4,160	149,777	85	3,057	4,160	1,233
September	0	116	0	0	993	449	3,112	548	7,560	4,026	144,946	82	2,958	4,026	1,265
Annual	0	2,606	0	0	12,077	6,105	41,720	7,903	103,479	54,614	1,966,094	1,115	40,124	54,614	16,773

DAILY NUTRIENT PRODUCTION

Type of Animal	Pounds/Day of Nutrients from LIQUIDS: N	P2O5	K2O	Pounds/Day of Nutrients from SOLIDS: N	P2O5	K2O	Pounds/Day of Nutrients from GRAZING: N	P2O5	K2O
MILKER (Holstein)	0.97	0.38	0.54	47.65	18.40	26.29	0.00	0.00	0.00
MILKER (DRY)	0.05	0.02	0.03	2.26	1.10	1.41	2.31	1.12	1.43
HEIFERS (12-24 Months)	0.09	0.04	0.05	4.56	1.79	2.48	4.66	1.82	2.53
CALVES (1-12 Months)	0.01	0.00	0.00	0.62	0.18	0.19	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
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MONTHLY NUTRIENT PRODUCTION

Month	Pounds of Nutrients from LIQUIDS: N	P2O5	K2O	Pounds of Nutrients from SOLIDS: N	P2O5	K2O	Pounds of Nutrients from GRAZING: N	P2O5	K2O	Pounds of Nutrients going OFF-FARM: N	P2O5	K2O	Total Pounds of Nutrients from ALL SOURCES: N	P2O5	K2O
October	32	12	18	1,581	612	869	130	55	74	0	0	0	1,743	679	961
November	34	13	19	1,653	644	911	0	0	0	0	0	0	1,686	657	930
December	35	14	19	1,708	665	942	0	0	0	0	0	0	1,743	679	961
January	35	14	19	1,708	665	942	0	0	0	0	0	0	1,743	679	961
February	31	12	17	1,543	601	850	0	0	0	0	0	0	1,574	613	868
March	35	14	19	1,708	665	942	0	0	0	0	0	0	1,743	679	961
April	33	13	18	1,632	635	900	21	9	12	0	0	0	1,686	657	930
May	32	12	18	1,581	612	869	130	55	74	0	0	0	1,743	679	961
June	30	11	16	1,448	557	795	209	88	119	0	0	0	1,686	657	930
July	31	12	17	1,496	576	821	216	91	123	0	0	0	1,743	679	961
August	31	12	17	1,496	576	821	216	91	123	0	0	0	1,743	679	961
September	30	11	16	1,448	557	795	209	88	119	0	0	0	1,686	657	930
Annual	388	150	213	19,001	7,367	10,456	1,130	478	643	0	0	0	20,518	[illegible]	[illegible]

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET

Version HRv3.0

12/15/11
STATE: OREGON

CLIENT: **Vogel Dairy**
ASSISTED BY: **ODA**

CHECKED BY:

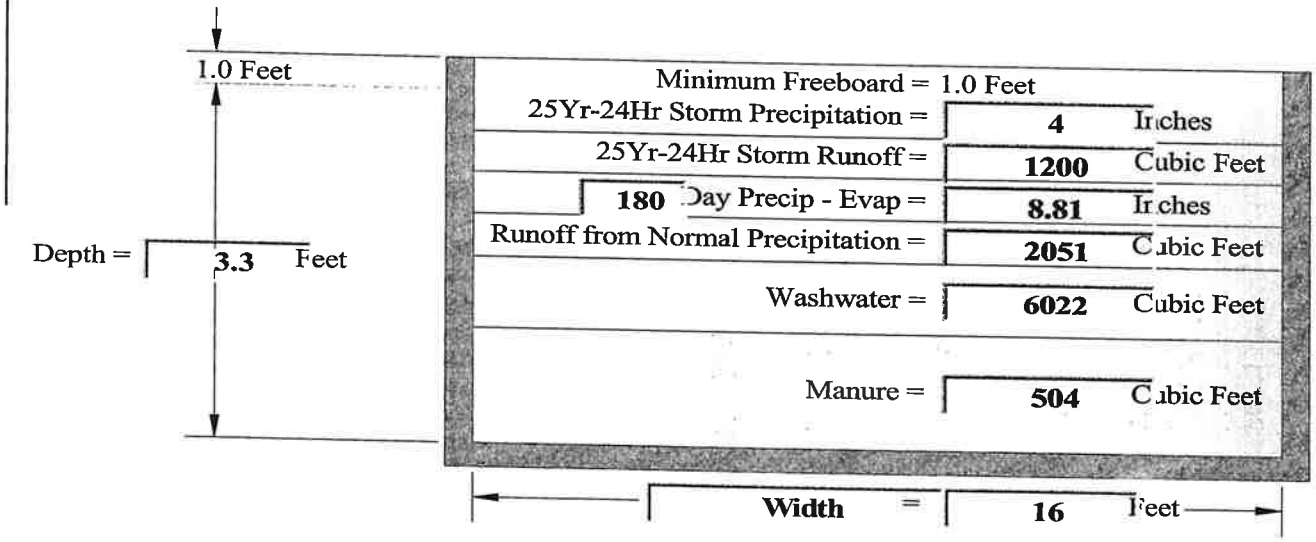
ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

TANK

Tank Parameters	Value
Storage Period, Days=	10
Tank Width, Feet=	0
Tank Length, Feet=	0
Existing Storage, Cubic Feet=	1,920.00
Surface Area of Existing Storage, SF=	320
25 Year-24 Hour Storm Runoff, CF=	1,200
Volume Needed, Cubic Feet=	1,874
Design Volume, Cubic Feet=	0
Is Tank Covered?	NO
Tank Dimensions?	Rectangular

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	0	0	209	1,026	79	92	1,197
November	30	0	67	459	993	85	99	1,176
December	31	0	67	428	1,026	87	102	1,216
January	31	0	55	404	1,026	87	102	1,216
February	28	0	30	282	926	79	93	1,098
March	31	0	15	270	1,026	87	102	1,216
April	30	0	-33	129	993	83	97	1,173
May	31	0	-71	137	1,026	79	92	1,197
June	30	0	-112	80	993	71	82	1,146
July	31	0	-153	44	1,026	74	85	1,184
August	31	0	-122	49	1,026	74	85	1,184
September	30	0	-56	116	993	71	82	1,146
Annual	365	0	-313	2,606	12,077	956	1,115	14,148



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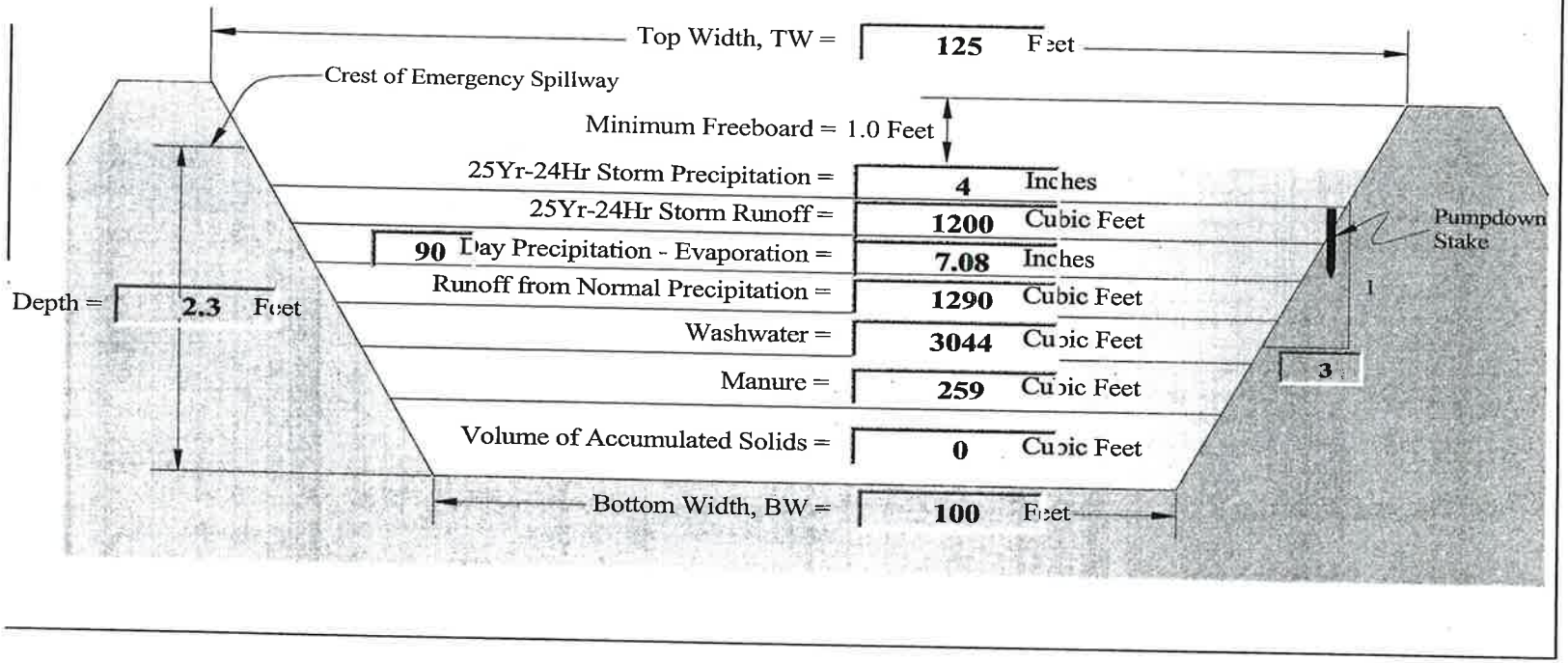
ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

WASTE STORAGE POND

Pond Parameters	Value
Storage Period, Days=	**160**
Side Slope (X:1)=	**2.00**
Bottom Width, BW, Feet=	**0**
Bottom Length, BL, Feet=	**0**
Accumulated Solids Duration, Years=	**0**
Existing Storage, Acre Feet=	**0.34**
Surface Area of Existing Storage, SF=	**5,000**
Minimum Soil Liner Depth, Feet=	**1.00**
25 Year-24 Hour Storm Runoff, CF=	**1,200**
Top Width, TW, Feet=	**0**
Top Length, TL, Feet=	**0**
Volume Needed, Acre Feet=	**0.3**
Design Volume, Acre Feet=	**0.0**

MONTHLY INFLOWS INTO WASTE STORAGE POND

Month	Number of Days	Rain-Evap on Pond CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Manure CF	Solids CF	Waste to Store CF
October	31	0	4	209	1,026	79	92	1,197
November	30	0	1,042	459	993	85	99	1,176
December	31	0	1,050	428	1,026	87	102	1,216
January	31	0	858	404	1,026	87	102	1,216
February	28	0	475	282	926	79	93	1,098
March	31	0	242	270	1,026	87	102	1,216
April	30	0	-521	129	993	83	97	1,173
May	31	0	-1,117	137	1,026	79	92	1,197
June	30	0	-1,750	80	993	71	82	1,146
July	31	0	-2,388	44	1,026	74	85	1,184
August	31	0	-1,904	49	1,026	74	85	1,184
September	30	0	-879	116	993	71	82	1,146
Annual	365	0	-4,888	2,606	12,077	956	1,115	14,148



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ANIMAL WASTE MANAGEMENT SYSTEM APPLICATION

MANAGEMENT CRITERIA FOR TRACTOR SPREADER APPLICATION OF SOLIDS

To apply **54,614** cubic feet of solids generated from the operation it will take approximately **274** 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/100CF	Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Inches of Solids to Apply	Travel Length per Load Needed in Feet	Loads per Acre
range	115	Fescue Hay/Pasture	160	199	15	3,624	22.61	29	1.00	0.1	2707	1
driveway field	50	Alfalfa Hay	160	199	15	3,624	22.61	270	1.00	0.5	295	10
across creek	19	Alfalfa Hay	160	199	15	3,624	22.61	270	1.00	0.5	295	10
across road	80	Hay/Pasture Mix 16 % Protein	160	199	15	3,624	22.61	205	1.00	0.4	389	7
creek pasture	10	Fescue Hay/Pasture	160	199	15	3,624	22.61	59	1.00	0.1	1354	2
0												
0												
0												
0												

MANAGEMENT CRITERIA FOR BIG GUN SPRINKLER APPLICATION OF LIQUIDS

To apply **125,459** gallons of liquids generated from the operation it will take approximately **7** 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
range	115	Fescue Hay/Pasture	300	250	3/4 Circle	110	0.92	29	1.00	1.80	0.97	3.06	1.07
driveway field	50	Alfalfa Hay	300	250	3/4 Circle	110	0.92	270	1.00	16.55	0.97	28.08	0.12
across creek	19	Alfalfa Hay	300	250	3/4 Circle	110	0.92	270	1.00	16.55	0.97	28.08	0.12
across road	80	Hay/Pasture Mix 16 % Protein	300	250	3/4 Circle	110	0.92	205	1.00	12.56	0.97	21.30	0.15
creek pasture	10	Fescue Hay/Pasture	300	250	3/4 Circle	110	0.92	59	1.00	3.61	0.97	6.12	0.53
0													
0													
0													
0													

MANAGEMENT CRITERIA FOR TANK WAGON APPLICATION OF LIQUIDS

To apply **125,459** gallons of liquids generated from the operation it will take approximately **31** 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
range	115	Fescue Hay/Pasture	4,000	15	110	0.92	29	1.00	0.77	557	5.2
driveway field	50	Alfalfa Hay	4,000	15	110	0.92	270	1.00	7.05	61	47.8
across creek	19	Alfalfa Hay	4,000	15							

ANIMAL WASTE MANAGEMENT SYSTEM APPLICATION

across road	80	Hay/Pasture Mix 16 % Protein	**4,000**	**15**	**110**	**0.92**	**205**	1.00	5.35	80	36.3
creek pasture	10	Fescue Hay/Pasture	**4,000**	**15**	**110**	**0.92**	**59**	1.00	1.53	279	10.4
0											
0											
0											
0											

U.S. Department of Agriculture
Natural Resources Conservation Service

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ANIMAL WASTE MANAGEMENT WORKSHEET

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ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation / Type of Storage Facility	Pounds of Nutrients Available			Percent Nutrients Retained After Storage			Pounds of Nutrients Retained After Storage		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Liquids	Dairy / Storage Pond (>50%) Dilution	388	150	213	30%	65%	80%	116	98	171
Solids	Solids Storage Facility (Unroofed)	19,001	7,367	10,456	65%	80%	80%	12,351	5,893	8,365
Grazing	NONE	1,130	478	643	100%	100%	100%	1,130	478	643

NUTRIENTS AVAILABLE AFTER APPLICATION

Nutrient Source	Type of Application System	Pounds of Nutrients Available			Percent Nutrients Retained After Application			Pounds of Nutrients Retained After Application		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Liquids	Sprinkling	116	98	171	75%	100%	100%	87	98	171
Solids	Broadcast (Incorporated 7 or more days after application)	12,351	5,893	8,365	70%	100%	100%	8,645	5,893	8,365
Grazing	Grazing	1,130	478	643	85%	100%	100%	960	478	643

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location / Soil Drainage Class	Pounds of Nutrients Available			Percent Nutrients Retained After Denitrification			Pounds of Nutrients Retained After Denitrification		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Liquids	Between Coastal and Cascade Mountains / Moderately Well Drained	87	98	171	87%	100%	100%	75	98	171
Solids	Moderately Well Drained	8,645	5,893	8,365	87%	100%	100%	7,522	5,893	8,365
Grazing	Moderately Well Drained	960	478	643	87%	100%	100%	835	478	643

U.S. Department of Agriculture
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ASSISTED BY: **ODA**

ANIMAL WASTE MANAGEMENT WORKSHEET

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ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

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

Field Number	Acres	Crop	LIQUIDS			SOLIDS			GRAZING		
			Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients
range	115.0	Fescue Hay/Pasture	0%	0	0	0%	0	0	98%	819	28
driveway field	50.0	Alfalfa Hay	100%	75	0	50%	3,761	14	0%	0	0
across creek	19.0	Alfalfa Hay	0%	0	0	15%	1,128	4	0%	0	0
across road	80.0	Hay/Pasture Mix 16 % Protein	0%	0	0	35%	2,633	13	0%	0	0
creek pasture	10.0	Fescue Hay/Pasture	0%	0	0	0%	0	0	2%	13	0
Off-Farm											
TOTALS-	274		0%	0		0%	0		0%	4	
			100%	75	0	100%	7,522	31	100%	835	28

NUTRIENT BALANCE BASED ON AVAILABLE ACRES

Field Number	Acres	Crop	NUTRIENTS APPLIED			- NUTRIENTS REMOVED			= NUTRIENT BALANCE		
			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
range	115.0	Fescue Hay/Pasture	7	4	5	29	14	40	-22	-10	-35
driveway field	50.0	Alfalfa Hay	77	61	87	270	60	270	-193	0	-183
across creek	19.0	Alfalfa Hay	59	47	66	270	60	270	-211	-14	-204
across road	80.0	Hay/Pasture Mix 16 % Protein	33	26	37	205	57	157	-172	-31	-120
creek pasture	10.0	Fescue Hay/Pasture	1	1	1	59	28	80	-58	-28	-80
Off-Farm											

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer:	Vogel Dairy	Tract(s): 503	Field(s): range
Assisted by:	ODA		Date: December 15, 2011

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
Fescue Hay/Pasture	1

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC
8	20	53	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			
29	120	14		40				

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop							
2. Residual from long-term manure application							
3. Irrigation water							
4. Other (e.g., atmospheric deposition)							
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	7	0	4	0	5	0
9.	Subtotal (sum of lines 6, 7 and 8)	7	0	4	0	5	0
10.	Nutrients Recommended (from Table 1)	29	120	14	0	40	0
11.	Nutrient Status (subtract line 10 from line 9)	-22	-120	-10	0	-35	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	7	P_2O_5	4	K_2O	5

Method, Form, and Timing of Application

Recommended application rates are based on OSU Extension Recommendations.

Planned applications are the result of grazing. If comercial fertilizers are used do not exceed OSU Extension Recommendations, (listed in Trial B above) while accounting for Grazing contributions. grazed areas should be harrowed at the end of the grazing season, or if manure accumulation produces plant growth or water quality concerns.

Manure should be reduced or not applied if soil tests show Phosphorous and Potassium concentrations increaseing over time and approach very high levels as determined by OSU Extension guidelines.

U.S. Department of Agriculture
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ANIMAL WASTE MANAGEMENT WORKSHEET

Version HRv3.0

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STATE: OREGON

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer:	Vogel Dairy	Tract(s): 503	Field(s): driveway field
Assisted by:	ODA	Date:	December 15, 2011

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
Alfalfa Hay/Grass hay	6

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC
22	21	42			

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			
270		60		270				

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop							
2. Residual from long-term manure application							
3. Irrigation water							
4. Other (e.g., atmospheric deposition)							
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-)		77	77	61	61	87	87
9. Subtotal (sum of lines 6, 7 and 8)		77	77	61	61	87	87
10. Nutrients Recommended (from Table 1)		270	0	60	0	270	0
11. Nutrient Status (subtract line 10 from line 9)		-193	77	1	61	-183	87

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	77	P_2O_5	61	K_2O	87

Method, Form, and Timing of Application

Application rates are based on crop uptake and are not to be exceeded rates. Manure applications are not expected to meet all crop needs and additional fertilzation may be necessary.

Commercial fertilizer could be applied as all nutrients can not be supplied by manure applications. Sulfur, Magnesium, Zinc and Boron should be applied in accordance with the OSU extension fertilizer guides and soil tests.

Use nutrient concentrations in storage to determine application rates to apply @60 pounds per acre of nitrogen . Use nutrient concentration in storage to determine solids spreader loads per acre to apply @60 pounds per acre of nitrogen. No more than a total of 77 pounds of nitrogen per acre should be applied to the alfalfa . The planned operation will provide enough manure to fertilize 50 acres at this rate each year.

Score card soil testing should be done in the fall to insure excessive nitrates are not available for leaching.

Manure should be reduced or not applied if soil tests show Phosphorous and Potassium concentrations continue to increase over time and approach very high levels as determined by OSU Extension.

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer:	Vogel Dairy	Tract(s): 503	Field(s): across creek
Assisted by:	ODA		Date: December 15, 2011

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
Alfalfa Hay/ Grass hay	6

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC
22	21	42			

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			
270		60		270				

Table 2. Nutrient Sources

Credits		N	P_2O_5	K_2O			
		pounds per acre					
1. Nitrogen credits from previous legume crop							
2. Residual from long-term manure application							
3. Irrigation water							
4. Other (e.g., atmospheric deposition)							
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-)		59	59	47	47	66	66
9.	Subtotal (sum of lines 6, 7 and 8)	59	59	47	47	66	66
10.	Nutrients Recommended (from Table 1)	270	0	60	0	270	0
11.	Nutrient Status (subtract line 10 from line 9)	-211	59	-13	47	-204	66

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	59	P_2O_5	47	K_2O	66

Method, Form, and Timing of Application

Application rates are based on crop uptake and are not to be exceeded rates. Manure applications are not expected to meet all crop needs and additional fertilzation may be necessary.

Commercial fertilizer could be applied as all nutrients can not be supplied by manure applications. Sulfur, Magnesium, Zinc and Boron should be applied in accordance with the OSU extension fertilizer guides and soil tests.

Use nutrient concentrations in storage to determine application rates to apply @60 pounds per acre of nitrogen . Use nutrient concentration in storage to determine solids spreader loads per acre to apply @60 pounds per acre of nitrogen. No more than a total of 59 pounds of nitrogen per acre should be applied to the alfalfa . The planned operation will provide enough manure to fertilize 50 acres at this rate each year.

Score card soil testing should be done in the fall to insure excessive nitrates are not available for leaching.

Manure should be reduced or not applied if soil tests show Phosphorous and Potassium concentrations continue to increase over time and approach very high levels as determined by OSU Extension.

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET
Version HRv3.0

12/15/11
STATE: OREGON

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer:	Vogel Dairy	Tract(s): 503	Field(s): across road
Assisted by:	ODA		Date: December 15, 2011

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
Hay/Pasture Mix 16 % Protein/ Alfalfa	4

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC
22	21	42			

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			
205	180	57	60	157	150			

Table 2. Nutrient Sources

Credits		N	P_2O_5		K_2O	
		pounds per acre				
1. Nitrogen credits from previous legume crop						
2. Residual from long-term manure application						
3. Irrigation water						
4. Other (e.g., atmospheric deposition)						
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-)		33	33	26	26	37	37
9.	Subtotal (sum of lines 6, 7 and 8)	33	33	26	26	37	37
10.	Nutrients Recommended (from Table 1)	205	180	57	60	157	150
11.	Nutrient Status (subtract line 10 from line 9)	-172	-147	-31	-34	-120	-113

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	180	P_2O_5	57	K_2O	157

Method, Form, and Timing of Application

Application rates are based on crop uptake and are not to be exceeded rates. Manure applications are not expected to meet all crop needs and additional fertilzation may be necessary.

Commercial fertilizer could be applied as all nutrients can not be supplied by manure applications. Sulfur, Magnesium, Zinc and Boron should be applied in accordance with the OSU extension fertilizer guides and soil tests.

Use nutrient concentrations in storage to determine applcation rates to apply @60 pounds per acre of nitrogen . Use nutrient concentration in storage to determine solids spreader loads per acre to apply @60 pounds per acre of nitrogen. No more than a total of 180 pounds of nitrogen per acre should be applied to the hay/pasture . The planned operation will provide enough manure to fertilize 42 acres at this rate each year.

Score card soil testing should be done in the fall to insure excessive nitrates are not available for leaching.

Manure should be reduced or not applied if soil tests show Phosphorous and Potassium concentrations continue to increase over time and approach very high levels as determined by OSU Extension.

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer:	Vogel Dairy	Tract(s): 503	Field(s): creek pasture
Assisted by:	ODA		Date: December 15, 2011

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
Fescue Hay/Pasture	2

CURRENT SOIL TEST LEVELS (ppm or lb/ac)

N	P	K	pH	S.O.M.%	EC
8	23	51	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			
59	150	28	60	80	150			

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop							
2. Residual from long-term manure application							
3. Irrigation water							
4. Other (e.g., atmospheric deposition)							
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-)		1	1	1	1	1	1
9.	Subtotal (sum of lines 6, 7 and 8)	1	1	1	1	1	1
10.	Nutrients Recommended (from Table 1)	59	150	28	60	80	150
11.	Nutrient Status (subtract line 10 from line 9)	-58	-149	-27	-59	-79	-149

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	59	P_2O_5	28	K_2O	80

Method, Form, and Timing of Application

Recommended application rates are based on OSU Extension Recommendations.

Planned applications are the result of grazing. If comercial fertilizers are used do not exceed OSU Extension Recommendations, (listed in Trial B above) while accounting for Grazing contributions. grazed areas should be harrowed at the end of the grazing season, or if manure accumulation produces plant growth or water quality concerns.

Manure should be reduced or not applied if soil tests show Phosphorous and Potassium concentrations increaseing over time and approach very high levels as determined by OSU Extension guidelines.

Worksheet OR10A-7--Waste storage period determination

Basic Storage Period, SPb = 182 Days

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

Climatic Station- MEDFORD EXP STA

Day of Year	MONTH	Crop ET, Inches	Accum ET, Inches	Ppt, Inches
1-31	January	0.43	0.43	2.45
32-59	February	0.79	1.22	2.09
60-90	March	2.56	3.78	2.25
91-120	April	3.98	7.76	1.43
121-151	May	5.55	13.31	1.30
152-181	June	6.54	19.85	0.76
182-212	July	7.83	27.68	0.49
213-243	August	6.57	34.25	0.54
244-273	September	4.88	39.13	0.97
274-304	October	3.03	42.16	1.39
305-334	November	0.51	42.67	3.06
335-365	December	0.35	43.02	2.85

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

3/4 of Annual ET = 0.75 x **43.02** = **32.27** Inches

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

L = 243 Days

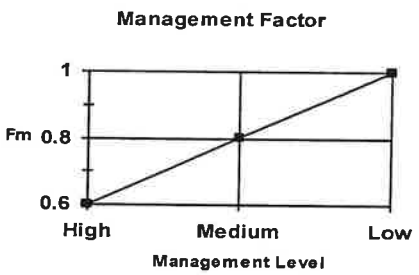
b. Determine first day for the month of the year when ET >= Ppt-

E = First Day of Month ET >= Ppt

E = 60 Days

c. **SPb** = 365 - (L - E) = 365 - (**243** - **60**)

Management Factor, Fm = 0.75



Low Level, Fm = 1.0
...The operator does not utilize a waste management plan.
...Proper operation and maintenance may not be performed.

Medium Level, Fm = 0.8
...The operator utilizes an up-to-date waste management plan.
...Manure application equipment is calibrated for nutrient applications.
...Maintains adequate soil moisture for crop growth.
...Agronomic treatments which would maximize crop nutrient uptake are not fully utilized.
...Proper operation and maintenance is planned.

High Level, Fm = 0.6
...The operator utilizes an up-to-date waste management plan.
...Soil fertility testing is performed annually.
...Manure in storage is tested for nutrient concentrations.
...Records of time, rate and location of manure applications are maintained.
...Manure application equipment is calibrated for nutrient applications.
...Irrigation water management techniques are practiced.
...Crop nutrient uptake is maximized with appropriate agronomic treatments such as residue management, conservation crop rotation, crop variety selection, prescribed grazing, and pest management.
...Proper operation and maintenance is planned.

Soils Factor: Fs_{LIQUID} = **0.9** Fs_{SOLID} = **0.7**

Soils must meet the following criteria for Fs to be less than 1.0-
... The average water holding capacity for the profile greater than 3.0 inches.

HSG	Soils Factor (Fs) Consistency of Waste			
	Liquid	Slurry	Semi-Solid	Solid

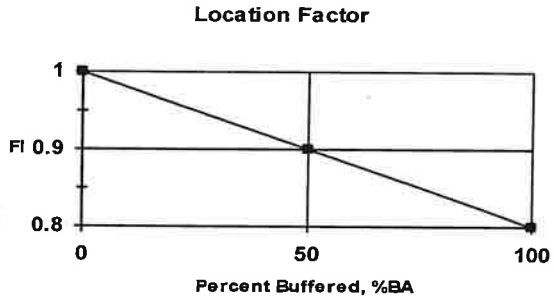
Worksheet OR10A-7--Waste storage period determination

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

A	1	0.95	0.9	0.8
B	0.8	0.75	0.7	0.6
C	0.9	0.85	0.8	0.7
D	1	1	0.95	0.85

HSG	Area	Fs_{LIQUID}	Wtd Fs_{LIQUID}	Fs_{SOLID}	Wtd Fs_{SOLID}
C	100	0.9	90	0.7	70
Total Weighted Fs_{LIQUID}=		0.9	Total Weighted Fs_{SOLID} =		0.7

Location Factor: Fl = 1.00

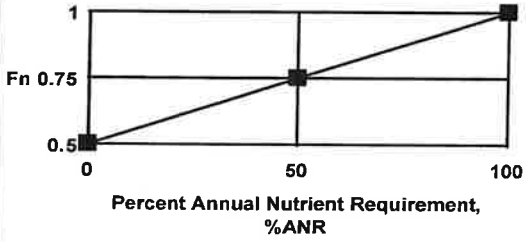


For an application area to be considered buffered there must be a 0 to 5 percent chance of flooding and the area must be at least 50 feet from water bodies, ground water sources(wells), and areas of concentrated flow. The percent buffered area (%BA) is delermined by taking the total buffered area(TBA)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

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

$$\%BA = \frac{0}{274} \times 100\% = 0\%$$

Nutrient Loading Factor: Fn = 1.00



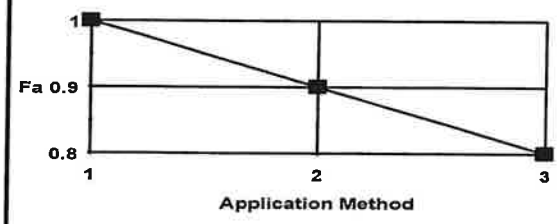
In order for the Nutrient Loading Factor, Fn to be less than 1, the Location Factor, Fl must be 0.95 or less.

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

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

$$\%ANR = \frac{512}{1{,}872} \times 100\% = 27\%$$

Application Method Factor: Fa_{LIQUID} = 0.90 Fa_{SOLID} = 1.00



Method 1 - Surface applied solid manure, no incorporation.

Method 2 - Surface applied liquid manure, no incorporation.

Method 3 - Injection or immediate incorporation.

Adjusted Storage Period: ASP_{LIQUID} = 111 Days ASP_{SOLID} = 96 Days

ASP = SPb X Fm X Fs X Fl X Fn X Fa

Worksheet OR10A-7--Waste storage period determination

ASP_{LIQUID} = 182 X 0.75 X 0.9 X 1 X 1 X 0.9

ASP_{SOLID} = 182 X 0.75 X 0.7 X 1 X 1 X 1

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

$E_{a\ LIQUID}$ = **-11**

$E_{a\ SOLID}$ = **-26**

Storage Period: SP_{LIQUID} = 154 Days SP_{SOLID} = 154 Days

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

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

L = **243** Days L_f = **365** Days

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

L_{sp} = **243** Days

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

E_f = **32** Days

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

$E_{sp\ LIQUID}$ = **32** Days $E_{sp\ SOLID}$ = **32** Days

c. SP_{LIQUID} = 365 - (Lsp - Esp LIQUID) = **154** Days

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

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

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

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

e. **Latest date (L_{sp}) for manure application (month-day) = * September 31**

* See page 5 for explanation

Day of Year Calendar

Day of month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						Month						
1	1	32	60	91	121	152	182	213	244	274	305	335
2	2	33	61	92	122	153	183	214	245	275	306	336
3	3	34	62	93	123	154	184	215	246	276	307	337
4	4	35	63	94	124	155	185	216	247	277	308	338
5	5	36	64	95	125	156	186	217	248	278	309	339
6	6	37	65	96	126	157	187	218	249	279	310	340
7	7	38	66	97	127	158	188	219	250	280	311	341
8	8	39	67	98	128	159	189	220	251	281	312	342
9	9	40	68	99	129	160	190	221	252	282	313	343
10	10	41	69	100	130	161	191	222	253	283	314	344
11	11	42	70	101	131	162	192	223	254	284	315	345
12	12	43	71	102	132	163	193	224	255	285	316	346
13	13	44	72	103	133	164	194	225	256	286	317	347

Worksheet OR10A-7--Waste storage period determination

14	14	45	73	104	134	165	195	226	257	287	318	348
15	15	46	74	105	135	166	196	227	258	288	319	349
16	16	47	75	106	136	167	197	228	259	289	320	350
17	17	48	76	107	137	168	198	229	260	290	321	351
18	18	49	77	108	138	169	199	230	261	291	322	352
19	19	50	78	109	139	170	200	231	262	292	323	353
20	20	51	79	110	140	171	201	232	263	293	324	354
21	21	52	80	111	141	172	202	233	264	294	325	355
22	22	53	81	112	142	173	203	234	265	295	326	356
23	23	54	82	113	143	174	204	235	266	296	327	357
24	24	55	83	114	144	175	205	236	267	297	328	358
25	25	56	84	115	145	176	206	237	268	298	329	359
26	26	57	85	116	146	177	207	238	269	299	330	360
27	27	58	86	117	147	178	208	239	270	300	331	361
28	28	59	87	118	148	179	209	240	271	301	332	362
29	29		88	119	149	180	210	241	272	302	333	363
30	30		89	120	150	181	211	242	273	303	334	364
31	31		90		151		212	243		304		365

USDA United States Department of Agriculture

NRCS Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Jackson County Area, Oregon, Parts of Jackson and Klamath Counties

Vogel Dairy soils report

December 14, 2011

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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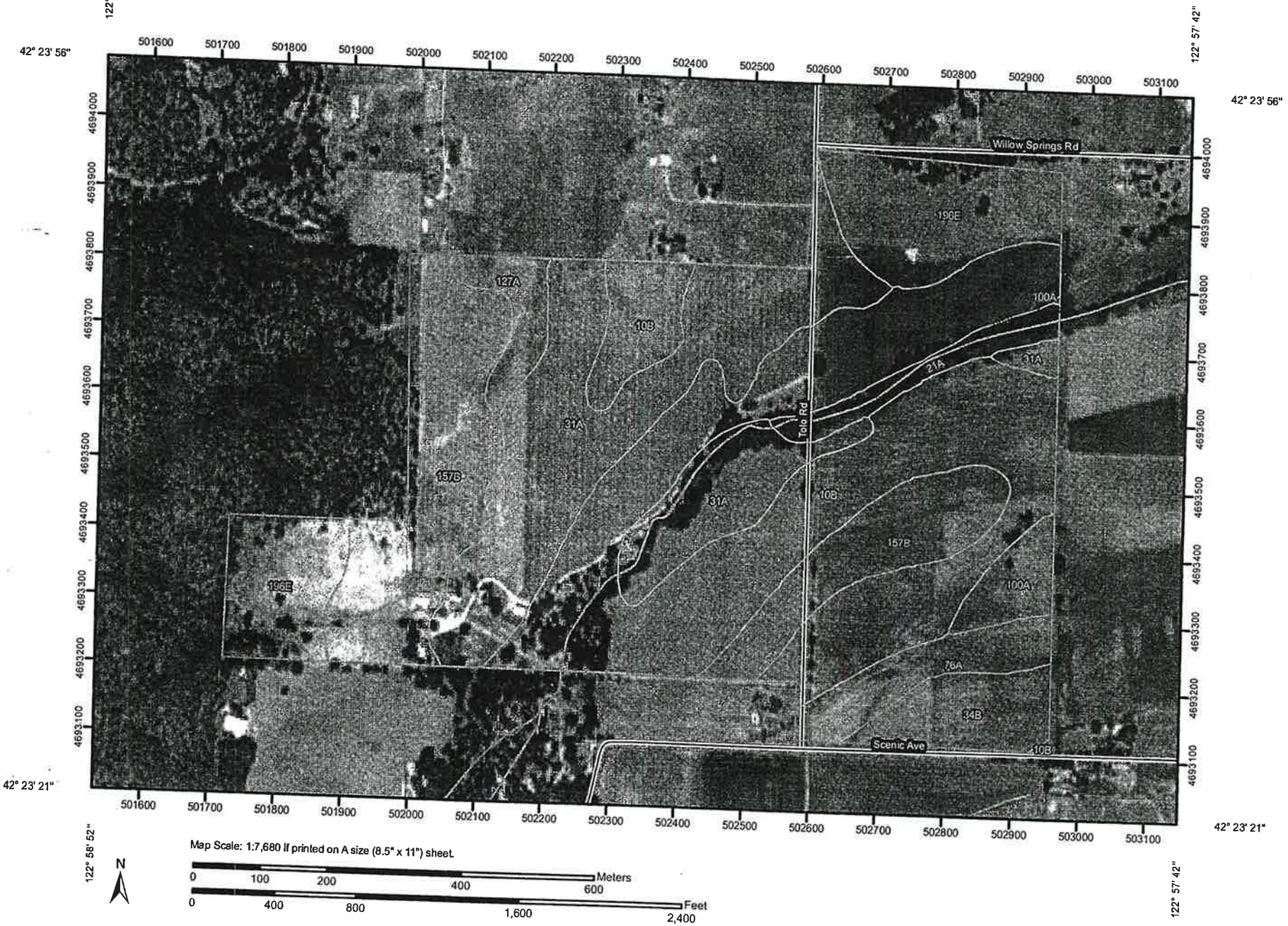
Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map (Vogel Dairy soils)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:7,680 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jackson County Area, Oregon, Parts of Jackson and Klamath Counties
Survey Area Data: Version 6, Feb 9, 2010

Date(s) aerial images were photographed: 7/19/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Vogel Dairy soils)

Jackson County Area, Oregon, Parts of Jackson and Klamath Counties (OR632)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
10B	Barron coarse sandy loam, 0 to 7 percent slopes	64.3	35.0%
21A	Camas sandy loam, 0 to 3 percent slopes	4.2	2.3%
31A	Central Point sandy loam, 0 to 3 percent slopes	40.8	22.2%
34B	Coleman loam, 0 to 7 percent slopes	6.7	3.7%
76A	Gregory silty clay loam, 0 to 3 percent slopes	6.5	3.6%
100A	Kubli loam, 0 to 3 percent slopes	3.7	2.0%
127A	Medford silty clay loam, 0 to 3 percent slopes	4.1	2.2%
157B	Ruch silt loam, 2 to 7 percent slopes	32.0	17.5%
196E	Vannoy silt loam, 12 to 35 percent south slopes	21.2	11.5%
Totals for Area of Interest		**183.6**	**100.0%**

Map Unit Descriptions (Vogel Dairy soils)

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, 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.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified

by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Jackson County Area, Oregon, Parts of Jackson and Klamath Counties

10B—Barron coarse sandy loam, 0 to 7 percent slopes

Map Unit Setting

Elevation: 1,000 to 2,500 feet
Mean annual precipitation: 18 to 35 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 120 to 180 days

Map Unit Composition

Barron and similar soils: 85 percent
Minor components: 4 percent

Description of Barron

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 4e
Other vegetative classification: DOUGLAS FIR-MIXED PINE-FESCUE FOREST (null_8)

Typical profile

0 to 6 inches: Coarse sandy loam
6 to 60 inches: Sandy loam

Minor Components

Clawson

Percent of map unit: 3 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: SEMI-WET MEADOW (R005XY012OR)

Aquepts

Percent of map unit: 1 percent
Landform: Outwash plains

21A—Camas sandy loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 1,000 to 3,000 feet
Mean annual precipitation: 18 to 40 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 180 days

Map Unit Composition

Camas and similar soils: 80 percent
Minor components: 7 percent

Description of Camas

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly alluvium

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water capacity: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability (nonirrigated): 4w
Ecological site: LOAMY FLOOD PLAIN 18-30 PZ (R005XY028OR)

Typical profile

0 to 10 inches: Sandy loam
10 to 60 inches: Extremely gravelly coarse sand

Minor Components

Aquolls

Percent of map unit: 3 percent
Landform: Flood plains

Cove

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear
Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

Riverwash

Percent of map unit: 2 percent
Landform: Flood plains

31A—Central Point sandy loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 18 to 40 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 180 days

Map Unit Composition

Central point and similar soils: 80 percent
Clawson and similar soils: 2 percent
Minor components: 3 percent

Description of Central Point

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability (nonirrigated): 4c
Ecological site: DEEP LOAMY TERRACE 18-28 PZ (R005XY036OR)

Typical profile

0 to 30 inches: Sandy loam
30 to 49 inches: Sandy loam
49 to 67 inches: Gravelly sandy loam

Description of Clawson

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability (nonirrigated): 3w
Ecological site: SEMI-WET MEADOW (R005XY012OR)

Typical profile

0 to 10 inches: Sandy loam
10 to 60 inches: Sandy loam

Minor Components

Gregory

Percent of map unit: 2 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

Aquolls

Percent of map unit: 1 percent
Landform: Terraces

34B—Coleman loam, 0 to 7 percent slopes

Map Unit Setting

Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 18 to 30 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 180 days

Map Unit Composition

Coleman and similar soils: 85 percent
Minor components: 4 percent

Description of Coleman

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from volcanic and sedimentary rock

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 4e
Ecological site: LOAMY HILLS 20-35 PZ (R005XY026OR)

Typical profile

0 to 8 inches: Loam
8 to 20 inches: Clay loam
20 to 40 inches: Clay
40 to 65 inches: Clay loam

Minor Components

Gregory

Percent of map unit: 4 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

76A—Gregory silty clay loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 1,000 to 4,000 feet
Mean annual precipitation: 18 to 30 inches

Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 120 to 180 days

Map Unit Composition
Gregory and similar soils: 80 percent
Gregory, 3-5% slopes, and similar soils: 2 percent
Minor components: 8 percent

Description of Gregory

Setting
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from metavolcanics and metasedimentary rock

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 9.0 inches)

Interpretive groups
Land capability classification (irrigated): 2w
Land capability (nonirrigated): 4w
Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

Typical profile
0 to 7 inches: Silty clay loam
7 to 44 inches: Clay
44 to 50 inches: Sandy clay loam
50 to 60 inches: Weathered bedrock

Description of Gregory, 3-5% Slopes

Setting
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from metavolcanics and metasedimentary rock

Properties and qualities
Slope: 3 to 5 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None

Available water capacity: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability (nonirrigated): 4w
Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

Typical profile

0 to 7 inches: Silty clay loam
7 to 44 inches: Clay
44 to 50 inches: Sandy clay loam
50 to 60 inches: Weathered bedrock

Minor Components

Cove

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

Padigan

Percent of map unit: 2 percent
Landform: Alluvial fans
Ecological site: POORLY DRAINED BOTTOM (R005XA016OR)

Gregory, moderately deep to bedrock

Percent of map unit: 2 percent
Landform: Terraces
Ecological site: POORLY DRAINED BOTTOM (R005XA016OR)

Gregory, very deep

Percent of map unit: 2 percent
Landform: Terraces
Ecological site: POORLY DRAINED BOTTOM (R005XA016OR)

100A—Kubli loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 1,000 to 2,300 feet
Mean annual precipitation: 18 to 30 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 180 days

Map Unit Composition

Kubli and similar soils: 90 percent
Minor components: 3 percent

Description of Kubli

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 6 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability (nonirrigated): 4w
Ecological site: DEEP LOAMY TERRACE 18-28 PZ (R005XY036OR)

Typical profile

0 to 15 inches: Loam
15 to 31 inches: Loam
31 to 60 inches: Clay

Minor Components

Aquolls

Percent of map unit: 2 percent
Landform: Terraces

Gregory

Percent of map unit: 1 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

127A—Medford silty clay loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 1,000 to 4,000 feet
Mean annual precipitation: 18 to 35 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 125 to 180 days

Map Unit Composition

Medford and similar soils: 85 percent
Minor components: 3 percent

Description of Medford

Setting

Landform: Stream terraces, alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from metavolcanics and/or metasedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability (nonirrigated): 4c
Ecological site: DEEP LOAMY TERRACE 18-28 PZ (R005XY036OR)

Typical profile

0 to 12 inches: Silty clay loam
12 to 22 inches: Silty clay
22 to 53 inches: Silty clay loam
53 to 71 inches: Stratified sandy clay loam to silty clay loam

Minor Components

Gregory

Percent of map unit: 2 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

Aquolls

Percent of map unit: 1 percent
Landform: Mountains

157B—Ruch silt loam, 2 to 7 percent slopes

Map Unit Setting

Elevation: 1,000 to 3,000 feet
Mean annual precipitation: 18 to 35 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 180 days

Map Unit Composition

Ruch and similar soils: 80 percent
Minor components: 3 percent

Description of Ruch

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from metavolcanics and metasedimentary rock

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 4e
Other vegetative classification: DOUGLAS FIR-MIXED PINE-FESCUE FOREST (null_8)

Typical profile

0 to 7 inches: Silt loam
7 to 70 inches: Loam

Minor Components

Gregory

Percent of map unit: 2 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Ecological site: POORLY DRAINED BOTTOM (R005XY016OR)

Aquolls

Percent of map unit: 1 percent
Landform: Alluvial fans

196E—Vannoy silt loam, 12 to 35 percent south slopes

Map Unit Setting

Elevation: 1,000 to 4,000 feet
Mean annual precipitation: 20 to 40 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 100 to 160 days

Map Unit Composition

Vannoy, south, and similar soils: 80 percent
Minor components: 1 percent

Description of Vannoy, South

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest, interfluve, nose slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from metavolcanics and metasedimentary rock

Properties and qualities

Slope: 12 to 35 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Land capability (nonirrigated): 4e
Other vegetative classification: PINE-DOUGLAS FIR-FESCUE (null_23)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 12 inches: Silt loam
12 to 39 inches: Clay loam
39 to 49 inches: Weathered bedrock

Minor Components

Aqualfs

Percent of map unit: 1 percent
Landform: Mountains

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Physical Soil Properties (Vogel Dairy soils)

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as

a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Physical Soil Properties– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
10B—Barron coarse sandy loam, 0 to 7 percent slopes														
Barron	0-6	-68-	-19-	8-13- 18	1.40-1.60	14.00-42.00	0.07-0.12	0.0-2.9	1.0-3.0	.24	.28	5	3	86
	6-60	-67-	-20-	8-13- 18	1.40-1.60	14.00-42.00	0.07-0.12	0.0-2.9	0.1-1.0	.28	.32			
21A—Camas sandy loam, 0 to 3 percent slopes														
Camas	0-10	-69-	-24-	5- 8- 10	1.20-1.40	14.00-42.00	0.10-0.13	0.0-2.9	1.0-3.0	.20	.20	2	3	86
	10-60	-91-	- 7-	0- 3- 5	1.40-1.60	141.00-705.00	0.03-0.05	0.0-2.9	0.0-1.0	.02	.10			
31A—Central Point sandy loam, 0 to 3 percent slopes														
Central point	0-30	-66-	-19-	12-15- 18	1.35-1.50	14.00-42.00	0.08-0.11	0.0-2.9	2.0-8.0	.24	.24	5	3	86
	30-49	-66-	-19-	12-15- 18	1.40-1.60	14.00-42.00	0.08-0.12	0.0-2.9	0.5-2.0	.20	.20			
	49-67	-66-	-23-	8-11- 13	1.45-1.65	14.00-42.00	0.06-0.11	0.0-2.9	0.0-0.5	.17	.24			
Clawson	0-10	-67-	-20-	8-13- 18	1.40-1.60	14.00-42.00	0.11-0.13	0.0-2.9	1.0-3.0	.28	.28	5	3	86
	10-60	-67-	-20-	8-13- 18	1.40-1.60	14.00-42.00	0.10-0.13	0.0-2.9	0.5-1.0	.32	.32			

Physical Soil Properties– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
34B—Coleman loam, 0 to 7 percent slopes														
Coleman	0-8	-39-	-37-	20-24- 27	1.35-1.50	4.00-14.00	0.16-0.18	0.0-2.9	2.0-4.0	.37	.37	5	6	48
	8-20	-35-	-34-	27-31- 35	1.30-1.40	1.40-4.00	0.19-0.21	3.0-5.9	1.0-2.0	.37	.37			
	20-40	-22-	-28-	45-50- 55	1.30-1.40	0.42-1.40	0.12-0.16	6.0-8.9	0.5-1.0	.24	.32			
	40-65	-34-	-32-	27-34- 40	1.30-1.50	1.40-4.00	0.10-0.18	3.0-5.9	0.0-0.5	.20	.37			
76A—Gregory silty clay loam, 0 to 3 percent slopes														
Gregory	0-7	-20-	-49-	27-31- 35	1.35-1.45	1.40-4.00	0.19-0.21	3.0-5.9	3.0-6.0	.24	.24	4	7	38
	7-44	-30-	-30-	35-40- 45	1.20-1.40	0.42-1.40	0.16-0.20	6.0-8.9	0.2-3.0	.28	.28			
	44-50	-55-	-17-	25-28- 30	1.30-1.40	1.40-4.00	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	50-60	—	—	—	—	—	—	—	—					
Gregory, 3-5% slopes	0-7	-20-	-49-	27-31- 35	1.35-1.45	1.40-4.00	0.19-0.21	3.0-5.9	3.0-6.0	.24	.24	4	7	38
	7-44	-30-	-30-	35-40- 45	1.20-1.40	0.42-1.40	0.16-0.20	6.0-8.9	0.2-3.0	.28	.28			
	44-50	-55-	-17-	25-28- 30	1.30-1.40	1.40-4.00	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	50-60	—	—	—	—	—	—	—	—					
100A—Kubli loam, 0 to 3 percent slopes														
Kubli	0-15	-41-	-37-	18-22- 25	1.35-1.50	4.00-14.00	0.16-0.18	0.0-2.9	2.0-6.0	.28	.28	5	6	48
	15-31	-41-	-37-	18-22- 25	1.35-1.50	4.00-14.00	0.16-0.18	3.0-5.9	0.5-2.0	.43	.43			
	31-60	-28-	-29-	35-43- 50	1.20-1.30	0.01-0.42	0.14-0.16	6.0-8.9	0.0-0.5	.32	.32			

Physical Soil Properties– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
127A—Medford silty clay loam, 0 to 3 percent slopes														
Medford	0-12	-20-	-49-	27-31- 35	1.25-1.40	1.40-4.00	0.16-0.18	3.0-5.9	2.0-4.0	.32	.37	5	7	38
	12-22	- 8-	-51-	35-41- 45	1.25-1.40	1.40-4.00	0.14-0.17	6.0-8.9	1.0-2.0	.28	.32			
	22-53	- 7-	-54-	35-39- 45	1.25-1.40	1.40-4.00	0.14-0.17	6.0-8.9	0.5-1.0	.28	.32			
	53-71	—	—	20-28- 35	1.25-1.40	1.40-4.00	0.15-0.17	3.0-5.9	0.0-0.5	.28	.32			
157B—Ruch silt loam, 2 to 7 percent slopes														
Ruch	0-7	-30-	-54-	12-16- 20	1.15-1.45	4.00-14.00	0.15-0.18	0.0-2.9	1.0-3.0	.32	.32	5	5	56
	7-70	-38-	-36-	20-26- 35	1.45-1.70	1.40-4.00	0.12-0.16	3.0-5.9	0.1-2.0	.37	.43			
196E—Vannoy silt loam, 12 to 35 percent south slopes														
Vannoy, south	0-1	-50-	-50-	0-15- 25	0.10-0.30	42.00-705.00	0.30-0.60	—	60.0-90.0			3	5	56
	1-12	-27-	-54-	15-19- 22	1.35-1.55	4.00-14.00	0.17-0.20	0.0-2.9	2.0-4.0	.37	.37			
	12-39	-35-	-34-	27-31- 35	1.55-1.70	1.40-4.00	0.12-0.18	3.0-5.9	0.3-2.0	.32	.32			
	39-49	—	—	—	—	—	—	—	—					

Vegetative Productivity

This folder contains a collection of tabular reports that present vegetative productivity data. The reports (tables) include all selected map units and components for each map unit. Vegetative productivity includes estimates of potential vegetative production for a variety of land uses, including cropland, forestland, hayland, pastureland, horticulture and rangeland. In the underlying database, some states maintain crop yield data by individual map unit component. Other states maintain the data at the map unit level. Attributes are included for both, although only one or the other is likely to contain data for any given geographic area. For other land uses, productivity data is shown only at the map unit component level. Examples include potential crop yields under irrigated and nonirrigated conditions, forest productivity, forest site index, and total rangeland production under of normal, favorable and unfavorable conditions.

Irrigated and Nonirrigated Yields by Map Unit Component (Vogel Dairy soils)

The average yields per acre that can be expected of the principal crops under a high level of management are shown in this table. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

If yields of irrigated crops are given, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

Pasture yields are expressed in terms of animal unit months. An animal unit month (AUM) is the amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in the table are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

The land capability classification of map units in the survey area is shown in this table. This classification shows, in a general way, the suitability of soils for most kinds of field crops (United States Department of Agriculture, Soil Conservation Service, 1961). 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 designed to show suitability and limitations of groups of soils for rangeland, for forestland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit.

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 slight limitations that restrict their use.
- Class 2 soils have moderate limitations that restrict the choice of plants or that require moderate conservation practices.
- Class 3 soils have severe limitations that restrict the choice of plants or that require special conservation practices, or both.
- Class 4 soils have very severe limitations that restrict 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.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 2e. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class 5 are subject to little or no erosion.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally

designated by adding an Arabic numeral to the subclass symbol, for example, 2e-4 and 3e-6. These units are not given in all soil surveys.

Reference:

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

Irrigated and Nonirrigated Yields by Map Unit Component– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties								
Map symbol and soil name	Land capability		Alfalfa hay		Barley		Grass hay	
	Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated
			Tons		*Bu*		*Tons*	
10B—Barron coarse sandy loam, 0 to 7 percent slopes								
Barron	2e	4e	7.00	3.00	75	40	—	—
21A—Camas sandy loam, 0 to 3 percent slopes								
Camas	4w	4w	5.00	2.50	—	22	—	—
31A—Central Point sandy loam, 0 to 3 percent slopes								
Central point	2s	4c	8.00	3.00	90	50	—	—
Clawson	3w	3w	—	—	—	—	5.00	—
34B—Coleman loam, 0 to 7 percent slopes								
Coleman	2e	4e	7.00	3.50	—	45	—	—
76A—Gregory silty clay loam, 0 to 3 percent slopes								
Gregory	2w	4w	—	—	95	40	—	—
Gregory, 3-5% slopes	2w	4w	—	—	95	40	—	—
100A—Kubli loam, 0 to 3 percent slopes								
Kubli	3w	4w	6.00	3.50	80	50	—	—
127A—Medford silty clay loam, 0 to 3 percent slopes								
Medford	1	4c	8.00	4.50	105	75	—	—
157B—Ruch silt loam, 2 to 7 percent slopes								
Ruch	2e	4e	7.00	3.50	85	45	—	—

Irrigated and Nonirrigated Yields by Map Unit Component– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties								
Map symbol and soil name	Land capability		Alfalfa hay		Barley		Grass hay	
	Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated
			Tons		*Bu*		*Tons*	
196E—Vannoy silt loam, 12 to 35 percent south slopes								
Vannoy, south	—	4e	—	—	—	—	—	—

Waste Management

This folder contains a collection of tabular reports that present soil interpretations related to waste management. The reports (tables) include all selected map units and components for each map unit, limiting features and interpretive ratings. Waste management interpretations are tools designed to guide the user in evaluating soils for use of organic wastes and wastewater as productive resources. Example interpretations include land application of manure, food processing waste, and municipal sewage sludge, and disposal of wastewater by irrigation or overland flow process.

Agricultural Disposal of Manure, Food-Processing Waste, and Sewage Sludge (Vogel Dairy soils)

Soil properties are important considerations in areas where soils are used as sites for the treatment and disposal of organic waste and wastewater. Selection of soils with properties that favor waste management can help to prevent environmental damage.

This table shows the degree and kind of soil limitations affecting the treatment of agricultural waste, including municipal and food-processing wastewater and effluent from lagoons or storage ponds. Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. In the context of this table, the effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

The ratings in the table are for waste management systems that not only dispose of and treat organic waste or wastewater but also are beneficial to crops. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the tables indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Application of manure and food-processing waste not only disposes of waste material but also can improve crop production by increasing the supply of nutrients in the soils where the material is applied. Manure is the excrement of livestock and poultry, and food-processing waste is damaged fruit and vegetables and the peelings, stems, leaves, pits, and soil particles removed in food preparation. The manure and food-processing waste are solid, slurry, or liquid. Their nitrogen content varies. A high content of nitrogen limits the application rate. Toxic or otherwise dangerous wastes, such as those mixed with the lye used in food processing, are not considered in the ratings.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, the rate at which the waste is applied, and the method by which the waste is applied. The properties that affect absorption include saturated hydraulic conductivity (Ksat), depth to a water table, ponding, the sodium adsorption ratio, depth to bedrock or a cemented pan, and available water capacity. The properties that affect plant growth and microbial activity include reaction, the sodium adsorption ratio, salinity, and bulk density. The wind erodibility group, the soil erosion factor K, and slope are considered in estimating the likelihood that wind erosion or water erosion will transport the waste material from the application site. Stones, cobbles, a water table, ponding, and flooding can hinder the application of waste. Permanently frozen soils are unsuitable for waste treatment.

Application of sewage sludge not only disposes of waste material but also can improve crop production by increasing the supply of nutrients in the soils where the material is applied. In the context of this table, sewage sludge is the residual product of the treatment of municipal sewage. The solid component consists mainly of cell mass, primarily bacteria cells that developed during secondary treatment and have incorporated soluble organics into their own bodies. The sludge has small amounts of sand, silt, and other solid debris. The content of nitrogen varies. Some sludge has constituents that are toxic to plants or hazardous to the food chain, such as heavy metals and exotic organic compounds, and should be analyzed chemically prior to use.

The content of water in the sludge ranges from about 98 percent to less than 40 percent. The sludge is considered liquid if it is more than about 90 percent water, slurry if it is about 50 to 90 percent water, and solid if it is less than about 50 percent water.

The ratings in the table are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, the rate at which the sludge is applied, and the method by which the sludge is applied. The properties that affect absorption, plant growth, and microbial activity include Ksat, depth to a water table, ponding, the sodium adsorption ratio, depth to bedrock or a cemented pan, available water capacity, reaction, salinity, and bulk density. The wind erodibility group, the soil erosion factor K, and slope are considered in estimating the likelihood that wind erosion or water erosion will transport the waste material from the application site. Stones, cobbles, a water table, ponding, and flooding can hinder the application of sludge. Permanently frozen soils are unsuitable for waste treatment.

Report—Agricultural Disposal of Manure, Food-Processing Waste, and Sewage Sludge (Vogel Dairy soils)

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Agricultural Disposal of Manure, Food-Processing Waste, and Sewage Sludge– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties					
Map symbol and soil name	Pct. of map unit	Application of manure and food-processing waste		Application of sewage sludge	
		Rating class and limiting features	Value	Rating class and limiting features	Value
100A—Kubli loam, 0 to 3 percent slopes					
Kubli	90	Very limited			
		Slow water movement	1.00		
		Depth to saturated zone	1.00		
		Runoff	0.40		
10B—Barron coarse sandy loam, 0 to 7 percent slopes					
Barron	85	Somewhat limited			
		Too acid	0.11		
127A—Medford silty clay loam, 0 to 3 percent slopes					
Medford	85	Somewhat limited			
		Slow water movement	0.30		
157B—Ruch silt loam, 2 to 7 percent slopes					
Ruch	80	Somewhat limited			
		Slow water movement	0.30		
196E—Vannoy silt loam, 12 to 35 percent south slopes					
Vannoy, south	80	Very limited			
		Too steep	1.00		
		Filtering capacity	0.99		
		Too acid	0.78		
		Slow water movement	0.30		
		Depth to bedrock	0.01		

Agricultural Disposal of Manure, Food-Processing Waste, and Sewage Sludge– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties					
Map symbol and soil name	Pct. of map unit	Application of manure and food-processing waste		Application of sewage sludge	
		Rating class and limiting features	Value	Rating class and limiting features	Value
21A—Camas sandy loam, 0 to 3 percent slopes					
Camas	80	Very limited			
		Filtering capacity	1.00		
		Droughty	0.99		
		Flooding	0.60		
		Leaching	0.45		
31A—Central Point sandy loam, 0 to 3 percent slopes					
Central point	80	Somewhat limited			
		Too acid	0.03		
Clawson	2	Somewhat limited			
		Depth to saturated zone	0.99		
		Runoff	0.40		
34B—Coleman loam, 0 to 7 percent slopes					
Coleman	85	Very limited			
		Slow water movement	1.00		
		Depth to saturated zone	1.00		
		Too acid	0.11		
76A—Gregory silty clay loam, 0 to 3 percent slopes					
Gregory	80	Very limited			
		Slow water movement	1.00		
		Depth to saturated zone	1.00		
		Runoff	0.40		
		Too acid	0.01		
Gregory, 3-5% slopes	2	Very limited			
		Slow water movement	1.00		
		Depth to saturated zone	1.00		
		Runoff	0.40		
		Too acid	0.01		

Water Features

This folder contains tabular reports that present soil hydrology information. The reports (tables) include all selected map units and components for each map unit. Water Features include ponding frequency, flooding frequency, and depth to water table.

Water Features (Vogel Dairy soils)

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

The *months* in the table indicate the portion of the year in which a water table, ponding, and/or flooding is most likely to be a concern.

Water table refers to a saturated zone in the soil. The water features table indicates, by month, depth to the top (*upper limit*) and base (*lower limit*) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely

grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. The table indicates *surface water depth* and the *duration* and *frequency* of ponding. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. *None* means that ponding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

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.

Duration and *frequency* are estimated. Duration is expressed as *extremely brief* if 0.1 hour to 4 hours, *very brief* if 4 hours to 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. *None* means that flooding is not probable; *very rare* that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); *frequent* that it 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); and *very frequent* that it 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).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Water Features– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
10B—Barron coarse sandy loam, 0 to 7 percent slopes										
Barron	B	—	Jan-Dec	—	—	—	—	None	—	—
21A—Camas sandy loam, 0 to 3 percent slopes										
Camas	A	—	January	—	—	—	—	None	Brief	Occasional
	A	—	February	—	—	—	—	None	Brief	Occasional
	A	—	March	—	—	—	—	None	Brief	Occasional
	A	—	April	—	—	—	—	None	Brief	Occasional
	A	—	May	—	—	—	—	None	Brief	Occasional
	A	—	November	—	—	—	—	None	Brief	Occasional
	A	—	December	—	—	—	—	None	Brief	Occasional

Water Features–Jackson County Area, Oregon, Parts of Jackson and Klamath Counties										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
31A—Central Point sandy loam, 0 to 3 percent slopes										
Central point	B	—	January	4.0-6.0	>6.0	—	—	None	—	None
	B	—	February	4.0-6.0	>6.0	—	—	None	—	None
	B	—	March	4.0-6.0	>6.0	—	—	None	—	None
	B	—	December	4.0-6.0	>6.0	—	—	None	—	None
Clawson	D	—	January	1.0-3.0	>6.0	—	—	None	—	None
	D	—	February	1.0-3.0	>6.0	—	—	None	—	None
	D	—	March	1.0-3.0	>6.0	—	—	None	—	None
	D	—	April	1.0-3.0	>6.0	—	—	None	—	None
	D	—	May	1.0-3.0	>6.0	—	—	None	—	None
	D	—	June	1.0-3.0	>6.0	—	—	None	—	None
	D	—	November	1.0-3.0	>6.0	—	—	None	—	None
	D	—	December	1.0-3.0	>6.0	—	—	None	—	None
34B—Coleman loam, 0 to 7 percent slopes										
Coleman	C	—	January	1.5-2.0	>6.0	—	—	None	—	None
	C	—	February	1.5-2.0	>6.0	—	—	None	—	None
	C	—	March	1.5-2.0	>6.0	—	—	None	—	None
	C	—	April	1.5-2.0	>6.0	—	—	None	—	None
	C	—	December	1.5-2.0	>6.0	—	—	None	—	None

Water Features– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
76A—Gregory silty clay loam, 0 to 3 percent slopes										
Gregory	D	—	January	0.0-1.0	>6.0	—	—	None	—	None
	D	—	February	0.0-1.0	>6.0	—	—	None	—	None
	D	—	March	0.0-1.0	>6.0	—	—	None	—	None
	D	—	April	0.0-1.0	>6.0	—	—	None	—	None
	D	—	May	0.0-1.0	>6.0	—	—	None	—	None
	D	—	December	0.0-1.0	>6.0	—	—	None	—	None
Gregory, 3-5% slopes	D	—	January	0.0-1.0	>6.0	—	—	None	—	None
	D	—	February	0.0-1.0	>6.0	—	—	None	—	None
	D	—	March	0.0-1.0	>6.0	—	—	None	—	None
	D	—	April	0.0-1.0	>6.0	—	—	None	—	None
	D	—	May	0.0-1.0	>6.0	—	—	None	—	None
	D	—	December	0.0-1.0	>6.0	—	—	None	—	None
100A—Kubli loam, 0 to 3 percent slopes										
Kubli	D	—	January	0.5-3.0	2.0-3.0	—	—	None	—	None
	D	—	February	0.5-3.0	2.0-3.0	—	—	None	—	None
	D	—	March	0.5-3.0	2.0-3.0	—	—	None	—	None
	D	—	April	0.5-3.0	2.0-3.0	—	—	None	—	None
	D	—	November	0.5-3.0	2.0-3.0	—	—	None	—	None
	D	—	December	0.5-3.0	2.0-3.0	—	—	None	—	None

Water Features– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
127A—Medford silty clay loam, 0 to 3 percent slopes										
Medford	B	—	January	4.0-6.0	>6.0	—	—	None	—	None
	B	—	February	4.0-6.0	>6.0	—	—	None	—	None
	B	—	March	4.0-6.0	>6.0	—	—	None	—	None
	B	—	April	4.0-6.0	>6.0	—	—	None	—	None
	B	—	December	4.0-6.0	>6.0	—	—	None	—	None
157B—Ruch silt loam, 2 to 7 percent slopes										
Ruch	B	—	Jan-Dec	—	—	—	—	None	—	—
196E—Vannoy silt loam, 12 to 35 percent south slopes										
Vannoy, south	C	—	Jan-Dec	—	—	—	—	None	—	—

Water Management

This folder contains a collection of tabular reports that present soil interpretations related to water management. The reports (tables) include all selected map units and components for each map unit, limiting features and interpretive ratings. Water management interpretations are tools for evaluating the potential of the soil in the application of various water management practices. Example interpretations include pond reservoir area, embankments, dikes, levees, and excavated ponds.

Irrigation - General and Sprinkler (Vogel Dairy soils)

This table shows the degree and kind of soil limitations that affect irrigation systems on mineral soils. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Irrigation systems are used to provide supplemental water to crops, orchards, vineyards, and vegetables in area where natural precipitation will not support desired production of crops being grown.

Irrigation – general evaluates a soil's limitation(s) for installation and use of non-specific irrigation methods and is intended to provide initial planning information. Additional interpretations provide more specific information. This interpretation does not apply if the crop planned for irrigation is rice or other crops with unique plant physiological characteristics (such as cranberries). The ratings are for soils in their natural condition and do not consider present land use.

The soil properties and qualities important in design and management of irrigation systems are sodium adsorption ratio, depth to high water table, available water holding capacity, permeability, slope, calcium carbonate content, ponding, and flooding. Soil properties and qualities that influence installation are stones, depth to bedrock or cemented pan, and depth to a high water table. The properties and qualities that affect performance of the irrigation system are depth to bedrock or to a cemented pan, the sodium adsorption ratio, salinity, and soil reaction.

Irrigation, sprinkler (close spaced outlets drops) evaluates a soil for installation and use of sprinkler irrigation systems equipped with close spaced outlets on drops. The ratings are for soils in their natural condition and do not consider present land use.

Sprinkler irrigation systems equipped with low pressure spray nozzles mounted on close spaced drops apply water close to the ground surface. These systems are generally found on linear move or center pivot systems and they have separate slope criteria from other sprinkler systems due to their higher application rate which increase risk of runoff and irrigation-induced erosion on steeper slopes. Examples of these types of systems include Low Pressure in Canopy (LPIC), Low Energy Precision Application (LEPA), Low Elevation Spray Application (LESA), and Mid-Elevation Spray Application (MESA) systems. These types of irrigation systems are generally suitable for small grains, row crops, and vegetables.

The soil properties and qualities important in the design and management of sprinkler irrigation systems utilizing close spaced spray nozzles on drops are depth, available water holding capacity, sodium adsorption ratio, surface coarse fragments, permeability, salinity, slope, wetness, and flooding. The features that affect performance of the system and plant growth are surface texture, surface rocks, salinity, sodium adsorption ratio, wetness, erosion potential, and available water holding capacity.

Irrigation, sprinkler (general) evaluates a soil for installation and use of sprinkler irrigation systems excluding those equipped with close spaced outlets on drops. The ratings are for soils in their natural condition and do not consider present land use.

Sprinkler irrigation systems apply irrigation water to a field through a series of pipes and nozzles and can be either solid set or mobile. Generally, this type of irrigation system is suitable for small grains, row crops, vegetables, and orchards.

The soil properties and qualities important in the design and management of sprinkler irrigation systems are depth, available water holding capacity, sodium adsorption ratio, surface coarse fragments, permeability, salinity, slope, wetness, and flooding. The features that affect performance of the system and plant growth are surface rocks, salinity, sodium adsorption ratio, wetness, and available water holding capacity.

Information in this table is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this table. Local ordinances and regulations should be considered in planning, in site selection, and in design. The irrigation interpretations are not designed or intended to be used in a regulatory manner.

Report—Irrigation - General and Sprinkler (Vogel Dairy soils)

[The information in this table provides irrigation interpretations for mineral soils. Onsite investigation may be needed to validate the interpretations and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Irrigation - General and Sprinkler– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties							
Map symbol and soil name	Pct. of map unit	Irrigation (general)		Irrigation, Sprinkler (close spaced outlet drops)		Irrigation, Sprinkler (general)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
10B—Barron coarse sandy loam, 0 to 7 percent slopes							
Barron	85			Somewhat limited		Somewhat limited	
				Slope	0.86	Low water holding capacity	0.16
				Low water holding capacity	0.16		
21A—Camas sandy loam, 0 to 3 percent slopes							
Camas	80			Somewhat limited		Somewhat limited	
				Low water holding capacity	0.96	Low water holding capacity	0.96
				Occasional flooding	0.40	Occasional flooding	0.40
				Slope	0.12		
31A—Central Point sandy loam, 0 to 3 percent slopes							
Central point	80			Somewhat limited		Somewhat limited	
				Low water holding capacity	0.16	Low water holding capacity	0.16
				Slope	0.12		
Clawson	2			Somewhat limited		Somewhat limited	
				Depth to saturated zone	0.99	Depth to saturated zone	0.99
				Slope	0.86	Low water holding capacity	0.01
				Water Erosion	0.01		
				Low water holding capacity	0.01		
34B—Coleman loam, 0 to 7 percent slopes							
Coleman	85			Somewhat limited		Somewhat limited	
				Slope	0.86	Slow water movement	0.20
				Slow water movement	0.20		
				Water Erosion	0.12		

Irrigation - General and Sprinkler– Jackson County Area, Oregon, Parts of Jackson and Klamath Counties							
Map symbol and soil name	Pct. of map unit	Irrigation (general)		Irrigation, Sprinkler (close spaced outlet drops)		Irrigation, Sprinkler (general)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
76A—Gregory silty clay loam, 0 to 3 percent slopes							
Gregory	80			Somewhat limited		Somewhat limited	
				Slow water movement	0.20	Slow water movement	0.20
				Slope	0.12		
Gregory, 3-5% slopes	2			Somewhat limited		Somewhat limited	
				Slope	0.86	Slow water movement	0.20
				Slow water movement	0.20		
100A—Kubli loam, 0 to 3 percent slopes							
Kubli	90			Somewhat limited		Somewhat limited	
				Slow water movement	0.99	Slow water movement	0.99
				Slope	0.12		
127A—Medford silty clay loam, 0 to 3 percent slopes							
Medford	85			Somewhat limited		Not limited	
				Slope	0.12		
157B—Ruch silt loam, 2 to 7 percent slopes							
Ruch	80			Somewhat limited		Not limited	
				Slope	0.99		
				Water Erosion	0.18		
196E—Vannoy silt loam, 12 to 35 percent south slopes							
Vannoy, south	80			Very limited		Very limited	
				Slope	1.00	Slope, sprinkler irrigation	1.00
				Water Erosion	1.00	Too acid	0.22
				Too acid	0.22	Depth to soft bedrock	0.01
				Depth to soft bedrock	0.01		

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://soils.usda.gov/

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://soils.usda.gov/

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://soils.usda.gov/

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.glti.nrcs.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://soils.usda.gov/

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

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FG 60
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Alfalfa

Southwest Oregon (Coos, Curry, Jackson, Josephine counties)

E.H. Gardner, W.S. McGuire, and T.L. Jackson

Alfalfa is capable of producing high yields of forage when grown on deep, well-drained soils. Good management practices are essential if optimum fertilizer responses are to be realized. These practices include use of recommended varieties, selection of adapted soils, weed control, disease and insect control, good seedbed preparation, proper inoculation and seeding methods, and timely harvest.

Alfalfa removes substantial amounts of mineral nutrients. Field experiments have shown that under different conditions in western Oregon, alfalfa has responded to phosphorus, potassium, sulfur, boron, and lime. The need for nutrients other than sulfur can be determined with a soil test. With borderline test values, retest every year.

Follow recommended soil sampling procedures to estimate fertilizer needs. The Oregon State University Extension Service agent in your county can provide you with soil sampling instructions, soil sample bags, and information sheets.

Inoculation

All alfalfa seed should be inoculated immediately before seeding to ensure an adequate supply of nitrogen-fixing bacteria. Use a fresh, effective, live culture of the correct strain of Rhizobia.

Nitrogen (N)

If alfalfa responds to applied N, the alfalfa has not been nodulated effectively.

Phosphorus (P)

The need for P fertilization can be determined by a soil test (Table 1).

P can be applied to alfalfa fields most effectively by banding ½–1 inch to the side or below the seed when seeding. Some soil should separate the seed from fertilizer.

Do **not** include boron in band applications.

Broadcasting and working P into the surface 2 inches of soil during seedbed preparation is more effective than broadcasting following seeding.

P recommendations assume the soil pH is above 6.0

On established stands, apply P in the fall.

Table 1.—P fertilization rates for alfalfa.

If the soil test for P is (ppm)	Apply this amount of phosphate (P_2O_5) (lb/a)*
0–5	80–100
5–10	60–80
10–20	40–60
over 20	0

*For nonband applications to new seedings, increase the P rate by 50 percent.

Potassium (K)

Alfalfa requires large amounts of K. Available soil K may decline rapidly under established stands. Check soil tests every year on soils with borderline values.

Table 2.—K fertilization rates for alfalfa.

If the soil test for K is (ppm)	Apply this amount of potash (K_2O) (lb/a)
0–75	80–100
75–100	60–80
over 100	0

On new seedings

Broadcast K and work it into the seedbed prior to seeding.

On established stands

On nonirrigated alfalfa, broadcast K in the fall or early spring. On irrigated alfalfa, apply half the K in fall or early spring and the other half after the first cutting.

A K deficiency is indicated by light-colored spots around the margins of the leaves. If K deficiency symptoms become apparent on alfalfa leaves, apply at least 80 lb K_2O to provide the needs of the following crop.

Responses to K fertilizer often are obtained before leaf deficiency symptoms are apparent.

OREGON STATE UNIVERSITY
EXTENSION SERVICE

E. Hugh Gardner, Extension soil scientist emeritus; W.S. McGuire, professor emeritus of agronomy; and T.L. Jackson, Extension soil scientist emeritus; Oregon State University. Reviewed by a committee of southwest Oregon county Extension agents.

Sulfur (S)

Include 20–40 lb S/a in the annual fertilizer program. Apply S in the fall or early spring. An early spring application is suggested for valley floor soils.

One ton of alfalfa hay removes about 5 lb S.

S is contained in several fertilizer materials used to supply other nutrients. Plants absorb S in the form of sulfate. Fertilizer materials supply S in the form of sulfate and elemental S. Elemental S must be converted to sulfate in the soil before the S becomes available to plants. The conversion of elemental S to sulfate usually is rapid for fine-ground (less than 40-mesh) material in warm, moist soil.

The S requirements of alfalfa can be provided by:

1. Annually applying 20–40 lb S/a in the form of sulfate or fine-ground (finer than 40-mesh) elemental S. Elemental S will not be available to plants until the soil warms up.
2. Applying 40–60 lb S/a as sulfate or fine-ground elemental S every second year.
3. Applying coarser ground elemental S at higher rates and less frequently.

Magnesium (Mg)

Responses to Mg applications have not been measured in alfalfa fertility experiments to date. Trial applications are suggested when soil test values are below 0.8 meq Mg/100 g or when the amount of calcium is more than 10 times the amount of Mg.

Mg can be applied in the form of dolomite lime, which is equal to ground limestone in reducing soil acidity.

Boron (B)

On established stands, apply 3 lb B/a if the soil test is 1 ppm B or less. The application of B is not recommended for new seedings.

Apply B uniformly to the soil. B and other materials should be thoroughly mixed when B application is combined with other fertilizers. Apply B in fall or early spring.

B can be toxic to plants if applied at rates higher than recommended.

Response to B is most apparent on the second or third cutting

Lime

Alfalfa is sensitive to soil acidity and is responsive to liming of acid soils. Apply lime if the soil pH is below 6.4 or the soil test for calcium is below 5 meq Ca/100 g of soil.

Table 3.—Lime application rates for alfalfa.

If the SMP buffer test for lime is	Apply this amount of lime (t/a)
under 5.2	5–7
5.2–5.5	4–5
5.5–6.0	3–4
6.0–6.4	2–3
6.4–6.6	1–2
over 6.6	0

These liming rates are based on dry 100-score lime. Check liming materials for moisture content and score.

Apply lime preferably a season ahead, or at least several weeks before seeding, and thoroughly mix it with the surface 5–6 inches of soil. A lime application is effective for several years. Broadcasting lime on established alfalfa fields is not effective.

Dolomite lime, which can be used as a source of Mg, is equal to ground limestone in reducing soil acidity.

For More Information

How to Take a Soil Sample ... and Why, EC 628, by E.H. Gardner (revised 1997). No charge.

A List of Analytical Laboratories Serving Oregon, EM 8677, by J. Hart (revised 1997). No charge.

To order copies of the above publications, send the complete title and series number, along with a check or money order for the amount listed (payable to Oregon State University), to:

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World Wide Web

Fertilizer and Lime Materials, FG 52, by J. Hart (reprinted 1997). No charge.

You can access the above publications, as well as FG 60, *Alfalfa: Southwest Oregon (Coos, Curry, Jackson, Josephine counties)*, our Publications and Videos catalog, and many other publications via our Web site at **eesc.orst.edu**

Fertilizer recommendations are based on experiments conducted by T.L. Jackson, E.H Gardner, and H. Hickerson, Oregon State University.

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Pastures

Western Oregon and Western Washington

J. Hart, G. Pirelli, L. Cannon, and S. Fransen

In western Oregon and Washington, forage shortages typically occur in late fall and early spring. In contrast, an excess supply may exist in late spring. By fertilizing in early fall and late winter, you can increase forage supply in deficient times. To reduce production in times of excess, reduce or eliminate late spring fertilization.

A single fertilization program will not fit all pastures. Determine which combination of grazing management, fertilization, and irrigation fits your resources and environment. Use a soil test and an assessment of forage supply and forage species to determine fertilizer need.

If suitable species are not present, fertilization will not compensate. In this case, consider renovating the pasture.

New Seedings

Match the pasture species to site conditions and livestock needs when renovating a pasture. Cows prefer grasses over legumes and graze perennial ryegrass before tall fescue. Sheep graze selectively, preferring clover and grass mixtures with short, lush feed to tall, coarse plants.

Horses are selective grazers, eating a wide range of plants. The horse digestive system cannot handle large amounts of legumes. Small and frequent amounts of forage are best. Horses avoid grazing near their own manure and urine; therefore, managing grazing on horse pastures is difficult.

Cool season forages such as tall fescue, perennial ryegrass, orchardgrass, subclover, and white clover are suited for our climate.

After choosing the appropriate forage species and planting method, use a soil test as the basis for fertilization. EC 628, *How to Take a Soil Sample . . . and Why*, contains instructions for obtaining a soil sample.

For a preplant soil test, obtain samples from the tillage depth, generally the surface to 6 inches. If you use a minimum tillage method of planting, you may wish to divide the sample into two parts: the top 2 inches and the lower 4 inches.

Analyze the soil sample for the following:

- pH
- Lime requirement (SMP or LR)
- Phosphorus (P)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)

Soil pH indicates whether lime is needed, and the SMP buffer or lime requirement (LR) test estimates the amount of lime needed. Estimate the rate of lime application from the following SMP buffer table.

Table 1.—Lime application rates for grass or white clover-grass pastures.

If the SMP buffer test for lime is:	Apply this amount of lime (t/a):
under 5.5	4–5
5.5–5.8	3–4
5.8–6.1	2–3
6.1–6.5	1–2
over 6.5	0–1

If soil pH is below 5.5, incorporate lime for stand establishment and longevity. Mix lime into the seedbed before seeding to allow time for lime to neutralize soil acidity.

Exceptions to Table 1 are subclover seedings and pastures on coastal county bottomland soils. For new subclover seedings where the pH of the top 2 to 3 inches of soil is 5.5 or lower, mix 1 to 2 t lime/a into the surface 2 inches of soil before seeding. Using lime-pelleted seed also can improve seedling establishment on acidic soils.

If your pasture is on coastal county bottomland soils, apply a maximum of 2 t lime/a if the soil pH is below 5.5.

Additional information about lime requirement and the SMP buffer is in FG 52, *Fertilizer and Lime Materials*.

Nitrogen fertilization usually is necessary to establish grass forages in western Oregon and Washington. Broadcast 20 to 40 lb N/a at planting, or band this amount 1 to 2 inches below the seed. When P or K is needed, N can be banded with these nutrients. The total N plus K_2O in the band should not exceed 100 lb/a. *Do not include B in band applications because this concentration of B can be toxic to seedlings.*

Working P into the top 2 inches of the soil during seedbed preparation is more effective than broadcasting after seeding. The most effective P application method is banding.

If you band P, place the band 1 to 2 inches to the side or below the seed. Some soil should separate seed from fertilizer. Phosphorus fertilization rates are given in Table 2.

In new clover or clover and grass seedings, broadcast K and work it into the seedbed anytime before seeding. See Table 3 for fertilization rates based on a soil test.

John Hart, Extension soil scientist; Gene Pirelli, Extension agent, Polk County; Lynn Cannon, Extension agent emeritus, Coos County; Oregon State University; and Steve Fransen, Washington State University.
Reviewed by western Oregon county Extension agents.

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If soil test K is below 125 ppm, band an additional 20 lb K_2O/a at the time of planting. At least 1 inch of soil should separate the seed and fertilizer. Potassium can be banded with N and P. Potassium fertilization at planting will not meet the need for K in subsequent years.

Inoculate legume seed immediately before planting to ensure an adequate supply of nitrogen-fixing bacteria. Use fresh, effective live culture of the correct rhizobial strain.

Established Pastures

Manage fertilization and grazing jointly in established pastures. Although growth rates are influenced by temperature, moisture, solar radiation, and soil fertility, grazing management has a profound impact on pasture production.

New Zealand sheep producers use plant growth phases in ryegrass pastures to manage pasture growth, grazing, and fertilizer applications. Phase I (lag phase), Phase II (vegetative phase), and Phase III (maturity) describe the stages of growth and the impact on grazing and dry matter production.

Grass-clover pastures in Phase II provide high-quality feed. The goal is to graze before excess forage is produced (Phase III) and to supply fertilizer for rapid regrowth after grazing.

Figure 1 is an example of how this works with a perennial ryegrass pasture grazed by sheep or cattle. In Phase I (3/4 inch, 550 lb of dry matter), the plants grow very slowly because they lack sufficient leaf area for photosynthesis.

Phase II (3/4 to 4 1/4 inches high, 550 to 1,900 lb of dry matter/a) growth is desired in pastures. Plants grow most rapidly and efficiently in this stage. Their leaf area is great enough for efficient use of sunlight.

Growth slows in Phase III (greater than 4 1/4 inches), as lower leaves become shaded and die, and the plant moves toward maturity and seed production.

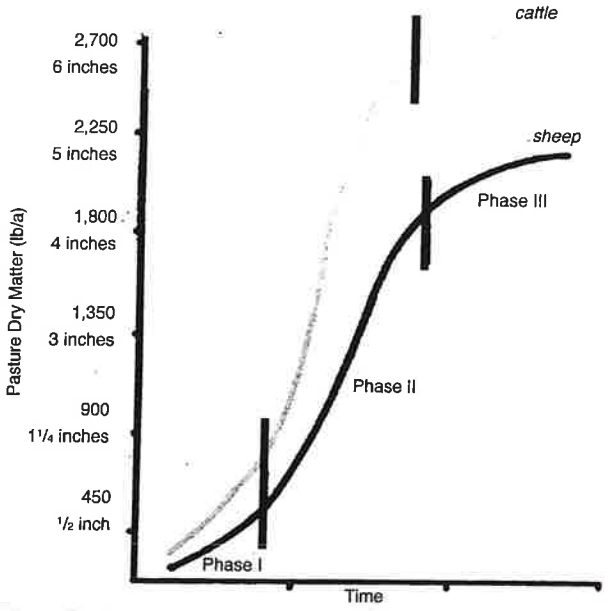


Figure 1.—Rate of perennial ryegrass pasture regrowth following grazing. For other grasses, multiply height by 2.

The grey line represents Phases I, II, and III if the pasture were managed for cattle. Cattle do not graze as closely as sheep, so the growth curve is based on higher initial and residual dry matter amounts. Other grass species such as orchardgrass and tall fescue have similar growth phases, but the grass heights listed for perennial ryegrass should be multiplied by two.

Fertilization of established pastures should be based on a soil test and the amount of forage needed. Obtain soil samples the year after establishment and every 2 to 3 years thereafter. Obtain samples from the top 3 inches of established pastures.

Nitrogen (N)

N fertilization should be based on moisture and temperature, which control pasture growth. Time N applications to crop and forage production needs. Avoid the following:

- *N applications in November and December*. N applied to cold, wet soils in winter can be leached beyond the root zone before slow-growing plants can use the fertilizer.
- *Late winter or early spring N application to saturated soils*. Soils that are too wet to drive on with a tractor may be too wet for plant growth. The plants may be yellow due to lack of oxygen from wet conditions and not lack of fertilizer. Wait for conditions conducive to plant growth before applying fertilizer.

See Figure 2 for an application schedule.

Fall

Assume the growing season begins with the fall rains. If sufficient rain falls in September to initiate growth, apply 40 to 60 lb N/a for the fall growing season (September and October). Do not apply N if adequate rain does not fall until late October or if the air temperature drops to or below freezing in October.

Many growers apply fertilizer to dry soil and note that the granules disappear before any rain. They fear volatile N loss. Nitrogen fertilizers, especially ammonium nitrate, often disappear overnight. Usually, this N has dissolved in dew and has moved onto the surface soil.

Winter

In cold conditions, pastures will not grow enough to use fertilizer. Forages in southwest coastal sites generally grow throughout winter, while conditions in the northern Willamette Valley allow only occasional winter growth.

For warm winters in the south coastal counties, apply 50 to 60 lb N/a in January or February (in addition to fall N application). Apply 50 to 60 lb N/a in the Willamette Valley or other cooler areas when a temperature of 40 to 45°F is maintained in the surface 2 inches.

Another method to estimate nitrogen demand is to monitor air temperature, then change the air temperature into heat units. A heat unit is the average of the high and low temperature for the day (in centigrade) and is a way to measure heat accumulation over time.

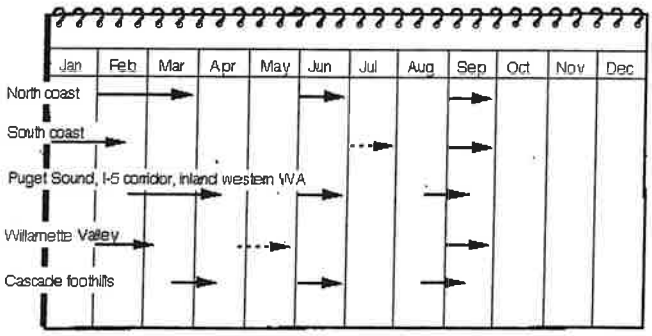


Figure 2.—Pasture nitrogen application calendar. Apply 50 to 60 lb N/a each time a solid arrow appears for your region. Additional applications for irrigated pastures are indicated by dotted lines. See nitrogen section in text for an explanation.

Table 4 shows a sample calculation of heat units. The process is as follows:

1. Beginning January 1, add together each day's maximum temperature and minimum temperature, and divide this total by 2. The result is the day's average temperature (column 4).

2. If this average temperature is in Fahrenheit, convert it to centigrade (column 5). To convert to centigrade, subtract 32 from the Fahrenheit temperature and then multiply by 0.556. For example:

42°F - 32 = 10

10 x 0.556 = 5.6°C

The centigrade average temperature is the number of heat units accumulated for that day. (If the average temperature is below freezing, give it a heat unit value of zero.)

3. To find the number of heat units that have accumulated since January 1, add together the heat units for each day (column 6).

Apply nitrogen when 200 heat units are accumulated or soon thereafter. The 30-year average for accumulation of 200 heat units is January 30 to February 14 in the Willamette Valley. Foothill temperatures and pasture growth typically lag 2 to 3 weeks behind the Willamette Valley.

Spring

Intensively grazed pastures that are expected to produce a high level of forage through June should receive a second application of nitrogen. Apply nitrogen only if moisture is sufficient for additional growth after mid-May. Apply summer N in July on irrigated coastal pastures.

Phosphorus (P)

Adequate P fertilization is particularly important for clover. Estimate the need for P fertilization with a soil test.

Table 2.—Phosphorus application rates for pastures.

If the Bray soil test for P is (ppm)	Apply this amount of phosphate (P_2O_5) (lb/a)
0–15	60–100
15–30	0–60
over 30	0

Apply P on established pastures in the fall or spring before growth begins. When using ammonium phosphate materials, do not over-apply N to supply adequate P.

Moderate rates of N and P (40 to 60 lb/a) applied together sometimes have a synergistic effect on plant growth. Fall applications of N and P from ammonium phosphate materials on south coastal Oregon pastures produced more forage than individual applications of either N or P.

Potassium (K)

An adequate level of available K is essential for optimal growth of clover-grass pastures. Potassium is particularly important for clover. Grass competes vigorously with clover for K. High-producing pastures can rapidly deplete soil test K. Test soil every 2 years to determine available K levels.

Potassium deficiency is indicated by light-colored spots around the margins of clover leaves and yellow to brown coloring of grass leaf tips. Growth responses to K fertilizer often can be obtained before deficiency symptoms are seen.

Table 3.—Potassium application rates for pastures.

If the soil test for K is (ppm)	Apply this amount of potash (K_2O) (lb/a)
0–125	100–150
125–200	70–100
over 200	None—Watch soil tests for K depletion

We suggest split applications of K for established, high-yielding irrigated pastures, with the first application in late

Table 4.—Sample heat unit calculation.

Day	Max Temp. (°F)	Min Temp. (°F)	Average Temp (°F) (Max T + Min T)/2	Average Temp. (°C) = Daily Heat Units	Cumulative Heat Units
Jan 1	47	37	42	5.6	5.6
Jan 2	46	32	39	3.9	9.5
Jan 3	45	36	40	4.7	14.2

heat unit = (Max T + Min T)/2. Convert temperatures to centigrade to determine heat units. The equation to convert Fahrenheit to centigrade is: (°F - 32) x 0.556.

spring to avoid tetany and the second in midsummer. For other pasture types, apply K in the fall or spring.

Sulfur (S)

Plants absorb S as sulfate. Most fertilizer materials (ammonium sulfate, gypsum, sulpomag) supply S as sulfate.

Soil sulfate, which increases in the fall, is decreased by leaching in November and December and use by microorganisms in the spring. Thus, we recommend late winter or spring applications unless there is a severe deficiency, which may require additional fall or spring applications.

You can meet pasture S requirements by applying 20 to 30 lb S/a annually as sulfate or by applying 30 to 40 lb S/a as sulfate every other year.

Boron (B)

Clover-grass pastures need adequate B. Clovers have a higher B requirement than grasses. Too much B can be highly toxic to plants; therefore, do not exceed suggested rates of B application. Distribute B evenly over the field. *Never band B-containing fertilizer materials.*

If the soil test for B is below 0.7 ppm, we suggest an application of 2 to 3 lb B/a. Mix thoroughly when applying B with other fertilizers. Spring applications are preferred. Apply B in the fall only when B is critically low.

Lime, Calcium (Ca), and Magnesium (Mg)

Soils west of the Cascades are naturally acidic. Lime applications overcome soil acidity, allowing for increased grass and legume growth. Determine the need for lime by soil pH or a calcium (Ca) soil test. The amount of lime required to raise soil pH is determined by the SMP buffer or lime requirement (LR) test. Additional information is available in FG 52, *Fertilizer and Lime Materials*.

Grass pastures have a moderate tolerance to soil acidity. We suggest a lime application if the soil pH is below 5.4 or the Ca soil test is below 5 meq Ca/100 g of soil. For acidic soils low in Mg (less than 0.8 meq Mg/100 g of soil), use 1 t/a of dolomitic lime as an Mg source. Dolomitic lime and ground limestone have about the same ability to neutralize soil acidity. Liming rate is based on 100-score lime.

Subclover is an annual, reseeding itself each year. We recommend lime on subclover pastures where soil pH in the surface 2 to 3 inches of soil is below 5.5. Broadcast 1 t lime/a on established stands.

Clovers other than subclover are more responsive to liming than grasses. We recommend a 1–2 t/a lime application when soil pH is below 5.8. Broadcasting lime on established pastures is not as effective as mixing lime with the soil at planting, but is the only alternative on established pastures.

Pasture yield responses to Mg have not been observed in western Oregon and Washington. We suggest trial applications of a soluble Mg fertilizer where soil test levels are below 0.8 meq/100 g soil.

Incidence of grass tetany, however, may make Mg applications desirable. If tetany is a problem, do not apply K fertilizer until after the tetany period, since K reduces plant Mg and can induce tetany.

For More Information

OSU Extension publications

To order copies of the following publications, send the publication's complete title and series number to:

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119

Gardner, E.H., and J. Hart. *How to take a soil sample. . . and why*, EC 628 (Revised 1995). No charge

Hart, J. *Fertilizer and lime materials,* FG 52, (Reprinted 1998). No charge

Hart, J. *A List of Analytical Laboratories Serving Oregon*, EM 8677 (reprinted 1999). No charge

Other publications

Controlled Grazing Systems, Farm Production and Practice 681, New Zealand Ministry of Agriculture and Fisheries, P.O. Box 2526 (Wellington, New Zealand, 1983).

Dawson, M.D., and W.S. McGuire. *Recycling nitrogen and sulfur in grass-clover pastures,* Agricultural Experiment Station Bulletin 610 (Oregon State University, Corvallis, 1972).

Jackson, T.L., H.H. Rampton, and J. McDermid. *The effect of lime and phosphorus on the yield and phosphorus content of legumes in western Oregon,* Agricultural Experiment Station Technical Bulletin 83 (Oregon State University, Corvallis, 1964).

Kilgour, R., and C. Dalton. *Livestock behavior, a practical guide.* Mathuen Publications (New Zealand, 1942).

McCarthy, M.J. *Some effects of sulfur fertilization on the nutrient value of subclover-grass forage.* M.S. thesis (Oregon State University, Corvallis, 1976).

Rogers, J. *The Effect of Topdressed Lime Upon Pasture Production and Quality.* M.S. thesis (Oregon State University, 1996).

Suggested P, K, Mg, B, and lime applications are based on soil test methods used in the Central Analytical Laboratory, OSU, Corvallis, OR. This fertilizer guide is based on experiments and field trials conducted by Lynn Cannon, M.D. Dawson, E. Hugh Gardner, John Hart, T.L. Jackson, W.S. McGuire, and Gene Pirelli, Agricultural Experiment Station and Extension Service, Oregon State University. This guide replaces FG 1, *Irrigated Clover-Grass Pastures (W. Ore.)*; FG 4, *Subclover-Grass Pasture (W. Ore.)*; FG 16, *Perennial Grass Pasture (W. Ore.)*; FG 58, *Irrigated Clover-Grass Pastures (SW Ore.)*; and FG 63, *Subclover-Grass Pastures (W. Ore.)*.

Revised April 1996. Reprinted January 2000.

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Alfalfa
Soil Map Unit Name:	Ruch
Soil texture:	silt loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	7	0.17	1.2
	7	70	0.14	8.8
Total Soil Water Capacity (in): in the soil profile				**10.0**

Irrigation Requirement HOW MUCH water to apply?	Month MAR	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in):	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**
Irrigation Timing WHEN to apply water?							
Daily Crop Water Use (in/day):	0.01	0.13	0.19	0.21	0.25	0.22	0.16
Maximum Irrigation Frequency (days):	220.5	17.0	11.6	10.5	8.8	10.0	13.8
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**0.1**	**1.7**	**2.4**	**2.7**	**3.2**	**2.7**	**2.1**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k:	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**3.39**	**3.39**	**3.39**	**3.39**	**3.39**	**3.39**	**3.39**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Required System Flow Rate (gpm):	**3**	**41**	**60**	**67**	**79**	**70**	**51**
Required System Flow Rate (gpm/acre):	**0.3**	**4.1**	**6.0**	**6.7**	**7.9**	**7.0**	**5.1**
System flow rate to meet peak demand:	**79.2 gpm**		**7.9 gpm/acre**				
Percent run time at peak system flow rate:	**4%**	**52%**	**76%**	**84%**	**100%**	**88%**	**64%**
GROSS Monthly Application (in):	**0.42**	**5.66**	**8.01**	**9.15**	**10.89**	**9.27**	**6.97**
GROSS Monthly Application (ac-ft):	**0.35**	**4.72**	**6.67**	**7.62**	**9.08**	**7.73**	**5.81**
GROSS Annual Application:	**50.38 inches**		**41.98 ac-ft**				

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Pasture
Soil Map Unit Name:	Ruch
Soil texture:	silt loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones

Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
0	7	0.17	1.2
7	70	0.14	8.8

Total Soil Water Capacity (in) in the soil profile: **10.0**

Irrigation Requirement
HOW MUCH water to apply?

	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP	Month OCT
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in):	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**

Irrigation Timing
WHEN to apply water?

Daily Crop Water Use (in/day):	0.14	0.19	0.24	0.27	0.23	0.18	0.11
Maximum Irrigation Frequency (days):	15.8	11.6	9.2	8.2	9.6	12.3	20.0
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**	**2.21**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**1.7**	**2.4**	**3.0**	**3.5**	**3.0**	**2.2**	**1.4**

System Capacity

NOT E: Actual precipitation will affect the timing and number of irrigations.

System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k:	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**3.39**	**3.39**	**3.39**	**3.39**	**3.39**	**3.39**	**3.39**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Required System Flow Rate (gpm):	**44**	**60**	**76**	**86**	**73**	**57**	**35**
Required System Flow Rate (gpm/acre):	**4.4**	**6.0**	**7.6**	**8.6**	**7.3**	**5.7**	**3.5**

System flow rate to meet peak demand:	**85.5 gpm**	**8.6 gpm/acre**

Percent run time at peak system flow rate:	**52%**	**70%**	**89%**	**100%**	**85%**	**67%**	**41%**
GROSS Monthly Application (in):	**5.90**	**8.28**	**10.12**	**11.76**	**10.02**	**7.59**	**4.79**
GROSS Monthly Application (ac-ft):	**4.92**	**6.90**	**8.43**	**9.80**	**8.35**	**6.32**	**3.99**

GROSS Annual Application:	**58.46 inches**	**48.72 ac-ft**

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Alfalfa
Soil Map Unit Name:	Medford
Soil texture:	Silty clay loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	12	0.17	2.0
	12	22	0.16	1.6
	22	53	0.16	5.0
	53	71	0.16	2.9
Total Soil Water Capacity (in): in the soil profile				**11.5**

Irrigation Requirement HOW MUCH water to apply?	Month MAR	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**
Irrigation Timing WHEN to apply water?							
Daily Crop Water Use (in/day):	0.01	0.13	0.19	0.21	0.25	0.22	0.16
Maximum Irrigation Frequency (days)	246.0	18.9	12.9	11.7	9.8	11.2	15.4
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**0.1**	**1.5**	**2.1**	**2.4**	**2.9**	**2.5**	**1.9**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k_r	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**3.78**	**3.78**	**3.78**	**3.78**	**3.78**	**3.78**	**3.78**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Required System Flow Rate (gpm):	**3**	**41**	**60**	**67**	**79**	**70**	**51**
Required System Flow Rate (gpm/acre):	**0.3**	**4.1**	**6.0**	**6.7**	**7.9**	**7.0**	**5.1**
System flow rate to meet peak demand:	**79.2 gpm**		**7.9 gpm/acre**				
Percent run time at peak system flow rate:	**4%**	**52%**	**76%**	**84%**	**100%**	**88%**	**64%**
GROSS Monthly Application (in):	**0.42**	**5.69**	**8.05**	**9.20**	**10.95**	**9.32**	**7.01**
GROSS Monthly Application (ac-ft):	**0.35**	**4.74**	**6.71**	**7.66**	**9.12**	**7.77**	**5.84**
GROSS Annual Application:	**50.65 inches**		**42.21 ac-ft**				

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Pasture
Soil Map Unit Name:	Medford
Soil texture:	Silty clay loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones

Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
0	12	0.17	2.0
12	22	0.16	1.6
22	53	0.16	5.0
53	71	0.16	2.9

Total Soil Water Capacity (in): in the soil profile 11.5

Irrigation Requirement
HOW MUCH water to apply?

	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP	Month OCT
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**

Irrigation Timing
WHEN to apply water?

Daily Crop Water Use (in/day):	0.14	0.19	0.24	0.27	0.23	0.18	0.11
Maximum Irrigation Frequency (days)	17.6	12.9	10.3	9.1	10.7	13.7	22.4
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**1.6**	**2.2**	**2.7**	**3.1**	**2.7**	**2.0**	**1.3**

System Capacity

NOTE: Actual precipitation will affect the timing and number of irrigations.

System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**3.78**	**3.78**	**3.78**	**3.78**	**3.78**	**3.78**	**3.78**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Required System Flow Rate (gpm):	**44**	**60**	**76**	**86**	**73**	**57**	**35**
Required System Flow Rate (gpm/acre):	**4.4**	**6.0**	**7.6**	**8.6**	**7.3**	**5.7**	**3.5**

System flow rate to meet peak demand:	**85.5 gpm**	**8.6 gpm/acre**

Percent run time at peak system flow rate:	**52%**	**70%**	**89%**	**100%**	**85%**	**67%**	**41%**
GROSS Monthly Application (in):	**5.93**	**8.32**	**10.17**	**11.83**	**10.07**	**7.63**	**4.82**
GROSS Monthly Application (ac-ft):	**4.95**	**6.93**	**8.48**	**9.85**	**8.39**	**6.36**	**4.01**

GROSS Annual Application:	**58.78 inches**	**48.98 ac-ft**

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Alfalfa
Soil Map Unit Name:	Kubli
Soil texture:	Loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	15	0.17	2.6
	15	31	0.17	2.7
	31	60	0.15	4.4
Total Soil Water Capacity (in): in the soil profile				**9.6**

Irrigation Requirement HOW MUCH water to apply?	Month MAR	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**
Irrigation Timing WHEN to apply water?							
Daily Crop Water Use (in/day):	0.01	0.13	0.19	0.21	0.25	0.22	0.16
Maximum Irrigation Frequency (days)	255.0	19.6	13.4	12.1	10.2	11.6	15.9
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**0.1**	**1.5**	**2.1**	**2.3**	**2.8**	**2.4**	**1.8**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**3.92**	**3.92**	**3.92**	**3.92**	**3.92**	**3.92**	**3.92**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Required System Flow Rate (gpm):	**3**	**41**	**60**	**67**	**79**	**70**	**51**
Required System Flow Rate (gpm/acre):	**0.3**	**4.1**	**6.0**	**6.7**	**7.9**	**7.0**	**5.1**
System flow rate to meet peak demand:	**79.2 gpm**		**7.9 gpm/acre**				
Percent run time at peak system flow rate:	**4%**	**52%**	**76%**	**84%**	**100%**	**88%**	**64%**
GROSS Monthly Application (in):	**0.42**	**5.70**	**8.07**	**9.21**	**10.97**	**9.34**	**7.02**
GROSS Monthly Application (ac-ft):	**0.35**	**4.75**	**6.72**	**7.68**	**9.14**	**7.78**	**5.85**
GROSS Annual Application:	**50.74 inches**		**42.28 ac-ft**				

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Pasture
Soil Map Unit Name:	Kubli
Soil texture:	Loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	15	0.17	2.6
	15	31	0.17	2.7
	31	60	0.15	4.4
Total Soil Water Capacity (in): in the soil profile				**9.6**

Irrigation Requirement HOW MUCH water to apply?	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP	Month OCT
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**
Irrigation Timing WHEN to apply water?							
Daily Crop Water Use (in/day):	0.14	0.19	0.24	0.27	0.23	0.18	0.11
Maximum Irrigation Frequency (days):	18.2	13.4	10.6	9.4	11.1	14.2	23.2
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**	**2.55**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**1.5**	**2.1**	**2.6**	**3.0**	**2.6**	**1.9**	**1.2**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**3.92**	**3.92**	**3.92**	**3.92**	**3.92**	**3.92**	**3.92**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Required System Flow Rate (gpm):	**44**	**60**	**76**	**86**	**73**	**57**	**35**
Required System Flow Rate (gpm/acre):	**4.4**	**6.0**	**7.6**	**8.6**	**7.3**	**5.7**	**3.5**
System flow rate to meet peak demand:	**85.5 gpm**		**8.6 gpm/acre**				
Percent run time at peak system flow rate:	**52%**	**70%**	**89%**	**100%**	**85%**	**67%**	**41%**
GROSS Monthly Application (in):	**5.94**	**8.34**	**10.19**	**11.85**	**10.09**	**7.64**	**4.83**
GROSS Monthly Application (ac-ft):	**4.95**	**6.95**	**8.49**	**9.87**	**8.41**	**6.37**	**4.02**
GROSS Annual Application:	**58.88 inches**		**49.07 ac-ft**				

Conservation Practice Worksheet — **OR IWM-W9.2.xls**

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — **Date:** 12/15/11

System Type: Wheel line

Field ID:	Various
Crop:	Alfalfa
Soil Map Unit Name:	Gregory
Soil texture:	silty clay loam
Soil Depth (in):	40
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	7	0.20	1.4
	7	44	0.18	6.7
	44	50	0.19	1.1
	50	60	0.00	0.0
Total Soil Water Capacity (in): in the soil profile				**9.2**

Irrigation Requirement HOW MUCH water to apply?	Month MAR	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in):	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**
Irrigation Timing WHEN to apply water?							
Daily Crop Water Use (in/day):	0.01	0.13	0.19	0.21	0.25	0.22	0.16
Maximum Irrigation Frequency (days):	277.0	21.3	14.6	13.2	11.1	12.6	17.3
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**0.1**	**1.3**	**1.9**	**2.2**	**2.6**	**2.2**	**1.7**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k:	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**4.26**	**4.26**	**4.26**	**4.26**	**4.26**	**4.26**	**4.26**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Required System Flow Rate (gpm):	**3**	**41**	**60**	**67**	**79**	**70**	**51**
Required System Flow Rate (gpm/acre):	**0.3**	**4.1**	**6.0**	**6.7**	**7.9**	**7.0**	**5.1**
System flow rate to meet peak demand:	**79.2 gpm**		**7.9 gpm/acre**				
Percent run time at peak system flow rate:	**4%**	**52%**	**76%**	**84%**	**100%**	**88%**	**64%**
GROSS Monthly Application (in):	**0.43**	**5.73**	**8.10**	**9.25**	**11.01**	**9.38**	**7.05**
GROSS Monthly Application (ac-ft):	**0.36**	**4.77**	**6.75**	**7.71**	**9.18**	**7.82**	**5.87**
GROSS Annual Application:	**50.95 inches**		**42.46 ac-ft**				

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy **Date:** 12/15/11

System Type: Wheel line

Field ID:	Various
Crop:	Pasture
Soil Map Unit Name:	Gregory
Soil texture:	Silty clay loam
Soil Depth (in):	40
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	7	0.20	1.4
	7	44	0.18	6.7
	44	50	0.19	1.1
	50	60	0.00	0.0
Total Soil Water Capacity (in): in the soil profile				**9.2**

Irrigation Requirement HOW MUCH water to apply?	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP	Month OCT
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**
Irrigation Timing WHEN to apply water?							
Daily Crop Water Use (in/day):	0.14	0.19	0.24	0.27	0.23	0.18	0.11
Maximum Irrigation Frequency (days)	19.8	14.6	11.5	10.3	12.0	15.4	25.2
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**	**2.77**
Percent of Root Zone Capacity Applied (%)	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**1.4**	**2.0**	**2.4**	**2.8**	**2.4**	**1.8**	**1.1**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**4.26**	**4.26**	**4.26**	**4.26**	**4.26**	**4.26**	**4.26**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Required System Flow Rate (gpm):	**44**	**60**	**76**	**86**	**73**	**57**	**35**
Required System Flow Rate (gpm/acre):	**4.4**	**6.0**	**7.6**	**8.6**	**7.3**	**5.7**	**3.5**
System flow rate to meet peak demand:	**85.5 gpm**		**8.6 gpm/acre**				
Percent run time at peak system flow rate:	**52%**	**70%**	**89%**	**100%**	**85%**	**67%**	**41%**
GROSS Monthly Application (in):	**5.97**	**8.37**	**10.23**	**11.90**	**10.13**	**7.67**	**4.85**
GROSS Monthly Application (ac-ft):	**4.97**	**6.98**	**8.53**	**9.91**	**8.44**	**6.40**	**4.04**
GROSS Annual Application:	**59.12 inches**		**49.27 ac-ft**				

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — **Date:** 12/15/11

System Type: wheel line

Field ID:	various
Crop:	Alfalfa
Soil Map Unit Name:	Coleman
Soil texture:	Loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	5.2
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	8	0.17	1.4
	8	20	0.20	2.4
	20	40	0.14	2.8
	40	65	0.14	3.5
Total Soil Water Capacity (in): in the soil profile				**10.1**

Irrigation Requirement HOW MUCH water to apply?	Month MAR	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in):	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**
Irrigation Timing WHEN to apply water?							
Daily Crop Water Use (in/day):	0.01	0.13	0.19	0.21	0.25	0.22	0.16
Maximum Irrigation Frequency (days):	258.0	19.8	13.6	12.3	10.3	11.7	16.1
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**0.1**	**1.4**	**2.0**	**2.3**	**2.8**	**2.4**	**1.8**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k_r	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**3.97**	**3.97**	**3.97**	**3.97**	**3.97**	**3.97**	**3.97**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
System flow rate to meet peak demand:	**41.2 gpm**		**7.9 gpm/acre**				
Percent run time at peak system flow rate:	**4%**	**52%**	**76%**	**84%**	**100%**	**88%**	**64%**
GROSS Monthly Application (in):	**0.42**	**5.71**	**8.07**	**9.22**	**10.98**	**9.35**	**7.02**
GROSS Monthly Application (ac-ft):	**0.18**	**2.47**	**3.50**	**4.00**	**4.76**	**4.05**	**3.04**
GROSS Annual Application:	**50.77 inches**		**22.00 ac-ft**				

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy **Date:** 12/15/11

System Type: wheel line

Field ID:	various
Crop:	pasture
Soil Map Unit Name:	Coleman
Soil texture:	Loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	5.2
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	8	0.17	1.4
	8	20	0.20	2.4
	20	40	0.14	2.8
	40	65	0.14	3.5
Total Soil Water Capacity (in): in the soil profile				**10.1**

Irrigation Requirement
HOW MUCH water to apply?

	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP	Month OCT
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**

Irrigation Timing
WHEN to apply water?

Daily Crop Water Use (in/day):	0.14	0.19	0.24	0.27	0.23	0.18	0.11
Maximum Irrigation Frequency (days)	18.4	13.6	10.8	9.6	11.2	14.3	23.5
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**	**2.58**
Percent of Root Zone Capacity Applied (%)	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**1.5**	**2.1**	**2.6**	**3.0**	**2.5**	**1.9**	**1.2**

System Capacity

NOTE: Actual precipitation will affect the timing and number of irrigations.

System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k_r	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**3.97**	**3.97**	**3.97**	**3.97**	**3.97**	**3.97**	**3.97**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0

System flow rate to meet peak demand:	**44.5 gpm**	**8.6 gpm/acre**

Percent run time at peak system flow rate:	**52%**	**70%**	**89%**	**100%**	**85%**	**67%**	**41%**
GROSS Monthly Application (in):	**5.95**	**8.34**	**10.20**	**11.85**	**10.10**	**7.65**	**4.83**
GROSS Monthly Application (ac-ft):	**2.58**	**3.61**	**4.42**	**5.14**	**4.38**	**3.31**	**2.09**

GROSS Annual Application:	**58.91 inches**	**25.53 ac-ft**

Conservation Practice Works..et — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Alfalfa
Soil Map Unit Name:	Central Point
Soil texture:	sandy loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	30	0.10	3.0
	30	49	0.10	1.9
	49	67	0.09	1.6
Total Soil Water Capacity (in): in the soil profile				**6.5**

Irrigation Requirement
HOW MUCH water to apply?

	Month MAR	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**

Irrigation Timing
WHEN to apply water?

Daily Crop Water Use (in/day):	0.01	0.13	0.19	0.21	0.25	0.22	0.16
Maximum Irrigation Frequency (days):	150.0	11.5	7.9	7.1	6.0	6.8	9.4
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**0.2**	**2.4**	**3.4**	**3.9**	**4.6**	**3.9**	**3.0**

System Capacity

NOTE: Actual precipitation will affect the timing and number of irrigations.

System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k_r	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**2.31**	**2.31**	**2.31**	**2.31**	**2.31**	**2.31**	**2.31**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0

System flow rate to meet peak demand:	**79.2 gpm**	**7.9 gpm/acre**

Percent run time at peak system flow rate:	**4%**	**52%**	**76%**	**84%**	**100%**	**88%**	**64%**
GROSS Monthly Application (in):	**0.41**	**5.56**	**7.86**	**8.98**	**10.69**	**9.10**	**6.84**
GROSS Monthly Application (ac-ft):	**0.34**	**4.63**	**6.55**	**7.48**	**8.90**	**7.58**	**5.70**

GROSS Annual Application:	**49.43 inches**	**41.19 ac-ft**

Conservation Practice Worksh... OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Pasture
Soil Map Unit Name:	Central Point
Soil texture:	Sandy Loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones

Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
0	30	0.10	3.0
30	49	0.10	1.9
49	67	0.09	1.6

Total Soil Water Capacity (in): in the soil profile **6.5**

Irrigation Requirement
HOW MUCH water to apply?

	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP	Month OCT
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**

Irrigation Timing
WHEN to apply water?

Daily Crop Water Use (in/day):	0.15	0.20	0.24	0.28	0.24	0.18	0.11
Maximum Irrigation Frequency (days):	10.0	7.5	6.3	5.4	6.3	8.3	13.6
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**2.7**	**3.7**	**4.3**	**5.2**	**4.4**	**3.2**	**2.0**

System Capacity

NOTE: Actual precipitation will affect the timing and number of irrigations.

System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**2.31**	**2.31**	**2.31**	**2.31**	**2.31**	**2.31**	**2.31**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0

System flow rate to meet peak demand:	**88.7 gpm**	**8.9 gpm/acre**

Percent run time at peak system flow rate:	**54%**	**71%**	**86%**	**100%**	**86%**	**64%**	**39%**
GROSS Monthly Application (in):	**6.20**	**8.55**	**9.93**	**11.97**	**10.26**	**7.45**	**4.70**
GROSS Monthly Application (ac-ft):	**5.17**	**7.12**	**8.27**	**9.97**	**8.55**	**6.20**	**3.92**

GROSS Annual Application:	**59.05 inches**	**49.21 ac-ft**

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — **Date:** 12/15/11

System Type: wheel line

Field ID:	various
Crop:	Alfalfa
Soil Map Unit Name:	Camas
Soil texture:	sandy loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	25
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	10	0.12	1.2
	10	60	0.04	2.0
Total Soil Water Capacity (in): in the soil profile				**3.2**

Irrigation Requirement HOW MUCH water to apply?	Month MAR	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Irrigation Timing WHEN to apply water?							
Daily Crop Water Use (in/day):	0.01	0.13	0.19	0.21	0.25	0.22	0.16
Maximum Irrigation Frequency (days)	100.0	7.7	5.3	4.8	4.0	4.5	6.3
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**0.3**	**3.5**	**5.0**	**5.7**	**6.8**	**5.8**	**4.4**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k_r	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**1.54**	**1.54**	**1.54**	**1.54**	**1.54**	**1.54**	**1.54**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
System flow rate to meet peak demand:	**198.0 gpm**		**7.9 gpm/acre**				
Percent run time at peak system flow rate:	**4%**	**52%**	**76%**	**84%**	**100%**	**88%**	**64%**
GROSS Monthly Application (in):	**0.41**	**5.45**	**7.70**	**8.80**	**10.47**	**8.92**	**6.70**
GROSS Monthly Application (ac-ft):	**0.84**	**11.35**	**16.05**	**18.33**	**21.82**	**18.58**	**13.96**
GROSS Annual Application:	**48.45 inches**		**100.93 ac-ft**				

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy **Date:** 12/15/11

System Type: wheel line

Field ID:	various
Crop:	Pature
Soil Map Unit Name:	Camas
Soil texture:	sandy loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	25
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	10	0.12	1.2
	10	60	0.04	2.0
Total Soil Water Capacity (in): in the soil profile				**3.2**

Irrigation Requirement
HOW MUCH water to apply?

	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP	Month OCT
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Irrigation Timing
WHEN to apply water?

Daily Crop Water Use (in/day):	0.15	0.20	0.25	0.29	0.24	0.19	0.11
Maximum Irrigation Frequency (days)	6.7	5.0	4.0	3.4	4.2	5.3	9.1
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**4.0**	**5.4**	**6.6**	**7.9**	**6.5**	**5.0**	**3.0**

System Capacity

NOTE: Actual precipitation will affect the timing and number of irrigations.

System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k_r	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**1.54**	**1.54**	**1.54**	**1.54**	**1.54**	**1.54**	**1.54**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0

System flow rate to meet peak demand:	**229.7 gpm**	**9.2 gpm/acre**

Percent run time at peak system flow rate:	**52%**	**69%**	**86%**	**100%**	**83%**	**66%**	**38%**
GROSS Monthly Application (in):	**6.08**	**8.38**	**10.14**	**12.15**	**10.05**	**7.70**	**4.61**
GROSS Monthly Application (ac-ft):	**12.67**	**17.46**	**21.12**	**25.31**	**20.95**	**16.05**	**9.60**

GROSS Annual Application:	**59.11 inches**	**123.15 ac-ft**

Conservation Practice Worksheet — OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon — February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy — Date: 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	alfalfa
Soil Map Unit Name:	Baron
Soil texture:	coarse sandy loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	6	0.20	1.2
	6	60	0.20	10.8
Total Soil Water Capacity (in): in the soil profile				12.0

Irrigation Requirement — HOW MUCH water to apply?	Month MAR	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in)	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**
Irrigation Timing — WHEN to apply water?							
Daily Crop Water Use (in/day):	0.01	0.13	0.19	0.21	0.25	0.22	0.16
Maximum Irrigation Frequency (days):	300.0	23.1	15.8	14.3	12.0	13.6	18.8
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**0.1**	**1.2**	**1.8**	**2.0**	**2.4**	**2.0**	**1.5**
System Capacity	***NOTE: Actual precipitation will affect the timing and number of irrigations.***						
System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k_r	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**4.62**	**4.62**	**4.62**	**4.62**	**4.62**	**4.62**	**4.62**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0
System flow rate to meet peak demand:	**79.2 gpm**		**7.9 gpm/acre**				
Percent run time at peak system flow rate:	**4%**	**52%**	**76%**	**84%**	**100%**	**88%**	**64%**
GROSS Monthly Application (in):	**0.43**	**5.75**	**8.13**	**9.29**	**11.06**	**9.42**	**7.08**
GROSS Monthly Application (ac-ft):	**0.36**	**4.79**	**6.78**	**7.74**	**9.21**	**7.85**	**5.90**
GROSS Annual Application:	**51.15 inches**		**42.63 ac-ft**				

Conservation Practice Worksh... OR IWM-W9.2.xls

Natural Resources Conservation Service, Oregon February 2007

Irrigation Water Application – How Much, When, System Capacity

Client: Vogel dairy **Date:** 12/15/11

System Type: wheel line

Field ID:	Various
Crop:	Pasture
Soil Map Unit Name:	Barron
Soil texture:	Coarse sandy loam
Soil Depth (in):	80
Managed Root Zone Depth (in):	30
Management Allowed Deficit (%):	50%
Irrigated Area (acres):	10
System Application Efficiency (%):	65%
Hours of Operation per Day (hr):	22

Soil Profile Depth Zones	Upper Limit (in)	Lower Limit (in)	AWC (in/in)	AWC in soil zone (in)
	0	7	0.20	1.4
	7	42	0.20	7.0
	42	60	0.19	3.3
Total Soil Water Capacity (in): in the soil profile				**11.7**

Irrigation Requirement
HOW MUCH water to apply?

	Month APR	Month MAY	Month JUN	Month JUL	Month AUG	Month SEP	Month OCT
Managed Root Zone Depth (in):	30	30	30	30	30	30	30
Soil Water Capacity in Root Zone (in):	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Management Allowed Deficit (%):	50%	50%	50%	50%	50%	50%	50%
Maximum Net Irrigation Requirement (in):	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**

Irrigation Timing
WHEN to apply water?

Daily Crop Water Use (in/day):	0.14	0.19	0.24	0.27	0.23	0.18	0.11
Maximum Irrigation Frequency (days):	21.4	15.8	12.5	11.1	13.0	16.7	27.3
Actual Irrigation Period (days):							
Actual NET Irrigation Application (in):	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**
Percent of Root Zone Capacity Applied (%):	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Expected number of irrigations per month:	**1.3**	**1.8**	**2.2**	**2.6**	**2.2**	**1.7**	**1.1**

System Capacity

NOTE: Actual precipitation will affect the timing and number of irrigations.

System Application Efficiency (%):	65%	65%	65%	65%	65%	65%	65%
Frequency Factor, k:	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROSS Irrigation Application (in):	**4.62**	**4.62**	**4.62**	**4.62**	**4.62**	**4.62**	**4.62**
Hours of System Operation per Day (hr):	22.0	22.0	22.0	22.0	22.0	22.0	22.0

System flow rate to meet peak demand:	**85.5 gpm**	**8.6 gpm/acre**

Percent run time at peak system flow rate:	**52%**	**70%**	**89%**	**100%**	**85%**	**67%**	**41%**
GROSS Monthly Application (in):	**5.99**	**8.40**	**10.27**	**11.94**	**10.17**	**7.70**	**4.87**
GROSS Monthly Application (ac-ft):	**4.99**	**7.00**	**8.56**	**9.95**	**8.48**	**6.42**	**4.05**

GROSS Annual Application:	**59.35 inches**	**49.46 ac-ft**

Calibrating Irrigation Equipment for Manure Application

Last Updated: February 14, 2011

Livestock and Poultry Environmental Learning Center:

Home Page (http://www.extension.org/animal+manure+management)

All articles about:

Manure Nutrients (/pages/8647/manure-nutrient-management)

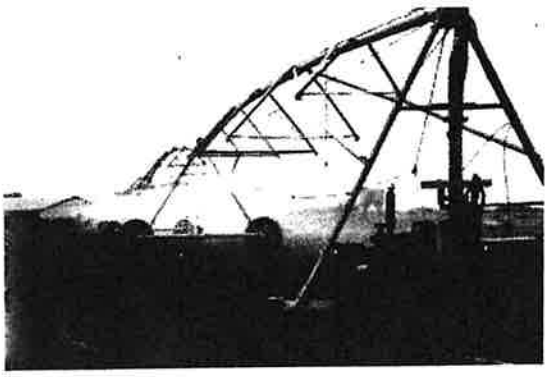
Irrigation equipment can be used to land apply manure with a solids content of up to 2-3 percent depending upon the type of equipment used and nozzle size. The types of systems typically used are stationary (also called solid-set), traveling guns, and center pivots. Irrigation equipment is typically used to land apply liquid manure from anaerobic lagoons and runoff holding ponds. If applied manure is undiluted, calibration requirements may differ slightly from those systems using diluted manure. If manure is diluted with freshwater, nutrient concentration must be adjusted by the dilution ratio when calculating nutrient rates. Always check with your state regulatory agency for calibration and reporting requirements.

As with the other types of equipment used for land applying manure, calibration consists of verifying application rates and application uniformity. Application rate and uniformity is measured by collecting applied manure in rain gages that are placed in a line for traveling gun (http://www.bae.ncsu.edu/programs/extension/evans/irr-cal/ag-553-2.pdf) and center pivot (http://www.bae.ncsu.edu/programs/extension/evans/irr-cal/ag-553-3.pdf) systems or in a grid for stationary systems (http://www.bae.ncsu.edu/programs/extension/evans/irr-cal/ag-553-1.pdf). Systems using undiluted manure may require measurement and reporting of application rate from the gun or nozzle and not what is collected in a rain gage if plant available nutrients are calculated to include evaporative losses and volatilization.

If measuring application rate from the gun, a flow meter or pressure measurement at the nozzle and a manufacturer's performance chart for the gun/sprinkler and nozzle will be required. Collected depths are used to calculate commonly-used measures of irrigation equipment uniformity such as the Christiansen uniformity coefficient (CU or Uc) or distribution uniformity (DU). Details of how to setup uniformity evaluations and calculate measures of uniformity and application rates are given in the links in a paragraph at the end of this document.

Uniformity of irrigation-type equipment can be affected by:

- Operating pressure
- Nozzle condition
- Pump impeller condition
- Wind



It is important that these types of systems be operated as designed. Normally this means that pressure and flow rate should be field-verified in the calibration procedure and compared to the design values or the ranges recommended by the manufacturer. Pressure should always be measured at the nozzle, not at the pump or other location. Pressure can be measured either with a pressure gauge mounted on the sprinkler riser or mounted on the gun body (for big guns) or measured using a pitot tube placed directly in the nozzle stream. For center pivots with drop nozzles, pre-set pressure regulators are normally located on the drop tubing, so nozzle pressure is known. In addition to pressure and flow rate measurement, the wetted diameter of the sprinkler or gun

(for solid set and traveling gun systems respectively) should be measured.

It is generally recommended that flow rates be within 10 percent of the design rate, and that wetted diameter be within 15 percent of that specified in the manufacturer's chart at the measured nozzle pressure. Flow rates may be obtained either by using a flow meter or by using values obtained from the manufacturer's chart at the measured pressure. For animal waste systems, flow meters are normally temporarily placed in the main irrigation line either in-line or temporarily strapped on depending upon the type of flow meter used.

Adjustments to achieve the proper application rate and uniformity include adjusting operating pressure, travel speed (for traveling gun or pivot systems), replacing worn nozzles, and operating systems when there is little wind. Changes in equipment (e.g. nozzle size) should not be done without consultation with an irrigation specialist.

Recommended Educational Resources

- Lesson 36 Calibrating Manure Application Equipment (/mediawiki/files/d/dd/LES_36.pdf) from the Livestock and Poultry Environmental Stewardship (LPES) Curriculum offers an overview of the different equipment used to land apply animal manure, including irrigation equipment.
- North Carolina Cooperative Extension has a series of publications that can be used to evaluate application uniformity for stationary (http://www.bae.ncsu.edu/programs/extension/evans/irr-cal/ag-553-1.pdf), traveling systems (http://www.bae.ncsu.edu/programs/extension/evans/irr-cal/ag-553-2.pdf), and center pivot or linear move systems (http://www.bae.ncsu.edu/programs/extension/evans/irr-cal/ag-553-3.pdf).
- Calibration of Lagoon Irrigating Equipment (http://extension.missouri.edu/explorepdf/envqual/eq0327.pdf) from University of Missouri Extension provides information on how to calculate application rates and depths for stationary and traveling type systems.

Author: Garry Grabow, North Carolina State University Reviewers: Marsha Mathews, University of California-Davis, Rick Koelsch, University of Nebraska

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Calibrating Liquid Manure Application Equipment

Last Updated: February 14, 2011

Types of Liquid Manure Application Equipment

Liquid manure application equipment includes tankers (sometimes called honey-wagons) and hose-drag (also referred to as drag-hose) systems. Depending upon the type of liquid application system being calibrated, calibration may require weighing the tanker, recording the time to empty a load, measuring application spread width and length and/or recording equipment speed. Also, with some calibration methods, determination of manure density is required.

Livestock and Poultry Environmental Learning Center:

Home Page (http://www.extension.org/animal+manure+management)

All articles about:

Manure Nutrients (/pages/8647/manure-nutrient-management)

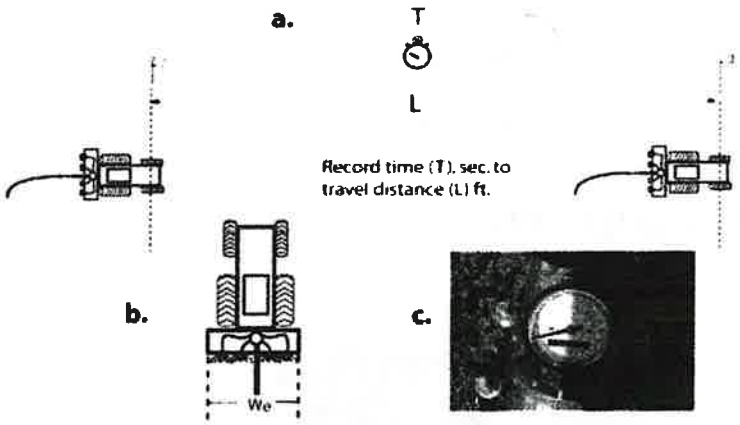
Important Factors For Making Calibration Calculations

Normally calibration requirements are specific to the equipment, i.e. one piece of equipment needs only to be calibrated once during the calibration interval, often annually. However, it is a good idea to calibrate equipment that may be used under different conditions. For instance, adding more hose to a hose-drag system when moving from one field to the next can increase friction loss and alter manure flow rates though the applicator. It may also be valuable to calibrate for multiple travel speeds, each representing a different application rate. This allows one to select an application rate that most closely matches the nutrient requirements of individual fields or crops.

It is important to select the calibration procedure that is consistent with your manure analysis. For instance some analysis reports nutrients in a weight per volume measure (e.g. pounds per thousand gallons) while some analysis is provided on a weight per weight basis (e.g. pounds per ton). Calibration of liquid tanker spreaders can be done by weighing a load or knowing the capacity (volume) of the spreader as specified by the manufacturer. Conversion between volume and weight may be done by determining the manure density.

By knowing the spreader capacity, distance traveled to empty the spreader, and width of spread pattern (or distance you move laterally with each pass through the field), a fairly simple estimate of application rate can be made. This should be repeated several times to determine an average application rate each manure source. The speed of the tractor can be varied to adjust the application rate to achieve the planned application rate(s). The general procedure for calibrating a liquid manure tanker spreader is illustrated in the following file Liquid Spreader Calibration (/mediawiki/files/5/53/Liquid_Spreader_Calibration.pdf) .

Hose drag type systems are calibrated by measuring tractor speed, flow rate of the manure through the system and effective width (distance between passes). These factors allow conversion to volume of manure over area applied, e.g. gallons per acre.



Calibration of hose-drag (drag-hose) equipment requires measurement of (a.) tractor speed, (b.) spread width (We in illustration) and (c.) flow through the hose.

Recommended Educational Resources

- Lesson 36 Calibrating Manure Application Equipment (/mediawiki/files/d/dd/LES_36.pdf) from the Livestock and Poultry Environmental Stewardship (LPES) Curriculum offers an overview of the different equipment used to land apply animal manure.
- Calibrating Liquid Tank Manure Applicators

(http://www.extension.iastate.edu/Publications/PM1948.pdf), Iowa State University Extension provides a step-by-step guide to calibration based upon load size and application area.

- Field Calibration Procedures for Semi-Solid Animal Waste Application Equipment – Load-Area Method (http://www.bae.ncsu.edu/programs/extension/evans/irr-cal/ag-553-5.pdf), North Carolina Cooperative Extension is similar to the previous publication but provides a field sheet that incorporates speed and other equipment settings.
- Field Calibration Procedures for Hose-Drag Wastewater Application Equipment (http://www.bae.ncsu.edu/programs/extension/publicat/wqwm/AG-553-8.pdf), North Carolina Cooperative Extension shows how to field calibrate both boom-type and incorporation-type liquid spreaders that use a hose-drag type system.

Author: Garry Grabow, North Carolina State University Reviewers: Marsha Mathews, University of California-Davis, Rick Koelsch, University of Nebraska, Doug Beegle, Pennsylvania State University

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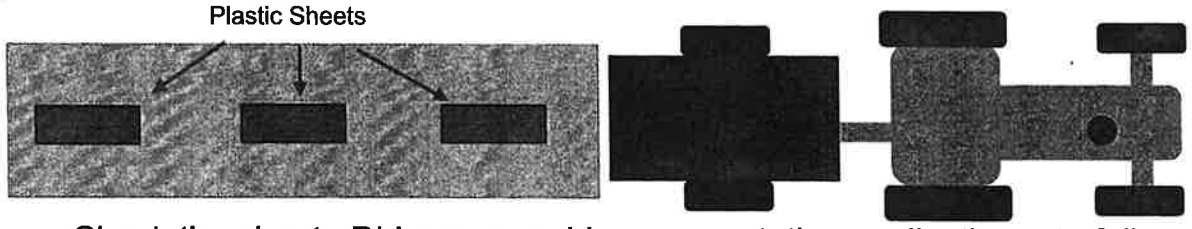
Calibration of Rear Discharge "Box" Spreader if Capacity is Unknown.

a. Cut three or more sheets of equally sized plastic. 22 square feet (3' x 7'4" or 4' X 5'6") is preferred size.
b. Weigh empty 5 gallon bucket plus one plastic sheet on a scale: _____ lbs.
c. Lay sheets in field with edges secured by stones or other heavy objects.
d. Drive tractor at normal speeds and discharge manure at typical rates over plastic sheets.
   Record tractor gear: _____, engine RPM: _____, and spreader settings: _____



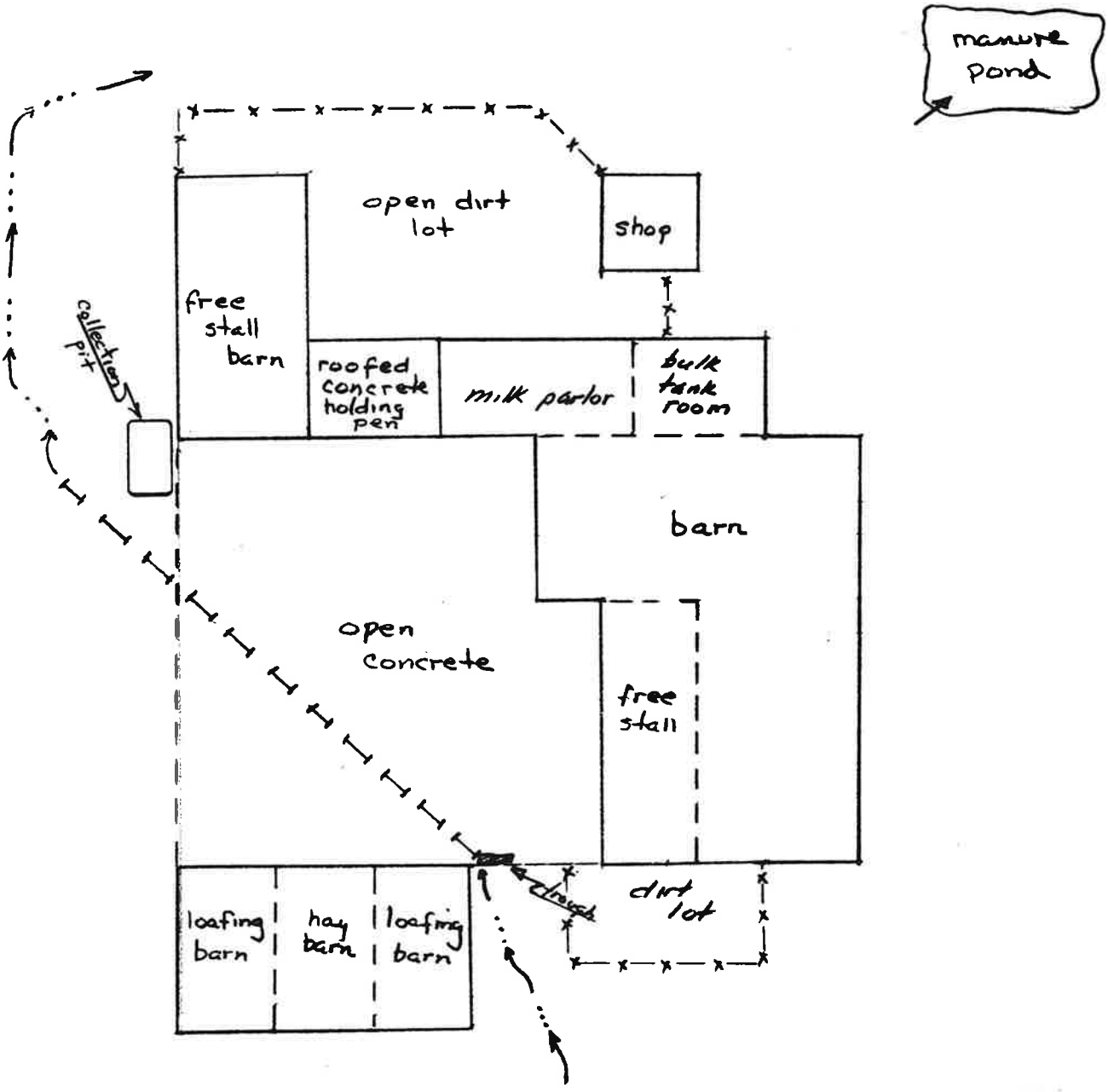
e. Check the sheet. Did a reasonably representative application rate fall on the plastic sheet?
f. Carefully fold individual sheets without losing manure and place each sheet in separate buckets.
   Weigh each bucket. Bucket 1: _____lbs. Bucket 2: _____lbs. Bucket 3: _____lbs.
g. Subtract weight of empty bucket and plastic (step b) to determine net manure weight is each bucket.
   Net manure weight for Bucket 1: _____lbs. Bucket 2: _____lbs. Bucket 3: _____lbs.
h. Calculate average weight of buckets. Average Net Manure Weight: _____lbs.
i. Calculate application rate. Tons per Acre = (Net Manure Weight X 22) ÷ area of plastic sheet (ft^2)

If plastic sheet = 22 ft^2, then Tons per Acre = Net Manure Weight

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	OREGON	PROJECT		
BY R. Edwards	DATE 5/00	CHECKED BY	DATE	JOB NO.
SUBJECT Ray Vogel Dairy				SHEET 1 OF 1



Vogel Dairy
Contact Point