Animal Waste Management Plan
July 2021

"J-S Ranch"

Operated by:

"J-S Ranch"
34905 Ranch DR
Brownsville, Oregon 97327
(541) 990-5999

Facility Address:
37225 Jeffereson-Scio Drive
Scio, Oregon 97374
(541) 990-5999

Operation:

Broiler Growout Operation
State Large CAFO

As owner and operator of "J-S Ranch". We intend to manage in accordance with the practices and operation and maintenance described in this Animal Waste Management Plan.

Name: Eric Simon Date 7/20/2021

Signature Eric E. Simon Date 7/20/21

The “J-S Ranch” is located at 37225 Jefferson-Scio Dr. and is owned and operated by Eric Simon. The farm is a contract farm which raises broilers for Foster Farms. The farm has 60.27 acres, 45.7 acres are irrigated with Oregon water rights. We are in the process of transferring an appropriate portion of the water rights to poultry drinking and cooling. Approximately 20 acres are leased to a local Scio grass seed farmer. For 2021, we plan to produce 566,400 broilers per flock. All poultry is delivered as day old chicks and will remain on the farm until 45-50 days maturity. Foster Farms will then pick the chickens up and deliver them to their processing facility. Our state CAFO licensing will permit us to grow up to 566,400 birds per flock.

Manure Collection Methods

All poultry raised on this farm is brooded and grown out inside either one of the 10- 60’ x 652’ houses or the one (1) 60’x560’ house. We will initially spread approximaely 450 yards of kiln dried wood shavings in each house before chick placement. Each flock after we will spread approximately 153 yards of kiln dried wood shavings in each house before bird placement.The houses provide manure storage for each grow out period and the year. We expect to use 15,048 yards of bedding a year. The first 7-10 days the chicks will be in the front half of the barn with a migration fence at the halfway point of the house. At day 7-10 the migration fences will be lifted and the chickens will be released into the full house. The sawdust/manure remains in the house until the chickens have been picked up by Foster Farms. We remove any caked manure from the houses with a poultry housekeeper, skidsteer and/or carry-all scraper and place it in the 60’ x 140’ manure shed.The manure shed is approximately 18’ tall and can hold up to 4977 yards of manure.The sheds provide storage for 118 days production of manure and bedding. Due to production cycles and the time for cleanouts the shed proivdes about 156 days of storage. These calculations do not account for volume reduction due to composting as the process is variable and may proceed at different rates at different times of year, however volume reduction due to composting will only increase the number of days of storage provided by the shed. These calculations also do not account for the 15,733 yards of bedding storage provided in the houses. This storage volume is greater than the calculated need to store the annual production of manure and bedding (14,906 yards of manure and bedding a year). The total water needed to moisten a single compost shed of manure and bedding to optimum composting moisture is calculated at 329,312 gallons so all cleanout moisture will be utilized during composting. The manure shed has gutters that direct the stormwater runoff away from the manure shed.This manure will also be used for composting the poultry mortality inside the manure shed. On the site map we have designed and alocated space for a 200’ manure space in case we ever decide to increase the size of the shed. This would, of course, increase the amount we could store if needed. The current plan for 140’ shed is in the same footprint as the 200’ shed.

We then wind row the manure inside the house with a tractor and windrower for 3 days. On the 4th day we rotate our manure windrows. If there is more time available we may rotate the windrows a third time. After the windrows have rested they are spread out level in the barn. We then spread approximately 153 yards of kiln dried shavings to topdress the manure/bedding. 100% of the poultry manure is exported at J-S Ranch. Manure is stored only on concrete under cover in the manure shed. Customers arrange an appointment time to pickup manure. Customers come to the ranch and the manure is loaded into the trucks by our loader’s buckets or litter convyer. The customer covers their manure with tarps and exports the manure from J-S Ranch.

<u>Mortality Management</u>

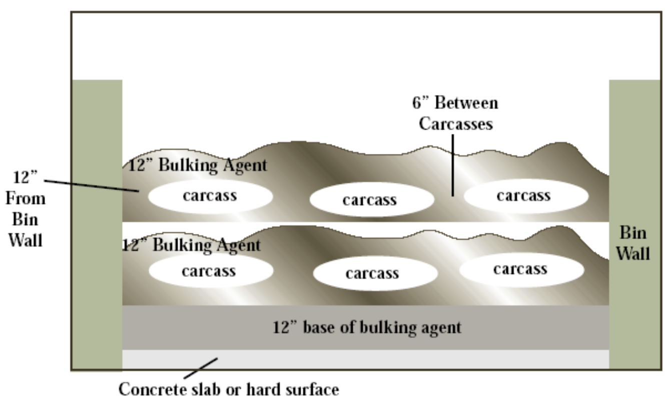
Currently animal mortalities for this operation are being disposed of by composting. All mortality is composted in the manure shed. After sufficient composting the mortality piles are added to the general manure pile and exported.

Rapid composting of dead animals occurs when the carbon to nitrogen (C:N) ratio of the compost mix ranges between 10 and 20 to 1. To achieve the recommended C:N ratio, build the initial compost pile by placing 12-18 inches of sawdust or other bulking agent on the floor of the composting area. The bulking agent should extend beyond the perimeter of the animal to be composted by at least 2 feet. If using a compost bin the bulking material should extend at least 1 foot beyond the perimeter of the animal being composted. Using a bulking agent such as sawdust will absorb any liquids as the animal decomposes during the composting process.

Once the bulking agent has been placed on the floor of the composting area, place the animal carcass on top. To decrease composting time and prevent bloating the body cavity should be cut open or shredded. Cover the carcass with 1 to 3 feet of manure solids or other material that has a moisture content between 30 to 60 percent and a C:N ratio of not more than 30 to 1. Use 1 foot of material for small carcasses. Be careful not to add material that is to wet as it will hinder the composting process and cause odors. Small animals can be layered in a compost pile by placing 12 inches of the bulking agent between layers as shown in the figure below. The total height of the compost pile wo;; not exceed 7 feet in height as it may spontaneously combust causing a fire.

The first heating or primary composting cycle will take approximately 15 to 90 days depending on the size of the animal being composted. Refer to the table below for estimated primary composting times. Check pile temperature using thermometer probe on a daily basis. The pile temperature should be checked at multiple points around the compost pile and at a point approximately 3 feet into the pile. The temperature of the compost pile should reach 130 degrees Fahrenheit (F) within a few days. Temperatures should peak between 130 and 150 degrees F in 3 to 4 days. When the temperature of the compost pile falls below 130 degrees F, the compost needs to be aerated by turning or other means. Be sure carcasses remain covered with the bulking agent after being aerated. It is important to maintain a temperature above 130 degrees F for at least 7 days during the primary composting cycle as failure to do so may result in the incomplete destruction of pathogens and can cause fly and odor problems. After aerating the compost pile, the secondary composting times will be similar to the first.

After aerating the compost pile by turning or other means, be sure to check the moisture content and add water if necessary being careful not to add to much water. The compost pile should feel moist to the touch but you should not be able to squeeze any water out of it.



Primary Composting Times

Carcass Size (lb)	*Estimated Primary Composting Days*
0-10	15
10-25	22
25-300	45
300-750	60
750-1400	90

Odors given off by the composting operation is a good indicator of how the compost operation is proceeding. Foul odors may mean that the process has turned from aerobic to anaerobic. Anaerobic conditions are the result of insufficient oxygen in the compost. This may be caused by excessive moisture in the compost or the need for turning or aerating of the compost pile.

After the composting process is finished, it may be used as a bulking agent for a new compost pile. A rule of thumb is to use 50 percent of the composted material for a bulking agent but you may want to use more or less depending on how degraded the bulking agent is in the finished compost. Using finished compost in a new compost pile reduces the amount of bulking agent needed for the new pile and provides microbial inoculants to get the composting process started.

Finished compost can also be exported to crop and pasture land fields for utilization of the nutrients and organics in the composted material. The nutrient content of the composted material should be determined and application equipment calibrated to ensure nutrients contained in the composted material are not over applied.

As an alternative one of the following methods may be used:

Landfill- Dead animals may be transported to a permitted landfill that accepts animal carcasses for disposal. Be sure to call the chosen landfill first to insure a landfill will accept your animal carcasses. Refer to the website given previously for permitted landfills to call. Contact the landfill operator and the DEQ at (800) 452-4011 if the landfill you would like to use is not a permitted facility to see if an exception may be granted for the disposal of animal carcasses.

Any catastrophic mortalty plan developed with the Oregon Department of Agriculture in response to an animal disease outbreak

<u>Stormwater Utilization</u>

Stormwater runoff from the roofs of the poultry houses will be directed to the non-working ends of the poultry houses. This way the stormwater will not be contaminated by any manure. We will install drain tile, slope grading, ditches and culverts to direct the stormwater to a ditch on the south end of the property. See maps. There are concrete aprons on the front and the back ends of the houses. They extend 4' inside the barn and 8' from the doorway of the barn and are 6" thick by 14' wide with proper slope to allow water to drain to the outside beginning at the outside doorway. The concrete is 3500 PSI with steel or mesh reinforcement. They are sloped so the top is flush with with the load out pad to the outside and and flush with the inside floor of the house.

Wastewater Utilization

Once a year the 2-110' cool cell systems per house (which use cardboard media that is sprayed with water to cool the incoming air) are cleaned and flushed before they are winterized. The wastewater from the cool cells is transferred to a liquid 275 gallon tote on a trailer or in the back of a pickup by a sump pump transfer system. The wastewater will be added to the manure/compost piles to try to maintain 60 % moisture content to aid in the composting process. 270 gallons of wastewater will be generated each year per cool cell side per house totalling 5,940 gallons of wastewater.

Each flock we clean our fans by pressure washing them from the inside of the barn. Approximately 2/3 of the water runs off the fans and back into the bedding/manure inside the barn. Approximately 1/3 of the water runs off the fan and fan cones and outside the building. In order to keep this runoff from getting on the ground either a catch basin or plastic will go under the fans and runoff will be collected and disposed of in the compost shed. Each fan takes about 5 minutes to clean with with a 4 gpm pressure washer for a total of 20 gallons used per fan. 1/3 of that, or about 7 gallons will be collected outside in our catch basins and used in the compost shed. Each house will have 17 fans for a total of 340 gallons per house X 11 = 3740 gallons per cleanout. Please note that not all fans are not used every flock and so won't need cleaned so this number represents summer time worst case senerio. With an average of 6 flocks year there will be 6 cleanouts. 3740X6=22,440 gallons per year.

Odor Barrier

When selecting a site to build a poultry ranch we considered the proximity of of neighboring homes and the surrounding land. We chose 37225 Jefferson-Scio Dr as our location due to the fact that it was secluded from neighboring homes and surrounded by farmland. We plan to plant trees as a wind and odor buffer to mimimize the impact on our neighbors. The nearest home that we don't own will be over 1200' from the closest exhaust fan.

Land Application Areas

No manure or waste water will be land applied at J-S Ranch.

Manure and Waste Volumes

Calculated volumes of all manure, bedding, wash water, and contaminated storm water have been completed using an excel worksheet based on the NRCS Agricultural Waste Field Handbook (ORAWM). The worksheet is included in this Animal Waste Management Plan. Please note chickens shown as grazing in the spread sheet are not actually grazing there are no animals onsite during those periods shown as grazing and buildding cleanout and maintenance are going on at those times. The spread sheet was not originally developed for short production rotations.

Nutrient Content of Manure, Litter and Process Waste Water

The ORAWM excel worksheet was used to estimate volume of manure.

Animal Mortality Management

All deceased animals will be composted on site in the manure shed.

Record Keeping and Reporting

Manure and waste water will be sampled at least annually. The protocol for sampling and testing soil, and manure are included in this Animal Waste Management Plan.

1) “J-S Ranch” records the date and amount of compost sold and exported from the ranch.

“J-S Ranch ” will report any discharge within 24 hours to the Oregon Department of Agriculture.

J-S Ranch will follow all additonal requirements for Large CAFO’s. This includes inspecting storm water diversions, runoff diversions, waste transport, storage structures and storage structure volume weekly. We check the waterlines daily and have no application equipment to check for leaks periodically. J-S Ranch will complete and keep accurate records of the results of daily inspections, weekly inspections, and results of periodic inspections. If any corrective action is taken it will be recorded and if it is not corrected explanations will be recorded.

ANIMAL WASTE MANAGEMENT PLAN

❑ **MINIMUM REQUIRED MAINTENANCE ELEMENT**

❑ Operation and Maintenance

❑ **J-S Ranch**
Name of Operation

- [ ] <u>Culverts</u>

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.

- [ ] <u>Dry Stack Storage Facility</u>

Solid manure storage facility will be inspected annually. Broken slabs and curbs will be repaired. Repair or replace rusted or damaged areas on roof structure. Broken gutters and/or downspouts will be repaired or replaced. Check for adequacy and function of drain away from downspouts. Check side and back walls for soundness.

- [ ] <u>Filter Strips</u>

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.

- [ ] <u>Gutters and Downspouts</u>

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.

- [ ] <u>Slabs</u>

Concrete Slabs will be cleaned after usage.

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 5.1

CLIENT: Simon

ASSISTED BY: ODA

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

ANIMAL INVENTORY

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	Annual Days Off Farm
CHICKEN(BROILER)	566,400	3	1,416.0	0.96	0.28	0.54	1359.36	396.48	764.64	1.37	365	0	0
Totals/Averages-	566,400	3	1,416.0	0.96	0.28	0.54	1,359.4	396.5	764.6	1.4			

GRAZING PERIOD

Percent of Month and Number of Animals Grazing

Type of Animal	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AU-YR.
CHICKEN(BROILER)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	566400	566400	566400	566400	566400	566400	566400	566400	566400	566400	566400	566400	0
													0
													0
													0
													0
													0
													0
													0
													0
													0
Total AUM's Available>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total AUM's Needed>>>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total AUM's>>>>>>>>>>	0	0	0	0	0	0	0	0	0	0	0	0	0

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ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

WEATHER STATION

EUGENE WSO AIRPORT

Month	25Yr-24Hr / RCN= / Average Monthly Inches: Precipitation	5.00 / 95.00 / Evaporation	Lot Runoff Factors as a Percent of Monthly Precipitation: Paved	Unpaved
October	3.35	1.66	50%	20%
November	8.43	0.50	50%	25%
December	8.29	0.26	55%	20%
January	7.65	0.30	55%	25%
February	6.35	0.59	50%	20%
March	5.80	1.47	45%	15%
April	3.66	2.38	40%	10%
May	2.66	3.77	35%	10%
June	1.53	4.66	35%	10%
July	0.64	6.09	30%	0%
August	0.99	5.32	35%	10%
September	1.54	3.57	45%	15%
Annual	50.89	30.57		

AREAS CONTRIBUTING RUNOFF TO LIQUID STORAGE FACILITY

Description of Runoff Area	Area in SF
Paved Lot Area >>> Is paved lot scraped daily? (Y/N) NO	0
Unpaved Lot Area >>>	0
Roof Area >>	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>>>>>>>>>>>>>>>>>	0

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	566400	0	0.00	0	0.0
Equipment Wash		1	16.27	16	2.2
Flushwater		0	0.00	0	0.0
Miscellaneous		0	0.00	0	0.0
Total>>				16	2.2

CROP DATA

Field Number	Acres	Crop	Percent Dry Matter (DM)	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre: Nitrogen N	Phosphorous P_2O_5	Potassium K_2O
Off Farm								
Total Acres-	0.0							

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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
CHICKEN(BROILER)	Loose Housing	Sawdust	12.00	6.84	0.57	807	9,685

SOLIDS SEPARATION FACTOR

Type of Animal	Type of Separator	% Solids Separated	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
CHICKEN(BROILER)	Dry Scrape System	100%	2,747	0	0	1,940	0	36	98,893
Totals>>>			2,747	0	0	1,940	0		98,893

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ASSISTED BY: **ODA**

ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY VOLUMES

Month	Runoff in Cubic Feet: Roof Area Square Feet 0	Paved Slab Area Square Feet 0	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	0	0	0	67	15,335	44,802	25,021	300,249	85,158	3,065,697	0	0	85,158	67
November	0	0	0	0	65	14,840	43,357	24,214	290,563	82,411	2,966,803	0	0	82,411	65
December	0	0	0	0	67	15,335	44,802	25,021	300,249	85,158	3,065,697	0	0	85,158	67
January	0	0	0	0	67	15,335	44,802	25,021	300,249	85,158	3,065,697	0	0	85,158	67
February	0	0	0	0	61	13,851	40,467	22,599	271,192	76,917	2,769,016	0	0	76,917	61
March	0	0	0	0	67	15,335	44,802	25,021	300,249	85,158	3,065,697	0	0	85,158	67
April	0	0	0	0	65	14,840	43,357	24,214	290,563	82,411	2,966,803	0	0	82,411	65
May	0	0	0	0	67	15,335	44,802	25,021	300,249	85,158	3,065,697	0	0	85,158	67
June	0	0	0	0	65	14,840	43,357	24,214	290,563	82,411	2,966,803	0	0	82,411	65
July	0	0	0	0	67	15,335	44,802	25,021	300,249	85,158	3,065,697	0	0	85,158	67
August	0	0	0	0	67	15,335	44,802	25,021	300,249	85,158	3,065,697	0	0	85,158	67
September	0	0	0	0	65	14,840	43,357	24,214	290,563	82,411	2,966,803	0	0	82,411	65
Annual	**0**	**0**	**0**	**0**	**794**	**180,558**	**527,513**	**294,599**	**3,535,186**	**1,002,670**	**36,096,106**	**0**	**0**	**1,002,670**	**794**
Annual Gallons	**0**	**0**	**0**	**0**	**5,939**	**1,350,574**	**3,945,795**	**2,203,599**		**7,499,969**		**0**		**7,499,969**	**5,939**

DAILY NUTRIENT PRODUCTION

Type of Animal	Pounds/Day of Nutrients from LIQUIDS: N	P_2O_5	K_2O	Pounds/Day of Nutrients from SOLIDS: N	P_2O_5	K_2O	Pounds/Day of Nutrients from GRAZING: N	P_2O_5	K_2O	Grazing Manure Gallons/Yr	Confined Manure Cubic Feet/Yr
CHICKEN(BROILER)	0.00	0.00	0.00	1,359.36	908.34	921.39	0.00	0.00	0.00	0	708,071
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
									Total-	**0**	**708,071**

CLIENT: **Simon**
ASSISTED BY: **ODA**

ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY NUTRIENT PRODUCTION

Month	Pounds of Nutrients from LIQUIDS			Pounds of Nutrients from SOLIDS			Pounds of Nutrients from GRAZING			Total Pounds of Nutrients from ALL SOURCES		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
October	0	0	0	42,140	28,158	28,563	0	0	0	42,140	28,158	28,563
November	0	0	0	40,781	27,250	27,642	0	0	0	40,781	27,250	27,642
December	0	0	0	42,140	28,158	28,563	0	0	0	42,140	28,158	28,563
January	0	0	0	42,140	28,158	28,563	0	0	0	42,140	28,158	28,563
February	0	0	0	38,062	25,433	25,799	0	0	0	38,062	25,433	25,799
March	0	0	0	42,140	28,158	28,563	0	0	0	42,140	28,158	28,563
April	0	0	0	40,781	27,250	27,642	0	0	0	40,781	27,250	27,642
May	0	0	0	42,140	28,158	28,563	0	0	0	42,140	28,158	28,563
June	0	0	0	40,781	27,250	27,642	0	0	0	40,781	27,250	27,642
July	0	0	0	42,140	28,158	28,563	0	0	0	42,140	28,158	28,563
August	0	0	0	42,140	28,158	28,563	0	0	0	42,140	28,158	28,563
September	0	0	0	40,781	27,250	27,642	0	0	0	40,781	27,250	27,642
Annual	**0**	**0**	**0**	**496,166**	**331,543**	**336,308**	**0**	**0**	**0**	**496,166**	**331,543**	**336,308**

MONTHLY IMPORTS INTO STORAGE FACILITIES

Month	Liquids		Solids	
	Cubic Feet	Gallons	Cubic Feet	Tons
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	0	0
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
Totals-	**0**	**0**	**0**	**0**

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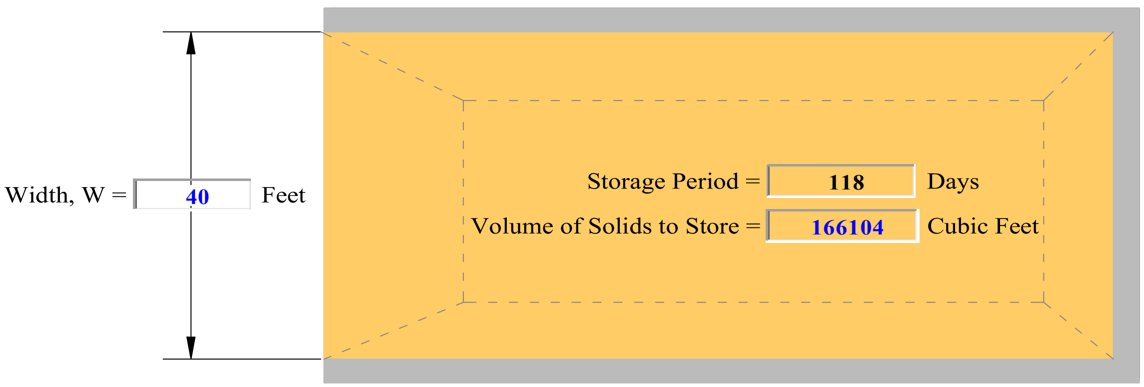
Version 5.1

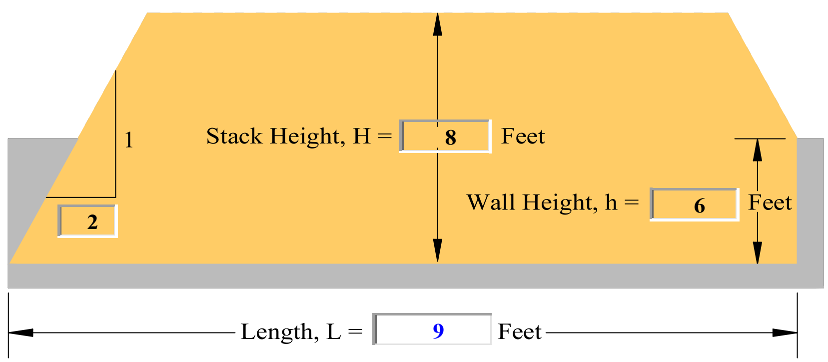
CLIENT: **Simon**
ASSISTED BY: **ODA**

ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

SOLIDS STACKING FACILITY / **VOLUME OF MONTHLY SOLIDS STACKED IN FACILITY**

Solids Storage Facility Parameters	Value	Month	Number of Days	Manure CF	Bedding CF	Solids to Store CF	Solids to Store Tons	Normal Runoff CF
Storage Period, Days=	118	October	31	60,138	25,021	42,579	1,533	0
Stacking Width, W in Feet=	40	November	30	58,198	24,214	41,206	1,483	0
Stacking Height, H in Feet=	8.00	December	31	60,138	25,021	42,579	1,533	0
Wall Height, h in Feet=	6.00	January	31	60,138	25,021	42,579	1,533	0
Stack Side Slope (X:1)=	2.00	February	28	54,318	22,599	38,459	1,385	0
Existing Storage, Cubic Feet=	166,000	March	31	60,138	25,021	42,579	1,533	0
Surface Area of Existing Storage, SF=	0	April	30	58,198	24,214	41,206	1,483	0
25 Year-24 Hour Storm Runoff, CF=	0	May	31	60,138	25,021	42,579	1,533	0
Volume Needed, Cubic Feet=	166,104	June	30	58,198	24,214	41,206	1,483	0
Design Volume, Cubic Feet=	227	July	31	60,138	25,021	42,579	1,533	0
Is Facility Covered?	YES	August	31	60,138	25,021	42,579	1,533	0
Volume Reduction Factor=	0.50	September	30	58,198	24,214	41,206	1,483	0
		Annual	365	708,071	294,599	501,334	18,048	0





OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 5.1

CLIENT: **Simon**
ASSISTED BY: **ODA**

ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

TANK — **MONTHLY INFLOWS INTO TANK**

Tank Parameters	Value	Month	Number of days	Rain-Evap on Tank CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Solids CF	Waste to Store CF	Waste to Store Gallons
Storage Period, Days=	90	October	31	0	0	0	67	0	67	504
Tank Width, Feet=	5	November	30	0	0	0	65	0	65	488
Tank Length, Feet=	5	December	31	0	0	0	67	0	67	504
Existing Storage, Cubic Feet=	100	January	31	0	0	0	67	0	67	504
Surface Area of Existing Storage, SF=	0	February	28	0	0	0	61	0	61	456
25 Year-24 Hour Storm Runoff, CF=	0	March	31	0	0	0	67	0	67	504
Volume Needed, Cubic Feet=	200	April	30	0	0	0	65	0	65	488
Design Volume, Cubic Feet=	100	May	31	0	0	0	67	0	67	504
Is Tank Covered?	YES	June	30	0	0	0	65	0	65	488
Tank Dimensions?	Rectangular	July	31	0	0	0	67	0	67	504
		August	31	0	0	0	67	0	67	504
		September	30	0	0	0	65	0	65	488
		Annual	365	0	0	0	794	0	794	5,939

6 Inches

Minimum Freeboard = 6 Inches

25Yr-24Hr Storm Precipitation = **0** Inches

25Yr-24Hr Storm Runoff = **0** Cubic Feet

90 Day Precip - Evap = **0** Inches

Runoff from Normal Precipitation = **0** Cubic Feet

Depth = **4** Feet

Washwater = **200** Cubic Feet

Manure = **0** Cubic Feet

Width = **5** Feet

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 5.1

CLIENT: **Simon**
ASSISTED BY: **ODA**

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation: Poultry / Type of Storage Facility	Pounds of Nutrients Available N	P_2O_5	K_2O	Percent Nutrients Retained After Storage N	P_2O_5	K_2O	Pounds of Nutrients Retained After Storage N	P_2O_5	K_2O
Liquids	Tank (Covered)	0	0	0	NA	NA	NA	NA	NA	NA
Solids	Solids Storage Facility (Unroofed)	496,166	331,543	336,308	65%	80%	80%	322,508	265,234	269,046
Grazing	NONE	0	0	0	100%	100%	100%	0	0	0

NUTRIENTS AVAILABLE AFTER APPLICATION

Nutrient Source	Type of Application System	Pounds of Nutrients Available N	P_2O_5	K_2O	Percent Nutrients Retained After Application N	P_2O_5	K_2O	Pounds of Nutrients Retained After Application N	P_2O_5	K_2O
Liquids	Sprinkling	NA	NA	NA	75%	100%	100%	NA	NA	NA
Solids	Broadcast (Incorporated 7 or more days after application)	322,508	265,234	269,046	70%	100%	100%	225,756	265,234	269,046
Grazing	Grazing	0	0	0	85%	100%	100%	0	0	0

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location: Between Coastal and Cascade Mountains / Soil Drainage Class	Pounds of Nutrients Available N	P_2O_5	K_2O	Percent Nutrients Retained After Denitrification N	P_2O_5	K_2O	Pounds of Nutrients Retained After Denitrification N	P_2O_5	K_2O
Liquids	Somewhat Poorly Drained	NA	NA	NA	80%	100%	100%	NA	NA	NA
Solids	Somewhat Poorly Drained	225,756	265,234	269,046	80%	100%	100%	180,605	265,234	269,046
Grazing	Somewhat Poorly Drained	0	0	0	80%	100%	100%	0	0	0
							TOTAL-	***180,605***	***265,234***	***269,046***

CAFO SITE PLAN

FOR

J-S RANCH INC.

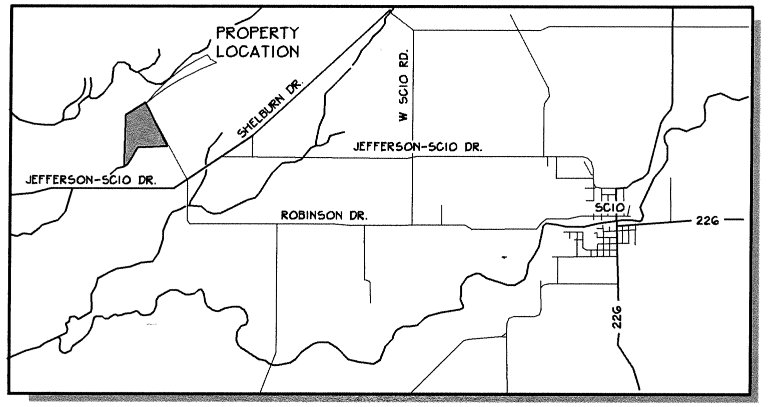
LOCATED IN THE

SW 1/4 OF SECTION 10, T. 10 S., R. 02 W., W.M.

IN

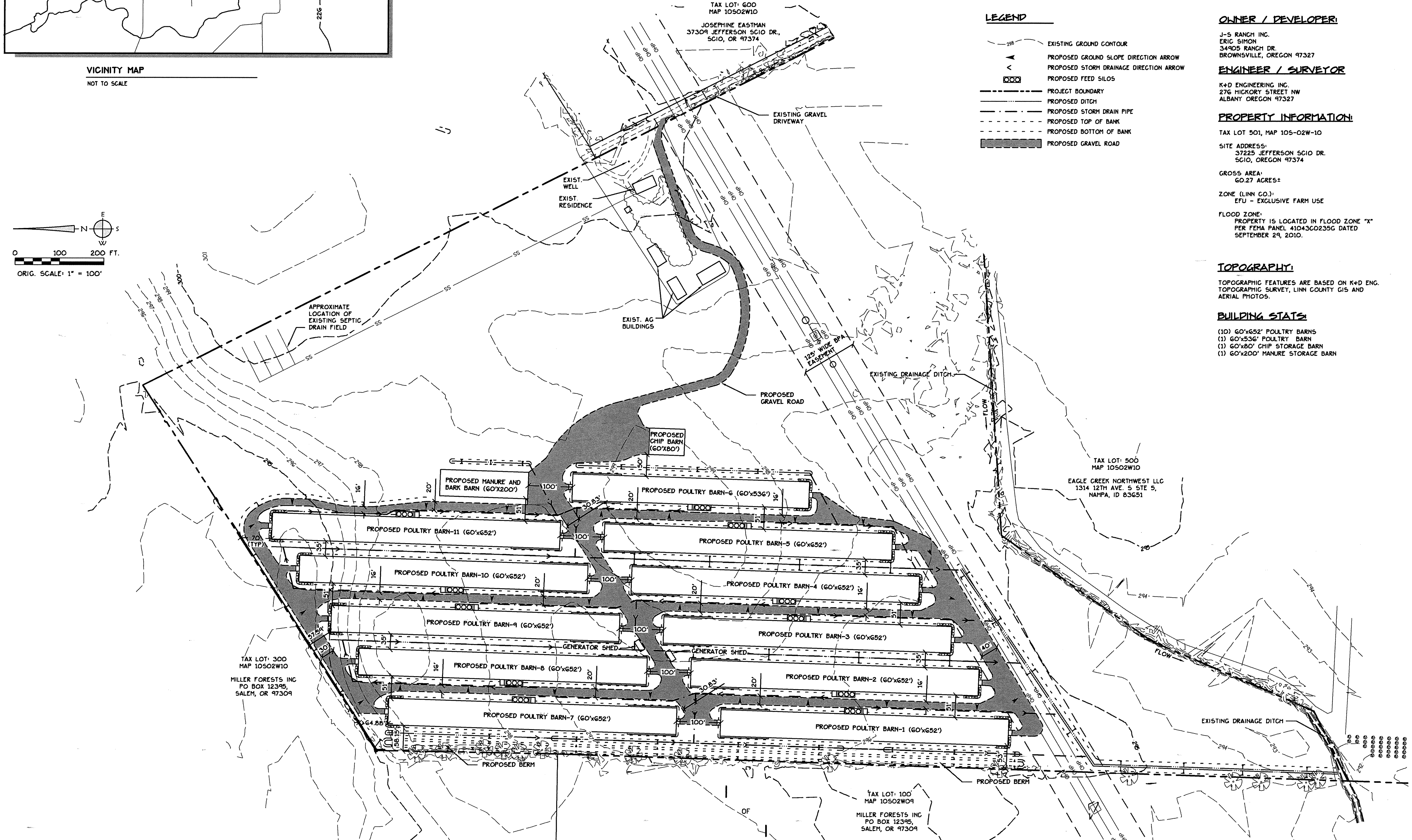
LINN COUNTY, OREGON

JUNE 28, 2021



VICINITY MAP

NOT TO SCALE



LEGEND

298	EXISTING GROUND CONTOUR
	PROPOSED GROUND SLOPE DIRECTION ARROW
	PROPOSED STORM DRAINAGE DIRECTION ARROW
	PROPOSED FEED SILOS
	PROJECT BOUNDARY
	PROPOSED DITCH
	PROPOSED STORM DRAIN PIPE
	PROPOSED TOP OF BANK
	PROPOSED BOTTOM OF BANK
	PROPOSED GRAVEL ROAD

OWNER / DEVELOPER:

J-S RANCH INC.
ERIC SIMON
34905 RANCH DR.
BROWNSVILLE, OREGON 97327

ENGINEER / SURVEYOR

K+D ENGINEERING INC.
276 HICKORY STREET NW
ALBANY OREGON 97327

PROPERTY INFORMATION:

TAX LOT 501, MAP 10S-02W-10

SITE ADDRESS:
37225 JEFFERSON SCIO DR.
SCIO, OREGON 97374

GROSS AREA:
60.27 ACRES±

ZONE (LINN CO.):
EFU - EXCLUSIVE FARM USE

FLOOD ZONE:
PROPERTY IS LOCATED IN FLOOD ZONE "X" PER FEMA PANEL 41043C0235G DATED SEPTEMBER 29, 2010.

TOPOGRAPHY:

TOPOGRAPHIC FEATURES ARE BASED ON K+D ENG. TOPOGRAPHIC SURVEY, LINN COUNTY GIS AND AERIAL PHOTOS.

BUILDING STATS:

(10) 60'x652' POULTRY BARNS
(1) 60'x536' POULTRY BARN
(1) 60'x80' CHIP STORAGE BARN
(1) 60'x200' MANURE STORAGE BARN

SITE PLAN

J-S RANCH INC.
CAFO PERMIT

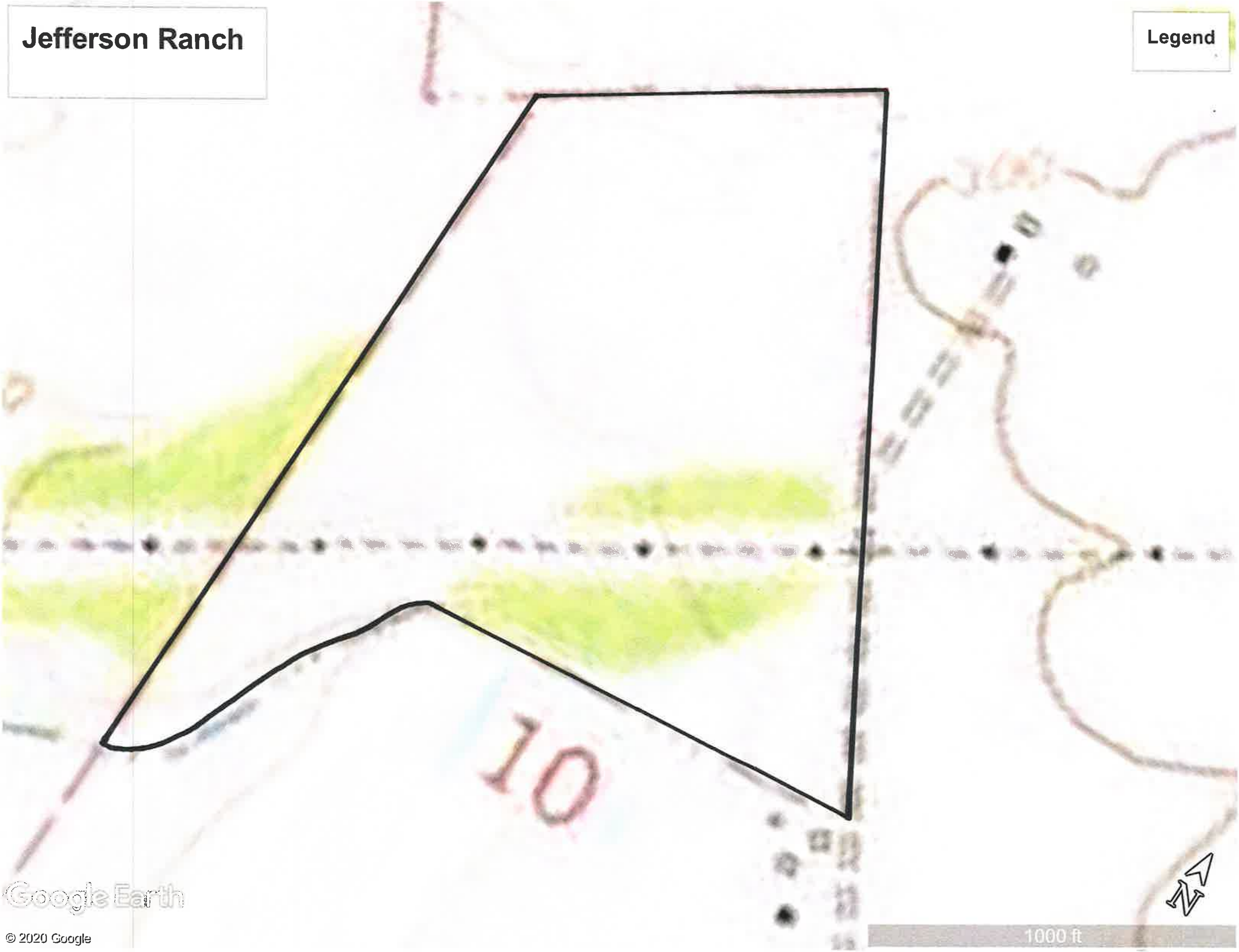
LINN COUNTY, OREGON

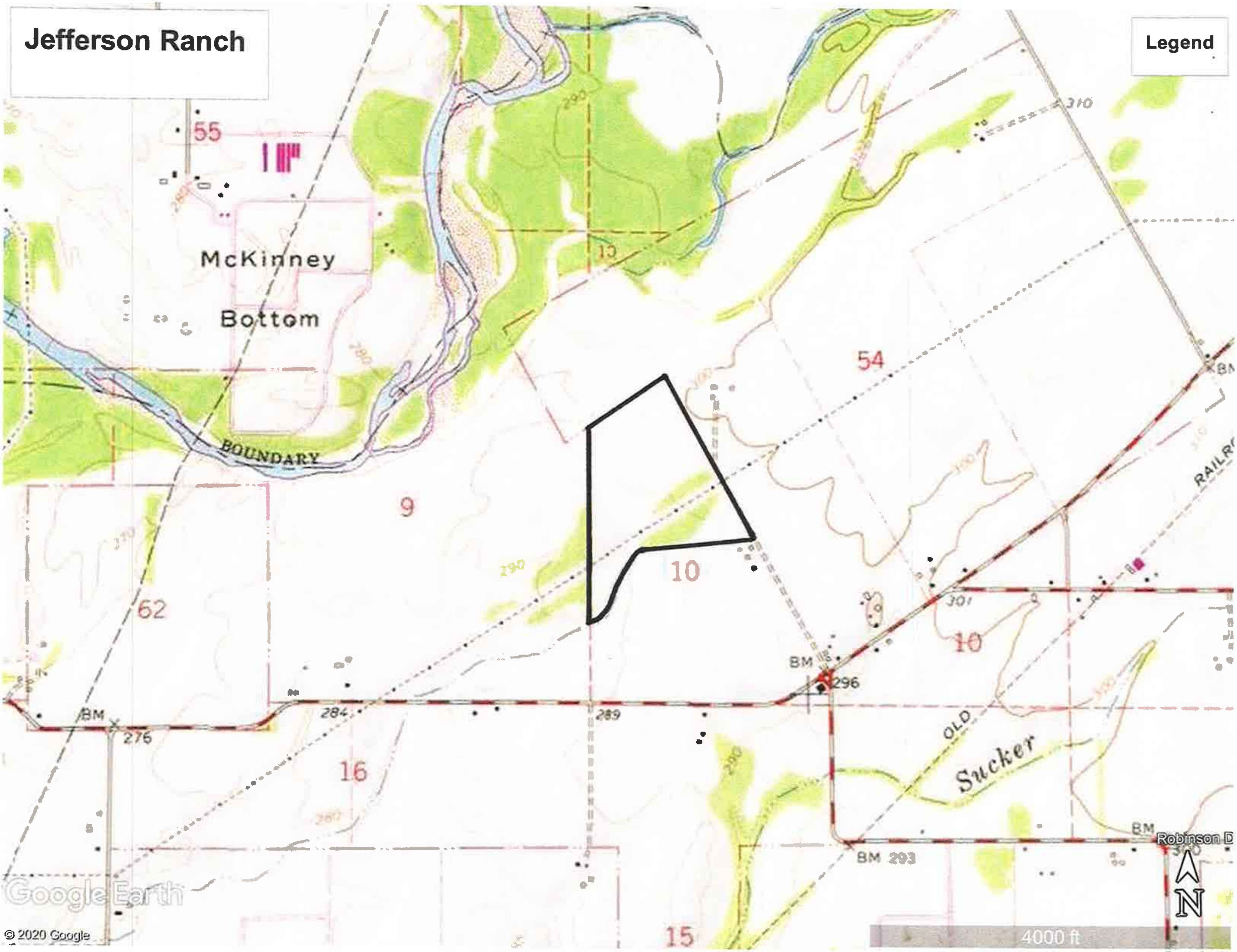
DATE	REVISIONS	BY

K&D ENGINEERING, INC.
276 N.W. HICKORY ST.
P.O. BOX 725
ALBANY, OREGON 97321
(541) 928-2583

HORZ. SCALE:	
VERT. SCALE:	
SIGN DATE:	
DSGN BY:	GMB
DRWN BY:	GSG
CHCK BY:	GMB
PROJECT No.:	21-20
SHEET No.:	1 OF 1

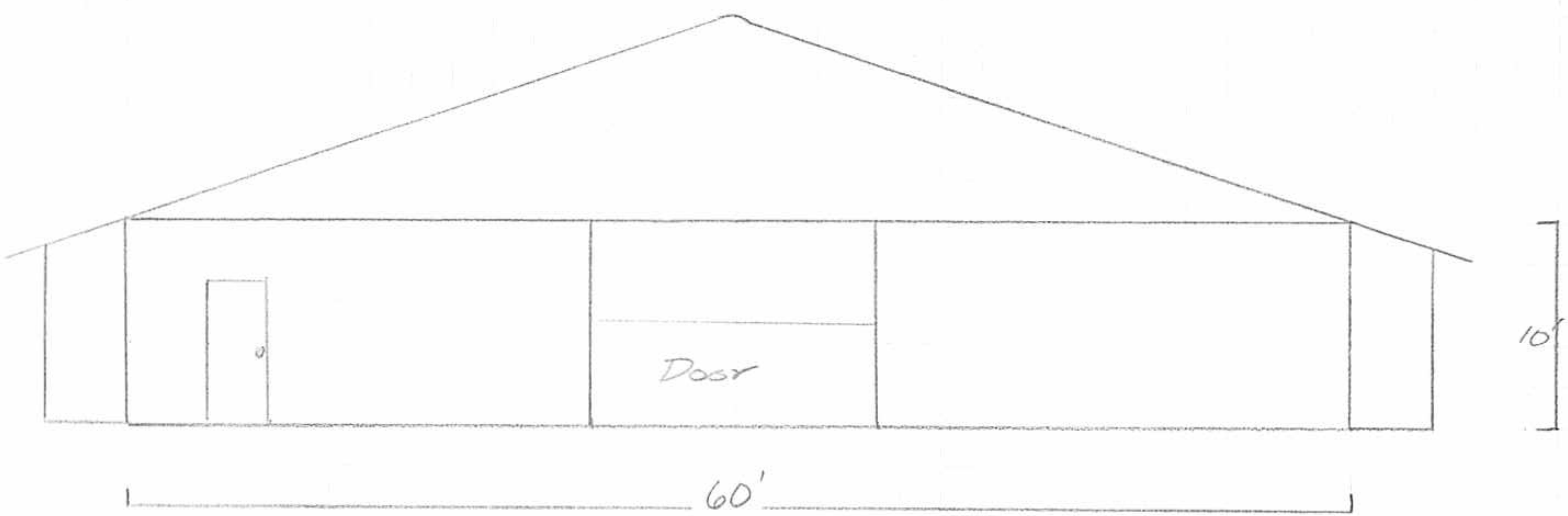
Date: 6/28/2021 Time: 9:52
Scale: 1=1(PS)
File: dwg\2021\21-20\21-20_cafo.dwg (cp60)


Jefferson Ranch
Legend
10
Google Earth
© 2020 Google
1000 ft


Jefferson Ranch
Legend
McKinney
Bottom
BOUNDARY
55
54
9
10
62
16
15
BM
276
284
289
296
301
BM 293
OLD
Sucker
4000 ft
N
Google Earth
© 2020 Google

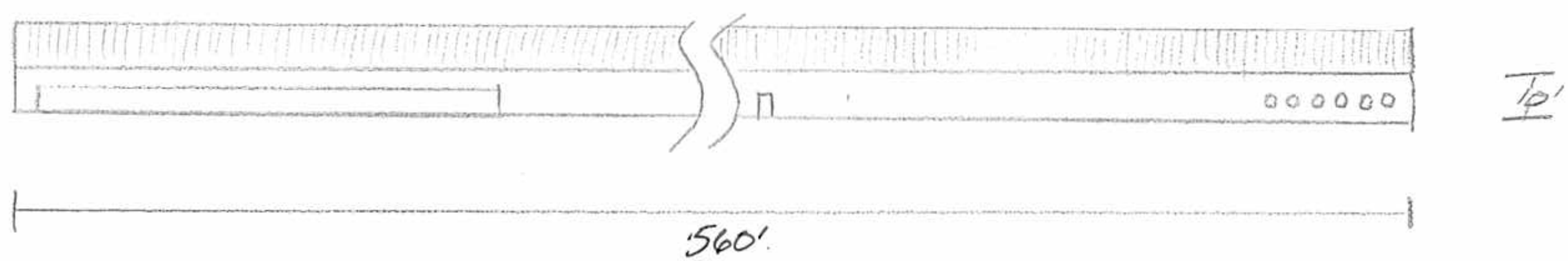
Front Elevation

Scale
1/4" = 2'



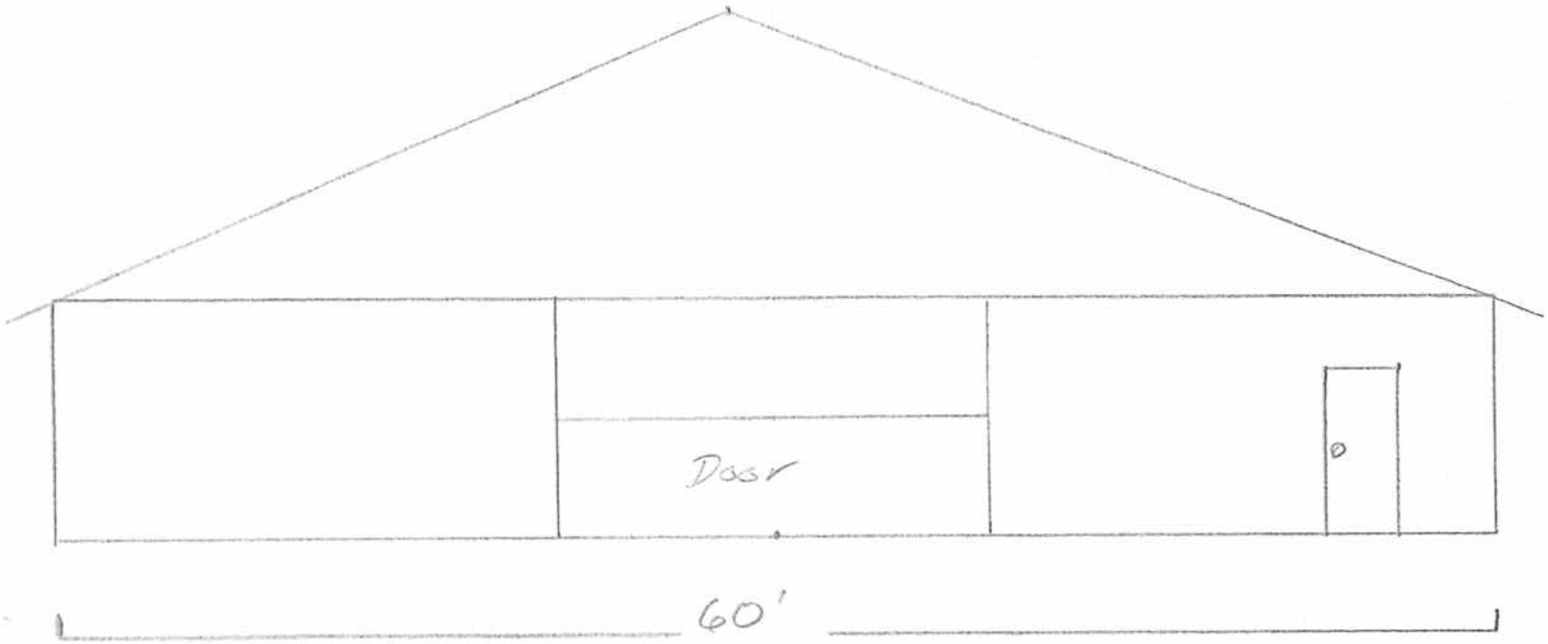
1/4" = 10'

Barn Side Elevation



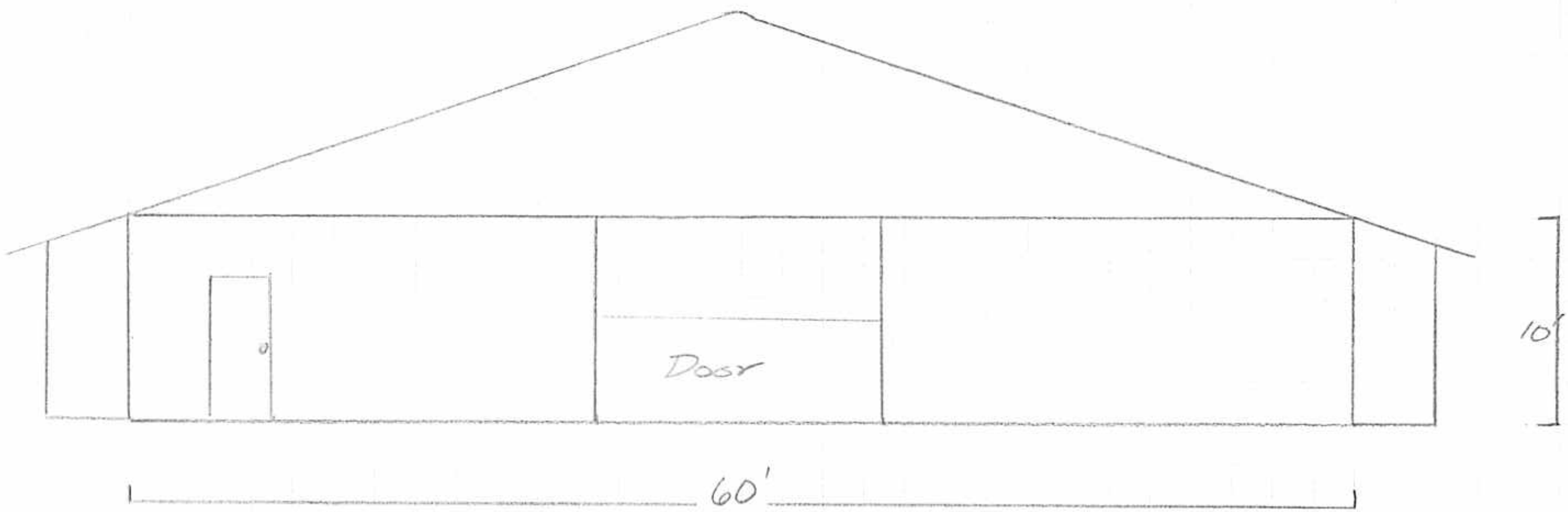
Rear Elevation

Scale
1/4" = 2'



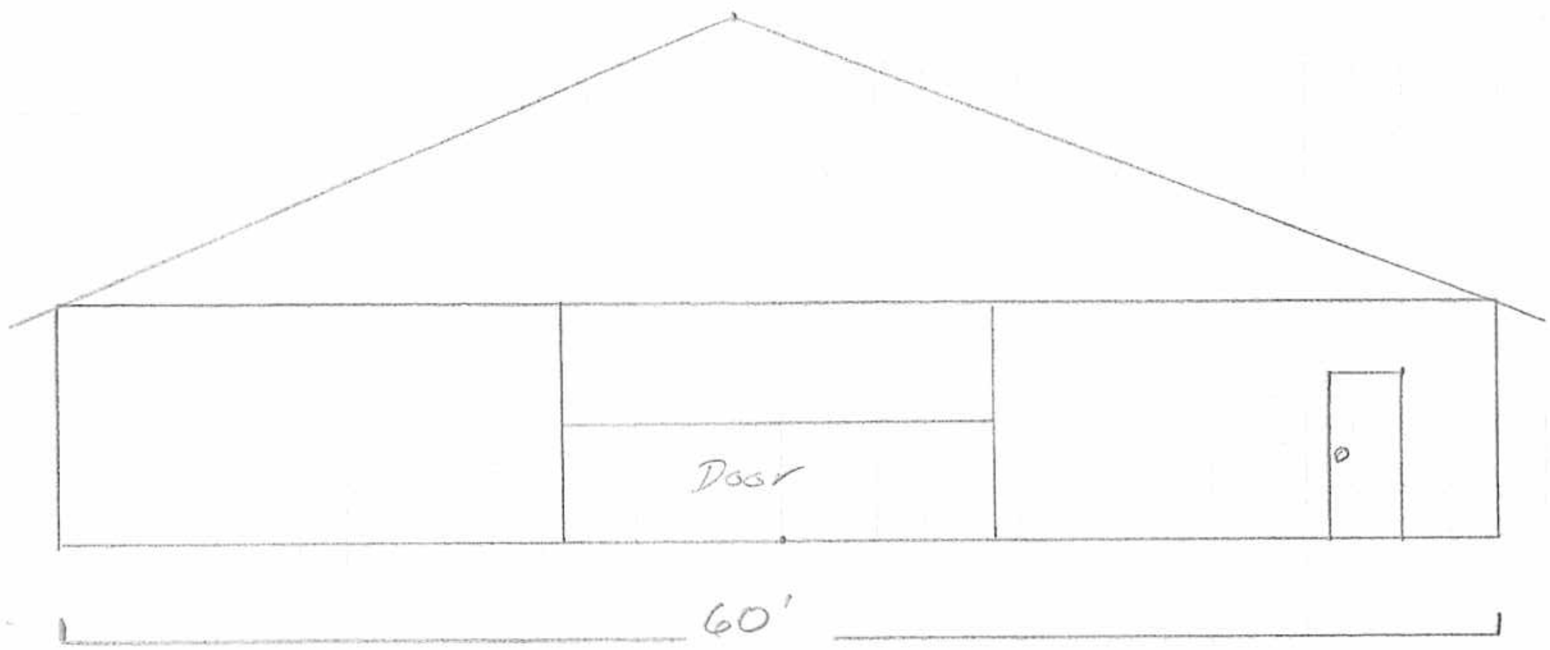
Front Elevation

Scale
1/4" = 2'



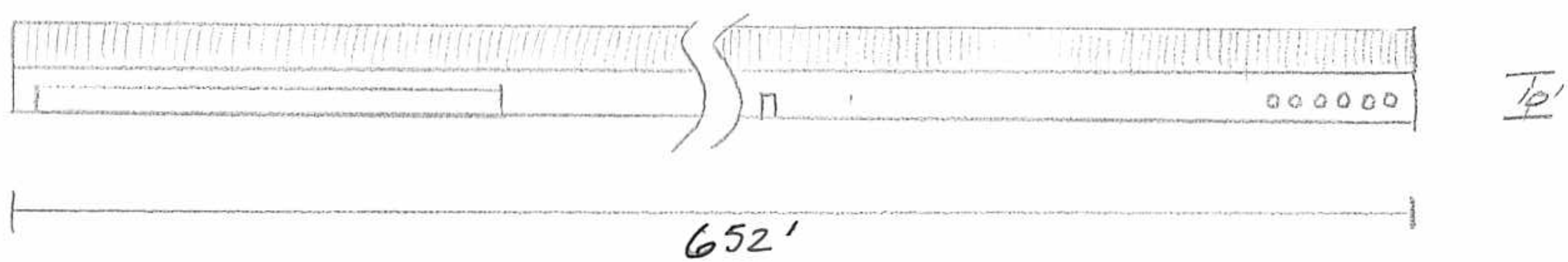
Rear Elevation

Scale
1/4" = 2'

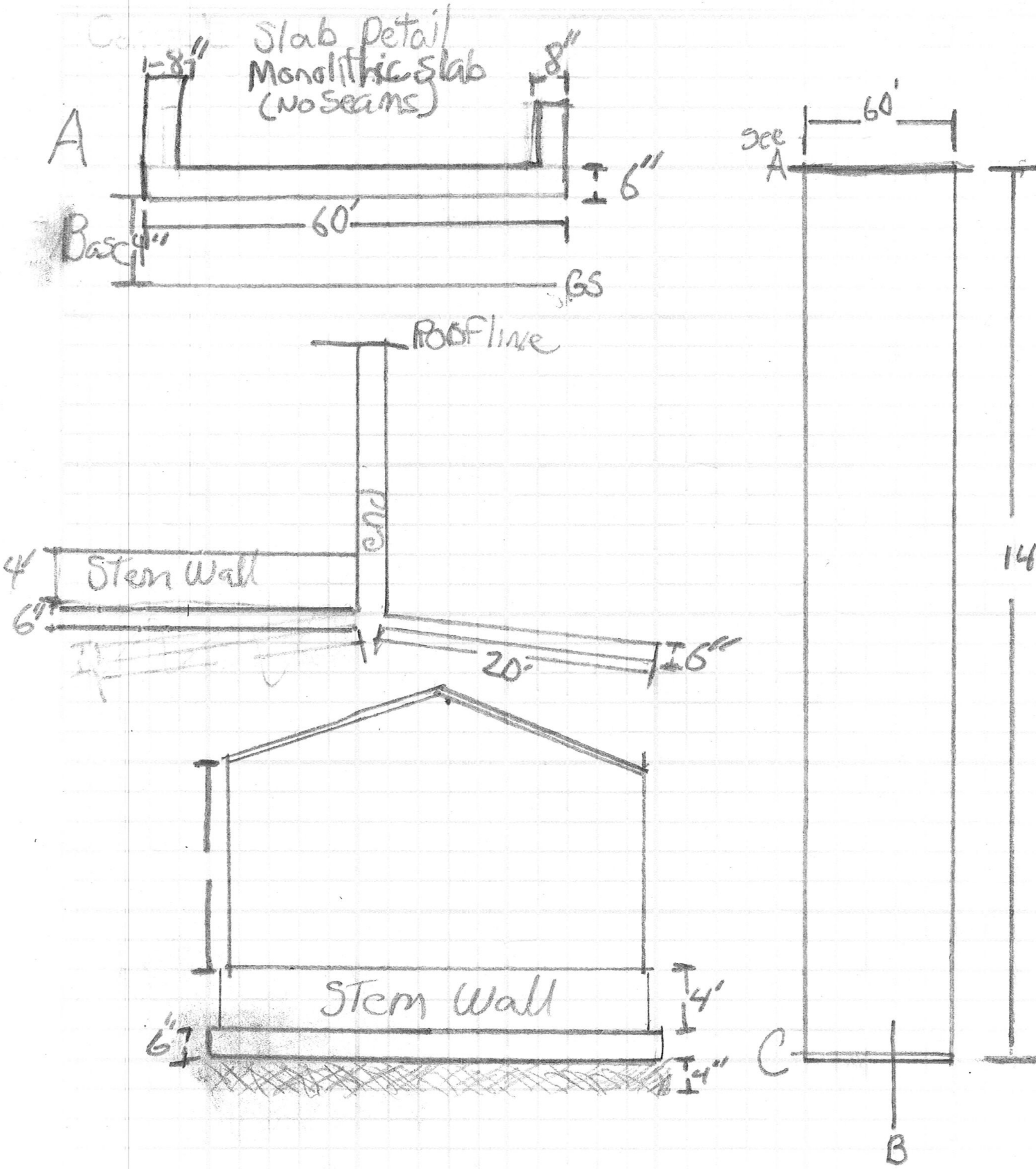


1/4" = 10'

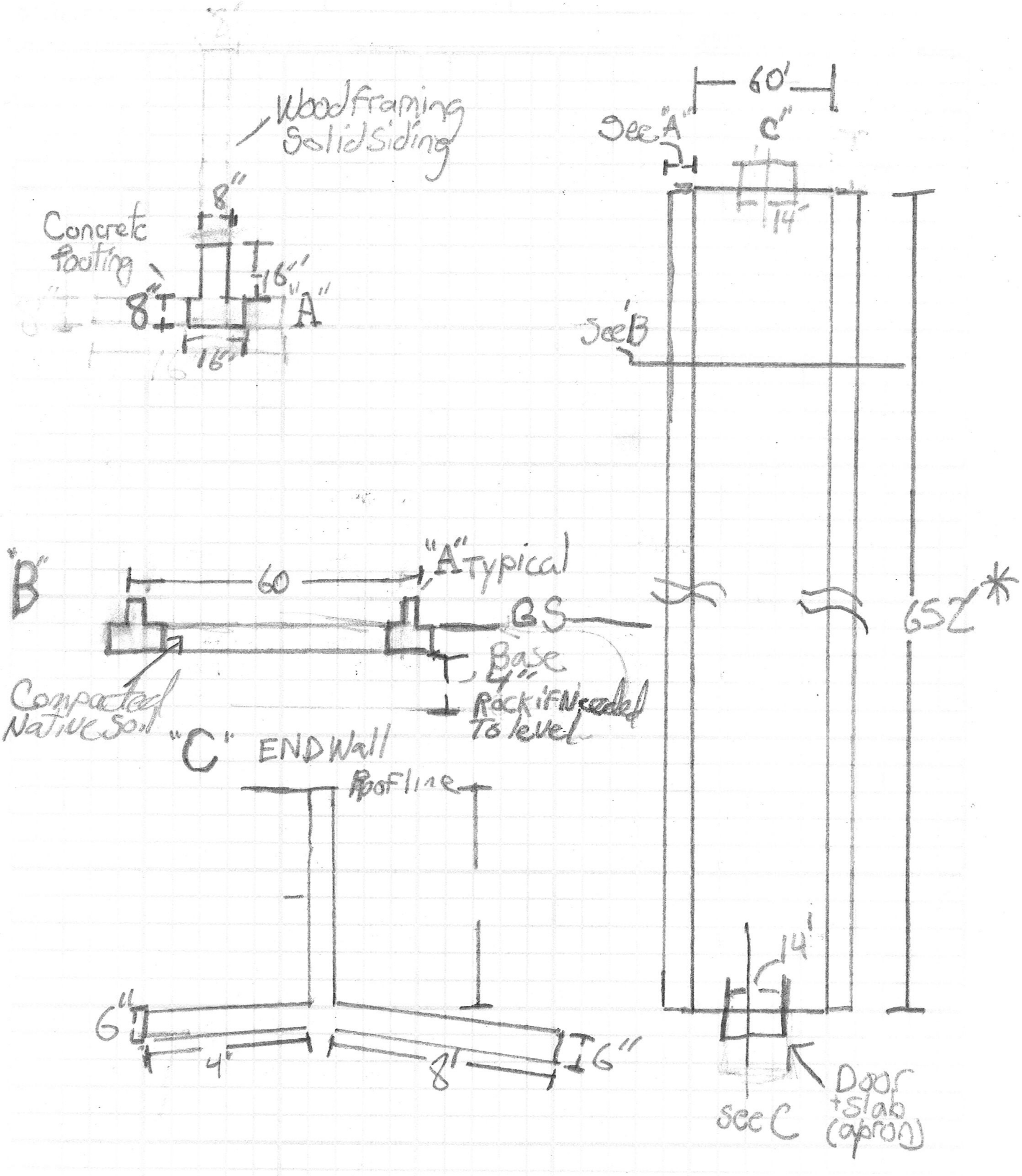
Barn Side Elevation



Storage Building

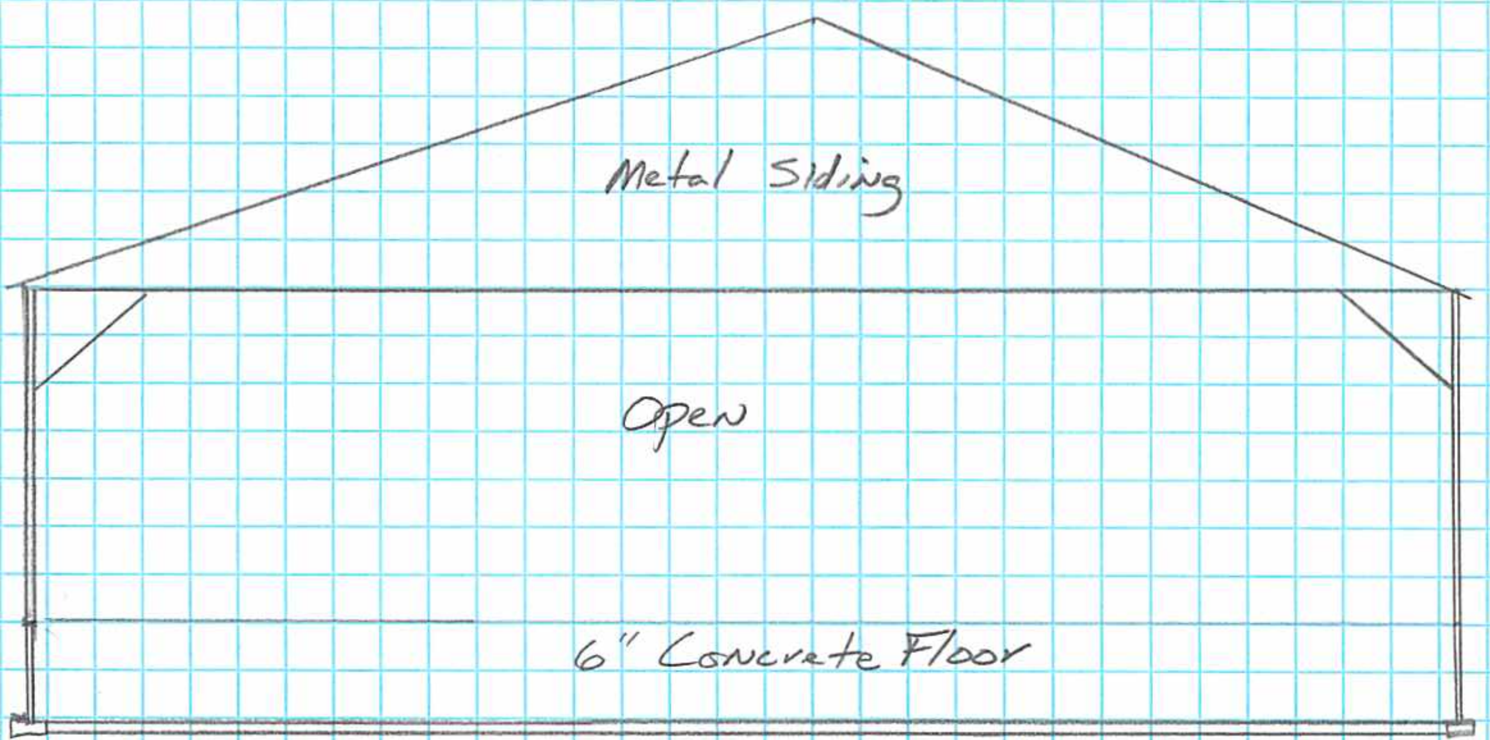


Housing NTS Dimensions as shown



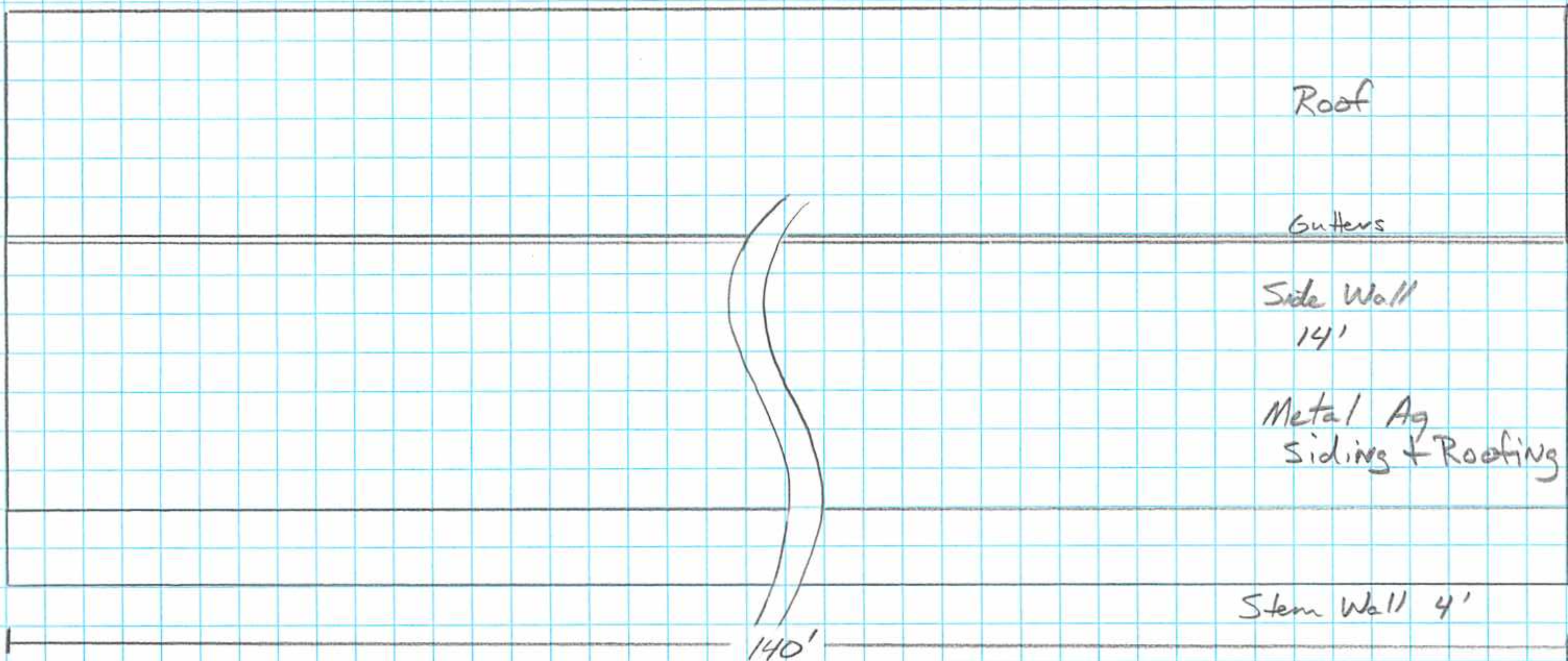
* One House is 560'

Manure Storage Building
Front Elevation



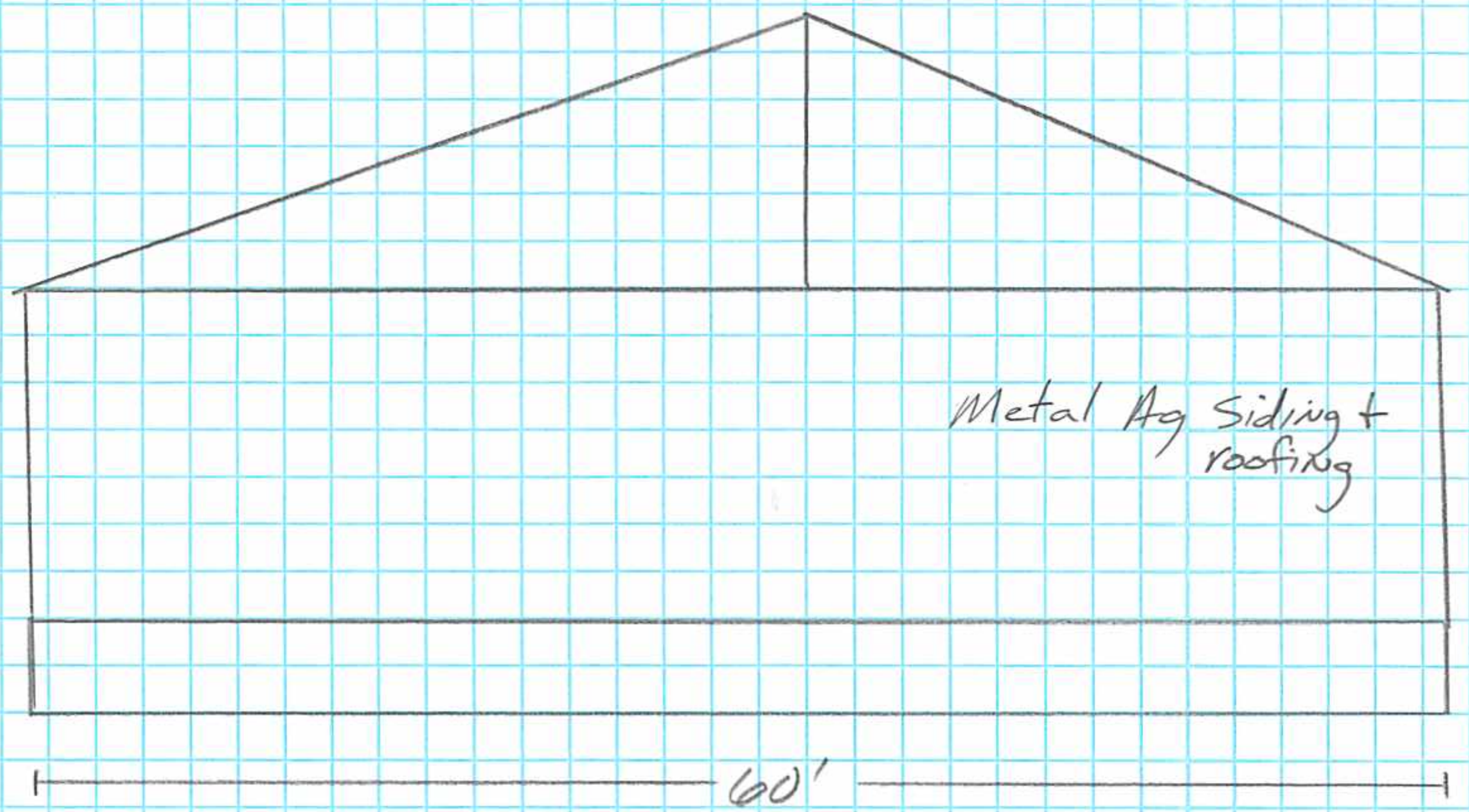
Manure Storage Building
Side Elevation

Scale 1/8" = 1'



Manure Storage Building
Rear Elevation

Scale 1/8" = 1'



A Guide to Collecting Soil Samples

for Farms and Gardens

Melissa Fery, Jeff Choate, and Elizabeth Murphy

Without a soil analysis, it's nearly impossible to tell what your soil needs to help your crop grow. A laboratory soil analysis, or a soil test, provides information on the capacity of your soil to supply adequate nutrients. This helps you select the correct mix of fertilizer and liming materials, which can help you to develop and maintain your soil and increase crop production.

The following recommendations are based on fertilizer experiments, soil surveys, and results obtained from on-farm trials.

Why should I collect a soil sample?

A soil sample can help:

- Establish baseline soil nutrient status for new landowners
- Determine nutrient application recommendations
- Assess pH and the need for liming
- Measure change in soil nutrient status over time
- Document soil nutrient management for certification requirements
- Avoid excessive nutrient applications or soluble salt accumulation
- Develop a plan for possible variable-rate fertilizing within a field

Melissa Fery, Extension Small Farms faculty, Lane, Benton and Linn counties, associate professor (practice), Oregon State University; and Jeff Choate and Elizabeth Murphy, formerly of Oregon State University Extension.

Photo: Lynn Ketchum, © Oregon State University

Using a soil probe to take a sample.

Oregon State University

EC 628
Revised October 2018

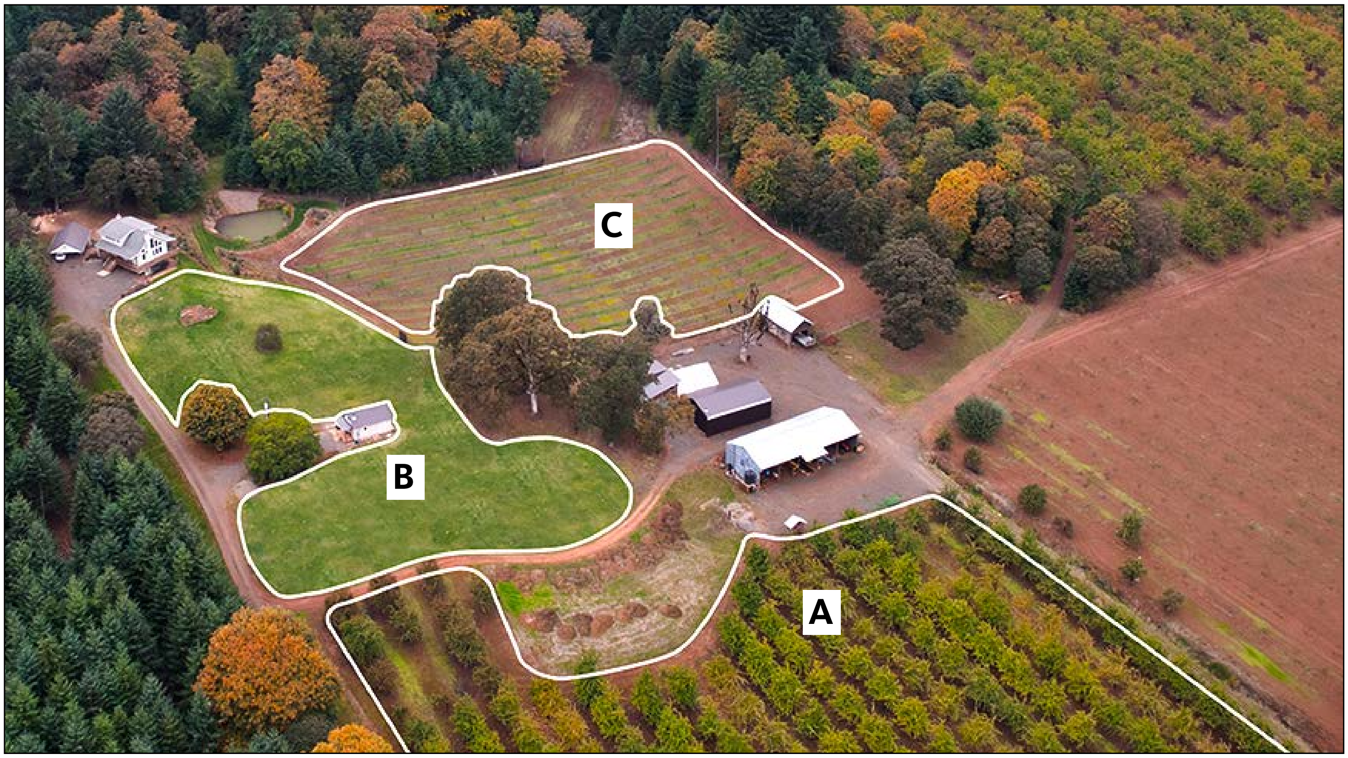


Photo: Lynn Ketchum, © Oregon State University

Figure 1. Collect a separate soil sample from each of the three areas (A, B, and C).

When should I collect my soil sample?

For annual crops, such as vegetables, test soils when you first cultivate a field or change crops or rotations. If you plant successive crops in a single season, you don't need to test before each planting.

For perennial crops, such as orchards, tree plantations, alfalfa, grass seed, and permanent pasture, the most important time to test the soil is before planting so necessary nutrients can be incorporated into the soil. If you plan to compare soil test results with the results of a leaf analysis, take samples in August. For more information about leaf analysis, refer to *Leaf Analysis of Nutrient Disorders in Tree Fruit and Small Fruits* (FS 118), *https://catalog.extension.oregonstate.edu/fs118*.

In high rainfall areas of western Oregon, soils are likely to be acidic and require periodic liming. Testing these soils in the late summer or fall allows time for these amendments to react with the soil before the following growing season.

How often should I collect a soil sample?

Soils should be analyzed often enough to recognize potential nutrient management issues before they adversely impact plant growth. In general, test every 2 to 3 years for annual crops, pastures, and legumes, and test every 3 to 5 years for Christmas trees, fruit and nut trees, berries, and grapes. Take samples at the same time of year so results are comparable from year to year.

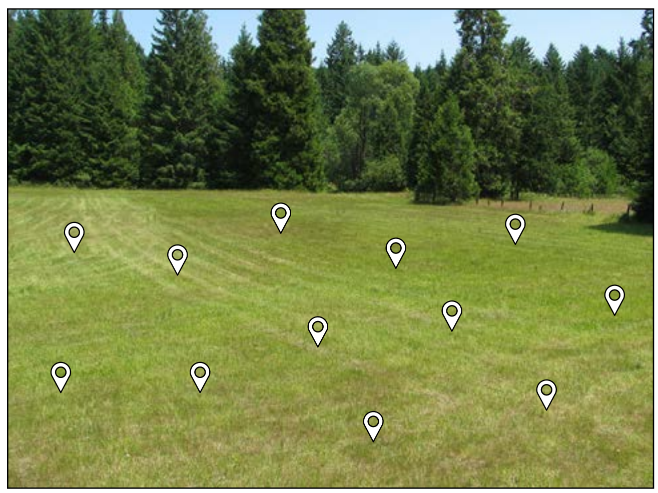


Photo: Lynn Ketchum, © Oregon State University

Figure 2. Take 15 to 20 subsamples within one sampling area.

Where should I collect a soil sample?

The area from which to collect a soil sample may depend on the soil type, topography, crops grown, management history, or all of the above. For example, the farm in Figure 1 has three separate sampling areas: A (orchard), B (pasture), and C (vegetable row crops). In this example, a separate soil sample should be collected from each of the three areas. The same concept applies to smaller acreages; for example, a lawn and a vegetable garden should each be sampled separately.

Photo: Melissa Fery, © Oregon State University

Figure 3. Soil sampling tools, from left: trowel, hori hori knife, probe, hammer probe (in two pieces), and a long-handled shovel.

How do I collect my soil sample?

Sample where the crop will be planted

If you are using raised beds, such as for vegetable crops, take your samples in the beds instead of the areas between the beds where there are minimal roots.

Avoid unusual areas

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

Take 15 to 20 subsamples

Each sample should consist of subsamples taken from 15 to 20 locations within the sampling area (Figure 2).

Use appropriate tools

Use a soil probe (Figure 3) for ease and consistency of sampling. If a soil probe is not readily available, a shovel will work.

To use a shovel, begin by pushing the blade into the soil at an angle to the desired depth (see "Take the soil sample to the correct depth"). You can make a mark on the shovel with a piece of tape as a guide for consistent sampling depth. Next, tilt the shovel back to remove the blade full of soil, being careful to keep the soil intact. At this point, one option is to use your hands or a trowel to remove excess soil from the shovel to arrive at a subsample with approximately equal amounts of soil across all depths. Another option is to use a trowel to remove a thin slice from the face left behind in the soil by the shovel (Figure 4).

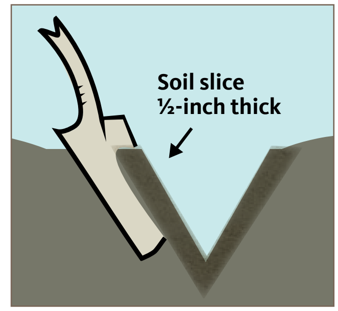


Figure 4. Slice sampling method using a shovel or trowel.

Avoid contaminating the sample

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

Take the soil sample to the correct depth

Sample the part of the soil where the plant roots will grow. For most annual and perennial crops, sample from the surface down to about 6 inches (Figure 5) or to the depth of tillage.

Photo: Melissa Fery, © Oregon State University

Figure 5. Measuring sampling depth.

For perennial crops such as pastures and orchards or other soils that have limited or no tillage, refer to *Evaluating Soil Nutrients and pH by Depth* (EM 9014), *https://catalog.extension.oregonstate.edu/em9014*, for more information about collecting your soil sample. Soils with limited or no tillage can experience significant pH changes in the top 2 inches resulting from the addition of nitrogen fertilizers and lime. However, those changes may be obscured when samples are collected to a depth greater than 2 inches.

Collect samples at the same depth. For example, if you take initial samples at a 6-inch depth, keep that same depth for all future samples to get a more accurate comparison.

Carefully mix the soil sample

Place all of the soil subsamples from a single sampling area in a clean container and mix thoroughly (Figure 6). Do not worry about breaking the sample up into tiny particles. Labs have soil grinders to further mix the sample.

Analyzing my soil sample

- Refer to *Analytical Laboratories Serving Oregon* (EM 8677) to find a lab that performs soil analysis. You can search for labs that participate in the North American Proficiency Testing (NAPT) program at *www.naptprogram.org* (EM 8677 includes NAPT-participating and also nonparticipating labs).
- Look for a lab that offers a soil test report that you understand. Labs may charge a fee for providing recommendations based on soil test results.
- Call or check the website of one or more labs to find out the cost of the soil analysis that you need.
- After choosing a lab, request any necessary paperwork (such as an information sheet), and find out how you should prepare and submit the sample.
- Prepare and submit the sample according to the lab's instructions. Plastic zipper bags work best; do not use a paper bag unless the lab provides one lined with plastic. Most laboratories ask you to label the sample bag with identifying information and to fill out and include an information sheet with the sample. If mailing, don't forget to include payment in a separate, sealed plastic bag.
- If you are requesting nitrogen tests, keep the sample cool and send it immediately to the lab. However, avoid shipping in the middle of the week if possible, as the sample may arrive over the weekend and may not be processed until the following week.
- For samples that will not be tested for nitrogen, spread the sample out on newspaper to air-dry prior to packaging for shipment.
- You may be able to obtain results sooner if you request to receive results via email. Ask the lab to provide both a printed report and an electronic spreadsheet format for more flexible recordkeeping.
- Number each sample, record sample depth, and keep a record of the fields and areas you sampled. Take a photo of the labeled sample bags before mailing them, for future reference (Figure 7).

What analysis should I request?

- In high rainfall areas of western Oregon, the standard soil analysis includes phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), soil pH, and SMP buffer pH. Soil pH is a measure of soil acidity, whereas the SMP buffer pH test is used to estimate the amount of lime required to raise the pH of the top 6 inches of soil. Nitrate nitrogen (NO3-N) is sometimes reported in standard soil tests, but is not useful to determine soil fertilizer applications in western Oregon, as nitrate is readily leached from the soil profile. To determine a nitrogen application rate for your crop, consult the specific fertilizer guide (see "Interpreting your soil analysis," page 5).
- In arid regions, such as east of the Cascades, test for phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), soil pH, soluble salts (measured by electrical conductivity [EC]), sodium (Na), nitrate nitrogen (NO3-N), and sulfate (SO4). Some of these tests may not be part of a standard analysis, so be sure to check with the lab.

Photo: Lynn Ketchum, © Oregon State University

Figure 6. Use a clean hand tool or trowel to mix the subsamples.

Photo: Lynn Ketchum, © Oregon State University

Figure 7. Take a photo of your sample bags before you mail them, for future reference. Do not use a paper bag unless the lab provides one lined in plastic.

- Certain crops might have higher requirements for specific nutrients. Consult OSU Extension publications (see "Resources," page 5) to determine whether you should test for additional nutrients. For example, boron (B) should be included in the analysis for tree fruits, nuts, berries, alfalfa, brassicas, and root crops.

Sampling over time

Once you have researched and selected a laboratory, plan to use the same lab for future tests to keep sample analysis consistent and detect changes in soil nutrients. Also, plan to take your soil sample at the same time of year, same depth, and same approximate field location.

Interpreting your soil analysis

Once you have received the analysis results for your soil, use the following tools to make decisions:

- *Soil Test Interpretation Guide* (EC 1478), *https://catalog.extension.oregonstate.edu/ec1478*
- OSU Extension Fertilizer and/or Nutrient Management guides. To search for your crop-specific guide, go to the OSU Extension Catalog at *http://extension.oregonstate.edu/catalog/* and search by keywords (nutrient management guide or fertilizer guide, and crop).

You can also consult your local OSU Extension Service agent.

Resources

OSU Extension Catalog publications

Visit the OSU Extension Catalog at *http://extension.oregonstate.edu/catalog/* to find these publications:

Analytical Laboratories Serving Oregon (EM 8677), *https://catalog.extension.oregonstate.edu/em8677*

Applying Lime to Raise Soil pH for Crop Production (Western Oregon) (EM 9057), *https://catalog.extension.oregonstate.edu/em9057*

Christmas Tree Nutrient Management Guide (EM 8856), *https://catalog.extension.oregonstate.edu/em8856*

Eastern Oregon Liming Guide (EM 9060), *https://catalog.extension.oregonstate.edu/em9060*

Evaluating Soil Nutrients and pH by Depth (EM 9014), *https://catalog.extension.oregonstate.edu/em9014*

Fertilizing with Manure (PNW 533), *https://catalog.extension.oregonstate.edu/pnw533*

Fertilizing Your Garden: Vegetables, Fruits, and Ornamentals (EC 1503), *https://catalog.extension.oregonstate.edu/ec1503*

Leaf Analysis of Nutrient Disorders in Tree Fruit and Small Fruits (FS 118), *https://catalog.extension.oregonstate.edu/fs118*

Monitoring Soil Nutrients Using a Management Unit Approach (PNW 570), *https://catalog.extension.oregonstate.edu/pnw570*

Soil Fertility in Organic Systems: A Guide for Gardeners and Small Acreage Farmers (PNW 646), *https://catalog.extension.oregonstate.edu/pnw646*

Soil Test Interpretation Guide (EC 1478), *https://catalog.extension.oregonstate.edu/ec1478*

OSU Vegetable Production Guides

http://horticulture.oregonstate.edu/content/vegetable-production-guides

Western SARE videos on soil sampling methods

http:westernsoil.nmsu.edu/soil-testing.html

WSU Extension publication

Soil Management for Small Farms (EB 1895). Washington State University Extension, *https://s3.wp.wsu.edu/uploads/sites/411/2014/12/Paper_SoilManageSmallFarms.pdf*

This publication was reviewed by Amber Moore and Shannon Cappellazzi, both of the Department of Crop and Soil Science, Oregon State University.

Revised October 2018

EM 8832-E
May 2003
$2.00

Post-harvest Soil Nitrate Testing

for Manured Cropping Systems West of the Cascades

D.M. Sullivan and C.G. Cogger

Contents

What's in this publication?

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

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

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

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

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

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

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

The post-harvest test and how to use it

What the post-harvest test measures

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

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

Use the post-harvest test to:

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

Soil sampling protocols

Sampling depth

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

Composite soil sample

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

What fields to sample

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

When to sample

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

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

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

continues on page 5

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

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

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

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

Using the test as part of a nutrient management program

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

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

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

Limitations to test results

Interpretive values for post-harvest soil nitrate are:

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

How *not* to use the post-harvest test

The test will *not*:

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

Crop and soil response to excess plant-available N

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

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

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

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

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

- Grass has a greater capacity to take up N supplied in excess of that needed for maximum yield. After enough N has been supplied for maximum yield, grass protein content increases in response to increased N supply. With grass, soil nitrate increases only when the available N supply exceeds that required to produce near-maximum protein. Corn does not take up additional N after the maximum yield is reached. Corn silage protein does not increase much in response to excess N supply.
- Grass utilizes N mineralized late in the growing season more efficiently. Grass managed for silage or hay continues to take up N until harvest. Corn grown for silage completes its N uptake approximately 4 weeks before harvest. Some of the soil nitrate measured after corn harvest is produced by mineralization of soil organic N to available forms during the final weeks of the growing season.

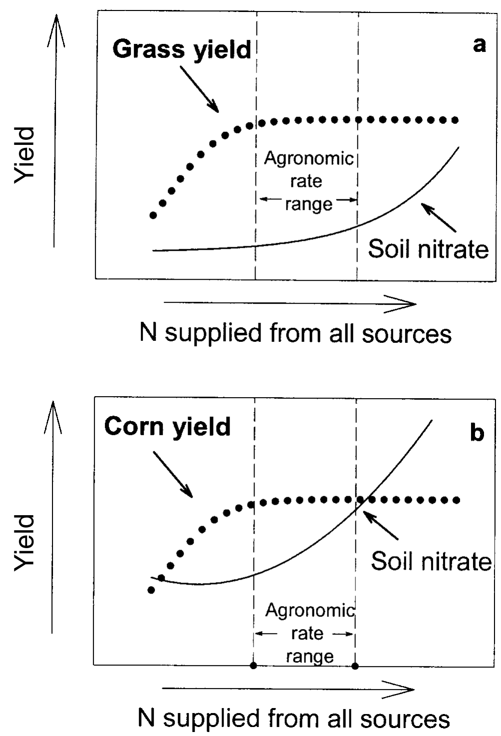

Figure 1.—Crop yield and soil nitrate response to increased N supply. Agronomic rate range = range of N supplied from all sources that results in near-maximum crop yield with acceptable post-harvest nitrate accumulation. Above the agronomic rate range, excess N accumulates as nitrate in soil. More nitrate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

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

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

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

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

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

Units used in soil nitrate testing

In this publication, interpretation of a post-harvest soil nitrate test (Tables 3 and 4) is based on units of parts per million (ppm). Some labs report soil test nitrate-N in units of lb/acre by assuming a standard value for soil bulk density. If the lab reports nitrate-N results in pounds per acre, ask them to provide a conversion factor to express data in units of ppm. The conversion factor assumed by laboratories usually is between 3 and 4, because 1 acre-foot of dry soil usually weighs about 3.5 million pounds (3.5 lb per acre-foot = 1 ppm).

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

Name	Interpretation	Equivalent units
nitrate-N or NO_3-N	N present in the nitrate form, soil dry weight basis	mg/kg or ppm (dry weight basis)

Interpreting soil nitrate test results

Data quality and variability

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

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

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

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

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

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

Interpretation for individual fields

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

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

Annual averages across grass and corn crops

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

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

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

Using the interpretive tables (Tables 3 and 4)

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

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

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

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

◆ Continue present N management.

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

◆ Reduce or eliminate sidedress N fertilizer application. Use the pre-sidedress nitrate test (PSNT). Apply sidedress N only when PSNT indicates a need.

◆ Reduce lagoon water application after August 1.

◆ Keep records to document crop yield, dry matter, and crop N removal. Total applied manure-N + fertilizer-N should be less than 125 percent of documented crop N removal.

◆ Reduce manure application on fields where corn follows grass sod plow-down.

◆ Plan to reduce manure-N application by 10 to 25 percent.

◆ Improve whole farm N balance.

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

◆ Apply only starter N (20 to 40 lb N/acre at planting).

◆ Plan not to sidedress N fertilizer in June. Apply sidedress N only when PSNT indicates a need.

◆ Eliminate lagoon water application after August 1.

◆ Keep records to document crop yield, dry matter, and crop N removal. Apply manure N at a rate less than or equal to crop N removal (approximately 200 lb total N per acre).

◆ Eliminate manure application on a few fields or a few strips within a field next year to determine the contribution of mineralized N vs. current-season application of manure.

◆ Plan to reduce manure-N application by 25 to 40 percent.

◆ Consult experts to improve whole farm nutrient balance.

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

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

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

- ◆ Continue present N management.

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

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

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

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

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

Detailed suggestions for soil sampling and planning

Collecting, preserving, and analyzing the soil sample

Tools for field sampling

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

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

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

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

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

A mud auger or bucket auger is the best tool for hand-sampling at sites that are difficult to sample with push probes. Use an auger for compacted, muddy, rocky, or dry soils. Augers can be purchased from several manufacturers. A 2- to 4-inch diameter mud auger (open-sided) works best for most situations because it is easy to remove the sample from the bucket. Use a larger diameter auger for soils with large rocks. Augers sample a 4- to 6-inch depth. You will need to take several bites from the same hole to sample to 12-inch depth. You will collect a larger sample volume, about 5 to 10 times that collected with a push tube. Because of the extra effort required for auger sampling, use this method only if other sampling methods are difficult or impossible.

Field sampling protocol

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

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

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

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

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

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

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

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

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

Sample handling

Mixing. If it is not too hard to break up the soil cores, break them, mix them all together, and homogenize thoroughly. Take a 1-cup subsample for shipment to the lab. If the soil cores are too hard to break apart, send the entire sample to the lab, where they can pass the sample through a mechanical grinder. Check with the lab to make sure they will grind and mix the *entire* sample before subsampling.

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

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

Working with an analytical laboratory

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

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

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

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

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

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

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

Developing a sampling plan

Nutrient management plans can be voluntary, required by regulatory agencies, or a part of an agreement with a conservation planning agency (e.g., Natural Resources Conservation Service or conservation district). If your nutrient management plan is not voluntary, consult the agency that supervises your nutrient management plan to determine whether they have specific requirements for how often fields must/should be sampled. Suggestions given here for sampling frequency are general in nature and are not intended to serve as policy for any agency.

Representative fields for long-term monitoring

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

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

Other fields

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

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

Sampling priority

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

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

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

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

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

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

Questions and answers

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

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

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

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

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

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

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

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

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

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

Drying of soils after sampling releases ammonium-N from microbial biomass. Most dried soils have 2 to 20 ppm ammonium-N that is caused by the soil drying process. Dry soil ammonium-N concentrations are poorly correlated with other indices of N availability in controlled experiments.

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

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

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

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

What is whole farm nutrient management?

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

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

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

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

Post-harvest nitrate test values may be used as part of a process to develop a new CNMP or to update an existing CNMP. The CNMP typically includes a plan for regular soil testing. Appropriate timing of the post-harvest nitrate test is critical (see "When to sample," page 2), while soil samples for P and K analysis may be collected any time of the year. Soil samples collected for the post-harvest nitrate test can be analyzed by routine agronomic soil testing procedures and used in developing plans for P and K utilization in a CNMP.

What are the implications of high nitrate concentrations in forages?

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

For more information

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

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

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

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MANURE SAMPLING AND ANALYSIS

This fact sheet was prepared by Jan Jarman, formerly with the Mn. Dept. of Agriculture.

Manure nutrients applied to cropland should be accounted for when determining commercial fertilizer needs. Manure nutrient composition varies widely between farms due to differences in animal species and management and manure storage and handling. Sampling and laboratory analysis is the only method for determining the actual nutrient content of manure. Published average values should only be used for initial application rate planning when no previous analyses are available, for estimating total nutrients generated in a specific time period, or for MPCA permitting requirements.

WHEN TO SAMPLE

Manure is very heterogeneous and nutrients stratify in storage. Sample manure at application time following adequate agitation of liquids in storage or mixing of solids in the spreader loading process. If no previous analyses are available, use published average values for initial application rate planning, then use the analysis results to calculate commercial fertilizer needs. Sample manure each time it is applied, over the course of several applications. Track analysis results to determine the needed sampling frequency and develop farm-specific average value to use for application rate planning. Nutrient content will change with changes in management (housing, feed, bedding, storage, handling) and can vary between years or seasons depending on precipitation (for manure stored outdoors).

WHAT TO SAMPLE

Agitated liquid slurries: Agitate liquid in entire structure for 2-4 hours just prior to application. Take one sample per 300,000 gallons of pumped manure. Avoid sampling near beginning and end of pump-out. Each sample may consist of several subsamples mixed together. If it is not possible to agitate liquid slurries before application, several samples taken throughout pump-out will be needed to characterize the manure. Keep track of which sample results correspond to manure applied to which fields.

Unagitated lagoon liquids (single/multiple stage, settling basins): Lagoons, which act as settling basins or are used in flush/recycle systems, are usually not agitated. Take out sample per 300,000 gallons of pumped liquid. Avoid sampling near beginning and end of pump-out. Each sample may consist of several subsamples mixed together.

Stored solids: Depending on the size of the pack, pile or stack, take at least three samples during application, each consisting of 5-10 subsamples from different loads. More samples are needed for stored solids because of its extreme variability. Avoid sampling the outside foot of a pile or stack.

Scrape and haul: Sample when applying to fields where nutrients will be credited. Fall is probably the most important time to sample. Take several subsamples from consecutive applications and mix together. Samples may be taken throughout the year to characterize variability.

Poultry in-house systems: For litter or manure that is not stored for any length of time prior to application. Use a pitchfork or shovel to sample to the depth of the floor in 5-10 locations in each house. Mix subsamples to obtain 1 or 2 samples for analysis. Take subsamples from around feeders and waterers in proportion to the areas they occupy.

HOW TO SAMPLE

Liquid manure: Samples can be taken in the field (for broadcast manure) or from the application equipment. Sampling in the field can be done by placing catch cans throughout the area where manure will be spread. Mix the subsamples in a bucket and take a smaller sample for analysis. Sampling from the application equipment is the easiest and most effective way to get a good sample. Take subsamples from the filling hose or from a bottom unloading port, mix together in a bucket and take a sample for analysis. Sampling from liquid storage structures is not recommended since it is much safer and easier to sample from application equipment or in the field.

Solid manure: Samples can be taken in the field or from the spreader. In the field, spread tarps to catch manure as it is applied. For each sample, take several small subsamples from the tarps and place in a bucket or pile. Avoid larger pieces or chunks of bedding. Collect other subsamples throughout application and keep cool. Subsamples can be mixed by placing in a pile and repeatedly shoveling the outside of the pile to the inside. Use a trowel or plastic gloves to take a smaller sample for analysis. Samples can also be taken with a pitchfork or shovel from the spreader box after it is loaded. Collect subsamples throughout application, keep cool, mix and take a smaller sample for analysis. Again, sampling from the field or spreader is much easier and safer than trying to sample from a pack or pile.

SAMPLE HANDLING AND ANALYSIS

Laboratories: A listing of manure testing laboratories is available from the Minnesota Department of Agriculture Manure Testing Laboratory Certification Program, (612) 297-2530.

Preparing samples: For liquids and solids, clean, leakproof plastic jars with wide mouths may be used for the samples. Solids with lower water content can also be placed in leakproof plastic ziplock bags. Most laboratories will provide sample jars and postpaid mailing packages. Jars should be filled no more than 2/3 – ¾ full, tightly sealed and placed in a leakproof plastic bag. For solids, plastic bags can be partially filled and all the air squeezed out. Fill the sample container with about 1-2 cups or 1-2 pounds (a large handful) of manure for analysis. Tightly seal containers and label with the farmer's last name and a sample ID using a waterproof marker. Place in a second plastic bag and freeze overnight if possible. Do not let samples sit in the sun or at room temperature for more than 12 hours. Mail samples early in the week and avoid weekends and holidays. Be sure to include payment and the sample information sheet.

Analyses: Analyses needed for developing a manure application plan are total nitrogen (N), phosphate (P_2O_5) and potash (K_2O). Laboratories usually provide these analyses plus dry matter (solids) and sometimes ammonium-N (NH_4-N) for a set fee. Knowing NH_4-N can be useful if this fraction makes up a large percentage of the total N in the manure. All of the NH_4-N is usually available the first year of application. If this fraction is high (70% or more of total N), then total N availability the first year may be higher than average. It is usually not necessary to analyze manure for other mineral constituents such as calcium, magnesium, zinc, sulfur or boron. Most manures contain significant quantities of these minerals, and fields with manure histories are rarely deficient.

Results: Manure nutrient content should be reported in units of lbs/ton or lbs/1000 gallons, on an as-is basis. Phosphate and potash should be reported as such, rather than as P and K. A table of conversion factors is given below. Always check results to make sure they fall within normal ranges for that particular species and storage system. Use University of Minnesota nutrient availability factors to calculate total available nutrients applied.

CONVERSION FACTORS

To convert Column 1 into Column 2, multiply by	Column 1	Column 2	To convert Column 2 into Column 1, multiply by
10,000	percent (%)	parts per million (ppm)	0.0001
% DM / 100	%, DM basis	%, as-is basis	100 / % DM
83.3	%, as-is basis	lbs/1000 gal	0.012
20	%, as-is basis	lbs/ton	0.05
2.29	P, any unit	P_2O_5, any unit	0.44
1.2	K, any unit	K_2O, any unit	0.83