UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT
(Acre)

Code 590

DEFINITION

Managing the amount, source, placement, form, and timing of applications of nutrients and soil amendments.

PURPOSE

- To budget and supply nutrients for plant production
- To properly utilize manure or organic by-products as a plant nutrient source.
- To minimize agricultural nonpoint source pollution of surface and ground water resources.
- To maintain or improve the physical, chemical and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied.

CRITERIA

Plans for nutrient management shall be developed in accordance with policy requirements of the NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH), the NRCS National Agronomy Manual (NAM) Section 503 and the EPA/625/R-95/001 Process Design Manual – Land Application of Sewage Sludge and Domestic Septage.

Laws and Regulations

All specifications shall be consistent with federal, state, and local regulations. Unless exceptions are granted according to ADEM Rule 335-6-7-26(2)(c) and (p) the minimum buffer distance for animal waste application shall be:

- 50 feet from surface waters of the state including, but not limited to, perennial or intermittent streams, ponds, lakes, springs, or sinkholes.
- 100 feet from nearest existing occupied dwelling, church, school, hospital, park, or non-potable water wells.
- 200 feet from Outstanding National Resources Water, Outstanding Alabama Water, potable water wells, or public water supply.
- 200 feet from nearest existing occupied dwelling, church, school, hospital, or park when applying wastewater.
- 500 feet from the nearest existing occupied dwelling, church, school, hospital, or park when using aerial wastewater irrigation application.
- not applied across property lines unless the adjoining property owner consents in writing.

Plan Certification

Persons who review and/or approve conservation plans for nutrient management shall be certified according to the NRCS job approval policy in Alabama.

Site Assessment

Evaluate each field, site, or farm for risk of vulnerability of nitrogen and phosphorus to impact water resources using all available information, such as soil ratings for leaching of soluble nutrients, soil infiltration rates, geology reports, sinkhole maps, stream classification, proximity of site to wells and streams, etc. The *Phosphorus Index for Alabama* shall be used to assess the potential risk of phosphorus

movement into water on all fields or portions of fields that will have animal manure, poultry litter, compost or other organic by-products applied on them.

Evaluate water quality standards and designated use limitations that exist locally or statewide in managing nutrients to protect the quality of water resources.

In areas with an identified or designated nutrient-related water quality impairment (303d and 305b watersheds), an assessment shall be completed for the potential of nitrogen and/or phosphorus transport from the field. The Leaching Index (LI) and/or Phosphorus Index (PI), or other recognized assessment tools will be used to assess movement potential of applied nutrients. The results of these assessments and recommendations shall be discussed with the producer and included in the conservation plan.

Conservation plans developed to minimize agricultural nonpoint source pollution of surface or groundwater resources will include practices and/or management activities that will reduce the risk of nitrogen or phosphorus movement from the field.

Erosion/Runoff Control

Erosion, runoff, and water management controls shall be installed, as needed, on fields that receive applications of nutrients. NRCS conservation practice standards, *Filter Strips-393* or *Riparian Forest Buffers-391* shall be established and/or maintained along edges of fields in environmentally high-risk areas, such as fields adjacent to water bodies or water supplies, to reduce nutrients transported with sediment and runoff water.

Soil Sampling and Laboratory Analysis (Testing)

Nutrient planning and application shall be based on current soil test results and recommendations developed in accordance with Auburn University Soil Testing Laboratory guidance or industry practice if recognized by the Auburn University Soil Testing Laboratory. Current soil tests are those that are no older than three years.

Soil samples shall be collected and prepared according to the Auburn University Soil Testing Laboratory guidance or standard industry practice. Soil test analyses shall be conducted by Auburn University Soil Testing Laboratory or other laboratories that are accepted in one or more of the following programs:

- State Certified Programs
- The North American Proficiency Testing Program (Soil Science Society of America), or
- Laboratories whose tests are accepted by the Auburn University Soil Testing Laboratory.

Soil testing shall include analysis for any nutrients for which specific information is needed to develop the nutrient plan, e.g. pH, electrical conductivity (EC), soil organic matter, nitrogen, phosphorus, potassium, copper and zinc.

Plant Tissue Testing

Tissue sampling and testing shall be done in accordance with Auburn University standards and recommendations.

Sources of Nutrients

Sources of plant nutrients include residual amounts in the soil, crop residues including cover and green manure crops, agricultural by-products, solids and waste water from municipal treatment plants, livestock and poultry manure to include nutrients recycled by grazing animals, poultry litter, compost, and commercial fertilizer.

Livestock and poultry manure, poultry litter, compost, and agricultural by-products shall be analyzed prior to land application to establish nutrient content and application rates. When trends are established for the nutrient content of a specific management system, laboratory analysis shall then be required only every three years to verify the nutrient content or when the management system is modified. At least three years of laboratory analysis are needed to establish a trend. Available nutrient content of livestock and poultry manure, poultry litter, and compost from specific management systems contained in Table 1 may be used for planning purposes and application rates in the absences of laboratory analysis. Laboratory results will need to be adjusted for nitrogen application losses by using Tables 2 and 3.

Municipal and industrial sources of organic nutrients as well as sludge accumulation from animal lagoons shall be analyzed prior to land application for nutrient content and heavy metal content. Nitrogen availability shall be accounted for using Tables 2 and 3.

Legume cover crops or green manure crops, where feasible, can provide a nitrogen source for the following crop. Be sure to consider these effects in the nutrient budget. Available nitrogen provided by legume and cover crops is contained in Table 4.

Nutrient Application Rates

Soil amendments shall be applied, as needed, to adjust soil pH to the specific range of the crop for optimum availability and utilization of nutrients.

Nutrient application rates, as documented in the nutrient budget, shall be based on a current soil test report for the intended land use from Auburn University Soil Testing Laboratory or other laboratory if recognized by Auburn University Soil Testing Laboratory. Table 5 contains Auburn University Soil Testing Laboratory standard nitrogen recommendations. Soil tests are required at least every three years. Soil tests no more than three years old will be considered current. Application will not exceed more than10% of the intended rates for the field.

The following guidance will be used:

- **Nitrogen Application** rates shall not exceed more than10% of recommended rates for the crop. When manure or other organic by-products are a source of nutrients and the application rate is based on phosphorus, an additional nitrogen application, from non-organic sources, may be required to supply the recommended amounts of nitrogen.

- **Phosphorus Application** rates shall not exceed more than 10% of recommended rates except when manure or other organic by-products are the source of nutrients. Where animal manure, poultry litter, compost or other organic by-products are used, a field assessment for potential risk of phosphorus transport to surface water will be conducted. The ***Phosphorus Index for Alabama*** will be used to make this assessment of each field. A record of these assessments shall be included in the conservation plan.

  The phosphorus application rate in excess of crop need shall be based on the field vulnerability for offsite phosphorus losses to surface waters.

Field Vulnerability Rating	Phosphorus Application Rate
Very Low, Low	Nitrogen Rate
Medium	3X P removal by crops
High	2X P removal by crops
Very High	1X P removal by crops
Extremely High	No P application

  Use Table 6 to determine the phosphorus removal by crops

- **Potassium Application** – Excess potassium shall not be applied in situations in which it causes unacceptable nutrient imbalances in crops or forages.

- **Other Plant Nutrients** shall be applied at rates consistent with Auburn University Soil Testing Laboratory recommendations or other laboratory if recognized by Auburn University Soil Testing Laboratory.

- **Starter fertilizer** containing 20 to 30 pounds of nitrogen per acre should be applied at planting of corn or sorghum for early seedling growth where cover crops or livestock or poultry manure is used for the nitrogen source. Starter fertilizer for other crops shall be in accordance with Auburn University Soil Testing Laboratory recommendations. When starter fertilizers are used, they shall be included in the nutrient budget.

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all sources of nutrients including, but not limited to animal manure, organic by-products, waste water, commercial fertilizer, crop residues, legumes residues, manure recycled by grazing animals, and irrigation water.

Application rates (in/hr) for liquid waste will not exceed soil intake rate and total application will not exceed field capacity of the soil.

Plant nutrient application rates for critical area plantings are contained in the NRCS conservation practice standard, *Critical Area Planting-342*.

Nutrient Application Method and Timing

Timing and method of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping system limitations, weather, and climatic conditions, and field accessibility.

Nitrogen sources should not be applied more than 30 days prior to planting of the crop. For maximum efficiency, nitrogen should be applied as close to the time of crop demand as practical.

Animal manure and related organic by-products will not be applied between November 15 and February 15 in North Alabama (See Figure 1). In the remainder of the state, livestock and poultry manure will not be applied in the fall or winter unless applied on an actively growing crop.

Figure 1. Geographical Subdivisions of Alabama for spreading manure and agriculture by-products.

When applying animal manure or other sources of organic nutrients to hay or pasture, apply when vegetation is actively growing. For hay, another cutting of hay should be expected during the current growing season. For pasture, another 45 days of grazing should be expected.

Animal manure, related organic by-products, or wastewater should not be applied within three days of a predicted storm event with more than 49% probability (as predicted by National Weather Service zone forecasts with rain predicted as likely, periods of rain, occasional, or 50% or more probability).

Nutrients and wastewater should not be applied where soils are saturated, frozen, or snow covered.

Surface applied animal manure and other related dry organic by-products will not be applied to soils, which are subject to very frequent and frequent flooding. This is more than a 50 percent chance of flooding in any year.

Animal manure and related organic by-products will not be applied when wind direction and velocity will cause drift onto public areas, roads, residential areas or cross property lines.

Animal manure and related organic by-products shall not be applied to root vegetable crops during the current growing season, or to other vegetable crops one-month or less before harvest because of fecal bacterial contamination concerns. Dead animal compost will not be applied to vegetable crops.

Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of the NRCS conservation practice standard, *Irrigation Water Management-449*.

Soil pH

Soil pH will be maintained within the specific range of the crop for optimum utilization of nutrients. Apply municipal and industrial sludge only to soils that are adjusted to pH 6.5 or higher and are to be maintained at pH 6.2 or higher.

Soil Quality

Nutrients shall be applied in such a manner as not to degrade the soil's structure, chemical properties, or biological condition. Use of nutrient sources with high salt content will be minimized unless provisions are used to leach salts below the crop root zone.

Nutrients shall not be vehicular applied when the potential for soil compaction and creation of tire ruts is high.

Heavy Metals Monitoring

When sewage sludge or other organic source of nutrients containing heavy metals are applied, the accumulation of potential pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soil shall be monitored in accordance with the US Code, Reference 40 CFR, Part 503, and/or any applicable state and local laws or regulations. Table 8 contains the maximum lifetime loading rates allowed by EPA for heavy metals on agricultural lands.

CONSIDERATIONS

Site Assessment

Cover and green manure crops can be used to take up excess nitrogen to prevent its movement from the root zone.

Consider induced deficiencies of nutrients due to excessive levels of other nutrients.

Buffers

General recommendations for application distances from various sites and/or objects are contained in Table 9. Site specific conditions may warrant a greater application distance.

Erosion/Runoff Control

Consider the effects of soil erosion control practices used to reduce soil loss, runoff, and transport and leaching of dissolved and attached nutrients.

Evaluate use of practices such as crop rotations, selection of specific crops, etc. that enhance efficiency of nutrient uptake and improve soil and soil water conditions.

Sources

Ammonium and urea forms of nitrogen tend to leach less and should be used when the potential for loss is high.

Consider the importance of organic material on soil tilth, nutrient absorption, and root development.

Application Rates

Consider induced deficiencies of nutrients due to excessive levels of other nutrients, and the effect of soil pH on the availability of both soil and applied sources of plant nutrients and the optimum pH range of the crop to be grown.

Application Method and Timing

Consider adjustments to rate, timing, placement, method of application, and nutrient form to conform to seasonal variation in plant needs, so as to avoid excessive soil nutrient concentrations that could leach out of the root zone when the adsorption capacity is exceeded. Any one method may have its advantage for a specific nutrient source, soil characteristic, and/or crop demand.

Consider animal and poultry manure storage and treatment to meet application timing as well as land area requirements for proper nutrient management.

Air Quality

Consider the potential problems from odors associated with the land application of animal manures and other organic nutrients, especially where applied near or up wind of residences.

Additional separation distances may be needed between the application site and public and/or residential areas. Also, vegetative screens such as trees can keep the application site form public view and may even influence air movement.

Soil injection or incorporation by tillage will reduce odor potential when applying animal manure and other organic nutrient.

Nitrogen Management

Loss of nitrogen from the soil is dependent upon climate, soil, and application program. Normally, with adequate soil moisture, applying nitrogen fertilizer close to the time of greatest crop demand can reduce nitrogen loss. Split applications of nitrogen and soil incorporation should be considered to minimize losses.

Nitrate Toxicity

Large applications of nitrogen on tall fescue, Orchardgrass, Sudangrass, Johnsongrass, and other grasses can cause nitrate buildup in the plants, especially in dry periods. When concentrations of nitrate nitrogen in the dry harvested forage exceeds 0.4 percent, the forage is considered toxic to grazing animals. (Refer to Agronomy Ref. No. 16-16 in the Field Office Technical Guides for more information.

PLANS AND SPECIFICATIONS

Nutrient management records shall be kept as required by federal, state, and local regulations.

This practice shall be recorded using approved documents, guide sheets, and narrative statements in the conservation plan. The following shall be included in a conservation plan containing nutrient management:

- aerial photograph or map and a soil map of the site,
- current and/or planned plant production sequence or crop rotation,
- results of soil, plant, water, manure or organic by-product sample analyses,
- realistic yield potential for the crops in the rotation,
- quantification of all nutrient sources,
- recommended nutrient rates, timing, form, method of application and incorporation, and

maximum acceptable levels of trace elements and heavy metals, if applicable,

- location of designated sensitive areas or resources and the associated, nutrient management restriction,
- guidance for implementation, operation, maintenance, recordkeeping, and
- complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

If increases in soil phosphorus levels are expected, conservation plans shall document:

- soil phosphorus levels at which it may be desirable to convert to phosphorus based implementation,
- the relationship between soil phosphorus levels and potential for phosphorus transport from the field, and
- the potential for soil phosphorus drawdown from the production and harvesting of crops.

Conservation plans shall include all applicable practices or management activities as determined by regulations, program requirements, or producer goals. Conservation plans for nutrient management shall also include:

- discussion of the relationship between nitrogen and phosphorus transport and water quality impairment. The discussion about nitrogen should include information about nitrogen leaching into shallow ground water and potential health impacts. The discussion about phosphorus should include information about phosphorus accumulation in the soil, the increased potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface water bodies.
- discussion how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment.
- a statement that the plan was developed based on the requirements of the current standard and any applicable Federal, state, or local regulations or policies; and that changes in any of these requirements may necessitate a revision of the plan.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

- periodic plan review to determine if adjustments or modifications to the plan are needed. As a minimum, plans will be reviewed and revised, if needed with each soil test cycle.
- protection of fertilizer and organic by-products storage facilities from weather and accidental leakage or spillage.
- calibration of application equipment to ensure uniform distribution of material at the planned rates. Application shall not exceed more than 10% of the intended rates for the field.
- documentation of the actual rate at which nutrients are applied. When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.
- Maintaining records to document plan implementation. As applicable, records include:
  - soil test results and recommendations for nutrient application,
  - quantities, analyses and sources of nutrients applied,
  - dates and methods of nutrient applications,
  - crops planted, planting and harvest dates, yields, and crop residues removed,
  - results of water, plant, and organic by product analyses, and
  - dates of review and person performing the review, and recommendations that resulted from the review.

Records shall be maintained for five years; or for a period longer than five years if required by other Federal, state, or local ordinances, or program or contract requirements.

Wells and water supplies will be protected from back-siphoning contamination when using fertigation and wastewater irrigation.

Workers shall be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

Protect commercial fertilizer and agricultural waste in storage facilities from weather and accidental leakage or spillage that could result in undesirable effects on soil, water, and plants.

The disposal of material generated by the cleaning of nutrient application equipment should be accomplished properly. Excess material should be collected and stored or field applied in an appropriate manner. If system is flushed, use rinse water in the following batch of nutrient mixture, where possible, or dispose according to state and local regulations, always avoiding high runoff areas, ponds, lakes, streams, and other water bodies. Excess material should not be applied on areas of high potential risk for runoff and leaching. Extreme care must be exercised to avoid contaminating wells.

REFERENCES

ADEM Administrative Code Chapter 335-6-7, as amended (AFO/CAFO rule).

Alabama Cooperative Extension Service Circular ANR-790. Water Quality and Pollution Control Handbook.

Alabama Cooperative Extension Service Circular ANR-449. Nutrient Removal by Alabama Crops.

Alabama Agricultural Experiment Station Agronomy and Soils Departmental Series No. 178. Soil Test Fertilizer Recommendations for Alabama Crops.

Control of Pathogens and Vector Attraction in Sewage Sludge. EPA Environmental Regulations and Technology. EPA/625/R-92/013

NRCS Conservation Practice Standard Critical Area Planting – Code 342.

Nutrient Management Planning of Animal Feeding Operations, Alabama Cooperative Extension System and NRCS, January 1999.

Process Design Manual – Land Application of Sewage Sludge and Domestic Septage. 1995. U.S. Environmental Protection Agency. EPA/625/R-95/001.

Standards For The Use Or Disposal Of Sewage Sludge: Title 40 of the Code of Federal Regulations (40 CFR) Part 503.

United States Department of Agriculture - Natural Resources Conservation Service National Engineering Handbook. Agricultural Waste Management Field Handbook.

United States Department of Agriculture, Natural Resources Conservation Service. *National Soil Survey Handbook.*

Water Quality Functions of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed. A Report of the Nutrient Subcommittee of the Chesapeake Bay Program. August 1995.

TABLE 1. Nutrient Content of Livestock and Poultry Manure [1/]

Management System	Volume of Waste	Available Nutrients ----------Pounds per ton----------					
	Annual Production	Incorporated [2/]			Surface Applied		
	Tons/AU[3/]/Yr.	N	P_2O_5	K_2O	N	P_2O_5	K_2O
FEEDER BEEF							
1. Manure scraped daily, hauled and spread weekly, paved lot, 100% confinement.	6	11	8	12	9	8	12
DAIRY COWS							
1. Fresh manure scraped daily, hauled and spread weekly, paved lot, 100% confinement.	12	8	6	8	7	6	8
POULTRY							
1. Broiler, cornish, and roaster litter cleaned yearly.	–[4/]	56	58	45	47	58	45
2. Broiler, cornish and roaster litter cleaned yearly and temporarily stored.	---[4/]	45	58	45	38	58	45
3. Caged layer manure, cleaned annually.	5	31	57	46	26	58	48
4. Dead bird compost.	-	50	58	45	43	58	45
5. Pullet and rooster breeder replacement litter, cleaned yearly.	1	29	57	35	25	57	35
6. Pullet layer replacement litter, cleaned yearly.	1.6	39	57	35	34	57	35
7. Breeder hen and rooster litter, cleaned yearly.	1.4	32	53	35	28	53	35
SWINE							
1. Fresh manure collected and applied weekly, no dilution.	12	11	11	9	9	11	9

TABLE 1. (con't) **Nutrient Content of Livestock and Poultry Manure (con't)** [1/]

Management System	Volume of Waste	Available Nutrients					
LIQUID WASTE [5/]	**Annual Production acre inch/AU** [3/]	**Incorporated** [2/] lbs/acre inch			**Surface Applied** lbs/acre inch		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
1. Beef lagoon, surface liquid only [6/]	0.26	111	108	180	93	108	180
2. Beef lagoon, 5th year cleanout [7/]	0.60	229	250	221	194	250	221
3. Beef storage pond, agitated [7/]	0.10	653	625	760	556	625	760
4. Dairy lagoon (anaerobic), surface liquid only 100% confinement, recycled flush water [6/]	0.50	82	42	116	70	42	116
5. Dairy lagoon, 5th year cleanout, 100% confinement, recycled flush water [7/]	1.05	139	118	159	119	118	159
6. Dairy lagoon, surface liquid only, 50% confinement, recycled flush water [6/]	0.29	70	36	100	60	36	100
7. Dairy lagoon, 5th year cleanout, 50% confinement, recycled flush water [7/]	0.57	125	106	141	107	106	141
8. Dairy lagoon, surface liquid only, 17% confinement, recycled flush water [6/]	0.15	45	23	64	38	23	64
9. Dairy lagoon, 5th year cleanout, 17% confinement, recycled flush water [7/]	0.25	90	79	100	77	79	100
10. Dairy lagoon, surface liquid only, 100% confinement, 20 g fresh flush water/AU/day [6/]	0.86	48	24	68	41	24	68
11. Dairy lagoon, 5th year cleanout, 100% confinement, 20 g fresh flush water/AU/day [7/]	1.41	95	83	105	81	83	105
12. Dairy lagoon, surface liquid only, 50% confinement, 20 g fresh flush water/AU/day [6/]	0.65	32	16	45	27	16	45
13. Dairy lagoon, 5th year cleanout, 50% confinement, 20g fresh flush water/AU/day [7/]	0.93	69	61	75	59	61	75
14. Dairy lagoon, surface liquid only, 17% confinement, 20 g fresh flush water/AU/day [6/]	0.51	14	7	19	11	7	19

TABLE 1. (con't) **Nutrient Content of Livestock and Poultry Manure (con't)** [1/]

Management System	Volume of Waste	Available Nutrients					
LIQUID WASTE [5/]	**Annual Production** acre inch/AU[3/]	**Incorporated** [2/] lbs/acre inch			**Surface Applied** lbs/acre inch		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
15. Dairy lagoon, 5th year cleanout, 17% confinement, 20 g fresh flush water/AU/day [7/]	0.61	34	31	36	28	31	36
16. Dairy storage pond, 100% confinement, 20 gal fresh flush water/AU/day [7/]	0.48	175	94	181	150	94	181
17. Dairy storage pond, 50% confinement, 20 gal fresh flush water/AU/day [7/]	0.45	102	56	109	87	56	109
18. Dairy storage pond, 17% confinement, 20 gal fresh flush water/AU/day [7/]	0.40	41	21	41	35	21	41
19. Poultry lagoon, surface liquid only [6/]	0.36	151	47	250	128	47	250
20. Poultry lagoon, 5th year cleanout [7/]	0.95	216	345	242	184	345	242
21. Poultry waste storage pond [7/]	0.11	1661	1800	1080	1394	1800	1080
22. Swine lagoon, surface liquid only [6/]	0.25	89	48	124	75	48	124
23. Swine lagoon, 5th year cleanout [7/]	0.54	120	117	125	101	117	125
24. Swine storage pond [7/]	0.12	750	850	630	633	850	630

1/ The nutrient content from animal waste management systems is highly variable. Waste analyses should be made to establish trends for the specific management system to determine the rates of application.
2/ Manure is incorporated into the soil within a time frame which prevents losses from volatilization. See Table 2
3/ AU = Animal Unit. One animal unit = 1000 lbs. live weight
4/ Annual manure production can vary depending on management. In absence of actual production date use the following: Broiler 1.5 t/au/yr, cornish 2.25 t/au/yr, roaster 0.85 t/au/yr.
5/ Lagoons are anaerobic with volumes accounting for animal waste, minimum treatment, surface rainfall, 5-year sludge accumulation, and milking parlor washwater (if appropriate). Storage pond volumes account for animal waste, surface rainfall, and milking parlor washwater (if appropriate) for a 180 day storage period. No outside runoff is considered.
6/ Pumping of annual volume of wastewater produced, with no agitation.
7/ Method of cleanout is agitation and complete pumpout, with no mechanical removal of sludge.

TABLE 2. Ammonia Nitrogen Available for Crop Use After Volatilization Losses [1/]

Application Method	Available N from Ammonia		
	Soil Conditions		
	warm dry	warm wet	cool wet
	%	%	%
Injection	90	95	100
Irrigation	65	75	85
Other Surface Application			
Days between application and incorporation			
1-2	70	90	100
3-5	60	80	95
6+	50	70	90

TABLE 3. Organic Nitrogen Which Becomes Available for Crop Use [1/]

Application Method	Available N from Organic N
	%
Surface applied	65
Incorporated	75

1/ The forms of nitrogen which occur in manure or organic waste are: ammonia N (NH_3-N), organic N (ON), and nitrate/nitrite N (NO_3/NO_2). The nitrate/nitrite forms are usually <1% of the total N or below detection level. This form is usually ignored. Ammonia N & nitrate N are both readily available for plant use. Ammonia N is subject to volatilization, while nitrate is subject to leaching. Organic N becomes slowly available through mineralization. Total Kjeldahl Nitrogen (TKN) equals ammonia N plus organic N. Laboratories often report TKN as Total N.

Example: To determine available N using Tables 2 & 3:
Situation: Lagoon effluent irrigation on a warm dry soil

Lab analysis of effluent (reported on an as-is basis):*
TKN = 100 lbs/acre inch
Ammonia N (NH_3-N) = 70 lbs/acre inch

Solution: Organic N (ON) = TKN - NH_3-N
ON = 100 - 70 = 30 lbs/acre inch
Available N = (70 lbs NH_3-N/acre inch)(.65)+(30 lbs ON/acre inch)(.65) = 65 lbs/acre inch

* Some laboratories report results on a dry-weight basis (these results will have to be converted to a wet basis).

Table 4. Available Nitrogen Provided by Cover Crops or Previous Crop's Residue

Crop	Maximum Available Nitrogen [1/]
	lbs/ac
Arrowleaf Clover	95
Austrian Winter Pea	195
Ball Clover	90
Berseem Clover	105
Big Flower Vetch	120
Bur Clover	150
Caley Pea	65
Common Vetch	150
Crimson Clover	135
Hairy Vetch	155
Red Clover	95
Ryegrass	85 [2/]
Rye	70 [2/]
Sub Clove	105
Wheat	50 [2/]
Soybeans	30

1/ Maximum amount of available nitrogen to a following crop that is provided by legumes at full bloom and small grain or ryegrass in the boot stage. These values should be reduced according to account for less than optimum growth or if grazed, they should be reduced by one-half.

2/ Available nitrogen that is contained in highly fertilized (with livestock or poultry manure) grass cover crops that are turned or killed in the boot stage.

TABLE 5. Auburn University's Standard Nitrogen Recommendations for Row Crops, Forage Crops, Pastures, and Forest. [1/]

Crop	lbs/ac	Remarks
Row Crop		
Corn Sandy Soil Irrigated Silage	120 150 180 180	Apply 25% of nitrogen at planting and side dress the remainder in one or more applications when plants are about knee-high.
Cotton	90	On land where excessive growth causes problems of late maturity or boll rot, reduce the nitrogen rate 20 to 30 pounds. Where vegetative growth has been inadequate, increase nitrogen by 20 to 30 pounds. On sandy soils, apply nitrogen in a split application. Side dress the second application prior to early square stage.
Peanuts	0	Nitrogen is not required for legumes.
Small Grain	100	Apply nitrogen in a split application of 25% at planting and remainder just prior to jointing (June or early March.)
Sorghum, Grain	80	Timing of nitrogen application is critical for grain sorghum. On sandy soils where leaching can occur, apply one-third of nitrogen at planting and apply the remainder approximately 30 days after planting. On other soils, all of the nitrogen can be applied at planting.
Silage Sweet	180 80	Apply 25% of nitrogen at planting and side dress the remainder in one or more applications when plants are about knee-high.
Soybeans	0	Nitrogen is not required for legumes.
Pasture and Forage Crops		
Alfalfa	0	Nitrogen is not required for legumes.
Annual Legumes [2/]	0	Nitrogen is not required for legumes.
Bermuda Hay (Improved Varieties)	100/cutting	Apply 100 pounds of nitrogen per acre as growth begins in spring and repeat after each cutting of hay up to September 1.

Table 5 (con't)	Auburn University's Standard Nitrogen Recommendations for Row Crops, Forage Crops, Pastures, and Forest (con't)	
Crop	**lbs/ac**	**Remarks**
Pasture and Forage Crops (con't)		
Cool Season Annual Grasses 3/	160	For planting made in early fall, apply 100 pounds of nitrogen per acre at or near planting and 60 pounds per acre in late winter or early spring. If planted in late fall, apply 60 pounds of nitrogen per acre at planting and 60 pounds per acre in late winter or early spring.
Cool Season Annual Grasses With Legumes 4/	60	Apply 60 pounds of nitrogen per acre at or near planting. If the legume does not make up at least 30 percent of the ground cover in late winter or early spring do not apply additional nitrogen.
Cool Season Perennial Grass Pasture or Hay 5/	120	Apply 60 pounds of nitrogen per acre around September 1 and in late winter or early spring.
Cool Season Perennial Grass Pasture with Legumes 6/	0	Do not apply nitrogen if the legumes make up 30 percent or more of the ground cover. If the legume cover is less than 30 percent apply 60 pounds of nitrogen per acre around September 1 and in late winter or early spring.
Johnsongrass Hay	60/cutting	Apply 60 pounds of nitrogen per acre as growth begins in spring and repeat after each cutting of hay up to Sept. 1.
Sericea Lespedeza	0	Nitrogen is not required for legumes.
Warm Season Annual Grasses 7/	60/cutting or grazing period	Apply 60 pounds of nitrogen per acre at or near planting and 60 pounds after each time the forage is grazed down or hay is cut up to September 1.
Warm Season Perennial Grass, Pasture or Hay 8/	60/cutting or grazing period	Apply 60 pounds of nitrogen per acre as growth begins in the spring and an additional 60 pounds after each hay cutting or for grazing when more growth is desired up to September 1.
Warm Season Perennial Grass Pasture With Perennial or Late Maturing Legume 9/	30	If legume makes up 30 percent or more of the stand, do not apply nitrogen in the early spring. Apply 60 pounds of nitrogen per acre in mid-summer if extra growth is needed

Table 5 (con't) Auburn University's Standard Nitrogen Recommendations for Row Crops, Forage Crops, Pastures, and Forest (con't)

Crop	lbs/ac	Remarks
Forest		
Pine Plantations 10/	50	Annual application rate
Pine Plantations	100	Mid-rotation rate at first thinning
Hardwoods 10/, except	75	Annual application rate
Cottonwood		
Cottonwood 10/	100	Annual application rate

1/ Standard nitrogen recommendations are in addition to nitrogen applied as a starter fertilizer. When crops follow soybeans, the available nitrogen from the soybeans must be considered.

2/ Arrowleaf clover, ball clover, crimson clover, caley peas, lespedeza, and vetch.

3/ Barley, oats, rye, wheat, and/or ryegrass.

4/ Barley, oats, rye, wheat and/or ryegrass with arrowleaf clover, crimson clover or vetch.

5/ Fescue or orchardgrass.

6/ Fescue or orchardgrass with red clover and/or white clover.

7/ Millets, sorghums, sudangrass or sorghum-sudan grass hybrid.

8/ Bahia, bermuda, or dallisgrass grazed or cut for hay except hybrid bermuda hay.

9/ Bahia, bermuda, or dallisgrass pasture with white clover, arrowleaf clover or red clover.

10/ Excessive weed growth may be a problem in young stands

Table 6. Nutrient Removal by Selected Crops

Crop	Unit Yield	Nutrient Removal		
		N	P_2O_5	K_2O
		lbs./acre/unit yield		
Alfalfa hay	1 ton	52	12	50
Bahiagrass hay	1 ton	25	7	42
Bermudagrass hay	1 ton	50	12	43
Clover hay	1 ton	40	10	40
Corn, grain	1 bu.	0.96	0.4	0.27
Corn, silage	1 ton (wet)	10	4	10
Cotton, lint & seed	1 bale	32	12	16
Oats, grain only	1 bu.	0.8	0.25	0.2
Oats, grain and straw	1 bu.	1.15	0.40	1.45
Pasture, bahia or bermuda	200 lbs. beef	6	5	1
Pasture, tall fescue	300 lbs. beef	9	7	1
Peanuts, nuts only	1 ton	70	11	16
Peanuts, nuts & vines	1 ton	120	15	93
Potatoes, sweet	1 bu.	0.13	0.06	0.32
Potatoes, white	100 cwt.	0.3	0.16	0.53
Sorghum, grain	1 bu.	0.79	0.45	0.23
Sorghum, silage	1 ton (wet)	10.5	4.4	10
Soybean, grain	1 bu.	3.8	0.8	1.5
Switchgrass hay	1 ton	23	6	46
Ryegrass hay	1 ton	33	5.4	28
Tall Fescue hay	1 ton	40	9	48
Tomatoes, fruit	100 cwt.	4.2	0.8	8.6
Wheat, grain	1 bu.	1.17	0.6	0.33
Wheat, grain & straw	1 bu.	1.67	0,67	2.03

Table 7. Nitrogen (N) Fertilization Rates per Unit of Crop Yield

Crop	Unit Yield	Nitrogen Recommendation
		lbs./acre/unit yield
Row Crops		
Corn		
Grain	bu	1 lb/bu to 120 bu, 1.25 lbs/bu over 120 bu
Grain-Sandy Soil	bu	1.25
	ton	10
Cotton	bale	-
Small Grains		
Barley	bu	1.4
Oats	bu	1.0
Rye	bu	1.7
Wheat	bu	1.7
Sorghum		
Grain	cwt	2
Silage	ton	10
Pasture & Forage Crops		
Bahiagrass Hay	ton	50
Bermuda Hay (Improved Varieties)	ton	50
Cool Season Annual Grasses	ton	50
Dallisgrass	ton	50
Eastern Gamagrass	ton	40
Johnsongrass Hay	ton	40
Orchardgrass	ton	40
Tall Fescue	ton	40
Switchgrass	ton	40
Warm Season Annual Grasses	ton	50

TABLE 8 Land Application Pollutant Limits for Heavy Metals on Agricultural Land [1/]

Metal	Ceiling Concentration Limits (mg/kg) [2/]	Cumulative Pollutant Loading Rate Limits (kg/ha) [3,5/]	Annual Pollutant Loading Rate Limit (kg/ha/yr.) [4,5/]
Arsenic	75	41	2
Cadmium	85	39	1.9
Copper	4300	1500	75
Lead	840	300	15
Mercury	57	17	0.85
Selenium	100	100	5
Zinc	7500	2800	140

1/ From 40 CFR Part 503.

2/ Dry weight basis; all sewage sludge samples (instantaneous values) must be below the ceiling concentration to be eligible for land application; applies to all sewage sludge that is land applied.

3/ Bulk sewage sludge.

4/ Applies only to sewage sludge sold or given away in a bag or other container (of 2,200 pounds or less) for application to the land.

5/ To convert to lbs./ac. multiply by 0.892.

Table 9. Recommended Application Distance for Animal Manure and Organic By-Products

Object, Site	Situation	Application Distance (ft.) from Object, Site
Well	Located up-gradient of application site	200
Well	Located down-gradient of application site	300
Waterbody or Stream [1/]	Waste applied to pasture[3/], hayland, or cultivated land[4/]	50 [2/]
Public Road	Spray irrigated wastewater	100
Public Road	Waste applied with spreader truck	50
Public Use Area [5/]	Dry waste	100
	Liquid waste	200
	Spray irrigated wastewater	500
Property Line	All	25

1/ Waterbody includes pond, lake, wetland, or sinkhole. Stream includes both perennial and intermittent streams.

2/ On edges of the application field where runoff occurs to environmentally sensitive areas and to non-vegetated concentrated flow areas within the field, application distance must include a vegetated filter at least 50 feet wide that is established to permanent grasses (filter strip) with a stem density of at least 1 per square inch. If the filter incorporates a riparian forest buffer, in accordance with NRCS Conservation Practice Standard, Riparian Forest Buffer - Code 391A, the permanent grass filter strip may be 20 feet wide. The vegetated width must be located adjacent to the application field or concentrated flow area and be shaped so that flow from runoff is uniform (sheet flow) and does not concentrate.

3/ If good grazing management (i.e. rotational grazing) is not used on pasture land, the vegetative filter must be protected from over grazing with a fence.

4/ Cultivated land for waste application must have adequate erosion control practices in place.

5/ Public use areas include such occupied locations as a non-owner dwelling, church, school, hospital, or park.