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Circle Four Farms

Nutrient Management Plan

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Table of Contents

Table of Contents (Continued)

Introduction

Circle Four Farms will use the following plan to apply lagoon liquid and/or solids at agronomic rates to ensure maximum crop growth and economic return while protecting ground water quality. This plan does not cover the land application of sludge that has accumulated over a long period of time. This plan will apply to solid manure, manure contaminated soils, solids from an anaerobic digester and material harvested from the Bion system.

Overview

Best management practices will be utilized to ensure that applications of lagoon liquid or solids match plant nutrient uptake. Appropriate local irrigation and application scheduling procedures as outlined by NRCS will be followed. In Attachment 1 are the NRCS guidelines for irrigation water management entitled "Irrigation Water Management Supplement". In Attachment 2 are sample field data sheets that the person leasing the farmland from Circle Four will be required to maintain and return to Circle Four so that it can be kept on file. The irrigation and spreading equipment will be maintained and operated to ensure the uniform application of nutrients.

Field Soil Sampling and Testing

Each field to receive lagoon liquid or solids will be soil tested prior to application to determine its nutrient content and to track nutrient movement and build-up. Soil moisture will also be measured to determine the soil water holding capacity. Soil samples will be taken according to chapter two of the "Utah Fertilizer Guide" found in Attachment 3. The following procedures and guidelines will be followed:

Soil Nutrient Testing

- Application rates will be calculated on a field basis. Except where a portion of the field has received lagoon liquid or solids from a previous application then that portion will be treated as a separate plot to assure correct calculations of application rates. Applicability of the sampling protocol will be assessed for each new land application field or for a change in land application activity.
- Soils will be tested no more than one month before application of lagoon water or solids.
- Three representative composite soil samples will be analyzed for every 25 acres of a given application field. Each soil sample submitted will

be a composite of 10 randomly collected soil cores from the same soil strata mixed together. Cores will be sampled as follows:

- 0" – 12" depth
- 13" – 24" depth
- 25"-36" depth

- The uppermost (0" – 12") soil sample will be analyzed for the following parameters:
  - Nitrate-N, TKN, Available Phosphorus, Available Potassium, pH, SAR and Ec_e.
  - Soils will be analyzed for B, Zn, Cu, Fe, and Mn at least once every three years.
- The lower (13" – 24" and 25" – 36") soil samples will be analyzed for Nitrate-N, TKN, SAR and Ec_e .
- Random samples will be collected according to figure 2.2 of the Utah Fertilizer Guide.
- The final soil sample will be properly stored and labeled with the day, time, sampler, field identification and soil strata.
- Soil samples will be sent to Utah State University or other laboratory that is certified through the North American Proficiency Testing Program. Soil tests will be sent within 24 hours after collection. Samples will be stored in a cool, dry environment between collection and delivery to the lab.

Soil Moisture Testing

- The Appearance and Feel Method will be used to determine soil moisture.
  - Three sample cores will be taken. One from the top, middle and bottom of each field starting from the side where irrigation will begin.
  - Soil cores will be taken to the rooting depth of the crops.
  - A sample field data sheet is found in Attachment 4.

Potassium Warning

- Potassium does not pose any threat to groundwater. However, high levels of potassium fed to dry dairy cattle or calves can induce a medical condition know as "milk fever". The soils found on Circle Four's property contain naturally occurring high potassium levels. Hog manure also contains high levels of potassium. Therefore, a warning will be issued to farmers using alfalfa that has had manure applied to it in any form from Circle Four's facilities warning them of the above mentioned medical condition.

- Potassium levels in the soils will be controlled by the phosphorus threshold limits.

Lagoon Liquid or Solids Sampling and Testing

The source of lagoon liquid or solids will be analyzed for its nutrient content prior to determining an application rate. Lagoon liquids and solids will be collected according to the most recently approved version of the Sampling and Analysis Plan. This Sampling and Analysis plan is currently being developed by Circle Four in conjunction with DWQ. Below are some general guidelines for sample collection:

- The lagoon liquid or solids to be applied will be sampled and shipped to Utah State University or other laboratory certified through the North American Proficiency Testing Program.
- A representative liquid sample will be taken for each 5 to 6 foot depth of primary lagoon water that is to be pumped from the lagoon (pump intake will also be set at 5 to 6 foot depths).
- One representative liquid sample will be taken from the secondary lagoon to be pumped.
  - Representative samples will be taken according to the USU guidelines found in the "Guidelines for Sampling Manure" found in Attachment 5.
- Solid samples will be taken according to the guidelines given by Utah State University Extension for sampling solids in the "Guidelines for Sampling Manure".
- Samples will not be taken more than one month prior to application event.
- Each liquid sample collected will be analyzed for the following parameters:
  - Nitrate-N, TKN, Ammonia-N, Total Phosphorus, Potassium, Total Dissolved Solids, pH, Total Solids, Mg, Ca, Na, Bicarbonate, Sulfate, Chloride and Ec_e.
- Each solid sample collected will be analyzed for the following parameters:

- % Moisture, Nitrate-N, TKN, Ammonia-N, Total Phosphorus, Potassium, pH, Mg, Ca, Na, Sulfate, Chloride and Ec_e.

Application Rate Calculations for Liquid Manure

Manure applications will be made according to the NRCS practice standard for Nutrient Management found in Attachment 6. This strategy will limit excessive nitrate migration, phosphate build-up, or soil salinity build-up.

The following calculations take into consideration best management practices for the production of a crop and protection of the environment:

I.) Determination of Liquid Manure Composition and Nutrient Availability

Test results from the liquid manure analysis in ppm or lb/acre-inch where 1ppm = .2266 lb/acre-inch.

(1.a) TKN _________ ppm

(1.b) Ammonia-N _________ ppm

(1.c) P_2O_5 (P x 2.29) _________ ppm ___________lb/acre-in

(1.d) K_2O (K x 1.20) _________ ppm ___________lb/acre-in

Plant available nitrogen (PAN) will be determined by the following formula:

PAN= (MR x (TKN, ppm – Ammonia, ppm)) + ((1 – VR) x Ammonia, ppm)

PAN = (.49 x (_____ (1.a) – _____ (1.b)) + ((1-_____) x _____(1.b))

Where: MR = mineralization rate (3rd year mineralization rates are being used to assure conservative application rates) Source: USDA-NRCS AWMFH, Table 11-9

VR = volatilization rate (see Table 1)

(1.e) PAN = __________ ppm

(1.f) PAN = ______________lbs. nitrogen/acre-in liquid

Table 1.
Nitrogen Volatilization Percentages (VR)

Method of Application	Type of Manure	% Nitrogen loss (VR factor)
Injection	Liquid	5
Sprinkling	Liquid	25

Source: USDA-NRCS AWMFH, Table 11-6

2.) Determination of Nutrient Value Existing in the Soil

Test results from the 0" – 12" soil analysis in ppm or lb/acre where 1 ppm = 3.8 lb/acre.

(2.a) K_2O (K x 1.20) ______ ppm _________ lb./acre

(2.b) P_2O_5 (avail. P x 2.29) ______ ppm _________ lb./acre

(2.c) Nitrate – N ______ ppm _________ lb./acre

(2.e) pH ___________

(2.f) EC_e ___________ mmhos/cm

3.) Determination of Nutrient Needs of a Crop

Average yields for the Milford area are currently being used for determining crop nutrient needs. Yield data is currently being gathered on individual fields. Where three or more years of data have been gathered, the average of those yields, will be used to determine crop nutrient needs.

(3.a) Crop to Be Grown ______________

(3.b) Yield Goal (bu or ton/acre) ______________

Threshold salinity value for crop (use Table 2)

(3.c) EC_e threshold (Closest value to 2.f) _________ mmhos/cm

(3.d) % of normal Crop Yield (see Table 2) _________ %

(3.e) Anticipated Crop Yield (3.b x 3.d/100) _________ (bu or ton/acre)

Table 2. Crop Tolerance to Soil Salinity

Crop	% of Normal Crop Yield			
	100	90	75	50
Alfalfa Threshold (mmhos/cm)	2.0	3.4	5.4	8.8
Barley Threshold (mmhos/cm)	8.0	9.6	13.0	17.0
Barley, forage Threshold (mmhos/cm)	5.3	7.4	9.5	13.0
Corn, silage Threshold (mmhos/cm)	1.8	2.7	6.8	8.6
Wheat grass, crested (mmhos/cm)	3.5	6.0	9.8	12

Source: Salinity and Crop Tolerance, by J.Kotoby-Amacher, Boyd Kitchen, and R.T. Koenig. USU Extension

Nutrients needed by anticipated crop yield (3.e x appropriate value from table 3)

(3.f) N required ______________ lb/acre

(3.g) P_2O_5 required ______________ lb/acre

(3.h) K_2O required ______________ lb/acre

Table 3. Crop Nutrient Uptake Rates

Crop	Unit	N (lb/unit)	P_2O_5 (lb/unit)	K_2O (lb/unit)
Alfalfa	Ton	34*	13.3	60
Barley	Bushel	1.45	.55	1.45
Corn	Bushel	.9	.37	.87
Corn Silage	Ton	9	3.1	9
Wheat	Bushel	1.7	.7	2

Source: Kerry Goodrich USDA NRCS values

*NRCS does not recommend that liquid manure be applied to alfalfa on the basis of nitrogen. However, since alfalfa is generally the only crop available for application and since there are times during the year that the lagoon liquid will be higher in nitrogen content than in phosphorus content, a maximum nitrogen application rate of 60% of alfalfa has been suggested by NRCS.

4.) Determination of Liquid Manure Application Rate

Application rates will be determined according to the NRCS practice standard for Nutrient Management. The rates of application will be based on Soil Test Phosphorous (STP) according to the following Table:

Table 4. NRCS Criteria for Manure Application

*Soil test for available phosphorus	Application based on
< 50 parts per million	Nitrogen requirement
50 – 100 parts per million	Annual phosphorus removal by the crop
>100 parts per million	No application of phosphorus

* Based on Olsen Method

Source: USDA NRCS Nutrient Management Standard (Code 590)

Manure application rates for nitrogen will be based on soil test results and crop utilization values. Manure application rates for phosphorus and potassium will be based on crop nutrient utilization values.

Application for phosphorus can be made for multiple year crop phosphorus needs following the NRCS practice standard for Nutrient Management (Code 590).

Plant nitrogen requirements will be calculated according to the nitrogen demands of the crop, residual nitrogen in the field, and plant available nitrogen in the application source. The rate will be calculated according to the following formula:

(4.a) N to be Applied = Crop Uptake N (3.f) – Soil Residual N (2.c)

= _____(lb/acre) - ________ (lb/acre) = ________ lb/acre

(4.b) Liquid Application Rate = Applied N (4.a) / PAN (1.f)

= ______ (lb/acre) / ______ (lb/acre-in) = ______ inches lagoon liquid

Plant phosphorus requirements, if required by the above chart, will be calculated according to the following formula:

(4.c) P_2O_5 to be Applied = _______ (3.g) lb/acre

(4.d) Liquid Application Rate = (P_20_5 to be Applied 4.c / P_20_5 in Manure 1.c / Mineralization rate (=0.9) (3rd year mineralization rates are being used to assure conservative application rates) Source: USDA-NRCS AWMFH, Table 11-9

= _______ (lb/acre) / _______ (lb/acre-in) / 0.9 = _______ inches lagoon liquid to be applied

Sodium Adsorption Ratio (SAR)

No application of manure will be allowed on soils with a SAR greater than 13. Source: USDA-NRCS AWMFH, page 5-12.

Land Application Acreage Needed

Land application acreage needed to apply certain amounts of effluent cannot be calculated at this time due to the high variability of current liquid manure tests. It is expected that with time the liquid manure tests will tend to be less variable allowing us to calculate the needed acreage.

Soil Available Water Holding Capacity (AWC)

No single liquid application will exceed the water holding capacity of the soil (field capacity) or NRCS nutrient limitations. Values for available water holding capacity are listed in Attachment 7, NRCS soil survey information. Fields will be managed such that only 50% of the available water holding capacity will be utilized when applying during the spring, summer, or fall. If a situation arises where fields will be irrigated at greater than 50% AWC, the amount of water added will be reduced accordingly. If necessary, evapotranspiration information will be used to determine the number of days before irrigation is needed. Liquid manure applications can be made outside the active growing season but will not exceed 70% of AWC. The total amount of water/lagoon liquid to be applied will be determined by the following formula:

AWC - _____ Amount of moisture in the soil prior to land application = Maximum allowed inches in a single land application event.

Sample Calculations for Lagoon Liquid Application

Actual test results are used where possible. Analytical test results can be found in Attachment 8. Some assumptions are made because of inadequate availability of test information.

Test results from the liquid manure analysis in ppm or lb/acre-inch where 1ppm = .2266 lb/acre-inch.

(1.a) TKN	**1097**	ppm		
(1.b) Ammonia-N	**932.1**	ppm		
(1.c) P_2O_5 (P x 2.29)	**98.9**	ppm	**22.4**	lb/acre-in
(1.d) K_2O (K x 1.20)	**1532.9**	ppm	**347.5**	lb/acre-in

Plant available nitrogen (PAN) will be determined by the following formula:

PAN= (MR x (TKN, ppm – Ammonia, ppm)) + ((1 – VR) x Ammonia, ppm)

PAN = (**.49** x (**1097** (1.a) – **932.1** (1.b)) + ((1- **.25**) x **932.1**(1.b))

Where: MR = mineralization rate

VR = volatilization rate (see Table 2)

(1.e) PAN = **779.88** ppm

(1.f) PAN = **176.72** lbs. nitrogen/acre-in liquid

Test results from the 0" – 12" soil analysis in ppm or lb/acre where 1 ppm = 3.8 lb/acre.

(2.a) K_2O (K x 1.20)= 214 x 1.2= **257** ppm **976.6** lb./acre

(2.b) P_2O_5 (avail. P x 2.29)= 2.7 x 2.29 = **6.18** ppm **23.48** lb./acre

(2.c) Nitrate – N **5.5** ppm **20.9** lb./acre

(2.e) pH **7.6**

(2.f) EC_e **0.8** mmhos/cm

(3.a) Crop to Be Grown **Alfalfa**

(3.b) Yield Goal (bu or ton/acre) **5**

Threshold salinity value for crop (use Table 2)

(3.c) EC_e threshold (Closest value to 2.f) **2.0** mmhos/cm

(3.d) Crop Yield Decrement (see Table 2) **100** decreases

(3.e) Anticipated Crop Yield (3.b x 3.d/100) **5** (bu or ton/acre)

Nutrients needed by anticipated crop yield (3.e x appropriate value from table 3)

(3.f) N required 5 x 34 = **170** lb/acre

(3.g) P_2O_5 required 5 x 13.3 = **66.5** lb/acre

(3.h) K_2O required 5 x 60 = **300** lb/acre

(4.a) N to be Applied = Crop Uptake N (3.f) – Soil Residual N (2.c)

= **170** (lb/acre) - **20.9** (lb/acre) = **149.1** lb/acre

(4.b) Liquid Application Rate = Applied N (4.a) / PAN (1.f)

= 149.1 (lb/acre) / 176.72 (lb/acre-in) = 0.84 inches lagoon liquid

(4.c) P_2O_5 to be Applied = **66.5** (3.g) lb/acre

(4.d) Liquid Application Rate = (P_20_5 to be Applied 4.c / P_20_5 in Manure 1.c / Mineralization rate (=0.9)

= 66.5 (lb/acre) / 22.4 (lb/acre-in) / 0.9 = 3.3

inches lagoon liquid to be applied

Lagoon liquids will be applied based on crop nitrogen requirements because soil concentrations are not above 50ppm phosphorus. Nitrogen is the limiting nutrient.

Soil Available Water Holding Capacity (AWC)

AWC - _____ Amount of moisture in the soil prior to land application = Maximum allowed inches in a single land application event

AWC= 7-8.5 inches--Average 7.75inches

Example 1-Irrigation at 50% AWC

50% moisture in the soil x 7.75 = 3.875 inches of water in the soil

7.75 – 3.875 = 3.875 maximum allowed inches in a single land application event.

Example 2-Irrigation at 70% AWC

70% moisture in the soil x 7.75 = 5.425 inches of water in the soil

7.75 – 5.425 = 2.325 maximum allowed inches in a single land application event.

Example 3-Irrigation at 40% AWC outside of the growing season

40% moisture in the soil x 7.75 = 3.1 inches of water in the soil

7.75 x 70% = 5.425

5.425 – 3.1 = 2.325 maximum allowed inches in a single land application event.

Calculation Data Sheet for Lagoon Liquid Application

Dates of Application	
Lagoon (site)	
Field Location	
Field Size (Acres)	
Total Amount Applied (Acre-inches or tons/acre)	
Method of application	

Test results from the liquid manure analysis in ppm or lb/acre-inch where 1ppm = .2266 lb/acre-inch.

(1.a) TKN _______ ppm

(1.b) Ammonia-N _______ ppm

(1.c) P_2O_5 (P x 2.29) _______ ppm __________lb/acre-in

(1.d) K_2O (K x 1.20) _______ ppm __________lb/acre-in

Plant available nitrogen (PAN) will be determined by the following formula:

PAN= (MR x (TKN, ppm – Ammonia, ppm)) + ((1 – VR) x Ammonia, ppm)

PAN = (.49 x (_____ (1.a) – _____ (1.b)) + ((1-_____) x _____(1.b))

Where: MR = mineralization rate

VR = volatilization rate (see Table 1)

(1.e) PAN = ________ ppm

(1.f) PAN = _________lbs. nitrogen/acre-in liquid

Test results from the 0" – 12" soil analysis in ppm or lb/acre where 1 ppm = 3.8 lb/acre.

(2.a) K_2O (K x 1.20) _______ppm _________ lb./acre

(2.b) P_2O_5 (avail. P x 2.29)_____ppm _________ lb./acre

(2.c) Nitrate – N ______ ppm _________ lb./acre

(2.e) pH ________

(2.f) EC_e __________ mmhos/cm

(3.a) Crop to Be Grown __________

(3.b) Yield Goal (bu or ton/acre) ____________

Threshold salinity value for crop (use Table 2)

(3.c) EC_e threshold (Closest value to 2.f) ______ mmhos/cm

(3.d) Crop Yield Decrement (see Table 2)______ decreases

(3.e) Anticipated Crop Yield (3.b x 3.d/100) ________ (bu or ton/acre)

Nutrients needed by anticipated crop yield (3.e x appropriate value from table 3)

(3.f) N required ______________ lb/acre

(3.g) P_2O_5 required ______________ lb/acre

(3.h) K_2O required ______________ lb/acre

(4.a) N to be Applied = Crop Uptake N (3.f) – Soil Residual N (2.c)

= _____(lb/acre) - ______ (lb/acre) = _______ lb/acre

(4.b) Liquid Application Rate = Applied N (4.a) / PAN (1.f)

= _______ (lb/acre) / ______(lb/acre-in) = ____inches lagoon liquid

(4.c) P_2O_5 to be Applied = _____ (3.g) lb/acre

(4.d) Liquid Application Rate = (P_20_5 to be Applied 4.c / P_20_5 in Manure 1.c / Mineralization rate (=0.9)

= _______ (lb/acre) / _______lb/acre-in) / 0.9 =

_______inches lagoon liquid to be applied

AWC - _____ Amount of moisture in the soil prior to land application = Maximum allowed inches in a single land application event

AWC= _______

Application Rate Calculations for Solid Manure

Manure applications will be made according to the NRCS practice standard for Nutrient Management found in Attachment 6. This strategy will limit excessive nitrate migration, phosphate build-up, or soil salinity build-up.

All fields to receive solid manure will be evaluated using the "Utah Manure Risk Index" (UMARI). A sample UMARI calculation is found in Attachment 9 for all fields owned by Circle Four. A copy of the UMARI is also found in Attachment 9.

The following calculations take into consideration best management practices for the production of a crop and protection of the environment:

1.) Determination of Solid Composition and Nutrient Availability

(1.a) TKN __________ Lbs/Ton (Dry Basis)

(1.b) Ammonia-N __________ Lbs/Ton (Dry Basis)

(1.c) P_2O_5 (P x 2.29) __________ Lbs/Ton (Dry Basis)

(1.d) K_2O (K x 1.20) __________ Lbs/Ton (Dry Basis)

Plant available nitrogen (PAN) will be determined by the following formula:

PAN= (MR x (TKN, Lbs/Ton – Ammonia, Lbs/Ton)) + ((1 – VR) x Ammonia, Lbs/Ton)

PAN = (.49 x (_____ (1.a) – _____ (1.b)) + ((1-_____) x _____(1.b))

Where: MR = mineralization rate (3rd year mineralization rates are being used to assure conservative application rates) Source: USDA-NRCS AWMFH, Table 11-9

VR = volatilization rate (see Table 1)

(1.e) PAN = __________ Lbs/Ton

Table 1.
Nitrogen Volatilization Percentages (VR)

Method of Application	Type of Manure	% Nitrogen loss (VR factor)
Broadcast without incorporation	Solid	15-30
Broadcast with incorporation within a couple of hours	Solid	1-5

Source: Colorado State University Cooperative Extension Bulletin 552a, table 5

2.) Determination of Nutrient Value Existing in the Soil

Test results from the 0" – 12" soil analysis in ppm or lb/acre where 1 ppm = 3.8 lb/acre.

(2.a) K_2O (K x 1.20) ______ ppm ________ lb./acre

(2.b) P_2O_5 (avail. P x 2.29)______ ppm ________ lb./acre

(2.c) Nitrate – N ______ ppm ________ lb./acre

(2.e) pH __________

(2.f) EC_e __________ mmhos/cm

3.) Determination of Nutrient Needs of a Crop

Average yields for the Milford area are currently being used for determining crop nutrient needs. Yield data is currently being gathered on individual fields. Where three or more years of data have been gathered, the average of those yields will be used to determine crop nutrient needs.

(3.a) Crop to Be Grown ____________

(3.b) Yield Goal (bu or ton/acre) ____________

Threshold salinity value for crop (use Table 2)

(3.c) EC_e threshold (Closest value to 2.f) ________ mmhos/cm

(3.d) Crop Yield Decrement (see Table 2) ________ % decreases

(3.e) Anticipated Crop Yield (3.b x 3.d/100) ________ (bu or ton/acre)

Table 2. Crop Tolerance to Soil Salinity

Crop	% of Normal Crop Yield			
	100	90	75	50
Alfalfa Threshold (mmhos/cm)	2.0	3.4	5.4	8.8
Barley Threshold (mmhos/cm)	8.0	9.6	13.0	17.0
Barley, forage Threshold (mmhos/cm)	5.3	7.4	9.5	13.0
Corn, silage Threshold (mmhos/cm)	1.8	2.7	6.8	8.6
Wheat grass, crested (mmhos/cm)	3.5	6.0	9.8	12

Source: Salinity and Crop Tolerance, by J.Kotoby-Amacher, Boyd Kitchen, and R.T. Koenig. USU Extension

Nutrients needed by anticipated crop yield (3.e x appropriate value from table 3)

(3.f) N required ______________ lb/acre

(3.g) P_2O_5 required ______________ lb/acre

(3.h) K_2O required ______________ lb/acre

Table 3. Crop Nutrient Uptake Rates

Crop	Unit	N (lb/unit)	P_2O_5 (lb/unit)	K_2O (lb/unit)
Alfalfa	Ton	34*	13.3	60
Barley	Bushel	1.45	.55	1.45
Corn	Bushel	.9	.37	.87
Corn Silage	Ton	9	3.1	9
Wheat	Bushel	1.7	.7	2

Source: Kerry Goodrich USDA NRCS values
*NRCS does not recommend that liquid manure be applied to alfalfa on the basis of nitrogen. However, since alfalfa is generally the only crop available for application and since there are times during the year that the lagoon liquid will be higher in nitrogen content than in phosphorus content a maximum nitrogen application rate of 60% of alfalfa has been suggested by NRCS.

4.) Determination of Solid Manure Application Rate

Application rates will be determined according to the NRCS practice standard for Nutrient Management. The rates of application will be based on Soil Test Phosphorous (STP) according to the following Table:

Table 4. NRCS Criteria for Manure Application

*Soil test for available phosphorus	Application based on
< 50 parts per million	Nitrogen requirement
50 – 100 parts per million	Annual phosphorus removal by the crop
>100 parts per million	No application of phosphorus

* Based on Olsen Method
Source: USDA NRCS Nutrient Management Standard (Code 590)

Manure application rates for nitrogen will be based on soil test recommendations and crop utilization values. Manure application rates for phosphorus and potassium will be based on crop nutrient utilization values.

Application for phosphorus can be made for multiple year crop phosphorus needs following the NRCS practice standard for Nutrient Management (Code 590).

Plant nitrogen requirements will be calculated according to the nitrogen demands of the crop, residual nitrogen in the field, and plant available nitrogen in the application source. The rate will be calculated according to the following formula:

(4.a) N to be Applied = Crop Uptake N (3.f) – Soil Residual N (2.c)

= _____(lb/acre) - ________ (lb/acre) = ________ lb/acre

(4.b) Solid Application Rate = Applied N (4.a) / PAN (1.e)

= ______ (lb/acre) / ______ (lbs/Ton) = ______ Tons/Acre

Plant phosphorus requirements, if required by the above chart, will be calculated according to the following formula:

(4.c) P_2O_5 to be Applied = _______ (3.g) lb/acre

(4.d) Liquid Application Rate = (P_20_5 to be Applied 4.c / P_20_5 in Manure 1.c / Mineralization rate (=0.9) (3^{rd} year mineralization rates are being used to assure conservative application rates) Source: USDA-NRCS AWMFH, Table 11-9

= _______ (lb/acre) / _______ (lb/Ton) / 0.9 = _______ Tons/Acre

Sodium Adsorption Ratio (SAR)

No application of manure will be allowed on soils with a SAR greater than 13. Source: USDA-NRCS AWMFH, page 5-12.

Land Application Acreage Needed

Land application acreage needed to apply certain amounts of solid manure cannot be calculated at this time due to the high variability of current solid manure tests. It is expected that with time the solid manure tests will tend to be less variable allowing us to calculate the needed acreage.

Sample Calculations for Solid Application

Actual test results are used where possible found in Attachment 8. Some assumptions are made because of inadequate availability of test information.

(1.a) TKN	81.8	Lbs/Ton (Dry Basis)
(1.b) Ammonia-N	27.6	Lbs/Ton (Dry Basis)
(1.c) P_2O_5 (P x 2.29)	256.5	Lbs/Ton (Dry Basis)
(1.d) K_2O (K x 1.20)	51.4	Lbs/Ton (Dry Basis)

Plant available nitrogen (PAN) will be determined by the following formula:

PAN= (MR x (TKN, Lbs/Ton – Ammonia, Lbs/Ton)) + ((1 – VR) x Ammonia, Lbs/Ton)

PAN = (.49 x (81.8 (1.a) – 27.6 (1.b)) + ((1- .15) x 27.6 (1.b))

Where: MR = mineralization rate

VR = volatilization rate (see Table 1)

(1.e) PAN = 50.02 Lbs/Ton

Test results from the 0" – 12" soil analysis in ppm or lb/acre where 1 ppm = 3.8 lb/acre.

(2.a) K_2O (K x 1.20) = 214 x 1.2 = 256.8 ppm 975.8 lb./acre

(2.b) P_2O_5 (avail. P x 2.29) = 2.7 x 2.29 = 6.18 ppm 23.48 lb./acre

(2.c) Nitrate – N 5.5 ppm 20.9 lb./acre

(2.e) pH 7.6

(2.f) EC_e 0.8 mmhos/cm

(3.a) Crop to Be Grown **Alfalfa**

(3.b) Yield Goal (bu or ton/acre) 5

Threshold salinity value for crop (use Table 2)

(3.c) EC_e threshold (Closest value to 2.f) __2.0__ mmhos/cm

(3.d) Crop Yield Decrement (see Table 2) __100__ decreases

(3.e) Anticipated Crop Yield (3.b x 3.d/100) __5__ (bu or ton/acre)

Nutrients needed by anticipated crop yield (3.e x appropriate value from table 3)

(3.f) N required 5x 34 = __170__ lb/acre

(3.g) P_2O_5 required 5 x 13.3 = __66.5__ lb/acre

(3.h) K_2O required 5 x 60 = __300__ lb/acre

(4.a) N to be Applied = Crop Uptake N (3.f) – Soil Residual N (2.c)

= __170__ (lb/acre) - __20.9__ (lb/acre) = __149.1__ lb/acre

(4.b) Solid Application Rate = Applied N (4.a) / PAN (1.e)

= __149.1__ (lb/acre) / __50.02__ (lbs/Ton) = __2.98__ Tons/Acre

(4.c) P_2O_5 to be Applied = __66.5__ (3.g) lb/acre

(4.d) Solid Application Rate = (P_20_5 to be Applied 4.c / P_20_5 in Manure 1.c / Mineralization rate (=0.9)

= __66.5__ (lb/acre) / __256.5__ (lb/Ton) / 0.9 =. __288__ Tons/Acre

Phosphorus is the limiting nutrient. Application will be .29 tons/Acre or the crop rotational need for phosphorus (according to the NRCS practice standard) which would be .29 tons/acre x 5 years= 1.45 tons/acre

Sodium Adsorption Ratio (SAR)

No application of manure will be allowed on soils with a SAR greater than 13. Source: USDA-NRCS AWMFH, page 5-12.

Calculation Data Sheet for Solid Manure Application

Dates of Application	
Lagoon (site)	
Field Location	
Field Size (Acres)	
Total Amount Applied (Acre-inches or tons/acre)	
Method of application	

(1.a) TKN _______ lbs/Ton (Dry Basis)

(1.b) Ammonia-N _______ lbs/Ton (Dry Basis)

(1.c) P_2O_5 (P x 2.29) _______ lbs/Ton (Dry Basis)

(1.d) K_2O (K x 1.20) _______ lbs/Ton (Dry Basis)

Plant available nitrogen (PAN) will be determined by the following formula:

PAN= (MR x (TKN, Lbs/Ton – Ammonia, Lbs/Ton)) + ((1 – VR) x Ammonia, Lbs/Ton)

PAN = (.49 x (_____ (1.a) – _____ (1.b)) + ((1-_____) x _____(1.b))

Where: MR = mineralization rate

VR = volatilization rate (see Table 1)

(1.e) PAN = ________ lbs/Ton

(1.f) PAN = _________lbs/Ton

Test results from the 0" – 12" soil analysis in ppm or lb/acre where 1 ppm = 3.8 lb/acre.

(2.a) K_2O (K x 1.20) ________ppm _________ lb./acre

(2.b) P_2O_5 (avail. P x 2.29)_____ppm _________ lb./acre

(2.c) Nitrate – N _______ ppm _________ lb./acre

(2.e) pH _________

(2.f) EC_e __________ mmhos/cm

(3.a) Crop to Be Grown ___________

(3.b) Yield Goal (bu or ton/acre) _____________

Threshold salinity value for crop (use Table 2)

(3.c) EC_e threshold (Closest value to 2.f) _______ mmhos/cm

(3.d) Crop Yield Decrement (see Table 2) ______ decreases

(3.e) Anticipated Crop Yield (3.b x 3.d/100) _________ (bu or ton/acre)

Nutrients needed by anticipated crop yield (3.e x appropriate value from table 3)

(3.f) N required _______________ lb/acre

(3.g) P_2O_5 required _______________ lb/acre

(3.h) K_2O required _______________ lb/acre

(4.a) N to be Applied = Crop Uptake N (3.f) – Soil Residual N (2.c)

= ______(lb/acre) - ______ (lb/acre) = _______ lb/acre

(4.b) Solid Application Rate = Applied N (4.a) / PAN (1.f)

= ________ (lb/acre) / ______(lb/Ton) = ____ Tons/Acre

(4.c) P_2O_5 to be Applied = _____ (3.g) lb/acre

(4.d) Solid Application Rate = (P_20_5 to be Applied 4.c / P_20_5 in Manure 1.c / Mineralization rate (=0.9)

= _______ (lb/acre) / _______lb/Ton) / 0.9 = _______

Tons/Acre of Manure to be applied

Application

Land application of lagoon liquids or solids will not be made on frozen, saturated, or snow covered ground. Applications will generally be made just prior to or after planting in the spring for annual crops or prior to spring crop growth on alfalfa. Applications may also be made between alfalfa harvests provided caution is used to avoid leaf burn of the alfalfa. Fall or winter applications will be made only in emergency situations or on winter annuals such as winter wheat.

Applications will be timed to minimize odors and applied in such a manner as to avoid contamination of surface waters, springs, drinking wells, pipelines, and groundwater.

The method of application may be by wheel line irrigation, center pivot irrigation, water cannon, spreader trucks or other methods of reliable application. In the event the rate of liquid or solids application cannot be reliably calculated, buckets placed in the field will be used to measure the rate of application.

Removal of Manure

If Liquid or Solid manure is given away or sold to any other person or organization the following guidelines will be followed:

- The person taking the manure will be given a report summarizing the nutrient content of the manure.
- A record (Attachment 10) will be kept by Circle Four detailing the following:
  - Date
  - Amount sold or taken
  - Copy of the nutrient content report given
- The person will be given general manure application guidelines. (Attachment 11)
- The person will be required to sign the release form found in Attachment 10.

Record Keeping

Records will be kept for a minimum of five years. Records will provide information on each land application. Information contained in the records will include field applied to, field size, manure source, laboratory test results for the soil and the manure, method of application, date of application, amount of effluent or solids applied, available water holding capacity of the soil, crop yield and application rate calculations. For each land application event a copy of this land application plan will be completed. All records will be kept on file for inspection by the Division of Water Quality if requested.

Dates of Application	
Lagoon (site)	
Field Location	
Field Size (Acres)	
Total Amount Applied (Acre-inches or tons/acre)	
Method of application	

Signatures

This land application plan is based on Circle Four's planned manure management system and objectives. We have reviewed this plan and understand all that is included. Our decisions regarding the management and utilization of hog lagoon effluent is accurately represented by this plan. We agree to manage the lagoon effluent in accordance with this plan. We understand it is our responsibility to obtain any and all permits required to implement this plan.

Agreed to by:

James W. Webb 11/27/01

James W. Webb
for
Circle Four Farms

Date

Plan reviewed and approved by:

Kerry Goodrich 12/4/01

Kerry Goodrich
NRCS State Agronomist

Date

List of Attachments

Attachment 1. ....NRCS "Irrigation Water Management Supplement"

Attachment 2................Field data sheets for irrigation water management

Attachment 3................Chapter 2-Soil Sampling of the "Utah Fertilizer Guide"

Attachment 4................Field data sheets for recording soil moisture.

Attachment 5................Utah State University Extension "Guidelines for Sampling Manure"

Attachment 6................NRCS practice standard for Nutrient Management

Attachment 7................NRCS soil survey map and information sheet

Attachment 8............... Laboratory results for lagoon water, bio-solids, and soil tests used in sample calculations

Attachment 9................NRCS "Utah Manure Application Risk Index" and Sample

Attachment 10..............Release form for Removed Substances

Attachment 11...............General Manure Application Guidelines

Attachment 1

NRCS "Irrigation Water Management Supplement"

IRRIGATION WATER MANAGEMENT SUPPLEMENT

Knowing when to irrigate and how much water to apply is the key to good water management. With some basic knowledge of the soil type, root zone, and crop water use information, an irrigator can easily learn to use irrigation water more efficiently. Applying the right amount of water at the right time will reduce runoff and deep percolation losses, and at the same time maximize crop yields.

Effective management depends on knowing how much of the water in a soil is available for plant use. The term field capacity (FC) refers to the total amount of water that a soil can hold. The term permanent wilting point (PWP) refers to the point at which a plant will die because it cannot obtain water from the soil. The amount of water between field capacity and permanent wilting is referred to as available water (AW), because it is water that is available for plant use. This amount is generally expressed in inches of water per foot of soil. Table 1 shows the available water holding capacity of different types of soils. For best management only 40 to 60% of the available water should be allowed to be depleted. (See Table 2)

Table 1. Available water Holding Capacity of Soils

Soil Texture	Available Moisture *	
	Range	Average
Sands and fine sands	0.5-1.00	0.75
loamy sands and loamy fine sands	0.75-1.25	1.00
sandy loams and fine sandy loams	1.25-1.75	1.50
very fine sandy loams, loam, and silt loams	1.50-2.30	2.00
sandy clay loams, clay loams, and silty clay loams	1.75-2.50	2.20
sandy clays, silty clays, and clay	1.60-2.50	2.30

* Values are expressed in inches per foot

The active root zone is the depth at which roots are actively growing. It should be used as a guide for determining how much water to apply. Water should not be applied below the active root zone. The active root zone varies with the crop, the depth of the soil, and the stage of crop growth. For example, at the tillering stage, small grains only have a 6 to 12 inch root depth. Table 2 shows the root zone for crops in our area, the time it takes for the root zone to reach full maturity, and the amount of available water that can be depleted.

Evapotranspiration (ET) or consumptive use (CU) refers to the amount of water removed from the root zone over a given period of time. It includes the moisture used by the crop (transpiration) and that which is lost through evaporation. Evapotranspiration varies with the crop grown, time of season, amount of cloud cover, percent crop cover, wind movement, and temperature. Table 3 shows typical consumptive use for crops in

Table 2. Root zone depths for selected crops

Crop	Root zone* (ft)	Time to reach mature root zone	Allowable depletion %
Alfalfa	6.0	0	60
Corn	3.0	10 days after tasseling	50
Potatoes	2.0	80 days after planting	30-40
Pasture/Turf	3.0	0	60
Small Grains	3.0	heading	50

*The root zone can be limited by shallow soils, compaction layers, and dry soil--all of which reduce amount of water available to crop, thus requiring more frequent irrigations.

3 different zones in the Utah. Zone 2 is in cooler high elevation areas such as Tabiona, Panguitch, Heber, and Woodruff. Zone 3 includes the middle warmer areas of Utah such as Roosevelt, Richfield, and Cedar City, and Zone 4 is in the hotter areas such as Tremonton, Salt Lake, Delta, and Randlett. As a general rule, crops in Utah use from 0.1 to 0.2 inches of water per day in the spring, and from 0.2 to 0.3 inches per day during the summer.

Table 3. Consumptive Use for Crops in 3 Zones in Utah

Climatic Zone	Monthly Consumptive Use in Inches Apr	May	Jun	Jul	Aug	Sep	Oct	Annual
Alfalfa								
2	---	2.9	5.0	6.5	5.5	2.5	---	22.4
3	0.5	3.9	5.9	7.5	6.3	3.8	0.3	28.2
4	1.5	4.4	6.5	8.5	7.1	4.4	1.8	34.2
Pasture								
2	0.8	2.8	4.1	5.4	4.7	2.9	1.1	21.8
3	1.5	3.2	4.8	6.2	5.4	3.4	1.6	26.1
4	2.1	3.7	5.3	7.0	6.1	3.9	1.9	30.0
Small Grain								
2	0.4	2.4	5.4	5.8	1.2	---	---	15.2
3	0.8	3.4	6.5	5.1	0.7	---	---	16.5
4	1.4	4.4	6.8	4.6	0.3	---	---	17.5
Corn Silage								
2	---	0.3	2.5	5.1	5.4	1.6	---	14.9
3	---	1.1	3.1	6.2	6.3	3.1	---	19.8
4	---	2.0	3.9	6.4	7.1	2.7	---	22.1

Many different methods of monitoring soil moisture are available. The more accurate of these include the use of tensiometers, gypsum blocks, electronic data pods, and neutron probes. Less accurate, but also less expensive methods include the feel method, the checkbook method, the use of an evaporation tub, or a combination of these. The Soil Conservation Service has additional information on each of these methods. They can help you decide which method will best fit your farming operation.

All of the above methods must take into account the available water holding capacity, the active root zone, and the amount of allowable moisture depletion. This is done by multiplying the depth of the root zone (Table 2), the available water holding capacity (Table 1), and the amount of allowable moisture depletion (Table 2). This calculation gives the inches of water that are available when the root zone is completely full. The amount of available water is then adjusted downward, based on the reading or measurement determined through monitoring.

Example 1: The crop is small grain. It has a root zone of 3 feet. The soil has an available water holding capacity of 2 inches of water per foot of soil, and has an allowable depletion of 50% (3 ft. X 2 inches X 0.50 percent = 3.0 inches of available water). The feel method shows that 30% of the available water has been withdrawn. Available water is then adjusted downward by 30% [3.0 inches of available water - (0.30 percent withdrawn X 3.0 inches) = 2.1 inches of available water].

The next irrigation can then be determined by dividing the adjusted available soil moisture by the estimated daily consumptive use (Table 3), or by using a consumptive use chart. At irrigation time, the soil can be refilled to field capacity by replacing only the available water that has been withdrawn.

Example 2: 2.1 inches usable moisture / 0.3 inches per day consumptive use = 7 days to the next irrigation. At irrigation time, 3.0 inches of water should be replaced.

Irrigation systems are designed to deliver water at a rate necessary to meet crop water needs during the hottest part of the season. In the spring and fall lower amounts of water are needed, thus irrigation sets should be adjusted accordingly. Every irrigator should know how much water their system is capable of delivering. The following formula can be used for this calculation.

Inches applied = (cfs X hrs) / ac.

(cfs is the cubic feet per second, hrs. is the hours that the water has run, and ac. is the acres covered) If the water is measured in gpm, it can be converted to cfs by dividing gpm by 450. The acres can be calculated by multiplying the width and length of the set, and then dividing by 43,560.

Example 3: A wheeline is running at 225 gpm. 225/450 = .5 cfs. If the line covers 1.5 acres, and is run for 11.5 hours, then it would deliver 3.8 inches. (.5 cfs X 11.5 hrs / 1.5 acres = 3.8 inches)

Example 4: If a surface system is using 3 cfs, the set is 12 hours, and 6 acres are being covered then 6 inches is being delivered. (3 cfs X 12 hours / 6 acres = 6 inches)

For a system to be 100% efficient, only the amount of water that has been withdrawn should be replaced. Evaporation, unlevel fields, plugged furrows, uneven water delivery, worn nozzles, leaky drains, wind and etc... however, keep systems from being 100% efficient. Thus, more water must be applied than has been withdrawn. The amount actually applied should take into account these inefficiencies. This is done by multiplying the inches applied by the approximate efficiency. Table 4 lists the approximate efficiency of various types of systems.

Example 5: A wheeline delivers 3.8 inches in 11.5 hours. The wheeline has an approximate efficiency of 65% (3.8 inches delivered X .65 percent efficiency = 2.47 inches actually applied).

Table 4. Approximate Efficiencies for Irrigation Systems

Method of Irrigation	Efficiency
Controlled Flood	55
Corrugations	70
Wheel Line	65
Center Pivot	80

In review, knowing when to irrigate and how much water to apply are the keys to good water management. This requires knowing the available water holding capacity of the soil, the active root zone of the crop that is growing, and the consumptive use of that crop at different times during the growing season. For best management, some method of monitoring soil moisture should be used. By knowing the capability of the system, water can be applied to replace only that which has been withdrawn.

Attachment 2

Field Data Sheets for Irrigation Water Management

CROPLAND/HAYLAND-FIELD RECORD-INSTRUCTIONS

Cultural Practices	Include tillage implements used, time of use, other cultural practices (i.e. tillage on the contour; crop planting dates, rates, and depth; harvest date; stage of growth when harvested for hayland; and etc...)
Fertilizer/Manure Applied	Include kinds of fertilizers used, including manure, rates used, method of application, and time of application. Manure test results and soil test reports should be included as a part of the records.
Pesticides Applied	Include all types of pesticides used whether for insects, weeds, or other pests. Include chemical used, rate of application, time applied, method of application, or alternate method of of control (i.e. cultural or biological). If the chemical is a restricted use chemical any additional information required by law should also be included.
Irrigation Water Management	Include dates of irrigation and amounts of water applied per irrigation. (This can be calculated by the formula - cfs x time in hours/ acres covered).
Yield and Observations	Include accurate yield information and other observations made during the growing year that may help you in future years (i.e. frost kill due to early planting, weeds not controlled through chemical use, visual nutrient deficiencies, yield variances throughout the field, and etc...).

USDA-NRCS
UT-ECS-3
Rev. 3/01

Cropland/Hayland Field Record

Field No./Name:
Total Acres:
Soil Texture:

Year	Crop & Acres	FACTORS AFFECTING PRODUCTION				Yield	Observations
		Cultural Practices	Fertilizer/Manure Applied	Pesticides Applied	Irrigation Water Management		

Crop Rotation - Yield Record

Explanation	Field		20__	20__	20__	20__	20__
	No.	Ac.					

Annual Crop Summary	Total Acres	Total Yield	Yield/ Acre	Total Acres	Total Yield	Yield/ Acre	Total Acres	Total Yield	Yield/ Acre	Total Acres	Total Yield	Yield/ Acre	Total Acres	Total Yield	Yield/ Acre
Total Acreage															

Attachment 3

Chapter 2—Soil Sampling of the "Utah Fertilizer Guide"

Chapter 2
Soil Sampling

D. W. James and *K. F. Topper*

Chemical analyses of soil samples are a prime source of information on soil fertility. When the soil test procedure is well calibrated with crop nutrient requirements, and where soil samples are properly obtained, the diagnostic soil test result can be a firm foundation on which to base soil fertility management practices.

Other chapters of the **Utah Fertilizer Guide** discuss soil test interpretations. This chapter emphasizes the proper soil sampling technique. A nonrepresentative soil sample is essentially useless, and may even be misleading when seeking the most appropriate soil fertility management for a given soil and crop situation.

Since an appropriate plant sampling technique for tissue analyses depends on crop type, plant sampling is discussed in the respective chapters of the **Utah Fertilizer Guide** which deal with different crops.

The soil sampling techniques described below are based on two contrasting field situations: Fields that are relatively uniform or homogeneous and fields that are relatively nonuniform or heterogeneous.

Soil Sampling Equipment

The basic soil sampling tools include the following:

1. A stainless steel soil sampling tube which has a knife edge cutting end and is slotted for easy extraction of the soil core (Fig. 2.1). This tube is used for sampling the plow layer or surface 10 to 12 inches of soil.
2. Plastic buckets for collecting soil cores during the field sampling operation.
3. Soil sample bags or boxes for use in transporting the soil sample to the diagnostic laboratory.
4. For depth soil sampling below the 0-12 inch layer (when testing for nitrates for example), a hydraulic ram mounted on a pickup truck or tractor is very useful for forcing sampling tubes into the subsoil. If this kind of equipment is not available then a specially built hand driven soil sampling tube is usually needed.

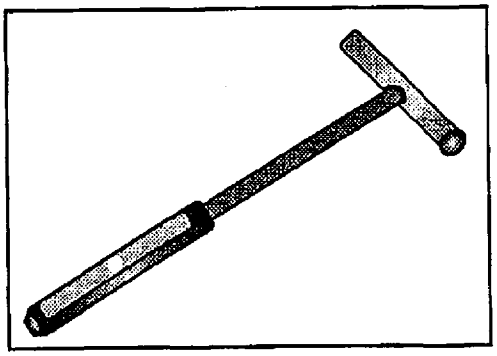

Figure 2.1 Soil sampling probe.

Soil Sampling Depth

Most fertility elements are immobile in soil. In Utah the principal elements of concern in this category include phosphorus (P), potassium (K), and zinc (Zn). The appropriate sampling depth for the immobile elements is the plow layer. Applied fertilizer, whether band or broadcast-applied, will be mixed into the plow layer during the plowing operation. It is recommended therefore, that soil samples be taken uniformly to the 10 to 12 inch depth which will be adequate for all routine plowing depths.

The principal mobile fertility element in soil is nitrate-nitrogen (NO_3-N). Diagnostic tests for this element require that the soil sampling procedure represent most or all of the effective root zone. For corn and wheat, for example, the soil sample should be taken to at least 4 feet or to a limiting layer, whichever occurs first. Limiting layers include water table, caliche or other cemented layers, gravel layers, or bedrock. The depth soil samples should be segregated into two or more depths, including the surface (0-12") layer, and at least one sample representing all lower layers. Each foot depth increment below the surface should be maintained separate. Most of the soil fertility information with respect to nitrogen will come from the subsurface samples. The surface sample alone has very little utility for prescribing nitrogen fertilizer needs.

An effective procedure is to run the routine soil test package (i.e. pH, EC, P, K and NO_3-N) on the surface sample. Then for all subsurface samples analyze only for NO_3-N.

Special caution is needed with nitrate soil sampling and analysis. Changes may take place in soil nitrate composition if the sample is stored in a closed (e.g. plastic) bag and held at room temperature for several days. Soil samples to be tested for nitrate should be air-dried immediately, or frozen, or taken to the diagnostic laboratory immediately after the field sampling is complete.

Components of soil salinity and sodicity are also mobile and depth soil sampling is necessary for these kinds of diagnostic tests as well.

When to Soil Sample

Soil sampling can be done any time. However, there are specific advantages of soil sampling in the fall and spring. Fall fertilization has the advantage of incorporation of applied fertilizer with fall plowing. On the other hand, spring soil testing for nitrates will provide a better evaluation of nitrogen availability for the spring crop establishment period. Residual nitrogen from the previous season depends on the amount of snow-melt/rainfall that has occurred between growing seasons.

How Often to Soil Test

Test the soil before crop establishment and subsequently every three years for perennial crops. For annual crops it would be good practice to sample the soil annually or at least biennially. Farm managers should keep complete soil test records for all farm fields, together with fertilizer application records (kinds and amounts) in order to relate changes in soil test results to cropping and fertilizer practices. This will allow for the development of site specific information which can improve the efficiency of the overall farm soil fertility management program.

Sampling Uniform Fields

A uniform field or field portion will have similar characteristics in respect to slope, aspect, soil depth and texture, cropping history, fertilization history, and uniform irrigation for irrigated fields. A uniform field will have uniform appearing crops in terms of presence or absence of deficiency symptoms, and uniform growth and productivity. Thus, for a large field which includes distinctive differences within its perimeters, there will be as many soil samples as there are distinctively different field portions. Clearly identify field differences before beginning soil sample collection in the field.

Soil sampling of uniform fields involves collection of 20 to 30 soil cores, using the slotted soil sampling tube shown in Figure 2.1. The sample is collected by following a zigzag path, taking care to force the path into corners and along edges of the field. Figure 2.2 illustrates the idea. The soil cores are then crushed and thoroughly mixed before reducing the sample size to the appropriate amount for transfer to the laboratory. This is referred to as a composite soil sample.

Crushing and mixing of the collected soil cores, together with reduction in sample size, must be done properly to assure that the final sample represents the original whole sample.

It is recommended that one composite soil sample not represent more than 20 to 30 acres regardless of apparent field uniformity. This is because non-uniformity is usually difficult to assess over broad areas of landscape. Thus a 50 acre field will be divided for sampling purposes into two or three smaller portions.

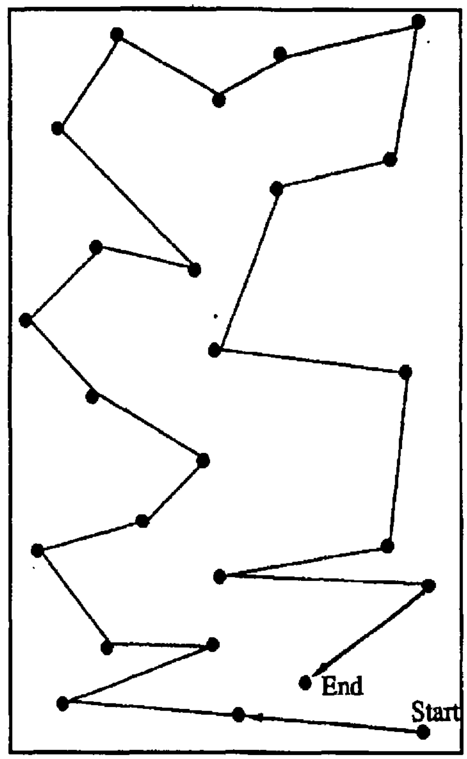

Figure 2.2. General approach used to sample a uniform field. Each dot represents a sampling spot.

Sampling Nonuniform Fields

Extreme field heterogeneity can result from subsoil exposure and also from fertilizer application by any of several injection methods (banded at seeding time, side-dress etc.) without a subsequent plowing or tillage operation, which would tend to mix the fertilizer in the plow layer.

Sampling Fields with Exposed Subsoil

Subsoil is typically very low in fertility, especially in regard to phosphorus. Subsoil exposure results from soil erosion and from land leveling. Eroded fields, hill tops, and side gullies are susceptible to subsoil exposure. In Utah this is seen frequently on summer-fallow wheat land. Leveling or smoothing of irrigated lands is a common practice to facilitate uniform water application by furrow or border methods.

On leveled lands the pattern of subsoil exposure usually depends on the original field contours. Soil is cut and moved from high areas and deposited in low areas, resulting in differing degrees of subsoil exposure in the cut areas. An example of field heterogeneity generated by land leveling is given in Figure 2.3. In this example the average soil test P was

12.6 which, standing alone, would not indicate any P fertility deficiency. But, in the actual case, 13.6% of the field was severely P deficient and 35.6% of the field was moderately deficient. This means that 51.8% of the field would have yielded at less than its potential if no P fertilizer was applied based on the average soil test value. On the other hand, if fertilizer was uniformly applied at any rate, 27.6% of the field would not provide a return on the fertilizer P investment, assuming two or three years for amortization.

Sampling of leveled fields is done by marking the field ends and sides at regular intervals, for example every 100 or 200 feet. Five or six soil cores are then collected from a 3-foot diameter circle centered on the intersection of the field grid lines. This type of sample is referred to as a point sample. Point samples are maintained separately and labeled with the field grid numbers in order to map the soil variability and facilitate the application of the appropriate amounts of fertilizer for each soil test category.

A 100 foot-square grid system would result in an average of 4.4 samples per acre while a 200 foot-square grid would result in an average of 1.1 samples per acre. On casual inspection this may seem to be prohibitive. However, intensive soil sampling may be indispensable in restoring cut lands to their original level of productivity within reasonable time limits.

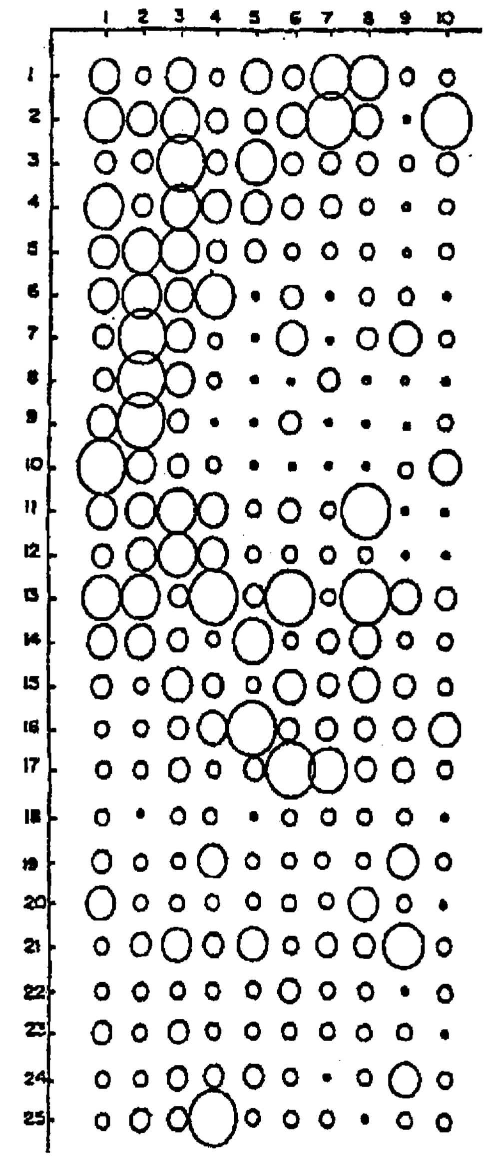

Figure 2.3. Soil test P results obtained from point soil samples taken on a 100 foot square grid on a newly leveled field in Cache County, Utah. Circles from small to large represent the following soil test P ranges: 0-3, 4-7, 8-11, 12-15, 16-19, and 20 respectively.

It is not necessary to apply all the standard soil fertility tests on every sample from an intensively sampled field; usually phosphorus alone will suffice. Further, when large numbers of samples to be treated alike are submitted to the laboratory, lower per sample analytical costs are encountered. Thus, the cost of re-establishing uniform crop growth and yield on leveled fields, expressed in terms of soil analyses, will usually be small compared to the loss of productivity associated with nonuniform soil fertility. Specific details on intensive soil sampling for specific field situations may be obtained from the Soil Plant and Water Analysis Laboratory at Utah State University.

Intensive soil sampling of nonuniform fields need not be repeated once the heterogeneity has been reduced by judicious application of fertilizer. The routine composite soil sample should suffice for future soil fertility diagnostics.

Soil Sampling No-till and Minimum-till Fields

Ordinarily fertilizer is mixed throughout the plow layer at plow time, whether or not the fertilizer was originally applied broadcast or injected (shanked) into the soil. Fertilizer mixing does not occur, however, where no-till or minimum-till is practiced. This is not important to plant use of fertilizer carried over from the previous season, but it does represent a special challenge in regard to obtaining representative soil samples which will accurately assess fertilizer requirements for the current season.

Injection fertilization without subsequent plowing, or other deep tillage operation, results in high soil variability. Narrow fertilizer-enriched bands alternate with wider strips (depending on injector spacing) of soil which has the lower, unfertilized, fertility level. The best soil sampling procedure for these conditions has not been fully developed. It is suggested however, that no-till and minimum-till fields be sampled in a manner similar to that suggested for uniform fields (Figure 2.2) except that the **number of soil cores collected for the composite sample be doubled**. In other words, for otherwise uniform field areas which have been injection fertilized without subsequent plowing, collect at random 40 to 60 soil cores for development of the composite soil sample. It is important that every core be collected at random so as not to bias the soil sample with too much representation in or out of the fertilizer enriched soil band. Also soil core crushing and mixing to form the composite soil sample would obviously be more involved. The suggestions given above for preparing the composite soil sample collected from plowed fields would need to be followed with extra caution.

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Attachment 4

Field Data Sheets for Recording Soil Moisture

SOIL MOISTURE ESTIMATE WORKSHEET

Name ______________________ Year ____________

Field ______________________ Acres ____________

Soil Type & Texture ______________________________

Crop ______________ Crop Rooting Depth ____________

% Maximum Allowable Depletion (%MAD) ______________

Maximum Allowable Depletion (Inches)[2] ______________

Average Available Water Holding Capacity of Soils (AWC)

Soil Texture	Available Moisture Range (in./ft)	Available Moisture Average (in./ft.)
Very coarse textures sands and fine sands	.5-1.0	0.75
Coarse textured loamy sands and loamy fine sands	.75-1.25	1
Moderately coarse textured sandy loams and fine sandy loams	1.25-1.75	1.5
Medium textured very fine sandy loams, loam, and silt loams	1.5-2.3	2
Moderately fine textured sandy clay loams, clay loams and silty clay loams	1.75-2.5	2.2
Fine textured sandy clays, silty clays and clay	1.6-2.5	2.3

			Feel Method Moisture Estimates									
			Date:		Date:		Date:		Date:		Date:	
Depth (inches)	Texture	AWC (inches)	Available Moisture[1] (%)	Available Moisture[1] (inches)	Available Moisture[1] (%)	Available Moisture[1] (inches)	Available Moisture[1] (%)	Available Moisture[1] inches	Available Moisture[1] (%)	Available Moisture[1] (inches)	Available Moisture[1] (%)	Available Moisture[1] (inches)
0-12												
12-24												
24-36												
36-48												
48-60												
60-72												
	Total AWC		Total Available Moisture		Total Available Moisture		Total Available Moisture		Total Available Moisture		Total Available Moisture	

[1]Available Moisture in Inches = AWC * %

[2]Maximum Allowable Depletion in Inches = % MAD * Total AWC

Note: Don't Let Total Available Moisture go below Maximum Allowable Depletion

[3]Moisture Remaining before Irrigation is Needed = Total Available Moisture - MAD (See IWM Record)

[4]Date of Next Irrigation = Moisture Remaining / Daily Comsumptive Use (See IWM Record)

8/6/01
NRCS-UT

FEEL AND APPERANCE METHOD FOR ESTIMATING THE AVAILABLE MOISTURE IN THE SOIL

Available Moisture	Feel, Appearance, and Texture of Soil			
	Coarse textured soils	**Moderately coarse textured soils**	**Medium textured soils**	**Fine & very fine textured soils**
AWC (In/Ft)	0.5-1.25	1.25-1.75	1.5-2.3	1.6-2.5
0 - 25 %	Dry, loose, and single grained; flows through fingers	Dry and loose; flows through fingers	Powdery dry; in some places slightly crusted but breaks down easily into powder	Hard, baked, & cracked; has loose crumbs on surface in some places
25 - 50%	Appears to be dry; does not form a ball under pressure*	Appears to be dry; does not form a ball under pressure*	Somewhat crumbly but holds together under pressure	Somewhat pliable; balls under pressure*
50 - 75%	Appears to be dry; does not form a ball under pressure*	Balls under pressure but seldom holds together	Forms a ball under pressure; somewhat plastic; slicks slightly under pressure	Forms a ball; ribbons out between thumb & forefinger
75 - 100%	Sticks together slightly; may form a very weak ball under pressure	Form weak ball that breaks easily; does not slick	Borms ball; very pliable; slicks readily if realatively hgih in clay	Ribbons out between fingers easily; has a slick feeling
At Field Capacity	On squeezing, no free water appears on soil but wet outline of ball is left on hand	Same as for coarse textures soils at field capacity	Same as for coarst textured soils at field capacity	Same as for coarse textured soils at field capacity
Above Field Capacity	Free water appears when soil is bounced in hand	Free water is realeased with kneading	Free water can be squeezed out	Puddles; free water forms on surface

* Ball is formed by squeezing a handful of soil very firmly

IRRIGATION WATER MANAGEMENT RECORD

Field ____________ Crop ____________ Year ________

Date	Action	Total Available Moisture	MAD	Moisture Remaining[3]	Daily Consump-tive Use	Date of Next Irrigation[4]	Irrigation Water Applied	Irrigation Efficiency (%)	Net Water Applied
						Total:			

Crop Yield ____________

NOTES:

Field ____________ Crop ____________ Year ________

Date	Action	Total Available Moisture	MAD	Moisture Remaining[3]	Daily Consump-tive Use	Date of Next Irrigation[4]	Irrigation Water Applied	Irrigation Efficiency (%)	Net Water Applied
						Total:			

Crop Yield ____________

NOTES:

Attachment 5

Utah State University Extension "Guidelines for Sampling Manure"

GUIDELINES FOR SAMPLING MANURE

Manure and wastewater sampling is messy and unpleasant. When sampling, acknowledge this fact and prepare ahead of time to collect the samples. Use rubber boots and gloves (if necessary), proper sampling tools (described below), clean buckets, and heavy-duty plastic bags or jars to ship the sample.

Manure is highly variable. In order to obtain a representative sample of manure or wastewater you will have to collect several small *subsamples* and combine them together into *one composite sample.* Follow the guidelines below for sampling solid and liquid manure sources.

Sampling Solids

When sampling manure solids, *remove the surface 6 to 8 inch crust* from the pile. Use a clean auger, probe, or shovel to *core into the pile as far as possible* and retrieve a subsample. Take samples from all sides, collecting *a minimum of six subsamples* from each pile. Place the subsamples into a clean bucket and mix well. Transfer approximately one pound (2 to 3 pints volume) of manure into a heavy duty, sealable plastic bag. Double bag the sample, mark the bag in pen with the sample identification, and place in a cooler or freezer. Ship the sample to the analytical lab as soon as possible. *Do not dry the manure sample before shipping* since the lab must determine moisture content in order to report manure nutrient values on an "as is" basis.

Sampling Liquids and Slurries

There are three ways to sample liquids and slurries:

1. Sample directly from the storage structure using a water sampler. A simple water sampler can be constructed by mounting a tin can on the end of a wooden dowel or old broom handle. Walk around the structure and collect a minimum of six subsamples of the liquid. If possible, mix or otherwise agitate the liquid prior to sampling.

2. Sample from a valve inserted in a recovery line or directly from the structure outlet. Collect a minimum of six subsamples, two at the beginning, two at the middle, and two at the end of the pumping cycle.

3. Place cups or cans in the field to collect manure as it is applied through a sprinkler system. Place a minimum of six cans in the field to collect the subsamples.

Combine the liquid subsamples in a clean bucket and mix thoroughly. Transfer approximately 1 to 2 pints of liquid into a clean sample jar. Label the jar with the sample identification. Pack the samples carefully to prevent breakage. Ship the sample to the analytical lab as soon as possible.

Presentation of Results

Results will be adjusted for the moisture content of the sample as it was submitted to the lab and presented on an "as is" basis (pounds per ton for solids, pounds per 1000 gallons or pounds per acre-inch for slurries and liquids). Additional information on interpreting a manure and wastewater analysis will be included with your test results.

USU Extension
Jan 2001

MANURE ANALYSIS INFORMATION SHEET

USU Analytical Labs
Ag. Science Room 166
4830 Old Main Hill
Logan UT 84322-4830
Phone: (435) 797-2217 or Fax: (435) 797-2117

Date: ______________________
Name: ______________________
Address: ______________________
____
County: ______________________
Phone: ______________________
Fax: ______________________

	Sample number 1	2	3
Sample ID:	____	____	____
Manure type (✓)			
Milking cows	❑	❑	❑
Heifer/dry cows	❑	❑	❑
Beef feeder	❑	❑	❑
Calves	❑	❑	❑
Sheep	❑	❑	❑
Horse	❑	❑	❑
Turkey, grower	❑	❑	❑
Swine, grower	❑	❑	❑
Swine, sow	❑	❑	❑
Poultry, pullet	❑	❑	❑
Poultry, layer	❑	❑	❑
Other	____	____	____

Comments: ______________________
____
____

	Sample number 1	2	3
Storage system (✓)			
Solid			
Bunker	❑	❑	❑
Stacked	❑	❑	❑
Open lot scrape	❑	❑	❑
Slurry/liquid			
Pit or tank	❑	❑	❑
Pond (<6 feet)	❑	❑	❑
Pond (>6 feet)	❑	❑	❑
Compost	❑	❑	❑
Length of storage (✓)			
0 to 3 months	❑	❑	❑
3 to 6 months	❑	❑	❑
6 to 12 months	❑	❑	❑
12+ months	❑	❑	❑
Bedding included (✓)			
Yes	❑	❑	❑
No	❑	❑	❑
Bedding type:	______________		
Present results in:			
lb/ton (solids)	❑	❑	❑
lb/1000 gallons	❑	❑	❑
lb/acre-inch	❑	❑	❑

Test	Price per sample
Total elemental composition: N, P, K, Ca, Mg, Na, S, B, Zn, Cu, Fe, Mn; moisture, pH and salinity (EC)	$35.00

Please enclose a check or money order payable to **USU Analytical Labs** to cover analytical costs, along with samples and this sample description sheet. Mail samples to the address above.

USU Extension
Jan 2001

Attachment 6

NRCS Practice Standard for Nutrient Management (code 590)

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Acre)

CODE 590

DEFINITION

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

PURPOSES

It is intended that nutrient management plans help producers improve or maintain their level of management and expertise related to the application of nutrients on the lands they manage.

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

CONDITIONS WHERE PRACTICE APPLIES

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

CRITERIA

General Criteria Applicable to All Purposes

Plans for nutrient management shall comply with all applicable Federal, State, and local laws and regulations (Refer to the reference section at the end of this standard).
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), and the NRCS National Agronomy Manual (NAM) Section 503.

Nutrient management plans that address land application of animal manure shall be developed using guidance from the USDA-NRCS Agricultural Waste Management Field Handbook (AWMFH) and Utah State University (USU) Extension publications.

Plans may be developed by anyone but must be reviewed and approved by an individual(s) who has been granted approval authority from the State Conservationist. Approval authority can be obtained by:

- attending NRCS/USU developed training programs,
- and submission, review, and approval of two nutrient management plans by the NRCS state and area agronomist.

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

Plant nutrient utilization values may be obtained from the Utah Fertilizer Guide, Ortho Agronomy Handbook, or Western Fertilizer Handbook. Values based on USU Extension research may be used if available.

Realistic yield goals shall be established based on soil productivity information, historical yield data, climatic conditions, level of management or University research on similar soil and cropping systems. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

Plans for nutrient management shall specify the form, source, amount, timing and method of application of nutrients on each field or Conservation Treatment Unit (CTU) to achieve realistic production goals, while minimizing nitrogen and/or phosphorus movement to surface and/or ground waters.

Irrigation Water Management (449) shall be a component of a nutrient management plan when nutrients are applied on irrigated land.

Erosion, runoff, and water management controls shall be installed, where needed, as determined by NRCS assessment tools such as the Utah Manure Application Risk Index (UMARI) or the Revised Universal Soil Loss Equation, on all fields that receive nutrients.

Soil Sampling and Laboratory Analysis (Testing)

Nutrient planning shall be based on current soil test results. Current soil tests are those that are taken at least once every three years where nutrients are applied on the basis of phosphorus (P) or yearly where nutrients are applied on the basis of nitrogen (N).

Soil samples shall be collected and prepared according to the Utah Fertilizer Guide or USU fact sheets.

Soil test analyses shall be performed by a laboratory that is a member of the North American Proficiency Testing Program (See Appendix A). Soil testing shall include analysis for all nutrients and/or soil conditions for which specific information is needed to develop the nutrient plan (e.g. pH, electrical conductivity (EC), soil organic matter, nitrogen, phosphorus, potassium, and micronutrients).

Plant Tissue Testing

Tissue sampling and testing, where used, shall be done in accordance with the Utah Fertilizer Guide.

Nutrient Application Rates

Recommended nutrient application rates shall be based on current soil test results, realistic yield goals, management capabilities, or plant nutrient utilization values found in the Utah Fertilizer Guide, Western Fertilizer Handbook or Ortho Agronomy Handbook.

The planned rates of nutrient application, as documented in the nutrient budget, shall be determined based on the following guidance:

- **Nitrogen, Phosphorus, or Potassium Application** - Planned applications shall not exceed the plant nutrient utilization values for the controlling nutrient. When manure or other organic by-products are a source of nutrients see "Additional Criteria" below.
- Excess potassium shall not be applied in situations in which it causes unacceptable nutrient imbalances in crops or forages
- **Other Plant Nutrients -** The planned rates of application of other nutrients shall be consistent with The Utah Fertilizer Guide.
- **Starter Fertilizers** - Starter fertilizers shall be applied in accordance with the Utah Fertilizer Guide. When starter fertilizers are used, they shall be included in the nutrient budget.

Nutrient Application Timing

Nutrient applications shall be timed to correspond with plant nutrient uptake characteristics, while considering cropping system limitations, weather and climatic conditions, and field accessibility.

Application of nutrients on frozen and/or snow-covered ground will not be allowed unless **all** of the following criteria are met:

- The risk for pollution as determined by UMARI is very low or low,
- Nutrient application rates do not exceed nutrient utilization values nor threshold values as defined in the section labeled "Manure or Other Organic By-Product Application Rates",
- Tank applications of liquid manure do not exceed nutrient utilization values nor 20% of the available water holding capacity of the soil,
- Appropriate setbacks from waters of the state, runoff containment, and/or other practices as determined by the risk index are applied.

Nutrient applications through irrigation systems shall be applied in accordance with the requirements of Irrigation Water Management (Code 449). The application rate shall not exceed the soil intake/infiltration rate as defined by NRCS's Utah Irrigation Guide. Individual applications shall not exceed the field capacity of the soil.

Liquid manure applications through irrigation systems may be made outside the active growing season where a water budget shows that deep percolation or runoff will not occur.

Additional Criteria Applicable to Manure or Organic By-Products Applied as a Plant Nutrient Source

Nutrient values of manure and organic by-products shall be determined prior to land application based on laboratory analysis.

Where actual analysis data is not available, standard "book values" found in the NRCS AWMFH may be used. In subsequent years, actual values shall be obtained through yearly testing. Tests should be taken yearly for at least five years in order to develop average nutrient values for the given management system. Once established, average values may be used for determining application rates as long as the management system remains the same (except as required by a UPDES permit).

Samples for testing shall be collected and prepared according to USU guidelines. Tests are to be taken separately for different types and consistencies of material.

Manure or Other Organic By-Product Application Rates

The rates of application shall be based on Soil Test Phosphorus (STP) (Olsen Method) according to the following threshold values:

STP (ppm)	Apply Based On:
< 50	Crop nitrogen utilization
50-100	Crop phosphorus utilization
>100	No application of manure

Agronomic Rate Determination

Acceptable manure application rates may be based on either soil test recommendations or crop nutrient utilization values.

Additional Nitrogen Application

When applications are made based on phosphorus needs, additional nitrogen from commercial fertilizer may be required to supply the nitrogen needs.

Phosphorus Limits

Manure or other organic by-products will be applied on the basis of crop phosphorus utilization on areas with the following soil limitations:

a. Where available water holding capacity is less than 3.0 inches in the top 5-foot.

b. Where depth to bedrock or cemented pan is less than or equal to 2 feet from the surface.

c. Where depth to the seasonal water table is less than or equal to 2 feet from the surface.

d. Where flooding frequently occurs, as defined in the soil survey.

e. Where rock fragments 3 - 10 inches in diameter exceed 25% by volume; stones and boulders greater than 10 inches in diameter exceed 10% by volume in the top 5 foot.

f. Where permeability is greater than 2.0 in/hr.

Applications for Multiple Year Crop Phosphorus Needs

Applications of manure may be made for crop phosphorus needs for multiple years in the crop sequence. When such applications are made, daily air temperatures must exceed 50 degrees F for a minimum of 7 days prior to incorporation, and the application rate shall:

- not exceed the recommended phosphorus needs for the crop rotation,
- not exceed the 50 ppm Olsen STP level after application,
- not be made on frozen/snow covered ground,
- not exceed 1½ times the recommended nitrogen application rate during the year of application,
- not be made on sites considered high or medium risk to runoff or leaching unless appropriate conservation practices, best management practices, or management activities are used to reduce the risk to low or very low

Field Risk Assessment

When animal manure or other organic by-products are applied, a field-specific assessment of the potential for nutrient runoff and leaching shall be completed. This assessment shall be made using UMARI. In such cases, the assessment shall include:

- a record of the limiting factors and risk index for each field,
- plan maps that show the location of sensitive areas,
- information about conservation practices and management activities that can reduce the potential for nutrient movement from the site.

The results of the assessment and recommendations shall be discussed with the producer during development of the plan.

Additional Criteria Applicable to Biosolids Applied as a Plant Nutrient Source

Nutrient Application Timing

Biosolids (sewage sludge) cannot be applied on frozen/snow covered ground on slopes greater than 6% unless there is 80% vegetative ground cover or a runoff containment plan in place.

Biosolids cannot be applied within 30 feet of wells, rivers, streams, ditches, or other waterbodies at any time.

Nutrient Application Rates

Applications that exceed agronomic rates for nitrogen require that a permit be obtained from the Utah Department of Environmental Quality.

Biosolids cannot be applied to the land if it is likely to adversely affect a threatened or endangered species.

Application records which track field operations, application rates, management practices, and site restrictions must be kept.

Cumulative and annual pollutant soil loading rates on a dry weight basis cannot exceed specified limits if pollutant concentrations are greater than those described:

Pollutant Concentrations and Loading Rate

Pollutant	Pollutant Concentrations ppm	Cumulative Loading lbs/ac	Annual Loading lbs/ac
Arsenic	41	37	1.8
Cadmium	39	35	1.7
Copper	1500	1338	67.0
Lead	300	268	13.0
Mercury	17	15	0.8
Nickel	420	375	19.0
Selenium	100	89	4.5
Zinc	2800	2498	125.0

Additional Restrictions

Additional site restrictions for Class B biosolids must also be met (Class B biosolids are those that exceed EPA defined pathogen levels):

- Food crops, feed crops, and fiber crops shall not be harvested for 30 days after application.
- Food crops that touch the soil surface (i.e. melons, cucumbers, etc.) shall not be harvested for 14 months after application.
- Food crops that have harvested parts below the soil surface (i.e. potatoes, carrots, etc.) shall not be harvested for 20 months after application if the sludge is incorporated 4 months or more after application. They shall not be harvested for 38 months if incorporated before 4 months after application.
- Turf shall not be harvested for 1 year after sludge application.
- Animals shall not be grazed on a site for 30 days after application.

Public access to land with high potential for public exposure shall be restricted for 1 year after sludge application. Access to land with low potential for public exposure shall be restricted for 30 days after application.

Heavy Metals Monitoring

When biosolids that exceed EPA regulations for heavy metal levels (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) are applied, the soil shall be monitored in accordance with US Code, Reference 40 CFR, Parts 403 and 503.

Additional Criteria to Improve the Physical, Chemical, and Biological Condition of the Soil.

Nutrients shall be applied in such a manner as not to degrade the soil's structure, chemical properties, or biological condition. Caution should be used when applying nutrient sources with high salt content. Provisions may need to be made to leach salts below the crop root zone.

CONSIDERATIONS

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

Consider additional practices such as Conservation Cover (327), Grassed Waterway (412), Contour Buffer Strips (332), Filter Strip (393), Riparian Forest Buffer (391A), Dike (356), Irrigation System Tailwater Recovery (447), Conservation Crop Rotation (328), Cover and Green Manure (340), and Residue Management (329A, 329B, or 329C, and 344) to improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms and to protect or improve water quality.

Consider double cropping or crops that have high nutrient requirements whenever possible to utilize and recycle residual nitrogen and/or phosphorus.

Consider application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere. Suggestions include:

- split applications of nitrogen to provide nutrients at the times of maximum crop utilization,
- band applications of phosphorus near the seed row,
- applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques,
- immediate incorporation of land applied manure or organic by-products,
- delaying field application of animal manure or other organic by-products when heavy precipitation is forecast within 24 hours of the time of the planned application,
- avoiding application on wet soils to prevent compaction and rutting,
- reducing or eliminating application on soils that are prone to flooding and saturation.

Consider increasing application setback distances from environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets or rapidly permeable soil areas.

Consider measures for minimizing potential problems from odors associated with the land application of animal manure, especially when applied near or upwind of residences.

Consider nitrogen volatilization losses associated with the land application of animal manure. Volatilization losses can become significant if manure is not immediately incorporated into the soil after application.

On sites where special environmental concerns exist, consider other sampling techniques. (For example: Soil profile sampling for nitrogen, where cultural resources exist, or soil surface sampling for phosphorus accumulation or pH changes.)

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet to reduce the manure nutrient content, to enhance the producer's ability to manage manure effectively.

PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.

The following components shall be included in the nutrient management plan:

- 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 and/or organic by-product sample analyses,
- realistic yield goals for the crops in the rotation,
- recommended nutrient rates, timing, form, and method of application and incorporation,
- quantification of all nutrient sources,
- location of designated sensitive areas and the associated management restrictions,
- guidance for implementation, operation, maintenance, recordkeeping,
- nutrient budget for nitrogen, phosphorus, and potassium for the crop being grown and/or for the crop rotation.
- the soil phosphorus threshold values at which it is necessary to convert to phosphorus based application.

Where applicable, plans shall include other practices or management activities as determined by specific regulations, program requirements, or producer goals.

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 changes in any of these requirements may necessitate a revision of the plan.

In addition to the requirements described above, the conservation planner shall discuss with the producer:

- 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,
- how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment.

OPERATION AND MAINTENANCE

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

- plans will be reviewed and/or revised a minimum of once every five years or yearly for a UPDES permit, or when significant changes occur such as when the crop rotation changes, nutrient handling methods change, or animal numbers or types change,
- protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage,
- calibration of application equipment to ensure uniform distribution of the material and that applications are within 25% of the planned rate,
- documentation of the actual rate at which nutrients were applied,
- Maintaining records to document plan implementation. As applicable, records shall include:
    1. soil test results and recommendations for nutrient application,
    2. quantities, analyses and sources of nutrients applied,
    3. dates and method of nutrient applications,
    4. crops planted, planting and harvest dates, and yields, results of water, plant, and organic by-product analyses,
    5. dates of review and person performing the review, and recommendations that resulted from the review.

Records shall be maintained for a minimum of three years.

Workers should 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.

When cleaning nutrient application equipment, excess material should be collected and stored or field applied in an appropriate manner. Application equipment should not be cleaned in areas where a high risk for runoff, leaching, or well contamination exists.

REFERENCES

California Fertilizer Association, *"Western Fertilizer Handbook"*, 8th Edition, 1995

"Definitions and General Requirements", R317-1, Utah Administrative Code, Utah Department of Environmental Quality (DEQ), Division of Water Quality (DWQ)

"Drinking Water Source Protection for Groundwater Sources", R309-600, UAC, UDEQ, DWQ

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Thorup, R.M., *"Ortho Agronomy Handbook"*, Chevron Chemical Company, 1989

"Utah Pollutant Discharge Elimination System (UPDES)', R317-8, Utah Administrative Code, UDEQ, DWQ

Utah State University Electronic Publications, http://www.ext.usu.edu/publica/index.htm

"Utah Water Quality Act", 19-5, Utah Code, UDEQ, DWQ

APPENDIX A

NORTH AMERICAN PROFICIENCY TESTING LABORATORIES

Laboratory Consultants
947 S. 48th St., Suite 127
Tempe, AZ 85281
Phone: 480-858-1841
Fax: 480-858-0752

IAS Labs
2515 E University Dr.
Phoenix, AZ 85034
Phone: 602-273-7248
Fax: 602-275-3836

Soil, Water and Plant Testing Lab
Colorado State University A319 NESB
Fort Collins, CO 80523
Phone: 970-491-5061
Fax: 970-491-2930

Colorado Analytical Lab
240 S Main St.
Brighton, CO 80601
Phone: 303-659-2313
Fax: 303-659-2315

WELD Laboratories Inc.
1527 1st Ave.
Greeley, CO 80631
Phone: 970-353-8118
Fax: 970-353-1671

AGRI-Test Inc.
2043 Kimberly Rd.
Twin Falls, ID 83301
Phone: 208-734-2303
Fax: 208-734-2580

Stukenholtz Lab
P.O. Box 353
2924 Addison Ave., E
Twin Falls, ID 83303-0353
Phone: 208-734-3050
Fax: 208-734-3919

Western Laboratories
211 W. Hwy. 95
P.O. Box 1020
Parma, ID 83660
Phone: 208-722-6564
Fax: 208-722-6550

NAPI-ATRL
6 Miles South on Highway 371
Farmington, NM 87401
Phone: 505-326-2730
Fax: 505-326-3152

SWAT Lab
Gerald Thomas Hall Rm 269
Las Cruces, NM 88003
Phone: 505-646-4422
Fax: 505-646-6041

ALBION Laboratories Inc.
101 N. Main St.
Clearfield, UT 84015
Phone: 801-773-4631
Fax: 801-773-4633

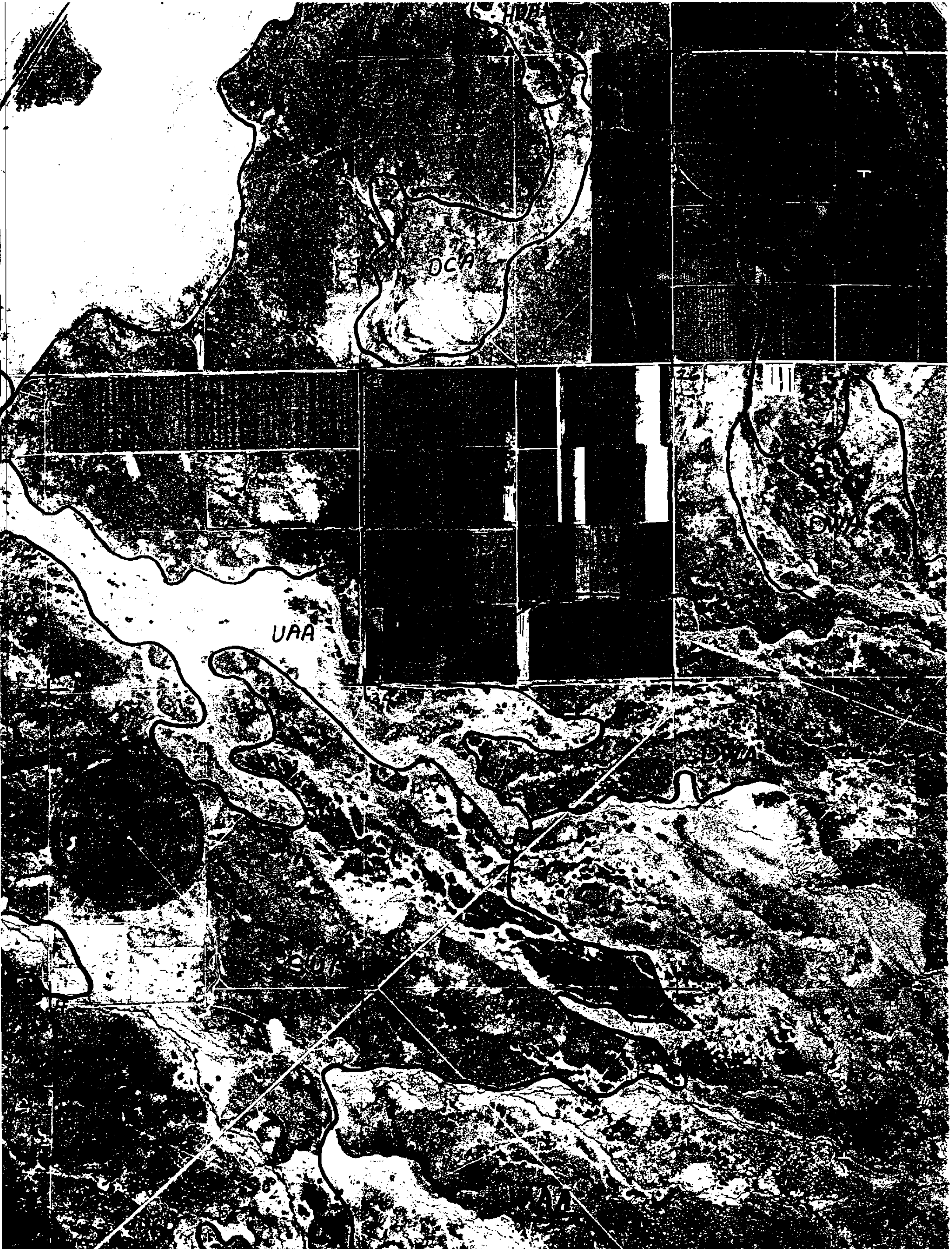
USU Analytical Laboratories
Utah State University
Ag. Science Rm. 166
Logan, UT 84322-4830
Phone: 801-797-2217
Fax: 801-797-2117

University of Wyoming Soil Testing
P.O. Box 3354
16th and Gibbon
Laramie, WY 82071
Phone: 307-766-2135
Fax: 307-766-5549

Energy Laboratories
2393 Salt Creek Hwy.
Casper, WY 82602
Phone: 307-235-0515
Fax: 307-234-1639

Attachment 7

NRCS Soil Survey Map and Information


DCA
UAA
DWA
DWA

Jim,
SOILS ON SEC 27 ARE SDA
ANY MORE QUESTIONS PLEASE CALL
ME. THANKS, TROY HENRIE 438-5092

SOIL & CAPABILITY
INFORMATION FOR:

See Sevy / See Juab Loam

MAP SYMBOL	DeC	SDA	DAA	DWA
CAPABILITY UNIT*	~~IV S24U~~ VII S S4	II S89 VII S5 8	IV S24 VII S5	IV S24 VII S04 OCA
NAME* AND SLOPE	Decca Loam 3-6%	~~Dinevo~~ Sandy Loam Gravelly Substratum 0-3% slopes	~~Decca Loam~~ Protected Juab L 0-3%	Decca GR-L 40% McLoughlin SICL 30% 0-3%
DEPTH IN INCHES AND TEXTURE*	0-4 Loam 4-15 SCL 15-60 GRV-S	0-3 SL 3-17 SCL 17-41 CL 41-60 GRV-LS	0-5 GR-L 5-19 CL GR-CL 19-60 GRV-SL GRV-LCOS GRV-COS	0-4 Loam 4-15 SCL 15-60 GRV-S
DEPTH IN INCHES AND PERMEABILITY IN IN./HR.	0-15 0.6-2.0 15-60 6.0-20.0	0-3 2.0-6.0 3-17 0.6-2.0 17-41 0.2-0.6 41-60 6.0-20.0	0-5 0.6-2.0 5-19 0.2-0.6 19-60 6.0+	0-15 0.6-2.0 15-60 6.0-20.0
AVAILABLE WATER HOLDING CAPACITY-5 FT. DEPTH-INCHES	3-4	7-8.5	~~3-6~~ 4-5	3-4
WATER SUPPLYING CAPACITY-INCHES	5-8	5.5-6.5	~~4-6~~ 5-8	5-8
DEPTH TO WATERTABLE-INCHES				
EROSION HAZARD	Moderate ~~Medium~~	moderate-wind Slight	slight	slight
SURFACE RUNOFF	Medium	slow	slow	slow
SOIL PROFILE DRAINAGE	Somewhat excessively	well	Somewhat excessively	Somewhat Excessively
MANAGEMENT CONDITIONS:	Suited for drought tolerant [illegible]	This soil will blow easily. Crops may be affected by alkali in spots	See DeC Low rainfall for dependable Range Seeding	It has patches that make up about 20% of the area of deep Silty Clay loam soil with good water holding capacity (10-11 inches) Most of this area is under [illegible] with [illegible] lacks soil holding capacity its adapted to light frequent irrigations.

* SEE SYMBOLS ATTACHED

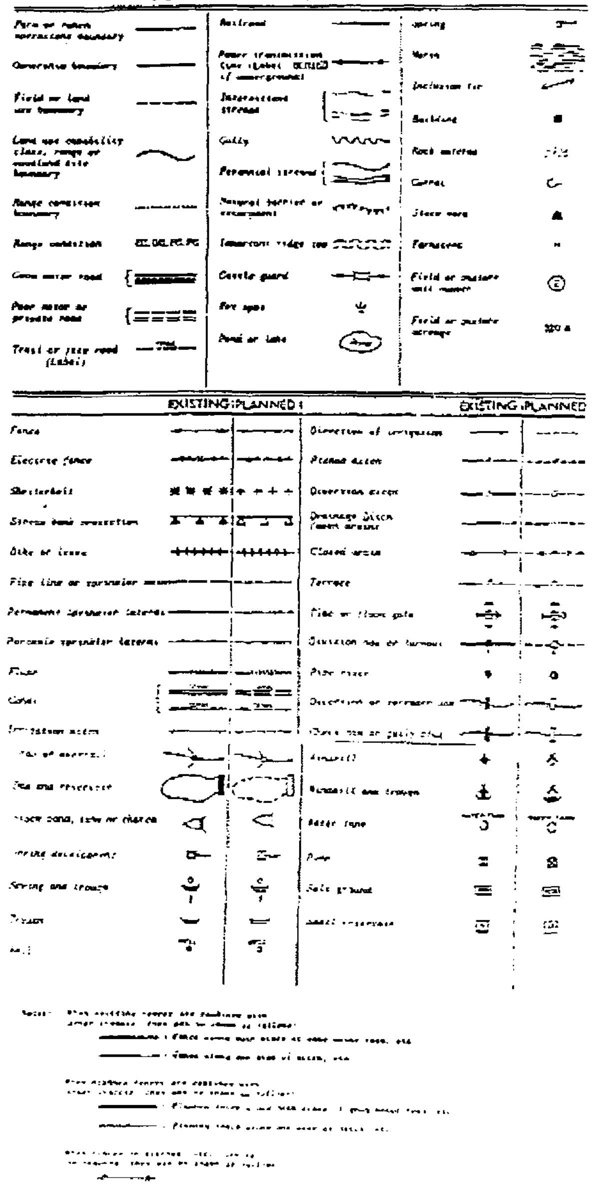
NON-Irrigated Droughty soil

SOIL TEXTURE
AND MODIFIER
SYMBOLS

COS Coarse sand
S Sand
FS Fine sand
VFS Very fine sand
LCOS Loamy coarse sand
LS Loamy sand
LFS Loamy fine sand
LVFS Loamy very fine sand
COSL Coarse sandy loam
SL Sandy loam
FSL Fine sandy loam
VFSL Very fine sandy loam
L Loam
SIL Silt loam
SI Silt
SCL Sandy clay loam
CL Clay loam
SICL Silty clay loam
SC Sandy clay
SIC Silty clay
C Clay
CE Coprogenous earth
CEM Cemented
DE Diatomaceous earth
FB Fibric material
FRAG Fragmental material
G Gravel
GYP Gypsiferous material
HM Hemic material
ICE Ice or frozen soil
IND Indurated
MARL Marl
MPT Mucky-peat
MUCK Muck
PEAT Peat
SG Sand and gravel
SP Sapric material
UWB Unweathered bedrock
VAR Variable
WB Weathered bedrock
CIND Cinders

BY Bouldery
BYV Very bouldery
BYX Extremely bouldery
CB Cobbly
CBA Angular cobbly
CBV Very cobbly
CN Channery
CNV Very channery
CR Cherty
CRC Coarse cherty
CRV Very cherty
FL Flaggy
FLV Very flaggy
GR Gravelly
GRC Coarse gravelly
GRF Fine gravelly
GRV Very gravelly
MK Mucky
PT Peaty
SH Shaly
SHV Very shaly
SR Stratified
ST Stony
STV Very stony
STX Extremely stony
SY Slaty
SYV Very Slaty
WAT Water
IMP Man-made impervious surfaces

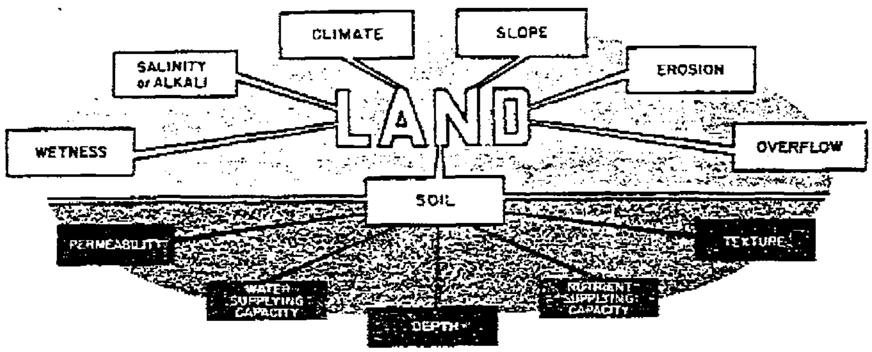
CONVENTIONAL MAPPING SYMBOLS FOR
CONSERVATION PLAN MAPS



CLASSIFYING LAND ACCORDING to it's CAPABILITY FOR USE

Step 1. COLLECTING LAND FACTS

The first step in making a conservation farm plan is a careful survey of the land itself. This is usually done by a trained soil surveyor who goes over the ground and identifies and maps the land conditions. He collects all the significant facts about the land that are likely to have a bearing on its proper use and treatment.



Step 2. CLASSIFYING LAND FACTS

The next step is to gather the soils with similar characteristics, limitations and management problems into groups and to identify these groups. This is done by use of the land capability classification.

CAPABILITY SYMBOL

III s 3

1 2 3

1 Land capability class: The Roman numeral expresses the possibilities for use and the degree of hazard or limitation for each use (see other side of page).

2 Land capability subclass: The small letter following the Roman numeral, indicates the dominating limitation or hazard (see other side of page).

3 Land capability unit: The Arabic number identifies the land unit which describes the condition and need for special conservation treatment.

M-2685

05/29/01 02:11pm 435 438 2168 BEAVER CO UT -->14353876081 ECM Pg. 03/03

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

THE LAND CAPABILITY CLASSIFICATION

Your conservation farm plan is fitted to the conditions on your farm or ranch. The first step is a careful survey of the soils, including slope, erosion and other features. An experienced soil scientist plots this information on an aerial photograph.

The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and production on the farm or ranch.

The classification contains two general divisions: (1) Land suited for cultivation and other uses, and (2) land limited in use and generally not suited for cultivation. Each of these broad divisions has four classes which are shown on the map by a ~~standard color and~~ number. The hazards and limitations in use increase as the class number increases. Class I has few hazards or limitations, or none, whereas Class VIII has a great many.

Capability classes are divided into subclasses. These show the principal kinds of conservation problems involved. The subclasses are: "e" for erosion, "w" for wetness, "s" for soil, and "c" for climate.

Capability classes and subclasses, in turn, may be divided into capability units. A capability unit contains soils that are nearly alike in plant growth and in management needs.

LAND SUITED FOR CULTIVATION AND OTHER USES

CLASS I

Soils in Class I have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland, or wildlife.

CLASS II

Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS III

Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS IV

Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

LAND LIMITED IN USE--GENERALLY NOT SUITED FOR CULTIVATION

Soils in Class V have little or no erosion hazard but have other limitations that prevent normal tillage for cultivated crops. They are suited to pasture, range, woodland, or wildlife.

CLASS VI

Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

CLASS VII

Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

CLASS VIII

Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

M-2695

7-L-15130
REV. 7-59

Attachment 8

Laboratory Results for Lagoon Water, Solids, and Soil Tests used in Sample Calculations

WARD

Laboratories, Inc.

Ag Testing - Consulting

SLURRY REPORT

25642
CIRCLE FOUR FARMS
PO BOX 100
MILFORD UT 84751

Invoice Number: 669576
Date Received: July 14 2000
Date Reported: July 17 2000

MAIL

Results For: CIRCLE FOUR FARMS
Lab Number: 420

Sample ID: 41203 LAGOON

1

	Analysis As Received	Total Lbs per Acre Inch	Total Lbs per 1000 gal	Amount Available First Year Lbs per Acre Inch	Amount Available First Year Lbs per 1000 gal
AMMONIUM, ppm N	932.1	211.3	7.8	211.3	7.8
TOTAL N (TKN), ppm N	1097.0	248.7	9.2	211.3	7.8
PHOSPHORUS, ppm P205	98.9	22.4	0.8	11.2	0.4
POTASSIUM, ppm K20	1532.9	347.5	12.9	347.5	12.9
pH	8.3				
TDS, mg/L	6152.0				
TOTAL SOLIDS, mg/L	6499.0				

Raymond Ward

Reviewed By: Raymond Ward

Bus: 308-234-2418
Fax: 308-234-1940

web site
www.wardlab.com

4007 Cherry Ave., P.O. Box 788
Kearney, Nebraska 68848-0788

Soil Test Report

and

Fertilizer Recommendations

USU Analytical Labs
Utah State University
Logan, Utah 84322-4830
(435) 797-2217
(435) 797-2117 (FAX)

Date Received: 3/24/00
Date Completed: 4/5/00

Name: CIRCLE FOUR FARMS
Address: JIM WEBB
BOX 100
MILFORD UT 84751

County: BEAVER

Lab Number: 00010431

Grower's Comments:

Acres in Field:

Identification: 41203 4

Crop to be Grown: Alfalfa

Soil Test Results			Interpretations	Recommendations
Texture		Loam		
Lime		0	Low	
pH		7.6	Normal	
Salinity - ECe	mmhos/cm	0.8	Normal	
Phosphorus - P	ppm	2.7	Very Low	200-220 lbs P2O5/A
Potassium - K	ppm	214	Adequate	0 lbs K2O/A
Nitrate-Nitrogen - N	ppm	5.5		0 lbs N/A
Zinc - Zn	ppm			
Iron - Fe	ppm			
Copper - Cu	ppm			
Manganese - Mn	ppm			
Sulfate-Sulfur - S	ppm			
SAR				
Organic Matter	%			

Notes

For further assistance, please see your County Agent -- Mark Nelson - 438-6451

WARD

Laboratories, Inc.

Ag Testing - Consulting

MANURE REPORT

25642
WEBB, JIM
CIRCLE FOUR FARMS
PO BOX 100
MILFORD UT 84751-0100

Invoice Number: 682877
Date Received: February 27 2001
Date Reported: February 28 2001

MAIL & FAX

Results For: CIRCLE FOUR FARMS
Lab Number: 221

Sample ID: W SIDE BIONSOIL
2/26/01

	Analysis Dry Basis	Lbs/Ton Dry Basis	Lbs/Ton As Is Basis	Lbs Available/Ton First Year As Is Basis
ORGANIC NITROGEN, % N	2.71	54.2	43.6	8.7
AMMONIUM, ppm N	13816	27.6	22.2	22.2
NITRATE, ppm N	3.9	0.0	0.0	0.0
TOTAL N (TKN), % N	4.09	81.8	65.8	30.9
NITRITE, ppm N	.04			
PHOSPHORUS, % P2O5	12.83	256.5	206.3	72.2
POTASSIUM, % K2O	2.57	51.4	41.3	41.3
SULFUR, % S	0.88	17.5	14.1	4.9
CALCIUM, % Ca	4.32	86.4	69.5	34.7
MAGNESIUM, % Mg	2.95	59.0	47.4	23.7
SODIUM, % Na	0.49	9.8	7.9	7.9
ZINC, ppm Zn	503	1.01	0.81	0.40
IRON, ppm Fe	3905	7.81	6.28	3.14
MANGANESE, ppm Mn	594	1.19	0.96	0.48
COPPER, ppm Cu	1948	3.90	3.13	1.57
CHLORIDE, ppm Cl	7644.35	15.29	12.30	12.30
SOLUBLE SALTS, mmho/cm	37.68	48	39	39
pH	6.4			
MOISTURE, %	19.58			
DRY MATTER, %	80.42			

The concentration of the plant nutrient levels and the amount of nutrient per ton of manure are shown. We have also estimated the amount that is available the first year. Sodium becomes a problem when the total sodium applied is greater than 500 lbs per acre. Soluble Salt problems start occurring when the total amount of "salt" applied is greater than 5,000 pounds per acre. As shown by the analysis above, sodium and soluble salts are low.

Raymond Ward

Reviewed By: Raymond Ward

Bus: 308-234-2418
Fax: 308-234-1940

web site
www.wardlab.com

4007 Cherry Ave., P.O. Box 788
Kearney, Nebraska 68848-0788

Attachment 9

NRCS "Utah Manure Application Risk Index"(UMARI) and Sample Calculations

Utah Manure Application Risk Index - Excel Spreadsheet
Instructions for Use

General Information:

Enter the landowner and planners name in the first two yellow boxes. Then enter the weather station that is closest to the site being evaluated. Weather station information can be found by clicking on the gray tab at the bottom of the screen marked "Winter Precip." The amount of winter precipitation will automatically be entered in the white box. The name of the weather station must be spelled exactly as shown in Table 3 for the correct precipitation to be displayed. Next enter the location of the site being evaluated. Today's date is automatically displayed. This can be changed if desired, but once changed the program will no longer pull in todays date.

Enter the tract and number of the field being evaluated. There is enough room on the spreadsheet to evaluate eight fields. Then enter the soil map symbol of the soil that is nearest to the water source, that is the most restrictive, or that is the dominant soil. From soil survey information, enter the adjusted available water holding capacity for a five foot depth or for the depth to any restrictive layers. Adj. AWC is determined by multiplying the AWC by 75% (0.75). Point values in Section 1 for Adj. AWC and Winter Precip. will be calculated automatically by the computer.

Section 1: Winter Application Parameters:

Using the point values obtained from Table 1, Winter Application Parameters, enter the number of points for each given field feature (Distance, Irr. Type, etc.). The computer will automatically calculate the total points and risk level for the field. If desired, the spreadsheet can be used to document both the before and after conditions of each field. As a minimum the spreadsheet should be used to document the after condition. Lastly, enter the code(s) listed at the bottom of the sheet for all practices that have been or will be implemented. Press the "space bar" to blank out an entry.

Section 2: Spring, Summer, Fall Application Parameters:

The computer will automatically fill in the values entered in Section 1 for Irr. Type, Restrict. Lay, Hyd Group, and % Slope since these values will be the same as those in Section 1. Using the point values obtained from Table 2, Spring, Summer, Fall Application Parameters, enter the number of points for the Distance, Cover Type, Incorporation, Runoff Control, and Irr. Efficiency. The computer will automatically calculate the total points and risk level for the field. Then enter the practice codes.

Interpretation:

An interpretation table (vulnerability table) can be found by clicking on the tab at the bottom of the screen labeled "Intrepretation". This table explains the ratings displayed in the row labeled "risk level".

To obtain additional information or help on the use of the Utah Manure Application Risk Index, (UMARI) contact your nearest NRCS Area Agronomist or Kerry Goodrich at (801) 524-4568. Additional information is also available that fully explains the use of UMARI and discusses how best management practices can be used to lower the risk index.

*Utah Manure Application Risk Index Worksheet

Landowner:	Circle Four Farms	**Weather Station:**	Milford
Planner:	Jim Webb	**Location:**	Milford, Utah
Winter Precipitation:	3.7	**Date:**	April 9, 2001

Tract:								
Field:	C4							
Soil Symbol:	SDA							
Adj AWC (5ft):	7							

Section 1: Winter Application Parameters

Distance	1.5							
Irr. Type	1.5							
Cover Type	1.5							
Containment	3							
Restrict. Lay.	1.5							
Hyd. Group	6							
% Slope	1.5							
Adj. AWC	2							
Winter Precip.	0.5							
Total Points:	19.0							
Risk Level:	Low							
Practices to be implemented								

Section 2: Spring, Summer, Fall Application Parameters

Distance	1.5	0	0	0	0	0	0	
Irr. Type	1.5	0	0	0	0	0	0	
Cover Type	1.5							
Incorporation	3							
Restrict. Lay.	1.5	0	0	0	0	0	0	
Hyd. Group	6	0	0	0	0	0	0	
% Slope	1.5	0	0	0	0	0	0	
Runoff Control	0.5							
Irr. Efficiency	2							
Total Points:	19.0	0.0	0.0	0.0	0.0	0.0	0.0	
Risk Level:	Low	V Low	V Low	V Low	V Low	V Low	V Low	
Practices to be implemented								

*Any individual features with a High rating should be evaluated and conservation practices applied where possible. Where a restrictive layer is present at <= 2 feet, manure should not be applied on frozen/snow covered ground nor at levels above agronomic rate for phosphorus.

Practices to be implemented:

CT = Cover Type
FS = Filter Strip
IN = Incorporation
SB = Setback
IS = Irrigation System Improvement
IWM = Irrigation Water Management
SM = Soil Moisture Management
TR = Tailwater Recovery System
RB = Riparian Buffer
RC = Runoff Containment
RL = Restrictive Layer
WS = Wetland System

Table 1
Winter Application Parameters*

Field Features	Very Low Risk	Low Risk	Medium Risk	High Risk**
Points:	**1.5**	**3**	**6**	**9**
Distance to water	> 1000 feet from water or ditch	500-1000 feet from water or ditch	Appropriate setback applied[1] (< 500 ft)	Downstream edge of field adjacent to water or ditch
Irrigation Type/ Field Surface	Sprinkler, level border, smooth level field	Graded border, Flood irrigation w/out furrows	Flood irrigation with furrows, rolling surface	Uncontrolled flood, unlevel, hummocky
Cover Type	Good stands of alfalfa, grass, or a cover crop	Grain stubble, plowed, or rough bare ground	Corn stubble, or poor stands of perennial crops	Smooth, bare ground
Runoff Containment	Fully contained for a 10 year 24 hour storm	Flows into adjacently owned field	Flows into internal field distribution ditch	Flows directly to water or off owned property
Soil Limitations[2]	> 5 ft	4-5 ft	2-4 ft	<=2 ft
Hydrologic Group[3]	A	B	C	D
% Slope	< 2%	2-3%	4-5%	> 5%
Points:	**0.5**	**1**	**2**	**3**
Adjusted AWC[4]	> 10"	7.5-10"	2.5-7.5"	< 2.5"
Winter Precipitation (Oct. to Mar.)	< Adjusted AWC	0 to 2" over Adjusted AWC	2 to 3" over Adjusted AWC	> 3" over Adjusted AWC

* Applicable only to irrigated lands.
**Individual high-risk features should be evaluated and conservation practices applied where possible.

1. Manure is applied according to an appropriate setback as shown in the following table. Where vegetative buffers such as filter strips or riparian buffers are applied, setback distances may be lowered as shown in the table. Setback distances shown are from the edge of the field when buffers are not used or from the edge of the buffer.

%Slope	Setback Distance w/out Buffers		Setback Distance with Buffers	
	Without Furrows	**With Furrows**	**Without Furrows**	**With Furrows**
0-1	50	100	0	10
1-2	150	200	10	20
2-3	250	300	20	30
3-4	350	400	30	40
4-5	450	500	40	50

2. Restrictive layers include water table, bedrock, and gravelly or sandy layers in the rooting depth.
3. Use the soil map unit that is nearest to the water source, that is most restrictive, or that is the dominant soil where more than one soil map unit exists in the field.
4. Multiply the available water holding capacity for a 5-ft depth or for the depth of the soil limitation by 75%.

Table 2
Spring, Summer, Fall Application Parameters*

Field Features	Very Low Risk	Low Risk	Medium Risk	High Risk**
Points:	**1.5**	**3**	**6**	**9**
Distance to water	> 1000 feet from water or ditch	500-1000 feet from water or ditch	Appropriate setback applied[1] (< 500 ft)	Downstream edge of field adjacent to water or ditch
Irrigation Type/ Field Surface	Sprinkler, level border, smooth level field	Graded border, Flood irrigation w/out furrows	Flood irrigation with furrows, rolling surface	Uncontrolled flood, unlevel, hummocky
Cover Type	Good stands of alfalfa, grass, or a cover crop	Grain stubble, plowed, or rough bare ground	Corn stubble, or poor stands of perennial crops	Smooth, bare ground
Incorporation of Manure	Injected or incorporated at time of application	Incorporated w/in 7 days by tillage or irrigation	Incorporated w/in 3 months by tillage or irrigation	Not incorporated, or incorporated after 3 months
Restrictive Layer[2]	> 5 ft	4-5 ft	2-4 ft	<=2 ft
Hydrologic Group[3]	A	B	C	D
% Slope	< 2%	2-3%	4-5%	> 5%
Points:	**0.5**	**1**	**2**	**3**
Runoff Control	No runoff, or tailwater recovery system in place	Flows into a semi-isolated wetland area	Flows, unregulated, into internal field distribution ditch	Flows directly to water or off owned property
Irrigation Efficiency	> 60%	50-60%	40-50%	< 40%

* Applicable only to irrigated lands.

** Individual high-risk features should be evaluated and conservation practices applied where possible.

1. Manure is applied according to an appropriate setback as shown in the following table, filter strips or riparian buffers are used, or manure is incorporated within 7 days after application. Incorporation must be done by tillage, sprinkler, or border irrigation only. Setback distances are from the edge of the field when buffers are not used or from the edge of the buffer.

% Slope	Setback Distance w/out Buffers		Setback Distance with Buffers	
	w/incorp.	**w/out incorp.**	**w/incorp.**	**w/out incorp.**
	Sprink / Flood	**Sprink / Flood**	**Sprink / Flood**	**Sprink / Flood**
0-1	10 / 20	20 / 40	0 / 5	5 / 10
1-2	20 / 40	40 / 80	5 / 10	10 / 20
2-3	30 / 60	60 / 120	10 / 15	15 / 30
3-4	40 / 80	80 / 160	15 / 20	20 / 40
4-5	50 / 100	100 / 200	20 / 25	25 / 50

2. Restrictive layers include water table, bedrock, and gravelly or sandy layers in the rooting depth.
3. Use the soil map unit that is nearest to the water source, that is most restrictive, or that is the dominant soil where more than one soil map unit exists in the field.

Table 3
Winter Precipitation Values (from Utah Climate Handbook)

Station	Jan	Feb	*Mar	*Oct	Nov	Dec	Total
Altamont	0.70	0.69	0.39	0.47	0.59	0.82	3.7
Bear River Bay Refuge	1.15	0.92	0.55	0.62	1.08	1.08	5.4
Beaver	0.81	0.87	0.51	0.41	0.87	0.85	4.3
Brigham City	2.23	1.54	0.98	0.77	2.12	2.10	9.7
Castle Dale	0.56	0.48	0.28	0.37	0.48	0.52	2.7
Cedar City Airport	0.69	0.89	0.68	0.48	1.00	0.70	4.4
Circleville	0.50	0.46	0.36	0.35	0.58	0.59	2.8
Coalville	1.08	1.12	0.77	0.76	1.59	1.27	6.6
Corinne	1.42	1.56	0.80	0.82	1.59	1.55	7.7
Cutler Dam	1.08	1.46	0.94	0.93	1.96	1.37	7.7
Delta	0.49	0.56	0.43	0.41	0.70	0.62	3.2
Duchesne	0.43	0.50	0.32	0.47	0.52	0.73	3.0
Elberta	0.81	0.86	0.51	0.54	0.92	0.86	4.5
Ft. Duchesne	0.33	0.34	0.24	0.44	0.37	0.47	2.2
Fairview	0.82	1.14	0.79	0.53	1.24	0.92	5.4
Grantsville	0.62	0.80	0.65	0.56	0.97	0.89	4.5
Heber	1.78	1.56	0.69	0.73	1.64	1.62	8.0
Huntsville	1.92	2.08	1.10	0.94	2.47	1.92	10.4
Jensen	0.46	0.52	0.31	0.51	0.59	0.63	3.0
Kamas 3 NW	1.45	1.74	0.81	0.85	1.61	1.53	8.0
Kanosh	1.12	1.17	0.97	0.65	1.36	1.36	6.6
Lapoint	0.66	0.41	0.29	0.52	0.68	0.66	3.2
Logan 5 SW Exp. Farm	1.43	1.59	0.89	0.95	1.75	1.51	8.1
Logan Experiment Sta.	1.58	1.28	0.82	0.72	1.45	1.54	7.4
Logan Radio	1.02	1.27	0.81	0.82	1.46	1.29	6.7
Logan USU	1.40	1.65	1.01	0.94	1.73	1.72	8.5
Milford	0.67	0.67	0.52	0.40	0.73	0.72	3.7
Minersville	0.78	0.84	0.74	0.50	0.88	0.89	4.6
Morgan	1.84	1.88	0.93	0.85	1.98	1.97	9.4
Moroni	0.85	0.82	0.48	0.46	0.86	0.93	4.4
Ogden Sugar Factory	1.31	1.29	0.83	0.78	1.59	1.35	7.1
Randolph	0.28	0.57	0.33	0.45	1.05	0.48	3.2
Richfield Radio	0.56	0.58	0.37	0.42	0.67	0.59	3.2
Richmond	1.46	1.53	0.99	0.92	1.72	1.68	8.3
Riverdale	1.51	1.57	1.08	0.93	1.69	1.62	8.4
Riverton	0.81	0.94	0.69	0.39	0.76	1.47	5.1
Spanish Fork 1 S	1.70	1.35	0.65	0.39	1.22	1.42	6.7
Tremonton	1.06	1.19	0.92	0.91	1.54	1.31	6.9
Trenton/Lewiston	1.38	1.50	0.83	0.84	1.61	1.45	7.6

* 1/2 avg. monthly precip.

Table 4 - Field Vulnerability for Manure Loss	
Manure Application Risk Index	**General Interpretation of Utah Manure Application Risk Index**
< 16	**VERY LOW** potential for manure movement from the field. If manure is managed properly, there is little or no probability of an adverse impact to surface or ground water. These fields have very good potential for year round spreading.
16 – 32	**LOW** potential for manure movement from the field. The chance of organic material and nutrients' getting into surface or groundwater is very small. Buffers, setbacks, improved irrigation and manure application practices, runoff containment/control alone or in combination will reduce impact. These fields have good potential for year round spreading provided best management practices are in place.
33 – 48	**MEDIUM** potential for manure movement from the field. The chance of organic material and nutrients getting to surface or ground water is very likely. A combination of buffers, setbacks, improved irrigation practices, and/or application practices, will lower the impact. These fields have very limited or no potential for winter spreading.
> 48	**HIGH** potential for manure movement from the field and an adverse impact on surface and ground water. Manure should not be applied unless best management practices are in place. Manure should not be spread during the winter.

Attachment 10

Release Form for Removed Substances

Concentrated Animal Feeding Operation (CAFO)
Release Form for Removed Substances

In cases where CAFO-generated manure is sold or given away to be used for land application activities that are not under the operational control of the permitted CAFO the permittee shall provide the recipient with accurate information on the nutrient content of the manure to be used in determining the appropriate land application rates. In cases where the permittee is selling or giving away more than one (1) pickup load of manure to an entity on an annual basis the permittee shall complete this form along with the person(s) accepting the manure. A copy of this form shall be kept with the permittees CNMP and provided to person(s) accepting the manure along with the general manure application guidelines listed on the back of this form.

1. Facility Information

Owner/Operator Name(s)____

____

Facility Address____

____

UPDES Permit No. ____________________

Name of Entity Accepting the Manure: Individual, Corporation, Partnership, Etc.____________________

____

Amount of Manure Accepted from the Facility on an Annual Basis ________________ lbs, tons (circle one)

Certification

I agree to apply the manure which I have accepted from the facility identified in section 1. of this form according to NRCS Field Office Technical Guide Standards for Nutrient Management and Waste Utilization. I assume full responsibility for proper application of this manure.

____

Signature Print Name Date

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted, is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

____

Signature Print Name Date

Attachment 11

General Manure Application Guidelines

General Manure Application Guidelines

- Take regular soil tests on fields where manure is to be applied. Apply manure on the basis of crop nitrogen needs where soil test phosphorus levels (STP) are below 50 ppm, or on the basis of crop phosphorus needs when STP level are from 50 to 100 ppm. Do not apply manure to fields when the STP level is above 100 ppm.
- Apply manure at agronomic rates based on the nutrients in the manure, soil test levels, realistic crop yield goals, and the crop nutrient requirements given in the following table:

CROP	Unit	N	P205	**K20**
Alfalfa	ton	56.6	13.3	60.0
Barley	bu	1.45	0.55	1.45
Corn Grain	bu	0.9	0.37	0.87
Corn Silage	ton	9.0	3.1	9.0
Grass Hay	ton	40	12.9	58.8
Grass Pasture	ton	31.6	12.7	58.8
Oats	bu	1.15	0.4	1.45
Onions	cwt	0.3	0.13	0.27
Potatoes	cwt	0.5	0.18	0.7
Safflower	lb	0.05	0.03	0.05
Small Grain Hay	ton	11.2	5.15	9.02
Sudangrass	ton	13.6	3.7	17.4
Wheat (Fall Dry)	bu	2	0.75	2
Wheat (Irrigated)	bu	1.7	0.7	2

- Reduce commercial fertilizer rates accordingly when using manure as a nutrient source.
- Service and calibrate application equipment to ensure manure is applied uniformly and at the correct rate. Do not clean application equipment in areas where water can get into a well, stream, river, or other waterbody.
- Incorporate manure with tillage equipment or sprinkler systems where possible and as soon as possible after application to prevent surface runoff.
- Do not apply manure within 50 foot of a stream, river, irrigation return flow ditch, canal, well, or other waterbody. Consider larger setbacks on slopes greater than 5 percent.
- Do not apply manure on steep slopes unless measures are taken to control both soil erosion and runoff.
- Do not apply manure in sensitive areas (e.g. areas where the watertable is 2 feet deep or less, where soils are extremely sandy or gravelly, in wetland areas, on fields that are saturated, next to streams, or in a flood plain).
- Apply manure in the spring, summer, or fall when it can be incorporated properly, as well as be used by growing crops more efficiently.
- Avoid manure applications on frozen or snow covered ground. If manure must be applied on frozen or snow covered ground, do so on areas where surface runoff is controlled by diking or other means.
- Manage irrigation water to minimize over application and leaching of nitrates to groundwater or runoff of nutrients to surface waters.
- Avoid application when soils are wet in order to prevent compation and rutting.
- Spread at times and in ways that will minimize potential odor problems (e.g. spread when the wind is not blowing, spread in the morning when the air is rising rather than in the afternoon, etc.).
- Keep good records of manure applications. Record the crops grown, field(s) and acres that manure is applied to, rate of application, total amount of manure applied, time of application, conditions during application, crop yields, and soil and manure test results.

Note: For more information on proper application of manure, contact the nearest Natural Resources Conservation Service office, Soil Conservation District office, or Utah State University County Extension office.