TECHNICAL NOTES

US DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE
AGRONOMY - 58 Albuquerque, NM
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NEW MEXICO STATE UNIVERSITY-SOIL TEST INTERPRETATION REPORT SOFTWARE * (590 Nutrient Management Job sheet)

BACKGROUND

In 2000, NRCS NM worked with NMSU-CES and NMED to train and certify staff and third party people to plan nutrient management practices for Comprehensive Nutrient Management Plans (CNMPs). Part of this effort was to improve NRCS's technical skills in the area of soil testing and fertilizer recommendations. We also needed a way to accurately recommend organic nutrients from manure and other nutrient sources. This technical note explains how to use an Excel (Microsoft Office 97 or better) spreadsheet developed by NMSU and NRCS to recommend nutrients for crop production.

SOIL TESTING

Soil testing is the key to nutrient management. Without a preplant soil test, fertilizing is a guess at best. Most soil testing is very cost effective. Many times growers put on fertilizer as "insurance" instead of testing the soil to see if fertilizer is needed. People could save as much as $100/ac by spending $20 on a soil test. NMSU has guidelines for soil sampling (Guide A-114) and interpretations (Guide A-122). This technical note assumes the user of the software knows these guidelines and has secured a proper soil test.

There are **three critical items** needed to get soil test values that work with the software. Without correct values from a soil test, the results with the spreadsheet may not be reliable. **First**, the soil test must be run with a saturated paste extract for determining soil salinity (electrical conductivity) and pH. Exchangeable calcium, magnesium and sodium is used to. compute sodium hazards (SAR and ESP). Salinity interpretations are based on the saturated paste. **Second**, soil phosphorus should be determined using the sodium bicarbonate procedures described by Olsen and others in 1954, since NM soils are usually alkaline (pH>7). A Bray test (which uses a mixture of acids) is used for soils with a pH<7 and will usually show too high in available P value for alkaline soils. **Third**, potassium (K) interpretations are based on water extractable K. Other extractants do not correlate to the NMSU software. **THESE THREE POINTS ARE CRITICAL TO USE THIS SPEADSHEET MOST EFFECTIVELY**. Most soil labs are capable of doing these tests as explained above. They will not do them without being asked, so **ASK** for them on the soil test data sheet (see **Attachment 1**).

Both organic manure applications and inorganic fertilizer applications **must use** the spreadsheet (Job sheet) to apply the 590 Nutrient Management practice. NRCS **does not** have a hand procedure. The new national job sheet for 590 is not to be used in NM, and the old one is now canceled.

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SPREADSHEET INSTRUCTIONS

- **Computer Requirements**

Any Pentium class computer with Microsoft Office 97 (Excel 97) can use the workbook (job sheet). The users need to know basic skills for spreadsheets. These skills can be learned by simply using the spreadsheet and following the example listed below.

- **Get A Copy**

The NRCS home page address is www.nm.nrcs.usda.gov. The sheet is listed as a nutrient management job sheet in section IV of the Field Office Technical Guide on the NRCS NM website (http://www.nm.nrcs.usda.gov/technical/fotg/section-4/std-specs.html). If there are difficulties in getting a copy, contact the NRCS State Agronomist for assistance.

- **Required Input**

Only the cells colored light yellow or tan will allow or require input. Some cells ask for information about the client that is for reference, such as address and comments on where the sample was taken. Other cells have required information to complete the interpretation. The cells with a small red corner (upper right hand) have comments that will help the first time user. Cells with down arrows at the right hand side have lookup pull-down lists that allow the user to select the correct data.

Attachment 2 shows the example "**Report" tab** printout and **Attachment 3** shows the example "**Organic Nut(rient). Source" tab** printout, and **Attachment 4** shows the example "**P uptake" tab** printout.

The user needs to have a copy of a recent (within the last 5 years for permanent crops or 1 year for annual crops) soil test that includes EC, pH, N, P, K, Mg, Ca, Na, the sampling depth, field acreage, expected rainfall and irrigation in inches, and nitrate-N content of the irrigation water, as a minimum. Users also need to know the crop to be grown and the expected yield. All information listed above is entered on the "**Report" tab (sheet)** of the workbook.

If the plan is to apply manure solid or liquid, the "Organic and Manure Land Application" Sheet and a Phosphorus Index must be completed. This requires lab tests for the solid and liquid or the use of the table values listed in "**Organic Nut. Source" tab**. Users must know the kind of material to be handled and the application method.

The third tab in the workbook is the "**P uptake" tab**. It is used to help the user balance the P uptake when the P Index shows the application must be P based. The only input needed is the P index number (Agronomy Technical Note 57 on the web). This sheet will tell the user how many tons or acre-inches of material can be applied to the field(s).

Be sure to review the results with the client and have them sign at the bottom. The planner is also asked to sign the printed form (sheet) to indicate they have the needed job approval to plan and apply the practice, and that all of the information is correct.

EXAMPLE

A grower has a 3000 cow dairy and spreads manure solids and lagoon liquids on a poorly drained soil on a 130-acre circle near the Los Lunas FO. The grower applies 30 inches of irrigation water with 2 ppm nitrate-N for corn silage. One acre-inch of lagoon liquid is applied per acre per year. There are 20 ton/ac of silage produced each year. The dry solids are kept in the barn lot and piled up. A sprinkler wash system in the holding pen of the dairy is used prior to milking. This wash water liquid is held in an aerobic lagoon. There are no lab samples for the liquid and solid stack for nutrient content. The grower's question is how many tons/ac of solids and acre-inches of lagoon liquid can be land applied per year. Current plans are to apply the solids to the surface and disk them in within a week. The liquid will be applied to the soil surface of established corn with no incorporation. The Phosphorus Index for the field in question came out to be 40. The soil test results from a 12 in depth sample are listed in **Table 1**.

Table 1 Results from the soil test.

Test Parameter	Units	Test Result	Detection Limit
pH (Soil Saturated Paste)	N/A	**7.2**	N/A
EC (Electrical Conductivity of Saturated Paste Extract.)	mmhos/cm	**1.0**	0.01
Mg (Magnesium for SAR)	meq/L	**1.99**	0.01
Ca (Calcium for SAR)	meq/L	**7.04**	0.01
Na (Sodium for SAR)	meq/L	**3.87**	0.01
OM (Organic Matter)	percent	**2.1**	0.01
NO_3-N (Nitrate from 1:5 soil:water extract)	ppm	**5.7**	0.1
P (Phosphorus from $NaHCO_3$ extract, Olsen test)	ppm	**141**	0.5
K (Potassium from 1:5 soil:water extract)	ppm	**25**	1
Texture (texture of the soil by feel method)	N/A	**Clay**	N/A

To find the answer to her question:

- **Step 1** Boot up Microsoft Excel on a computer that has the **NMSU Soil Test Interp.xls** file on it. Select (Left click) the "report" tab.
- **Step 2** Enter Client Name (in cell C3), Address, pull down and select the correct zip code for the client, the phone number, the field number(s), the crop rotation (starting with the crop for the fertilizer recommendation, Acres in the field(s), and any comments from the data field sheet. Navigate to cell E30 and enter the ppm of NO_3-N in the irrigation water.
- **Step 3** Enter All data from the soil test report. (pH, EC, soil texture, OM, NO_3-N, P, K, Mg, Ca, Na, Cu, Zn, Mn and Fe). If Zn, Mn, and Fe are not taken, leave them blank.
- **Step 4** Select the correct crop to be grown from the pull-down list, and enter the yield goal. *Note that at this point a basic inorganic fertilizer interpretation has appeared at the bottom of the sheet. You could add a note in the "Specific Notes:" cell and print the report if this were an inorganic interpretation.*
- **Step 5** Select the "organic nut source" tab at the bottom of the sheet. Enter the 1 acre-in/ac of effluent to be applied applies in cell E3. Since solids are also to be applied to the circle, put 1 ton/ac in cell E5. *The sheet will then compute the rates of fertilizer from a ton of manure solids applied based on book values for dairy manure.*
- **Step 6** Select the sources of solids and liquids using the pull downs since there is no lab data. Select Dairy Cattle (30% wet wt) Ave for the solids and NM Dairy Ponds (>99.5% liq.) Ave. for the liquid.
- **Step 7** Select the type of application and the type of climate for N volatilization. Select Broadcast-incorporated in 4 days and Warm Dry and Sprinkler without (w/o) incorporation and Warm Wet for climate.

- **Step 8** Select the manure source for dry and liquid manure for the Mineralization of N, P, and K. Select Beef and Dairy Solid w/o Bedding and Lagoon or diluted Pond.
- **Step 9** Select the OM and Soil Drainage Class for the N Denitrification calculation. Select <2% for OM and Poorly Drained for the Drainage Class.
- **Step 10** Select the P uptake tab and enter the PI (phosphorus index) of 40 in cell B5.
- **Step 11** While on the P uptake sheet note that cell B11 shows that there is 13 lbs/ton P_2O_5 as applied from manure. Also, note that the total P_2O_5 uptake by the harvested material is 80 lbs/ac. Finally, note that the 1 ac-in/ac application of lagoon liquid yielded 16 lbs/ac P_2O_5. The expected phosphorus removal by the crop is 80 lb P_2O_5 per acre. Subtract the total applied (29 lb/acre) from the crop removal rate to estimate how much additional liquid or solid material could be applied to meet the phosphorus index restrictions (80 – 29 = 51). Adjust the solids applied in the organic nut. Sheet such that total P applied (cell E12) equals P_2O_5 Crop Uptake (cell F10). For our example, **this means that 4.9 (~5) tons/ac manure can be applied in addition to the 1 acre-inch of lagoon liquid to meet the phosphorus index restriction of phosphorus based (at crop removal) application of organic sources.**
- **Step 12** Change to the Report tab, and go to the specific note cell. Type a note that explains the numbers on the report. For example: This recommendation is based on P uptake of the harvested material. Additional nitrogen is needed to meet the suggested N fertilizer needs for the 20 ton/acre estimated corn silage yield goal. The Fert Cost tab can be used to estimate quantities of different nitrogen fertilizers needed to supply an additional 67 lb/ac of nitrogen. A solution of urea ammonium nitrate would need to be applied during the growth of the corn crop at 210 lb/A. The K application is very high and feed nutrition should be monitored to avoid grass tetany conditions.

FUTURE CHANGES AND ONGOING RESEARCH

Updates continue to be made to this workbook until such time that a more suitable replacement is available for New Mexico conditions. NRCS and NMSU will add crops, and change fertilizer rates periodically based on applied research and new data. If the users find a need to have something changed, please contact the NRCS state agronomist or the NMSU Extension Agronomist to discuss changes. Please check the internet site for the most recent version of the workbook.

Attachment 1

Sampling Date:

Name

Address

City **State** Zip

Phone Number ( )

Email address:

SOIL SAMPLE INFORMATION SHEET

NEW MEXICO STATE UNIVERSITY

SWAT LABORATORY

Received Date:

CHECK DESIRED ANALYSIS

Standard	$19.00 ☐
Subsoil Nitrate	$5.00 ☐
Iron & Zinc	$6.00 ☐
Manganese & Copper	$6.00 ☐

Verify Prices at: http://swatlab.nmsu.edu/soilist.html

Sample is for:	☐Farm ☐ Home ☐ Orchard	☐Farm ☐ Home ☐ Orchard	☐Farm ☐ Home ☐ Orchard	☐Farm ☐ Home ☐ Orchard
Lab ID Number				
Field ID				
Geographic Location (TRS, X, Y, Lat/Long)				
Acres or Square Feet				
Sampling Depth (circle one)	0-2 0-4 0-6 0-8 0-12 12-24	0-2 0-4 0-6 0-8 0-12 12-24	0-2 0-4 0-6 0-8 0-12 12-24	0-2 0-4 0-6 0-8 0-12 12-24
Last years crop				
This years crop				
Yield Goal				
Orchard or Vineyard?				
Establishment year & number per acre				
Organic Amendments	Enter Quantity of Each	Enter Quantity of Each	Enter Quantity of Each	Enter Quantity of Each
Solids				
Liquids				
Irrigation System	☐Drip ☐ Flood ☐ Sprinkler	☐Drip ☐ Flood ☐ Sprinkler	☐Drip ☐ Flood ☐ Sprinkler	☐Drip ☐ Flood ☐ Sprinkler
Depth to Groundwater	☐<6' ☐ 6-12' ☐ >12'	☐<6' ☐ 6-12' ☐ >12'	☐<6' ☐ 6-12' ☐ >12'	☐<6' ☐ 6-12' ☐ >12'
Water Nitrate-N Credit	mg/l (ppm)	mg/l (ppm)	mg/l (ppm)	mg/l (ppm)

Person taking sample:

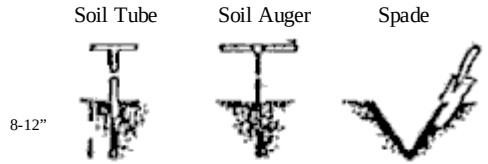
COMMENTS:

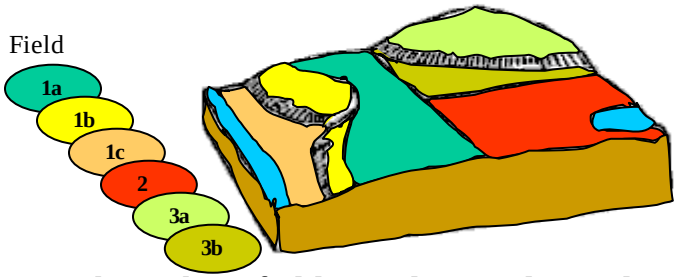
Please remove any rocks from the sample. Submit a minimum of 2 cups of soil that has been air dried. Avoid using rusty tools or containers. See back for sampling instructions and analysis description.

SAMPLING PROCEDURE

SOIL TESTS CAN BE NO BETTER THAN THE SAMPLE ITSELF

1. Use any of the tools shown below to take sample. Sample to the plow depth (Usually 8-12").





These three fields need six soil samples

2. Each sample should represent a uniform area. Size up the area and observe these variations:

   Differences in texture (sand, silt, clay), color, slope, degree of erosion, drainage, past management (fertilization, rotation, etc.).

3. Take 15 to 20 subsamples from each uniform area. Mix thoroughly in a plastic container and fill a plastic bag with a pint of soil. This is the composite sample which represents the field or area. Label each container with your name and address and the field or sample identification (ID) corresponding to the ID on the information sheet.

4. Avoid (or sample separately, if of interest) such areas as: Dead or back furrows, old straw piles, waterways, terraces, fence rows, and unusual or difficult spots.

5. Repeat the sampling procedure outlined on each uniform area you want tested.

6. Air dry the samples before mailing. Do not use heat for drying. Wet samples will delay analyses up to one week.

IMPORTANT

If your sample is to be tested for available zinc and iron, rusty tools will contaminate the sample with iron, and galvanized or brass containers will contaminate it with zinc. The resultant soil analysis could indicate a sufficiency of these elements when actually a deficiency exists. **Use plastic container when possible.**

ALL EQUIPMENT MUST BE ABSOLUTELY CLEAN

SOIL TESTS AVAILABLE

TEST	PURPOSE	COST PER SAMPLE
Standard: pH, total soluble salts, sodium adsorption ratio, organic matter nitrate-nitrogen (water extractable), phosphorus (bicarb) method, and water soluble potassium.	Basic evaluation for characterizing the soil fertility status for growing crops. A fertilizer recommendation is given with sufficient information. Normally this test is sufficient unless a special problem is suspected.	$19.00
Subsoil Nitrate:	Evaluation of nitrate supply below the plow depth. Fertilizer nitrogen recommendation based on routine soil test of surface soil is adjusted if subsoil nitrate is high.	$5.00
Iron and Zinc:	Information on the micronutrients Iron and Zinc. Zinc is usually deficient in New Mexico soil. Carbonates interfere with iron and zinc uptake.	$6.00
Manganese and Copper:	Information on the micronutrients Manganese and Copper.	$6.00

Checks or Money Orders are made payable to New Mexico State University. Always verify prices by contacting the lab or visiting their website at http://swatlab.nmsu.edu/ . Click on soil for a price list. Water samples can also be tested at this laboratory.

Information on additional tests (soil, water, and plant) is available from the Soil, Water, and Agricultural Testing Laboratory. Expected turn-around time is one week in lab. If a delay is expected, you will be notified by phone.

USPS Address:
New Mexico State University
SWAT LAB
Box 30003, Dept. 3Q
Agronomy and Hort Dept.
Las Cruces, New Mexico 88003

Physical Address:
New Mexico State University
SWAT LAB
2290 Knox Street, PGEL West
Las Cruces, NM 88003

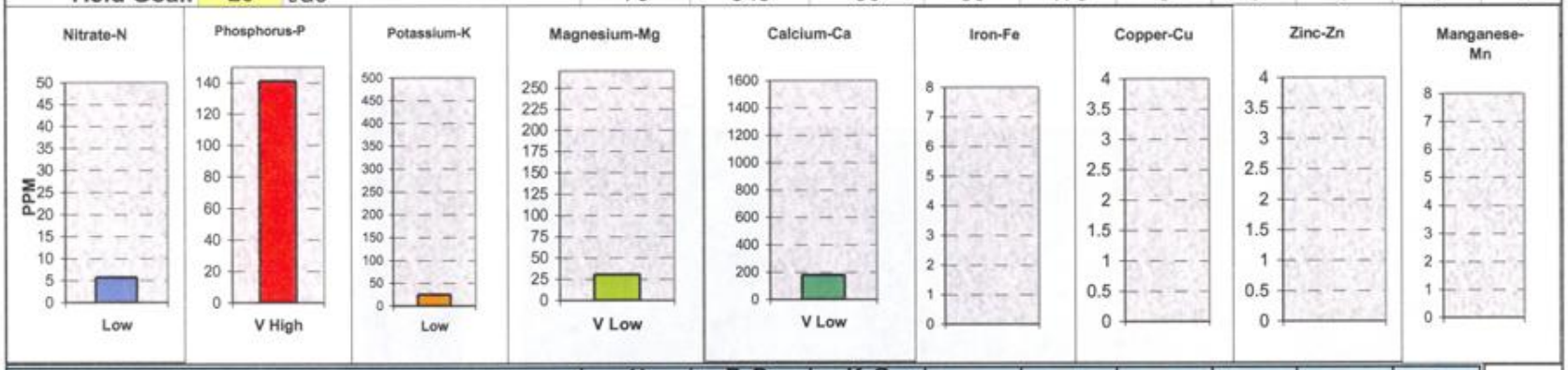
Attachment 2

N.M.S.U.-Soil Test Interpretation Report vs 4.09 - (590 Nutrient Management Jobsheet)

County: Valencia | Field ID: | Crop Rotation:
Client Name: | Record #: 1 | Acres: 130 | Irr. Water (acin/ac): 30
Address: | Planner Name: | Form Notes:
Zip Code: 87006 7/12/2007 | Depth of Sample (in): 6 | Sodium Adsorb. Ratio: 1.8 | ESP: 1.41
Phone:

Note: **E.C.**-Electrical Conductivity or Saltiness, **O.M.**-Organic Matter, and **ESP**-Exchangeable Sodium %.

Samp. ID (#)	pH (#)	E.C. (mmhos/cm)	Soil Texture (class)	O. M. (%)	NO_3-N (ppm)	P (ppm)	K (ppm)	Mg (meq/l)	Ca (meq/l)	Na (meq/l)	Cu (ppm)	Zn (ppm)	Mn (ppm)	Fe (ppm)
	7.2	1	Clay	2.1	5.7	141.0	25.0	2.0	7.0	3.9				
Crop to grow:	Corn, silage 35% DM				lbs/ac	P_2O_5 (lbs/ac)	K_2O (lbs/ac)	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac
Yield Goal:	20 t/ac				73	540	50	30	179	5	0	0	0	0



Nutrient Recommendation:	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac	Mg lbs/ac	Ca lbs/ac	Fe lbs/ac	Cu lbs/ac	Zn lbs/ac	Mn lbs/ac
Recommended Nutrient Rate:	127	0	80	0	0	0	0	0	0
Organic Nutrient Source (Liquid or Solid Manure):	46	80	213						
Irrigation Water Credits (ppm NO_3-N): 2	14								
Other Nutrient Sources (Standing Legume Crop.):									
Supplemental Nutrient Rate:	67	0	0	0	0	0	0	0	0
Available Nutrients > Crop Requirements:	NO	Caution P	Caution K	NO	NO	NO	NO	NO	NO

General Note: Apply P2O5 & K2O at planting time. Apply 1/2 N at planting time and side-dress 1/2 at lay-by. Split applying and banding can improve fertilizer efficiency.

Specific Notes:

EC Note: Very Low | No limitations

Gypsum Recom: 0 lbs/ac or 0 lbs/1000 ft^2

Robert P. Flynn, Ph.D.
Agronomy and Soils
cc: Valencia County Extension Agent

Suggested Fertilizer Blend			
Total Blend (lbs/ac):	210	210 lbs/ac	N Solutions 32% — 27,297.7 lbs Total Needed
Blend Cost ($/ac):	$18.27	0 lbs/ac	0.0 lbs Total Needed
		0 lbs/ac	0.0 lbs Total Needed

Client Signature: | **Planner Signature:** | **27,297.7 Tt Blend (lbs)**

Fertilizer Cost Note: *Default costs are from NASS 10yr ave. ending 2001. Actual cost need local material cost and application charges. (See fert cost tab).*

Attachment 3

590 Nutrient Mgt. Jobsheet for Organic and Manure Land Application

Client Name:		Acres:	130	Date:	7/12/2007	Field #:
Application information (*enter the units that will be applied to the field*):	Liquid Applied:	1	AcIn/ac	Needed for field (acin):		130
				(gal):		3,529,500
	Solids Applied:	4.9	ton/ac	Needed for field (tons):		637
	Liquid Loads Applied:		1000gal/ac	Loads needed for field:		

Nutrient Content of Organic Material

Solid-Lab Report	% Moisture	TKN (%) (dry)	NH_4-N (ppm) (dry)	P_2O_5 (%) (dry)	K_2O (%) (dry)
Fill in Lab data:					

Solid Book Values (select even if test values are used)	% Moisture		TKN (lbs/wet ton)		NH_4-N (lbs/ton)		P_2O_5 (lbs/wet ton)		K_2O (lbs/wet ton)	
	Book	Test	Book	Test	Book	Test	Book	Test	Book	Test
Dairy Cattle (30% wet wt) NM (Aver	30	0	25	0	0.4	0.0	17	0	35	0

Liquid-Lab Report	NH_3-N (mg/L)	TKN (mg/L)	NO_3-N (mg/L)	Tot-PO_4 (mg/L)	K (mg/L)
Fill in Lab data:					

Liquid	% Moisture		TKN (lbs/acin)		NH_4-N (lbs/acin)		P_2O_5 (lbs/acin)		K_2O (lbs/acin)	
	Book	Test	Book	Test	Book	Test	Book	Test	Book	Test
NM Dairy Ponds (>99.5% liq.) Ave.	99.5		67	0	41	0	22	0	93	0

	TKN (lbs/1000gal)		NH_4-N (lbs/1000gal)		P_2O_5 (lbs/1000gal)		K_2O (lbs/1000gal)	
	Book	Test	Book	Test	Book	Test	Book	Test
		0.0		0.0		0.0		0.0

N Volatilization

Solid (type of application)	Type of Climate	Percent Remaining	NH_4-N Remaining
Broadcast-incorporated in 4 days	Warm Dry	60 %	0 (lbs/ton) NH4-N
Liquid (type of application)	**Type of Climate**	**Percent Remaining**	**22.7** (lbs/acin) NH4-N
Sprinkler w/o incorporation	Warm Wet	55 %	0.0 (lbs/1000gal) NH4-N

Mineralization of N, P, & K

Manure Source	Percent Nutrient Available the 1st Year			
	Organic N	P	K	
Beef & Dairy Solid w/o bedding	35 %	75 %	80 %	Solid Source
Lagoon or diluted Pond	40 %	75 %	80 %	Liquid Source

Solid	Organic N (lbs/ton)	P_2O_5 (lbs/ton)	K_2O (lbs/ton)
	9	13	28

Liquid	Organic N (lbs/acin)	P_2O_5 (lbs/acin)	K_2O (lbs/acin)
	11	16	75
	Organic N (lbs/100gal)	P_2O_5 (lbs/1000gal)	K_2O (lbs/1000gal)
	0.00	0.0	0.0

Denitrification of N

Organic Matter Content (%)	Soil Drainage Class (See Survey Infor)	Percent Remaining (%)
<2	Poorly Drained	60

Summary of Nutrients

Net by Form as applied	lbs/1000gal	lbs/ac in	lbs/ton
N	0.0	20	5
P_2O_5	0.0	16	13
K_2O	0.0	75	28

Total Nutrients Applied (net to the field)	All Forms N (lbs/ac)	P_2O_5 (lbs/ac)	K_2O (lbs/ac)
	45.8	80.2	213.0

590 Nutrient Management Jobsheet for Phosphorus Removed by Crop Harvest

Client Name: 0 **Date:** 7/12/2007

Field: 0

P Index (#): 40 **P Based (at crop removal)**

Type of Application (Units)	P_2O_5 (lbs/units)	Crop (name)	Acres (Ac)	Organic P_2O_5 Applied (lbs/ac)	P_2O_5 Crop Uptake (lbs/ac)	Total Amt. that can be applied by type* (Units/ac)
Liquid (ac in):	16.4			16		4.9
Liquid (1000 gal units):	0.0	Corn, silage 35% DM	130	0	80	NA
Solid (tons):	13.0			64		6.2
			Total P Applied	80		

***Note: "None"** means that because of the risk of P in the enviroment no more organic nutrients can be applied until the PI drops to 37 or lower. **"NA"** means that no application of that type is scheduled.

The **number** is the number of acre inches, 1000 gal units, or tons that can be applied and meet the P restrictions.

"N Based" means that orgainic nutrients can be applied based on the N requirement of the Crop.

Attachment 4