

SOIL/MANURE MONITORING PROGRAM
at
BIG SKY RAMA COMPLEX

INTERIM REPORT

Prepared for
**THE SPIRIT CREEK WATERSHED MONITORING
COMMITTEE**

by
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Nipawin, SK. S0E 1E0

November 2001

SOIL/MANURE MONITORING PROGRAM

Interim Report

to
The Spirit Creek Watershed Monitoring Committee

by
Head & Associates Ltd.
November 10, 2001

INTRODUCTION

The Soil/Manure Monitoring Program is designed to monitor the effect that pig manure may have on the soils on which manure is used as a crop production input, and on the crops grown thereon.

The Program has five main areas of activity. These include:

1. **The Initial Benchmark Program** – This Program will establish benchmark soil sampling sites near each of the three barn sites.
2. **Manure/Commercial Fertilizer Comparison Program** – This Program will compare the efficiencies of manure and commercial fertilizer in crop production. The Program will be carried out on the Initial Benchmark Program fields.
3. **Yearly Monitoring Program** – This Program will track the nutrient movement in each of the fields sampled in the Initial Benchmark Program on an annual basis during 2003, 2004, 2005.
4. **Additional Benchmark Program** – Soil benchmark sampling will be done on 2 additional quarter sections in 2002 and in 2003.
5. **Data Management** - An appropriate Geographical Information System will be developed and used to store and manipulate all current and future environmental data for the Spirit Creek Watershed.

The Initial Benchmark Program was completed in the fall of 2001. This report covers the activities and results.

LOCATION OF BENCHMARK FIELDS

Four quarter sections were sampled in the Benchmark Program. Two were near the Finisher Barn, and one near each of the Breeder and Nursery Barns.

Barn	Field	Legal Location	Sample Code	Cooperator
Finisher	1	NW 06-33-06-W2	SCK 1	Lorne Matsalla
	2	SE 13-33-07-W2	SCK 2	Randy Nieckar
Breeder	3	SW 05-32-07-W2	SCK 3	Alec Dutchak
Nursery	4	SE 02-32-08-W2	SCK 4	Donald Dean

SOIL SAMPLING PROCEDURE

Each quarter section was divided into two areas. For the 2003 crop, the small area will receive commercial fertilizer, and the large area will receive pig manure.

Three composite soil samples were collected from each field area. One sample is the composite of 6 individual soil cores taken from the upper slope positions in the field. The second sample is a composite of cores taken from the mid slope positions, and the third is a composite from lower slope positions.

The soil cores were taken with a truck-mounted Giddings™ hydraulic soil sampling unit. The location of each soil core was permanently recorded using a global positioning satellite (GPS) system with differential correction to allow re-sampling at the same locations.

The attached field maps show the field areas and the geo-referenced location of every point at which a soil core was collected. The upper slope, mid slope, and lower slope sampling positions are differentiated on the field maps.

The soil samples were taken on 12 inch increments to a depth of 48 inches. The samples were analyzed by EnviroTest Laboratories in Saskatoon. The analyses carried out on each depth sample is outlined in the following table:

Depth (in)	Analyses
0 - 12	Available N, P, K, S, Cu, Fe, Zn, Mn, B, Total P, Organic Carbon (OM), Electrical Conductivity (EC)
12 - 24	Available N, S, Total P, EC
24 - 36	Available N, S, EC
36 - 48	Available N, S, EC

SOIL ANALYTICAL DATA

The soil analytical data are provided in the attached tables.

Please note that the units of measurement can be correlated to those used in standard farm soil test report using the following conversion factors:

ug/cc time 4 = pounds/acre

ug/g times 4 = pounds/acre

These conversion factors are listed at the bottom of each table.

INTERPRETATION OF ANALYTICAL RESULTS

The soil results were quite typical of what would be expected in stubble fields in the area. The results can be summarized as follows:

N - Available nitrogen or nitrate nitrogen – this represents the amount of crop available nitrogen in the soil. This form of nitrogen can move with soil water. If water percolates down into the soil, nitrate nitrogen will move down with it. Similarly, if soil water moves upward by capillary action to meet crop demands, nitrate nitrogen will move upwards with it.

The nitrogen levels in the soils are quite typical for stubble fields. There has been no accumulation of nitrates below the 24 inch level. The only exception appears to be the Upper Slope sample in the Manure Area of Field 3. There is no obvious reason for this, but it will be an interesting one to watch in future sampling.

There are generally higher available nitrogen levels in the lower slope samples. This corresponds to the higher organic matter levels in this slope position because of higher productivity due to better moisture conditions and due to the accumulation of material that erodes from the upper slopes.

P – Available phosphorus – this represents the amount of phosphorus that is readily available to plants. Phosphorus is immobile in the soil. It does not move with the soil water. Significant movement occurs only when the soil moves, ie soil erosion.

Phosphorus levels are relatively low. This is typical of most soils in Saskatchewan. The highest levels are usually in the lower slope positions as a result of the accumulation of soil materials that erode from the upper slopes.

K – Available potassium – this represents the amount of potassium that is readily available to plants. Potassium is quite immobile in the soil, although slightly more mobile than phosphorus and will move through very sandy soils in wet climates.

The potassium levels are high in these soils. This is typical of most Saskatchewan soils.

S – Available sulfur – sulfur is mobile in the soil and readily moves with soil water.

The sulfur levels are all sufficiently high in these soils. Some of the lower depths have quite high levels. This is usually a sign of shallow or fluctuating water tables that allow the sulfur to accumulate.

Micronutrients – Cu (Copper), Fe (Iron), Mn (Manganese), Zn (Zinc), and B (Boron)

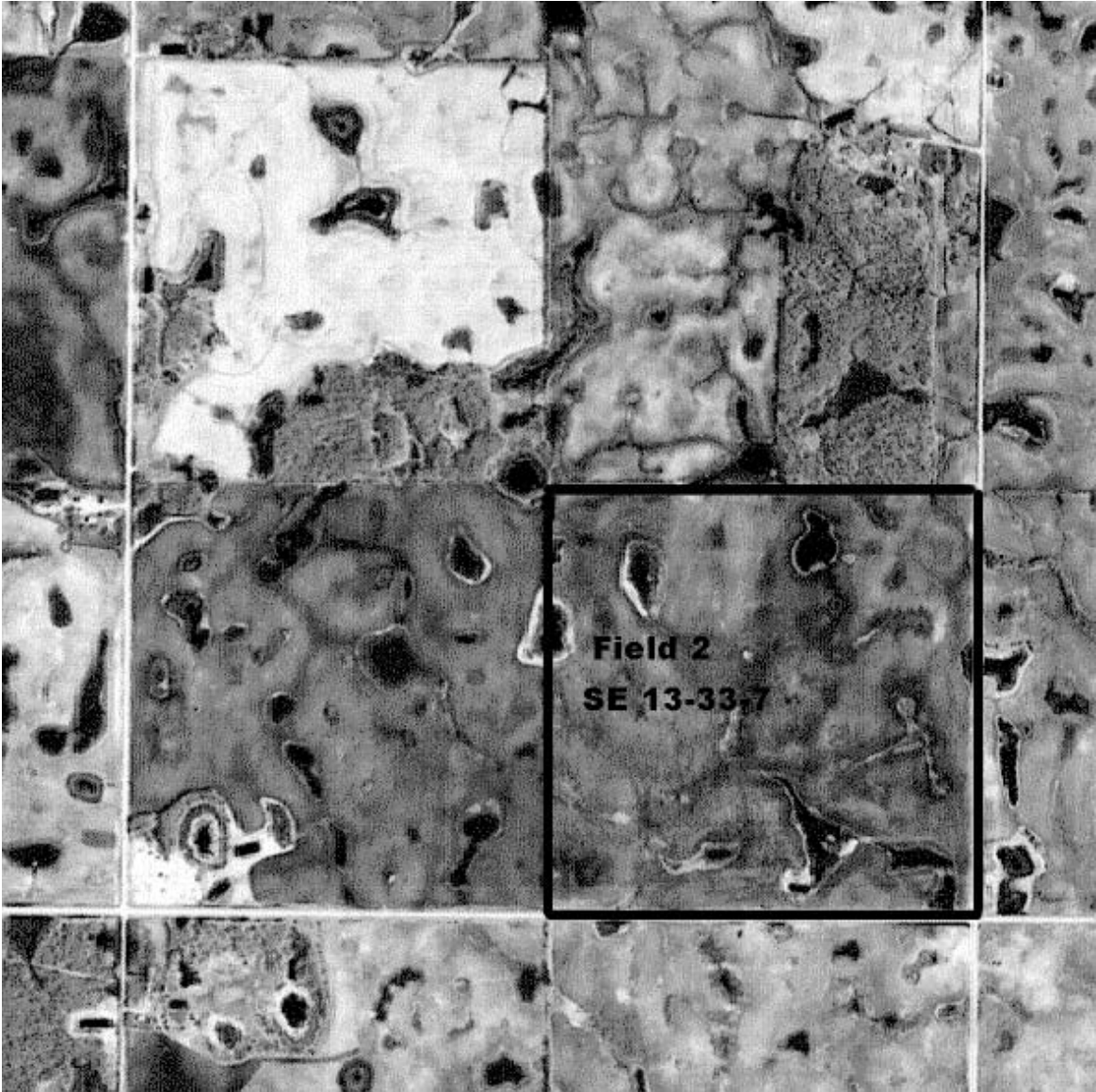
The micronutrients are all at sufficient but not excessive levels, except for copper that is at marginal levels. Low levels of copper are typical of many soils in eastern Saskatchewan.

Organic Matter (Organic Carbon) – These levels are quite variable but generally are higher for the lower slope samples. This reflects the higher productivity in low areas as well as the accumulation of topsoil that has eroded from up slope.

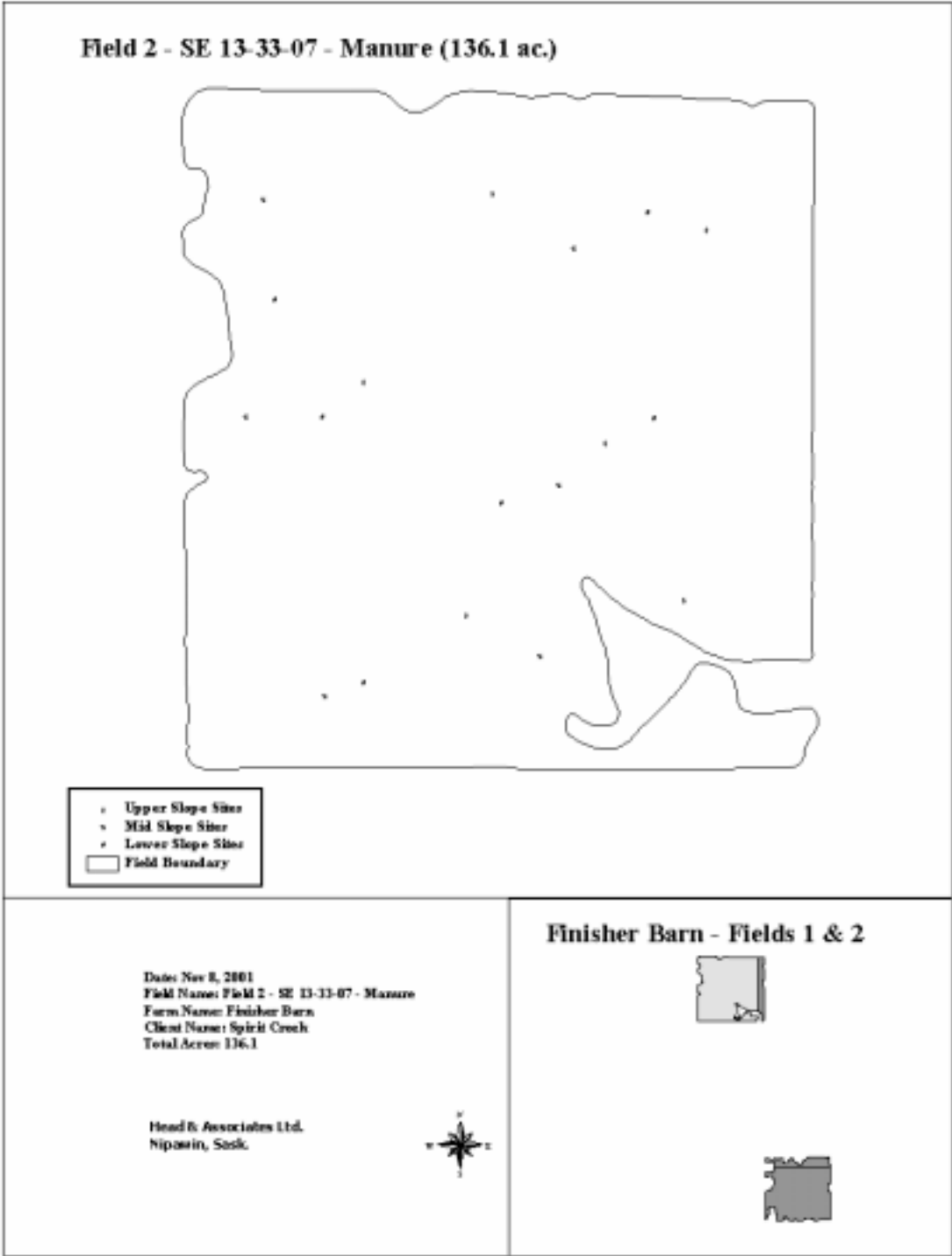
Electrical Conductivity (EC) – This is a measure of the concentration of soluble salts in the soil water and is an indication of the degree of salinity of the soil. The benchmark soils are primarily non-saline, but with some slightly saline subsoils.

pH - This is a measure of soil acidity. The lower the pH the more acid the soils are, with a pH of 7 being neutral. The benchmark soils are basic, a reflection of the high levels of carbonates typical of soils of the region.

Typical aerial photograph



Typical sample location



Field 2 - SE 13-33-07 - Commercial Fertilizer (12.2 ac.)



- Upper Slope Sites
- Mid Slope Sample Sites
- Lower Slope Sites
- Field Boundary

Date: Nov 8, 2001
Field Name: Field 2 - SE 13-33-07 - Commercial Fertilizer
Farm Name: Finisher Barn
Client Name: Spirit Creek
Total Acres: 12.2

Head B. Associates Ltd.
Nipawin, Sask.



Finisher Barn - Fields 1 & 2



INITIAL BENCHMARK PROGRAM SOIL ANALYTICAL RESULTS

Finisher Barn - NW 06-33-06-W2 - Field 1

Manure Area - 120 acres

Slope	Sample	Depth	N	P	Total P	K	S	Cu	Fe	Mn	Zn	B	Org C	O.M.	EC	pH
			ug/cc*	ug/cc	ug/g**	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	%	%	
Upper	SK1-M-U	0-12	2.2	1.7	476	137	7	0.7	25.4	4.4	0.4	0.3	1.4	2.3	0.1	8.6
		12-24	1.2		527		5								0.2	
		24-36	1.2				17								0.3	
		36-48	1.6				119								0.6	
Mid	SK1-M-M	0-12	3.4	2.3	501	127	74	0.7	24.0	2.8	0.4	0.5	1.8	3.1	0.3	8.5
		12-24	1.2		540		244								1.2	
		24-36	1.0				436								2.0	
		36-48	1.6				394								1.3	
Lower	SK1-M-L	0-12	41.4	4.1	462	108	1110	0.5	46.6	1.6	0.8	0.5	4.1	7.1	1.7	7.9
		12-24	10.0		424		394								1.4	
		24-36	4.2				234								1.2	
		36-48	4.0				446								2.0	

Commercial Fertilizer Area

Slope	Sample	Depth	N	P	Total P	K	S	Cu	Fe	Mn	Zn	B	Org C	O.M.	EC	pH
			ug/cc*	ug/cc	ug/g**	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	%	%	
Upper	SK1-C-U	0-12	3.2	2.6	554	111	7	0.7	13.6	3.6	0.3	0.3	1.3	2.3	0.1	8.7
		12-24	1.0		601		5								0.2	
		24-36	0.8				23								0.3	
		36-48	1.2				39								0.3	
Mid	SK1-C-M	0-12	3.4	2.5	511	119	282	0.7	25.0	3.4	0.4	0.4	1.6	2.8	0.7	8.3
		12-24	1.0		552		204								1.1	
		24-36	0.8				206								0.9	
		36-48	1.0				510								2.5	
Lower	SK1-C-L	0-12	4.2	30.0	660	140	672	0.6	33.6	2.2	1.8	0.8	4.0	6.8	1.3	8.0
		12-24	0.8		456		932								3.0	
		24-36	1.4				606								2.3	
		36-48	2.8				254								1.1	

* ug/cc times 4.3 = pounds/acre

**ug/g times 4 = pounds/acre

INITIAL BENCHMARK PROGRAM SOIL ANALYTICAL RESULTS

Finisher Barn - SE 13-33-07-W3 - Field 2

Manure Area - 120 acres

Slope	Sample	Depth	N	P	Total P	K	S	Cu	Fe	Mn	Zn	B	Org C	O.M.	EC	pH	
			ug/cc*	ug/cc	ug/g**	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	%	%	mS/cm		
Upper	SK2-M-U	0-12	3.6	8.4	384	136	9	0.7	19.0	4.8	0.7	0.2	1.0	1.8	0.1	8.6	
		12-24	1.6		549		15									0.3	
		24-36	1.2				43									0.3	
		36-48	1.4				474									1.3	
Mid	SK2-M-M	0-12	6.6	4.6	491	117	57	0.9	23.4	3.4	0.7	0.5	2.2	3.7	0.3	8.6	
		12-24	1.4		536		630									1.4	
		24-36	1.2				736									1.9	
		36-48	1.2				614									1.8	
Lower	SK2-M-L	0-12	30.4	7.7	592	92	970	0.6	82.8	2.6	2.4	0.7	6.7	11	1.6	7.8	
		12-24	20.2		425		1010									2.6	
		24-36	4.8				224									0.9	
		36-48	3.4				248									1.0	

Commercial Fertilizer Area

Slope	Sample	Depth	N	P	Total P	K	S	Cu	Fe	Mn	Zn	B	Org C	O.M.	EC	pH	
			ug/cc*	ug/cc	ug/g**	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	%	%	mS/cm		
Upper	SK2-C-U	0-12	4.0	8.2	377	150	17	0.6	22.6	4.8	0.7	0.2	1.5	2.5	0.2	8.5	
		12-24	1.2		583		7									0.3	
		24-36	1.4				17									0.3	
		36-48	1.4				38									0.3	
Mid	SK2-C-M	0-12	4.0	11.7	806	147	15	0.8	22.8	4.0	1.0	0.4	2.1	3.7	0.1	8.6	
		12-24	1.4		518		62									0.3	
		24-36	1.0				102									0.4	
		36-48	1.0				134									0.5	
Lower	SK2-C-L	0-12	5.2	14.5	554	113	69	0.9	49.2	2.8	1.2	0.5	2.9	5.1	0.3	8.4	
		12-24	1.6		544		69									0.4	
		24-36	1.0				47									0.4	
		36-48	1.4				55									0.3	

* ug/cc times 4.3 = pounds/acre

**ug/g times 4 = pounds/acre

INITIAL BENCHMARK PROGRAM SOIL ANALYTICAL RESULTS

Breeder Barn - SW 05-32-07-W2 - Field 3

Manure Area - 120 acres

Slope	Sample	Depth	N ug/cc*	P ug/cc	Total P ug/g**	K ug/cc	S ug/cc	Cu ug/cc	Fe ug/cc	Mn ug/cc	Zn ug/cc	B ug/cc	Org C %	O.M. %	EC mS/cm	pH	
Upper	SK3-M-U	0-12	8.6	5.2	620	117	144	0.5	6.6	3.4	0.2	0.4	1.8	3	0.4	8.3	
		12-24	1.4		543		67									0.4	
		24-36	5.0				352									1.0	
		36-48	10.8				272									1.0	
Mid	SK3-M-M	0-12	2.8	7.4	445	156	126	0.5	14.6	3.2	0.5	0.4	2.7	4.6	0.5	8.3	
		12-24	1.0		357		540									1.6	
		24-36	2.2				652									1.9	
		36-48	2.6				658									1.8	
Lower	SK3-M-L	0-12	4.8	14.3	584	145	888	0.6	29.4	3.0	1.3	0.5	4.7	8.1	1.4	7.9	
		12-24	1.8		452		444									1.2	
		24-36	1.2				566									1.4	
		36-48	2.0				382									1.1	

Commercial Fertilizer Area

Slope	Sample	Depth	N ug/cc*	P ug/cc	Total P ug/g**	K ug/cc	S ug/cc	Cu ug/cc	Fe ug/cc	Mn ug/cc	Zn ug/cc	B ug/cc	Org C %	O.M. %	EC mS/cm	pH	
Upper	SK3-C-U	0-12	8.2	4.5	594	142	48	0.5	13.2	4.0	0.4	0.4	2.6	4.6	0.3	8.4	
		12-24	1.8		522		258									0.8	
		24-36	2.0				272									0.9	
		36-48	2.8				290									1.0	
Mid	SK3-C-M	0-12	7.4	7.0	503	157	406	0.6	23.0	4.2	0.6	0.5	2.9	5	0.8	8.1	
		12-24	1.8		481		1090									2.1	
		24-36	1.6				1340									2.0	
		36-48	2.2				1300									3.0	
Lower	SK3-C-L	0-12	5.6	24.8	526	229	844	0.7	35.8	4.2	1.2	0.5	3.3	5.7	1.3	7.8	
		12-24	1.6		457		364									0.9	
		24-36	1.4				826									1.5	
		36-48	1.4				678									1.8	

* ug/cc times 4.3 = pounds/acre

**ug/g times 4 = pounds/acre

INITIAL BENCHMARK PROGRAM SOIL ANALYTICAL RESULTS

Nursery - SE 02-32-08-W2 - Field 4

Manure Area - 120 acres

Slope	Sample	Depth	N	P	Total P	K	S	Cu	Fe	Mn	Zn	B	Org C	O.M.	EC	pH	
			ug/cc*	ug/cc	ug/g**	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	%	%	mS/cm		
Upper	SK4-M-U	0-12	8.6	5.2	666	117	144	0.5	10.2	4.4	0.4	0.7	3.0	5.2	0.4	8.3	
		12-24	4.8		507		1210									2.5	
		24-36	3.8				1240									2.9	
		36-48	3.8				1200									2.9	
Mid	SK4-M-M	0-12	5.0	7.4	521	156	126	0.7	19.8	4.2	0.5	0.6	2.9	5	0.5	8.3	
		12-24	2.8		491		426									1.2	
		24-36	2.0				288									1.6	
		36-48	2.6				702									1.9	
Lower	SK4-M-L	0-12	4.8	14.3	537	145	888	0.8	25.2	3.4	1.1	0.5	3.8	6.5	1.4	7.9	
		12-24	1.4		487		600									1.6	
		24-36	1.4				173									0.6	
		36-48	1.6				104									0.4	

Commercial Fertilizer Area

Slope	Sample	Depth	N	P	Total P	K	S	Cu	Fe	Mn	Zn	B	Org C	O.M.	EC	pH	
			ug/cc*	ug/cc	ug/g**	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	ug/cc	%	%	mS/cm		
Upper	SK4-C-U	0-12	8.2	4.5	669	142	48	0.6	12.8	4.8	0.6	0.7	3.4	5.8	0.3	8.4	
		12-24	2.6		521		462									1.4	
		24-36	3.2				1410									3.2	
		36-48	3.6				1600									3.5	
Mid	SK4-C-M	0-12	7.4	7.0	594	157	406	0.8	20.4	5.6	0.7	0.6	3.2	5.5	0.8	8.1	
		12-24	3.6		436		950									2.4	
		24-36	2.2				928									2.2	
		36-48	2.8				1530									3.4	
Lower	SK4-C-L	0-12	5.6	24.8	549	229	844	1.1	36.2	3.6	1.3	0.6	3.8	6.5	1.3	7.8	
		12-24	2.2		489		476									1.3	
		24-36	2.8				442									1.2	
		36-48	3.2				624									1.5	

* ug/cc times 4.3 = pounds/acre

**ug/g times 4 = pounds/acre