2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS IRRIGATION/SOIL SUITABILITY COLLINS DRAW, WYOMING

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I. INTRODUCTION

The soils on T-Chair Ranch are hay fields within Collins Draw were evaluated pre discharge in 2006 for irrigation suitability as part of the Wyoming Department of Environmental Quality, Water Quality Division (WDEQ-WQD) Rules and Regulations (Chapter 1, Section 20). This evaluation occurred pre-discharge to any CBM development.

The T-Chair Ranch property is located along Collins Draw in Section 2 and 11, T42N, R76W, and Section 26 and 35, T43N, R76W. The area has historically been irrigated by spreader dikes during natural storm events. Water flows from Collins Draw and irrigates over 42 acres of native grass fields through a series of spreader dikes. Dikes in Sections 35 and 26 were constructed before 1950. Dikes in Sections and 2 and 11 were built in the 1960's. These fields have historically been used for grazing cattle. Collins Draw is split in two parts by a fence downstream of Field 4 (Addendum 6). Approximately 300 cows and calves are on the lower (north) Collins Draw from March through April and then the same number of cows and calves, plus 12 bulls, are on the upper (south) Collins Draw from May through October. No haying activity has taken place in recent years because of low vegetation productivity due to drought.

The purpose of the 2006 evaluation was to document the baseline condition of the soils within these areas for future comparison to post discharge coal bed natural gas (CBNG) water on the soils. Discharge into Collins Draw, from the Devon Energy 001CD, 002CD, 003CD, and 004CD CBNG facilities is scheduled to begin summer 2007. The 001CD discharge point is the furthest from the T-Chair Ranch fields and joins into Collins Draw in Section 11, upstream of Field 1. The 001CD discharge point is the furthest from the T-Chair Ranch fields and flow would enter Collins Draw in Section 11, upstream of Field 1. Flow from discharge points 002CD, 003CD, and 004CD would enter Collins Draw in Section 2, within Field 2 and just downstream of Field 1.

II. METHODOLOGY

Recent 2006 WDEQ-WQD permitting requirements expanded the depth and scope of the Section 20 demonstration to require quantification of the cover and production of the crops within a specific field. No baseline vegetation was sampled during the 2006 season. All fieldwork, laboratory analyses, and report preparation followed mandates outlined in the WDEQ Agricultural Use and Protection Policy; 5th draft, 2006.

Prior to fieldwork, maps compiled by CDG Engineers and dated April 9, 2004 were obtained from Patricia Clark for the T-Chair Ranch property that delineated the later project area. Fields were derived based on textural similarities and relative location within Collins Draw. Six fields, outlined on those maps are artificially irrigated lands based on the presence of spreader dikes that divert water from Collins Draw onto those fields. The fields were labeled 1 through 6. Fields 3, 4, and 6 were divided into subsets of A, B and C (in Fields 3 and 4) based on differences in soil type. A map showing field designation and sample point location can be found in Addendum 5. The number of sample points taken in each field was based on field size and WDEQ requirements. Four samples were taken in Field 2 instead of five; however, professional judgment by the soil scientist conducting the assessment was that these four points represented sufficiently

the soil types within this field. The sampled fields and their acreages are summarized in Table 1.

Table 1: Field Summary, Collins Draw 2006 Field Reconnaissance

Field	Acreage
1	4.54
2	5.74
3A	1.31
B	1.28
C	2.9
Sub Total Field 3	5.49
4A	2.86
B	4.65
C	1.34
Sub Total Field 4	8.85
5	11.75
6A	3.14
B	2.55
Sub Total Field 6	5.69
Total:	**42.06**

Water Quality Sampling

Water quality samples will be acquired by Devon Energy Production Co. or its contractors at discharge points. Laboratory analysis will follow WDEQ quidelines.

Soil Survey and Compositing

Soils were sampled on the T-Chair Ranch property October 28, 2006 and November 2, 2006. Samples were taken to Energy Laboratories in Gillette, Wyoming, for shipment to the Casper, Wyoming, lab on December 14, 2006. Samples were kept cool and dry prior to shipment to the lab. Requested analyses included pH, electrical conductivity (EC), sodium adsorption ratio (SAR), exchangeable sodium percentage (ESP), cation exchange capacity (CEC), texture, and organic matter for all depths. Samples 0-6" and 6-12" were then combined and analyzed for clay mineralogy.

Soil sample locations were recorded in the field with hand-held Garmin Global Positioning System (GPS) III data collection units and are identified on the map presented in Addendum 6. The soil was cored to 48 inches, based on the lack of alfalfa within the six fields.

The following general methodology was utilized during the soil field investigation:

1) Major soil series generally based on topographic location within a given field were sampled. No attempt was made to capture the variability within the series that is often found within soils behind bottomland spreader-dikes, in terms of variations in horizon depths and textural differences.
2) The diameter of the core barrel utilized for gathering soil samples was 1.75 inches.
3) Samples were gathered over a given field by depth. Sample depths were 0-6, 6-12, 12-24, 24-36, and 36-48 inches.
4) A photograph of the soil core was taken in which the zero depth end was in the upper left of the photograph.
5) Field descriptors such as horizonation (as determined by visual observations) and calcium carbonate effervescence with dilute (10%) hydrochloric acid, depth to moisture (i.e., slightly moist, moist, very moist or near saturation), relative presence of fine roots, visual redox areas, and obvious presence of alluvial layers were recorded.
6) Sampled depths were placed in plastic bags that were labeled by project/landowner, sample number, depth and date. Sample depths 0-6 and 6-12 inches were combined for lab analysis. If possible, soil horizons were combined wherever possible based on overall soil texture, horizon designation, and approximate calcium carbonate content.

III. RESULTS

General

A Natural Resources Conservation Services (NRCS) soil map of the area is found in Addendum 3, NRCS map unit descriptions are found in Addendum 4 and the NRCS soil series descriptions are found in Addendum 5. A map of the labeled fields can be found in Addendum 6. Table 9, showing coordinates of sample points, can also be found in Addendum 6.

SAR and ESP were both analyzed in 2006. SAR provides a relative measure of sodium hazard in the soil while ESP is more specifically tied to the amount of sodium on the soil exchange complex. Since the vast majority of soil samples from the T-Chair Ranch property exhibit little correlation between SAR and ESP (Table 4) above 36", it is recommended that ESP be analyzed for at least some of the samples after discharge occurs.

A graphical depiction of EC, SAR, ESP, and soil composition analyses by depth and field are found in Addendum 1. No trend analysis was conducted, but the following visual determinations can be made:

1) The surface (0-12") EC maintains a consistent level across the T-Chair Ranch fields.
2) 50% of the "Channel" sample points had the highest levels of EC at surface levels (0-12") compared to depth while 8.3% of the "Terrace" sample points had the highest levels of EC at surface levels compared to depth (Graph 1).

3) The EC at depth 24-36" in "Terrace" Sample Point 40 in Field 6B shows the highest level at 10.5, while level 36-48" in Sample Point 14 in Field 3A and 24-36" in Sample Point 16 in Field 3B, both "Channel" sample points, show the lowest EC at 0.24(Graph 2).
4) 88.9% of "Channel" sample points had SAR levels below 1. 11.1% of "Channel" sample points had SAR levels below 2 (Graph 2).
5) 66.7% of "Terrace" samples had SAR levels below 1. 25% of "Terrace" samples had SAR levels below 2. 8.3% of "Terrace" samples had SAR values above 3.
6) The SAR at depth 36-48" in "Terrace" Sample Point 42 in Field 6B shows the highest level at 17.0, while level 0-12" in "Channel" Sample Point 12 in Field 2 shows the lowest SAR at 0.07(Graph 3).
7) ESP values exhibit no pattern between depth and value (Graph 3).
8) Na values are similar across all fields with the exception of depths 24-36" and 36-48" at "Terrace" sample points 40 and 42 in Field 6B (Graph 4).
9) All fields with the exception of "Channel" Sample Point 14 in Field 3A show similar soil textural composition (Graphs 5-10).

Actual soil texture analysis indicates clays, silty clays, loams, clay loams, silty clay loams, sandy clay loams, sandy loams, and loamy sands.

Field 1

Field 1 is the southernmost evaluated in this Section 20 field reconnaissance. Field 1 is the furthest upstream field.

Field 1 was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within profiles in Field 1 (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 1:

1) Profiles generally reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in surface levels (0-12") in "Channel" sample points and at sub-surface levels (below 12") in "Terrace" sample points (Table 6).
2) Soil textures are variable and range from 3-67% sand, 12-41% silt, and 17-66% clay (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by smectite clays in Field 1 (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 2

Field 2 is north and downstream of Field 1 and south of Field 3A.

Field 2 was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within

profiles in Field 2 (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 2:

1) Profiles generally reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in surface levels (0-12") in "Channel" sample points and at sub-surface levels (below 12") in "Terrace" sample points (Table 6).
2) Soil textures are variable and range from 14-84% sand, 5-43% silt, and 11-43% clay (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by smectite clays within the clay fraction in Field 2 (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 3

Field 3A

Field 3A is north and downstream of Field 2 and south of Field 3B.

Field 3A was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within profiles in Field 3A (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 3A:

1) Profiles do not seem to reflect influence from silt deposition during flood events as a result of the spreader-dike diversion (Table 6).
2) Soil textures are generally coarse-textured and exceed 52% sand (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by K-feldspar within the clay fraction in Field 3a (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 3B

Field 3B is north and downstream of Field 3A and south of Field 3C.

Field 3B was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within profiles in Field 3B (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 3B:

1) Profiles generally reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in surface levels (0-12") in both "Channel" and "Terrace" sample points (Table 6).

2) Soil textures are generally coarse-textured and exceed 53% sand (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by smectite clays and K-feldspar within the clay fraction in Field 3B (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 3C

Field 3C is north and downstream of Field 3B and south of Field 4A.

Field 3C was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within profiles in Field 3C (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 3C:

1) Profiles do not seem to reflect influence from silt deposition during flood events as a result of the spreader-dike diversion (Table 6).
2) Soil textures are generally coarse-textured and exceed 43% sand (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by K-feldspar within the clay fraction in Field 3C (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 4

Field 4A

Field 4A is north and downstream of Field 3C and south of Field 4B.

Field 4A was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). Visible sodium was present at a depth greater than 42" at Sample Point 21 (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 4A:

1) Profiles generally reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in both surface and sub-surface levels in "Channel" and "Terrace" sample points (Table 6).
2) Soil textures are variable and range from 12-79% sand, 11-46% silt, and 10-44% clay (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by smectite clays and mica/illite within the clay fraction in Field 4A (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 4B

Field 4B is north and downstream of Field 4A and south of Field 4C.

Field 4B was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within profiles in Field 4B (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 4B:

1) Profiles generally reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in both surface and sub-surface levels in "Channel" and "Terrace" sample points (Table 6).
2) Soil textures are variable and range from 18-79% sand, 9-48% silt, and 12-48% clay (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by smectite clays within the clay fraction in Field 4B (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 4C

Field 4C is north and downstream of Field 4B and south of Field 5.

Field 4C was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within profiles in Field 4C (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 4C:

1) Profiles reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in sub-surface levels (below 12") of the "Terrace" sample point (Table 6).
2) Soil textures are generally loamy and exceed 24% sand, 33% silt, and 13% clay (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by K-feldspar within the clay fraction in Field 4C (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 5

Field 5 is north and downstream of Field 4C and south of Field 6A.

Field 5 was dry throughout the sampled profiles with the exception of Sample 34 that was moist throughout the profile. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within profiles in Field 5 (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 5:

1) Profiles generally reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in both surface and sub-surface levels in "Channel" and "Terrace" sample points (Table 6).
2) Soil textures are variable and range from 3-70% sand, 18-53% silt, and 12-60% clay (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by smectite clays, K-feldspar, and mica/illite within the clay fraction in Field 5 (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 6

Field 6A

Field 6A is north and downstream of Field 5 and south of Field 6B.

Field 6A was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). There was no visible sodium within profiles in Field 6A (Table 2). Laboratory results exhibit fairly low ESP and SAR values throughout.

The following general conclusions may be made regarding Field 6A:

1) Profiles generally reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in both surface and sub-surface levels in "Channel" and "Terrace" sample points (Table 6).
2) Soil textures are variable and range from 8-64% sand, 19-59% silt, and 17-37% clay (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by smectite clays in Field 6A (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

Field 6B

Field 6B is the northernmost evaluated in this Section 20 field reconnaissance. Field 6B is the furthest downstream field.

Field 6B was dry throughout the sampled profiles. Rooting depth for herbaceous species in this field was generally shallow (0-12 inches). Visible sodium was present at depths greater than 36" at Sample Point 42 and at depths greater than 40" at Sample Point 43. Laboratory results exhibit fairly low ESP and SAR values throughout with the exception of depth 36-48" at "Terrace" Sample Point 42 in Field 6B.

The following general conclusions may be made regarding Field 6B:

1) Profiles generally reflect influence from silt deposition during flood events as a result of the spreader-dike diversion in surface levels (0-12") in "Channel"

sample points and at sub-surface levels (below 12") in "Terrace" sample points (Table 6).

2) Soil textures are variable and range from 5-62% sand, 19-43% silt, and 17-63% clay (Table 6).
3) Analysis for the bulk fraction at depth 0-12" shows overall highest levels in quartz followed by smectite clays and K-feldspar in Field 6B (Table 7).
4) Smectite was highest overall in the clay fraction (Table 8).

IV. DISCUSSION

The spreader dike fields within the floodplain of Collins Draw within the T-Chair Ranch property have been in existence for at least 50 years as hay meadows and for grazing based on information from Patricia Clark.

Soils within this area primarily exhibit alluviated material that has been recently deposited from the spreader dike system. In general, soils are of the Entisol order which indicates lack of a stable environment for significant soil development.

In Fields 3, 4, and 6, no redox concentrations/depletion zones were noted.

Statistical analysis on the data was somewhat rudimentary through Excel and limited to the following specific question:

1) Is SAR analysis correlated to ESP analysis for future reference and ease of obtaining relative sodium hazard information?

There is no strong correlation between SAR and ESP at depths above 36" (Table 4). Analyses of ESP values are more involved than SAR and are subsequently more costly. Lack of correlation between EC and SAR can be seen in Table 5. More detailed statistics may be warranted to document any possible relationship between vegetation production and EC, SAR, ESP or percent clay values. However, for purposes of this report, detailed statistical work was not completed, due to the limited number of samples and report objective.

V. IMPACTS OF AGRICULTURAL USE OF CBNG DISCHARGE WATER ON THE SOILS IN THIS AREA

The T-Chair Ranch fields are irrigated from Collins Draw during storm events and only if water is diverted onto those fields. The evaluated fields receive no intermittent or perennial water flow.

Discharge of CBNG water through this portion of Collins Draw is unknown; most CBNG water is diluted during storm events. It is unlikely that surface irrigation with diluted CBNG water would significantly change the soil chemistry that is present throughout the current profile analysis.

VI. REFERENCES

U.S.D.A. Natural Resources Conservation Service (NRCS). 2007. Soil Survey, Campbell County, Wyoming, Southern Part.

Wyoming Department of Environmental Quality. 2006. Chapter 1. Water Quality Rules and Regulations.

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Table 2: Qualitative Field Observations within Collins Draw Fields

Field	Sample I.D.	Total Depth (inches)	Depth of Alluvial Layers (inches)	Depth of Visible Na (inches)	Depth of Moisture (inches)			Depth of Fine Roots (inches)		Depth of Redox (inches)
					Sl Moist	Moist	V Moist/Sat	Numerous	Scattered	
1	1	48	None	None	---	---	---	0-12	---	34-40
1	2	48	None	None	---	---	---	0-12	---	None
1	3	48	None	None	---	---	---	0-12	---	None
1	4	48	34-37	None	---	---	---	0-12	---	None
1	5	48	None	None	---	---	---	0-12	---	None
1	6	48	29-34	None	---	---	---	0-12	---	19-23
1	7	48	11-19	None	---	---	---	0-12	---	None
1	8	48	None	None	---	---	---	0-12	---	None
2	9	48	None	None	---	---	---	0-12	---	None
2	10	48	None	None	---	---	---	0-12	---	2-7
2	11	48	None	None	---	---	---	0-12	---	None
2	12	48	12-21	None	---	---	---	0-12	---	None
3A	13	48	None	None	---	---	---	0-12	---	None
3A	14	48	None	None	---	---	---	0-12	---	None
3B	15	48	None	None	---	---	---	0-12	---	None
3B	16	48	None	None	---	---	---	0-12	---	None
3C	17	48	None	None	---	---	---	0-12	---	None
3C	18	48	None	None	---	---	---	0-12	---	None
3C	19	48	18-24, 45-48	None	---	---	---	0-12	---	None
4A	20	48	None	None	---	---	---	0-12	---	None
4A	21	48	None	42-48	---	---	---	0-12	---	None
4B	22	48	18-24	None	---	---	---	0-12	---	None
4B	23	48	None	None	---	---	---	0-12	---	None
4B	24	48	None	None	---	---	---	0-12	---	None
4B	25	48	None	None	---	---	---	0-12	---	None
4B	26	48	None	None	---	---	---	0-12	---	None
4C	27	48	None	None	---	---	---	0-12	---	None
5	28	48	None	None	---	---	---	0-12	---	None
5	29	48	None	None	---	---	---	0-12	---	None
5	30	48	None	None	---	---	---	0-12	---	None
5	31	48	None	None	---	---	---	0-12	---	None
5	32	48	None	None	---	---	---	0-12	---	None
5	33	48	None	None	---	---	---	0-12	---	6-12
5	34	48	None	None	---	0-48	---	0-12	---	None
5	35	48	None	None	---	---	---	0-12	---	None
6A	36	48	None	None	---	---	---	0-12	---	None
6A	37	48	None	None	---	---	---	0-12	24-36	None
6B	39	48	None	None	---	---	---	0-12	---	None
6B	40	48	None	None	---	---	---	0-12	---	None
6B	41	48	30-36	None	---	---	---	0-12	---	None
6B	42	48	38-40	36-48	---	---	---	0-12	---	None
6B	43	48	None	40-48	---	---	---	0-12	---	None

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Table 3: Soil Analysis Summary between Collins Draw Sample Points

Field	Sample I.D.	Total Depth (inches)	EC mmhos/cm	pH s.u.	Ca meq/L	Mg meq/L	Na meq/L	SAR	CEC meq/100g	ESP %	Organic Matter
1	Collins 1	0-12	.49	8.2	2.8	2.1	0.97	0.62	16.0	1.60	0.78
		12-24	.67	8.1	3.0	2.0	3.10	1.98	15.0	2.50	
		24-36	.85	8.1	4.7	2.7	3.50	1.85	11.0	4.60	
		36-48	1.99	7.9	16.0	6.6	5.90	1.79	14.0	0.44	
1	Collins 2	0-12	.66	7.9	5.8	2.0	0.53	0.27	14.0	1.60	0.82
		12-24	.66	7.8	5.8	2.0	0.52	0.27	14.0	1.70	
		24-36	.82	7.9	7.3	3.0	0.92	0.41	12.0	1.80	
		36-48	1.24	8.0	11.0	4.7	1.60	0.58	11.0	1.60	
1	Collins 3	0-12	.63	7.9	5.2	1.9	0.73	0.39	13.0	0.36	1.40
		12-24	2.25	7.8	23.0	7.7	3.30	0.85	13.0	0.93	
		24-36	1.74	7.9	17.0	6.5	1.90	0.57	13.0	0.64	
		36-48	2.01	7.8	21.0	8.6	1.70	0.44	13.0	0.91	
1	Collins 4	0-12	0.40	8.0	2.7	1.7	0.62	0.42	14.0	0.82	0.93
		12-24	0.56	7.9	3.3	1.8	2.10	1.35	14.0	1.10	
		24-36	0.65	7.9	3.8	1.7	2.80	1.68	12.0	1.40	
		36-48	1.48	7.7	12.0	4.5	3.80	1.32	19.0	0.81	
1	Collins 5	0-12	0.72	7.8	6.4	2.3	0.57	0.27	15.0	0.49	1.40
		12-24	2.68	7.7	30.0	11.0	2.00	0.44	12.0	0.54	
		24-36	2.77	7.8	32.0	12.0	2.10	0.44	13.0	0.56	
		36-48	2.28	7.8	25.0	9.2	1.50	0.36	13.0	0.64	
1	Collins 6	0-12	0.58	8.0	4.3	1.9	0.85	0.48	28.0	0.48	1.40
		12-24	0.57	8.0	3.6	1.8	1.60	0.96	29.0	0.67	
		24-36	0.60	8.1	3.6	1.8	1.60	0.99	19.0	0.97	
		36-48	0.51	8.0	3.1	1.6	1.50	0.99	11.0	1.10	
1	Collins 7	0-12	0.60	8.0	4.6	2.0	0.44	0.24	13.0	0.74	1.00
		12-24	0.64	7.9	4.9	2.0	0.46	0.25	12.0	0.76	
		24-36	0.67	7.7	5.1	2.0	0.45	0.24	13.0	0.24	
		36-48	0.76	7.7	5.6	2.1	0.63	0.32	11.0	1.10	
1	Collins 8	0-12	0.58	8.0	5.2	1.7	0.30	0.16	13.0	0.94	1.20
		12-24	0.54	8.2	4.4	1.7	0.70	0.40	13.0	1.20	
		24-36	1.13	8.1	10.0	3.5	1.30	0.50	13.0	1.40	
		36-48	2.43	8.0	25.0	10.0	1.70	0.41	12.0	1.40	

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Table 3: Soil Analysis Summary between Collins Draw Sample Points continued

Field	Sample I.D.	Total Depth (inches)	EC mmhos/cm	pH s.u.	Ca meq/L	Mg meq/L	Na meq/L	SAR	CEC meq/100g	ESP %	Organic Matter
2	Collins 9	0-12	0.44	8.2	3.6	1.3	0.44	0.28	14.0	1.10	1.00
		12-24	0.42	8.2	3.0	1.1	1.00	0.71	12.0	1.70	
		24-36	0.64	8.3	4.7	1.7	1.30	0.73	10.0	1.90	
		36-48	0.93	8.5	7.2	2.4	1.30	0.60	15.0	1.40	
2	Collins 10	0-12	0.47	8.4	3.6	1.6	0.30	0.18	20.0	0.82	1.50
		12-24	0.48	8.0	3.7	1.5	0.36	0.22	18.0	0.86	
		24-36	0.46	8.0	3.9	1.5	0.43	0.26	14.0	1.10	
		36-48	0.38	8.2	2.9	1.2	0.43	0.30	7.9	1.70	
2	Collins 11	0-12	0.49	7.9	4.6	1.6	0.34	0.20	16.0	1.90	1.40
		12-24	0.50	8.1	3.8	1.4	1.40	0.86	16.0	2.10	
		24-36	1.82	7.9	19.0	5.9	2.70	0.79	15.0	1.30	
		36-48	1.92	7.9	21.0	6.7	1.80	0.49	17.0	0.28	
2	Collins 12	0-12	0.44	7.9	4.1	1.4	0.12	0.07	20.0	0.59	1.40
		12-24	0.39	7.9	3.3	1.2	0.19	0.13	13.0	0.89	
		24-36	0.36	8.2	2.9	1.1	0.19	0.14	7.5	1.60	
		36-48	0.37	8.5	2.7	1.2	0.22	0.16	4.8	2.20	
3A	Collins 13	0-12	0.55	8.0	5.2	1.7	0.19	0.10	14.0	0.74	1.20
		12-24	0.34	8.1	2.8	1.0	0.22	0.13	13.0	0.93	
		24-36	0.66	7.9	6.0	1.9	0.19	0.13	13.0	0.96	
		36-48	0.64	8.0	5.3	1.6	0.18	0.10	12.0	1.00	
3A	Collins 14	0-12	0.35	8.2	2.9	1.0	0.25	0.08	7.3	1.40	0.18
		12-24	0.34	8.6	2.3	1.1	0.18	0.13	4.7	2.50	
		24-36	0.29	8.7	2.1	1.0	0.12	0.15	4.6	2.10	
		36-48	0.24	7.9	1.6	0.9	0.17	0.18	4.8	2.10	
3B	Collins 15	0-12	0.63	7.4	5.2	2.0	0.18	0.19	16.0	0.82	1.20
		12-24	0.47	7.7	3.8	1.3	0.20	0.32	13.0	1.10	
		24-36	0.38	7.8	2.8	1.1	0.36	0.29	11.0	1.10	
		36-48	0.47	7.6	3.3	1.5	0.52	0.37	13.0	0.92	
3B	Collins 16	0-12	0.27	7.8	2.0	1.0	0.16	0.13	11.0	0.74	0.56
		12-24	0.28	8.0	1.9	1.1	0.21	0.17	5.5	1.70	
		24-36	0.24	8.0	1.6	0.9	0.18	0.16	6.1	1.40	
		36-48	0.30	7.9	2.2	1.0	0.31	0.25	10.0	0.85	

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Table 3: Soil Analysis Summary between Collins Draw Sample Points continued

Field	Sample I.D.	Total Depth (inches)	EC mmhos/cm	pH s.u.	Ca meq/L	Mg meq/L	Na meq/L	SAR	CEC meq/100g	ESP %	Organic Matter
3C	Collins 17	0-12	0.44	7.7	3.6	1.3	0.25	0.16	16.0	0.51	0.80
		12-24	0.43	7.7	3.2	1.4	0.89	0.59	18.0	0.99	
		24-36	2.30	7.5	20.0	9.4	2.90	0.77	11.0	1.40	
		36-48	2.38	7.6	23.0	8.6	3.20	0.82	11.0	1.30	
3C	Collins 18	0-12	0.30	7.9	2.4	0.8	0.13	0.11	7.2	0.83	0.15
		12-24	0.33	8.0	2.3	1.0	0.25	0.19	6.8	1.00	
		24-36	0.48	7.7	3.1	1.8	0.21	0.14	14.0	0.48	
		36-48	0.47	7.8	3.3	1.6	0.22	0.14	8.6	0.93	
3C	Collins 19	0-12	0.38	7.9	3.2	1.3	0.30	0.20	14.0	0.61	0.89
		12-24	0.49	7.8	3.0	1.4	1.20	0.82	15.0	1.10	
		24-36	1.14	7.3	8.4	3.5	2.60	1.07	16.0	1.20	
		36-48	1.70	7.7	13.0	6.1	2.50	0.81	16.0	1.90	
4A	Collins 20	0-12	0.73	7.6	6.5	2.3	0.30	0.14	22.0	0.43	2.40
		12-24	0.97	7.8	7.0	2.9	0.81	0.36	18.0	0.66	
		24-36	0.64	7.9	4.4	1.8	0.75	0.42	8.3	1.10	
		36-48	0.79	7.9	5.2	2.1	1.40	0.74	9.9	1.20	
4A	Collins 21	0-12	0.54	7.7	4.9	1.3	0.19	0.11	16.0	0.39	1.20
		12-24	2.13	7.6	24.0	5.5	0.47	0.12	22.0	0.37	
		24-36	2.49	7.5	28.0	7.0	1.40	0.34	25.0	0.59	
		36-48	2.58	7.5	28.0	6.5	1.40	0.32	24.0	0.62	
4B	Collins 22	0-12	0.57	7.7	4.9	2.0	0.23	0.12	17.0	0.22	2.00
		12-24	0.29	7.7	4.3	1.8	0.20	0.11	18.0	0.29	
		24-36	0.60	7.6	4.5	1.5	1.30	0.73	14.0	1.20	
		36-48	1.14	7.6	8.7	2.9	2.30	0.95	21.0	1.10	
4B	Collins 23	0-12	0.65	7.5	5.2	2.2	0.43	0.22	22.0	0.33	1.50
		12-24	1.06	7.6	7.5	3.7	2.30	0.95	20.0	1.10	
		24-36	2.74	7.5	24.0	12.0	5.90	1.40	21.0	1.60	
		36-48	2.51	7.5	22.0	11.0	4.50	1.12	18.0	1.00	
4B	Collins 24	0-12	0.72	7.6	5.3	2.2	0.63	0.33	23.0	0.75	2.00
		12-24	2.63	7.5	23.0	10.0	4.90	1.21	22.0	1.60	
		24-36	1.93	7.6	16.0	6.8	3.70	1.10	23.0	1.50	
		36-48	1.48	7.6	12.0	4.7	2.30	0.81	24.0	1.20	

Table 3: Soil Analysis Summary between Collins Draw Sample Points continued

Field	Sample I.D.	Total Depth (inches)	EC mmhos/cm	pH s.u.	Ca meq/L	Mg meq/L	Na meq/L	SAR	CEC meq/100g	ESP %	Organic Matter
4B	Collins 25	0-12	0.60	7.6	4.9	2.1	0.39	0.21	20.0	0.44	1.40
		12-24	0.53	7.7	3.7	1.8	0.97	0.58	20.0	0.89	
		24-36	0.93	7.7	6.6	2.9	1.70	0.79	14.0	1.00	
		36-48	2.70	7.6	28.0	9.7	4.40	1.02	23.0	1.60	
4B	Collins 26	0-12	0.61	7.6	4.8	1.8	0.22	0.12	26.0	0.26	1.40
		12-24	0.54	7.7	4.1	1.7	0.29	0.17	15.0	0.37	
		24-36	0.38	7.8	2.9	1.3	0.29	0.20	17.0	0.37	
		36-48	0.52	7.8	3.8	1.8	0.39	0.23	18.0	0.43	
4C	Collins 27	0-12	0.84	7.7	7.8	2.4	0.31	0.14	18.0	0.30	1.90
		12-24	0.96	7.8	6.9	3.2	1.50	0.66	18.0	0.90	
		24-36	3.06	7.8	28.0	15.0	5.10	1.11	17.0	2.30	
		36-48	3.61	7.8	34.0	15.0	5.70	1.15	18.0	1.70	
5	Collins 28	0-12	0.88	7.6	7.2	2.4	0.18	0.08	27.0	0.20	2.40
		12-24	0.66	7.7	4.8	2.3	0.61	0.32	29.0	0.49	
		24-36	1.18	7.7	9.3	4.2	1.90	0.73	30.0	1.10	
		36-48	2.25	7.6	22.0	8.6	3.20	0.83	38.0	0.96	
5	Collins 29	0-12	0.58	7.8	5.0	1.6	0.38	0.21	18.0	0.26	1.10
		12-24	0.72	7.7	5.8	1.8	1.10	0.56	17.0	0.63	
		24-36	2.54	7.6	5.9	1.5	0.61	0.32	15.0	1.40	
		36-48	2.88	7.8	32.0	9.6	3.20	0.70	11.0	0.77	
5	Collins 30	0-12	0.69	7.6	6.4	2.2	0.30	0.14	20.0	0.31	1.70
		12-24	0.44	7.8	3.4	1.4	0.63	0.41	18.0	0.55	
		24-36	2.74	7.6	27.0	9.7	3.80	0.88	23.0	1.30	
		36-48	2.88	7.4	28.0	10.0	4.70	1.08	21.0	1.30	
5	Collins 31	0-12	0.67	7.4	6.3	1.5	0.16	0.08	16.0	0.21	1.00
		12-24	2.14	7.5	23.0	7.5	0.96	0.25	22.0	0.29	
		24-36	2.57	7.4	29.0	8.4	2.00	0.47	16.0	0.81	
		36-48	1.14	7.6	10.0	3.4	1.50	0.56	15.0	0.88	
5	Collins 32	0-12	0.99	7.4	9.2	2.1	0.24	0.10	18.0	0.26	1.50
		12-24	0.56	7.6	5.0	1.4	0.29	0.16	15.0	0.36	
		24-36	0.77	7.6	6.8	1.9	1.10	0.52	18.0	0.21	
		36-48	2.49	7.5	30.0	7.9	1.20	0.27	17.0	0.54	

Table 3: Soil Analysis Summary between Collins Draw Sample Points continued

Field	Sample I.D.	Total Depth (inches)	EC mmhos/cm	pH s.u.	Ca meq/L	Mg meq/L	Na meq/L	SAR	CEC meq/100g	ESP %	Organic Matter
5	Collins 33	0-12	0.66	7.5	5.5	1.3	0.23	0.13	23.0	0.24	2.30
		12-24	0.84	7.6	5.6	1.5	0.51	0.27	13.0	0.44	
		24-36	1.21	7.6	8.8	2.9	3.70	1.51	18.0	1.90	
		36-48	2.26	7.5	18.0	5.7	6.30	1.82	19.0	2.50	
5	Collins 34	0-12	0.89	7.4	7.8	2.2	0.48	0.22	22.0	0.32	2.60
		12-24	0.66	7.4	6.2	1.7	0.41	0.21	22.0	0.34	
		24-36	0.42	7.5	3.1	1.1	0.30	0.20	24.0	0.41	
		36-48	0.38	7.6	2.8	1.0	0.28	0.20	23.0	0.36	
5	Collins 35	0-12	0.60	7.6	4.6	1.6	1.10	0.60	16.0	0.94	1.40
		12-24	0.91	7.6	7.5	2.7	1.50	0.67	16.0	1.10	
		24-36	2.64	7.5	26.0	9.4	4.20	1.00	17.0	1.60	
		36-48	2.77	7.6	5.3	2.0	1.00	0.53	15.0	3.40	
6A	Collins 36	0-12	0.68	7.4	7.0	2.0	0.34	0.16	17.0	0.46	1.50
		12-24	1.10	7.2	11.0	3.2	0.99	0.38	21.0	0.72	
		24-36	0.88	7.6	6.2	1.7	0.88	0.44	14.0	0.50	
		36-48	0.46	7.6	10.0	3.0	0.98	0.38	16.0	0.47	
6A	Collins 37	0-12	0.57	7.3	7.6	2.3	0.24	0.11	26.0	0.14	2.30
		12-24	1.75	7.6	4.1	1.4	0.30	0.18	23.0	0.23	
		24-36	2.06	7.5	5.3	1.9	0.64	0.34	24.0	0.36	
		36-48	0.45	7.5	15.0	6.5	2.90	0.87	24.0	0.95	
6B	Collins 39	0-12	2.06	7.4	18.0	4.6	0.35	0.10	28.0	0.13	2.10
		12-24	0.45	7.5	4.2	1.2	0.19	0.11	31.0	0.12	
		24-36	0.54	7.6	4.8	1.4	0.30	0.17	25.0	0.16	
		36-48	0.39	7.5	3.4	1.1	0.17	0.11	28.0	0.14	
6B	Collins 40	0-12	0.99	7.0	7.3	2.6	0.23	0.10	15.0	0.17	1.40
		12-24	1.10	7.3	6.2	3.1	1.20	0.55	14.0	0.53	
		24-36	10.50	7.2	66.0	46.0	21.00	2.78	17.0	2.60	
		36-48	9.15	7.4	59.0	35.0	27.00	3.89	21.0	3.70	
6B	Collins 41	0-12	0.86	7.4	7.1	2.3	0.21	0.10	26.0	0.23	2.50
		12-24	0.54	7.5	4.1	1.6	0.42	0.25	28.0	0.36	
		24-36	0.49	7.4	3.9	1.5	0.62	0.38	37.0	0.40	
		36-48	0.76	7.6	5.5	2.0	1.50	0.77	28.0	1.10	

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Table 3: Soil Analysis Summary between Collins Draw Sample Points continued

Field	Sample I.D.	Total Depth (inches)	EC mmhos/cm	pH s.u.	Ca meq/L	Mg meq/L	Na meq/L	SAR	CEC meq/100g	ESP %	Organic Matter
6B	Collins 42	0-12	0.95	7.4	7.5	2.5	0.39	0.17	19.0	0.27	1.20
		12-24	2.91	7.4	30.0	11.0	3.40	0.75	21.0	0.89	
		24-36	4.64	7.4	34.0	12.0	19.00	3.94	19.0	6.40	
		36-48	8.24	7.8	22.0	17.0	75.00	17.00	15.0	23.00	
6B	Collins 43	0-12	1.01	7.4	8.2	2.7	0.58	0.25	21.0	0.43	5.50
		12-24	0.85	7.6	6.3	2.5	0.89	0.42	20.0	0.80	
		24-36	0.74	7.6	5.4	2.2	1.30	0.67	19.0	1.40	
		36-48	2.30	7.5	23.0	8.4	3.30	0.83	12.0	3.30	

Color Key — Marginal; Unsuitable

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Table 4: Correlation Analysis between ESP and SAR Values

Field	Sample I.D.	SAR 0-12"	ESP 0-12"	SAR 12-24"	ESP 12-24"	SAR 24-36"	ESP 24-36"	SAR 36-48"	ESP 36-48"
1	1	0.62	1.6	1.98	2.5	1.85	4.6	1.79	0.44
1	2	0.27	1.6	0.27	1.7	0.41	1.8	0.58	1.6
1	3	0.39	0.36	0.85	0.93	0.57	0.64	0.44	0.91
1	4	0.42	0.82	1.35	1.1	1.68	1.4	1.32	0.81
1	5	0.27	0.49	0.44	0.54	0.44	0.56	0.36	0.64
1	6	0.48	0.48	0.96	0.67	0.99	0.97	0.99	1.1
1	7	0.24	0.74	0.25	0.76	0.24	0.24	0.32	1.1
1	8	0.16	0.94	0.4	1.2	0.5	1.4	0.41	1.4
2	9	0.28	1.1	0.71	1.7	0.73	1.9	0.6	1.4
2	10	0.17	0.82	0.2	0.86	0.26	1.1	0.3	1.7
2	11	0.2	1.9	0.86	2.1	0.79	1.3	0.49	0.28
2	12	0.07	0.59	0.13	0.89	0.14	1.6	0.16	2.2
3A	13	0.1	0.74	0.13	0.93	0.13	0.96	0.1	1
3A	14	0.08	1.4	0.13	2.5	0.15	2.1	0.18	2.1
3B	15	0.19	0.82	0.32	1.1	0.29	1.1	0.37	0.92
3B	16	0.13	0.74	0.17	1.7	0.16	1.4	0.25	0.85
3C	17	0.16	0.51	0.59	0.99	0.77	1.4	0.82	1.3
3C	18	0.11	0.83	0.19	1	0.14	0.48	0.14	0.93
3C	19	0.2	0.61	0.82	1.1	1.07	1.2	0.81	1.9
4A	20	0.14	0.43	0.36	0.66	0.42	1.1	0.74	1.2
4A	21	0.11	0.39	0.12	0.37	0.34	0.59	0.32	0.62
4B	22	0.12	0.22	0.11	0.29	0.73	1.2	0.95	1.1
4B	23	0.22	0.33	0.95	1.1	1.4	1.6	1.12	1
4B	24	0.33	0.75	1.21	1.6	1.1	1.5	0.81	1.2
4B	25	0.21	0.44	0.58	0.89	0.79	1	1.02	1.6
4B	26	0.12	0.26	0.17	0.37	0.2	0.37	0.23	0.43
4C	27	0.14	0.3	0.66	0.9	1.11	2.3	1.15	1.7
5	28	0.08	0.2	0.32	0.49	0.73	1.1	0.83	0.96
5	29	0.21	0.26	0.56	0.63	0.32	1.4	0.7	0.77
5	30	0.14	0.31	0.41	0.55	0.88	1.3	1.08	1.3
5	31	0.08	0.21	0.25	0.29	0.47	0.81	0.56	0.88
5	32	0.1	0.26	0.16	0.36	0.52	0.21	0.27	0.54
5	33	0.13	0.24	0.27	0.44	1.51	1.9	1.82	2.5
5	34	0.22	0.32	0.21	0.34	0.2	0.41	0.2	0.36
5	35	0.6	0.94	0.67	1.1	1	1.6	0.53	3.4
6A	36	0.16	0.46	0.38	0.72	0.44	0.5	0.38	0.47
6A	37	0.11	0.14	0.18	0.23	0.34	0.36	0.87	0.95
6B	39	0.1	0.13	0.11	0.12	0.17	0.16	0.11	0.14
6B	40	0.1	0.17	0.55	0.53	2.78	2.6	3.8	3.7
6B	41	0.1	0.23	0.25	0.36	0.38	0.4	0.77	1.1
6B	42	0.17	0.27	0.75	0.89	3.94	6.4	17	23
6B	43	0.25	0.43	0.42	0.8	0.67	1.4	0.83	3.3
Correlation		**0.40**		**0.50**		**0.81**		**0.97**	

Table 5: Correlation Analysis between EC and SAR Values

Field	Sample I.D.	SAR 0-12"	EC 0-12"	SAR 12-24"	EC 12-24"	SAR 24-36"	EC 24-36"	SAR 36-48"	EC 36-48"
1	1	0.62	0.49	1.98	0.67	1.85	0.85	1.79	1.99
1	2	0.27	0.66	0.27	0.66	0.41	0.82	0.58	1.24
1	3	0.39	0.63	0.85	2.25	0.57	1.74	0.44	2.01
1	4	0.42	0.4	1.35	0.56	1.68	0.65	1.32	1.48
1	5	0.27	0.72	0.44	2.68	0.44	2.77	0.36	2.28
1	6	0.48	0.58	0.96	0.57	0.99	0.6	0.99	0.51
1	7	0.24	0.6	0.25	0.64	0.24	0.67	0.32	0.76
1	8	0.16	0.58	0.4	0.54	0.5	1.13	0.41	2.43
2	9	0.28	0.44	0.71	0.42	0.73	0.64	0.6	0.93
2	10	0.17	0.47	0.2	0.48	0.26	0.46	0.3	0.38
2	11	0.2	0.49	0.86	0.5	0.79	1.82	0.49	1.92
2	12	0.07	0.44	0.13	0.39	0.14	0.36	0.16	0.37
3A	13	0.1	0.55	0.13	0.34	0.13	0.66	0.1	0.64
3A	14	0.08	0.35	0.13	0.34	0.15	0.29	0.18	0.24
3B	15	0.19	0.63	0.32	0.47	0.29	0.38	0.37	0.47
3B	16	0.13	0.27	0.17	0.28	0.16	0.24	0.25	0.3
3C	17	0.16	0.44	0.59	0.43	0.77	2.3	0.82	2.38
3C	18	0.11	0.3	0.19	0.33	0.14	0.48	0.14	0.47
3C	19	0.2	0.38	0.82	0.49	1.07	1.14	0.81	1.7
4A	20	0.14	0.73	0.36	0.97	0.42	0.64	0.74	0.79
4A	21	0.11	0.54	0.12	2.13	0.34	2.49	0.32	2.58
4B	22	0.12	0.57	0.11	0.29	0.73	0.6	0.95	1.14
4B	23	0.22	0.65	0.95	1.06	1.4	2.74	1.12	2.51
4B	24	0.33	0.72	1.21	2.63	1.1	1.93	0.81	1.48
4B	25	0.21	0.6	0.58	0.53	0.79	0.93	1.02	2.7
4B	26	0.12	0.61	0.17	0.54	0.2	0.38	0.23	0.52
4C	27	0.14	0.84	0.66	0.96	1.11	3.06	1.15	3.61
5	28	0.08	0.88	0.32	0.66	0.73	1.18	0.83	2.25
5	29	0.21	0.58	0.56	0.72	0.32	2.54	0.7	2.88
5	30	0.14	0.69	0.41	0.44	0.88	2.74	1.08	2.88
5	31	0.08	0.67	0.25	2.14	0.47	2.57	0.56	1.14
5	32	0.1	0.99	0.16	0.56	0.52	0.77	0.27	2.49
5	33	0.13	0.66	0.27	0.84	1.51	1.21	1.82	2.26
5	34	0.22	0.89	0.21	0.66	0.2	0.42	0.2	0.38
5	35	0.6	0.6	0.67	0.91	1	2.64	0.53	2.77
6A	36	0.16	0.68	0.38	1.08	0.44	0.68	0.38	1.1
6A	37	0.11	0.88	0.18	0.46	0.34	0.57	0.87	1.75
6B	39	0.1	2.06	0.11	0.45	0.17	0.54	0.11	0.39
6B	40	0.1	0.99	0.55	1.1	2.78	10.5	3.8	9.15
6B	41	0.1	0.86	0.25	0.54	0.38	0.49	0.77	0.76
6B	42	0.17	0.95	0.75	2.91	3.94	4.64	17	8.24
6B	43	0.25	1.01	0.42	0.85	0.67	0.74	0.83	2.3
Correlation		**-0.19**		**0.22**		**0.66**		**0.71**	

Table 6: Texture and Percent Sand, Silt, and Clay between Collins Draw Fields

Field	Sample I.D.	Depth of Sample inches	Sand %	Silt %	Clay %	Texture
1	Collins 1	0-12	26	33	41	C
		12-24	42	20	38	CL
		24-36	61	12	27	SCL
		36-48	46	21	33	SCL
1	Collins 2	0-12	42	24	34	CL
		12-24	36	33	31	CL
		24-36	50	21	29	SCL
		36-48	54	19	27	SCL
1	Collins 3	0-12	36	30	34	CL
		12-24	42	27	31	CL
		24-36	44	25	31	CL
		36-48	50	21	29	SCL
1	Collins 4	0-12	40	26	34	CL
		12-24	49	18	33	SCL
		24-36	56	15	29	SCL
		36-48	44	21	35	CL
1	Collins 5	0-12	36	30	34	CL
		12-24	55	16	29	SCL
		24-36	43	26	31	SCL
		36-48	42	27	31	CL
1	Collins 6	0-12	3	31	66	C
		12-24	7	41	52	SiC
		24-36	39	26	35	CL
		36-48	67	16	17	SL
1	Collins 7	0-12	36	39	25	L
		12-24	63	17	20	SL-SCL
		24-36	59	22	19	SL
		36-48	61	22	17	SL
1	Collins 8	0-12	48	33	19	L
		12-24	65	16	19	SL
		24-36	59	21	20	SL-SCL
		36-48	57	22	21	SCL
2	Collins 9	0-12	57	24	23	SCL
		12-24	65	14	21	SCL
		24-36	71	11	18	SL
		36-48	37	36	27	CL-L
2	Collins 10	0-12	32	33	35	CL
		12-24	31	34	35	CL
		24-36	55	23	22	SCL
		36-48	75	10	15	SL
2	Collins 11	0-12	40	34	26	L
		12-24	56	20	24	SCL
		24-36	44	29	27	CL-L
		36-48	31	38	31	CL

Table 6: Texture and Percent Sand, Silt, and Clay between Collins Draw Fields continued

Field	Sample I.D.	Depth of Sample inches	Sand %	Silt %	Clay %	Texture
2	Collins 12	0-12	14	43	43	SiC
		12-24	54	19	27	SCL
		24-36	80	5	15	SL
		36-48	84	5	11	LS
3A	Collins 13	0-12	58	19	23	SCL
		12-24	60	17	23	SCL
		24-36	56	20	24	SCL
		36-48	52	26	22	SCL
3A	Collins 14	0-12	84	3	13	LS
		12-24	87	4	9	LS
		24-36	88	4	8	LS
		36-48	89	3	8	LS
3B	Collins 15	0-12	53	26	21	SCL
		12-24	62	19	19	SL
		24-36	72	13	15	SL
		36-48	67	16	17	SL
3B	Collins 16	0-12	70	14	16	SL
		12-24	87	7	6	LS
		24-36	85	7	8	LS
		36-48	67	19	14	SL
3C	Collins 17	0-12	46	34	20	L
		12-24	53	28	19	SL
		24-36	71	18	11	SL
		36-48	70	16	14	SL
3C	Collins 18	0-12	84	6	10	LS
		12-24	82	10	8	LS
		24-36	65	19	16	SL
		36-48	72	17	11	SL
3C	Collins 19	0-12	52	32	16	L
		12-24	43	39	18	L
		24-36	47	35	18	L
		36-48	48	35	17	L
4A	Collins 20	0-12	23	46	31	CL
		12-24	33	43	24	L
		24-36	79	11	10	SL
		36-48	75	14	11	SL
4A	Collins 21	0-12	30	44	26	L
		12-24	28	36	36	CL
		24-36	12	45	43	SiC
		36-48	20	36	44	C
4B	Collins 22	0-12	42	37	21	L
		12-24	79	9	12	SL
		24-36	46	32	22	L
		36-48	27	48	25	L

Table 6: Texture and Percent Sand, Silt, and Clay between Collins Draw Fields continued

Field	Sample I.D.	Depth of Sample inches	Sand %	Silt %	Clay %	Texture
4B	Collins 23	0-12	27	44	29	CL
		12-24	42	37	21	L
		24-36	29	42	29	CL
		36-48	60	21	19	SL
4B	Collins 24	0-12	25	48	27	CL-L
		12-24	27	44	29	CL
		24-36	41	32	27	CL-L
		36-48	40	30	30	CL
4B	Collins 25	0-12	26	47	27	CL-L
		12-24	27	44	29	CL
		24-36	59	28	13	SL
		36-48	18	45	37	SiCL
4B	Collins 26	0-12	18	34	48	C
		12-24	58	25	17	SL
		24-36	39	36	25	L
		36-48	40	35	25	L
4C	Collins 27	0-12	47	33	20	L
		12-24	38	41	21	L
		24-36	38	49	13	L
		36-48	24	45	31	CL
5	Collins 28	0-12	5	47	48	SiC
		12-24	11	38	51	C
		24-36	4	37	59	C
		36-48	8	43	49	SiC
5	Collins 29	0-12	32	46	22	L
		12-24	48	31	21	L
		24-36	62	19	19	SL
		36-48	70	18	12	SL
5	Collins 30	0-12	28	45	27	CL-L
		12-24	32	45	23	L
		24-36	20	45	35	SiCL
		36-48	17	52	31	SiCL
5	Collins 31	0-12	55	26	19	SL
		12-24	26	46	28	CL
		24-36	24	47	29	CL
		36-48	38	38	24	L
5	Collins 32	0-12	39	34	27	CL-L
		12-24	40	36	24	L
		24-36	32	37	31	CL
		36-48	30	38	32	CL
5	Collins 33	0-12	8	45	47	SiC
		12-24	60	22	18	SL
		24-36	26	43	31	CL
		36-48	22	44	34	CL

Table 6: Texture and Percent Sand, Silt, and Clay between Collins Draw Fields continued

Field	Sample I.D.	Depth of Sample inches	Sand %	Silt %	Clay %	Texture
5	Collins 34	0-12	15	48	37	SiCL
		12-24	10	51	39	SiCL
		24-36	3	37	60	C
		36-48	30	30	40	C-CL
5	Collins 35	0-12	20	49	31	SiCL
		12-24	24	47	29	CL
		24-36	20	52	28	SiCL
		36-48	18	53	29	SiCL
6A	Collins 36	0-12	35	40	25	L
		12-24	14	49	37	SiCL
		24-36	64	19	17	SL
		36-48	48	31	21	L
6A	Collins 37	0-12	20	45	35	SiCL
		12-24	18	50	32	SiCL
		24-36	8	59	33	SiCL
		36-48	23	42	35	CL
6B	Collins 39	0-12	5	41	54	SiC
		12-24	8	42	50	SiC
		24-36	14	43	43	SiC
		36-48	20	38	42	C
6B	Collins 40	0-12	61	22	17	SL
		12-24	62	19	19	SL
		24-36	51	24	25	SCL
		36-48	38	32	30	CL
6B	Collins 41	0-12	10	43	47	SiC
		12-24	11	36	53	C
		24-36	32	21	47	C
		36-48	14	31	55	C
6B	Collins 42	0-12	48	25	27	SCL
		12-24	40	35	25	L
		24-36	26	39	35	CL
		36-48	47	26	27	SCL
6B	Collins 43	0-12	10	40	50	SiC
		12-24	12	36	52	C
		24-36	5	32	63	C
		36-48	11	29	60	C

Note: Abbreviations for Texture:

C – Clay
L – Loam
SL – Sandy Loam
SiCL – Silty Clay Loam
CL – Clay Loam
SCL – Sandy Clay Loam
SiC – Silty Clay

Table 7: X-Ray Defraction Results for the Bulk Fraction of the Collins Draw Field Samples

			Approximate Wt %									
Field	Sample I.D.	Depth (inches)	Quartz	K-feldspar	Plagioclase feldspar	Mica/illite	Kaolinite	Smectite	Chlorite	Calcite	Dolomite	Unidentified
1	1	0-12	38	9	-	12	10	18	<5	<3	<5	<5
1	2	0-12	48	7	<3	7	5	22	<3	<3	<3	<5
1	3	0-12	52	8	-	8	11	13	-	<5	<3	<5
1	4	0-12	52	7	<3	9	9	13	-	<3	<3	<5
1	5	0-12	50	13	<3	8	6	14	-	<3	<3	<5
1	6	0-12	25	5	<5	7	16	36	-	<3	<3	<5
1	7	0-12	48	15	<3	7	10	11	-	<3	<3	<5
1	8	0-12	48	10	<3	5	10	17	-	<3	<3	<5
2	9	0-12	53	6	<3	7	8	16	-	<3	<5	<5
2	10	0-12	38	8	-	11	15	20	-	<3	<3	<5
2	11	0-12	50	12	<3	6	8	14	-	<5	<3	<5
2	12	0-12	43	14	-	8	12	15	-	<3	<3	<5
3A	13	0-12	57	13	5	5	<5	<10	-	5	5	<5
3A	14	0-12	56	17	6	<5	<5	<10	-	<3	<3	<5
3B	15	0-12	52	11	<5	6	6	12	-	<5	<5	<5
3B	16	0-12	53	26	7	5	<5	-	-	<5	<5	<5
3C	17	0-12	56	13	<3	7	5	10	-	<5	<5	<5
3C	18	0-12	58	16	5	<5	<5	<10	-	<5	<5	<5
3C	19	0-12	57	12	<5	7	5	<10	-	<5	-	<5
4A	20	0-12	46	6	<3	9	10	17	-	<5	<3	<5
4A	21	0-12	49	9	<3	13	7	11	-	<5	<3	<5
4B	22	0-12	50	8	-	10	10	14	-	<3	<3	<5
4B	23	0-12	37	6	-	12	9	27	-	<5	<3	<5
4B	24	0-12	48	6	-	10	10	15	-	<5	<5	<5
4B	25	0-12	37	6	-	8	14	23	<5	<5	<3	<5
4B	26	0-12	33	6	-	12	15	26	-	<3	<3	<5
4C	27	0-12	51	16	-	9	7	<10	<3	<3	<3	<5
5	28	0-12	30	5	-	11	15	29	-	<5	<3	<5
5	29	0-12	53	10	-	6	10	<10	-	<5	<5	<5

Table 7: X-Ray Defraction Results for the Bulk Fraction of the Collins Draw Field Samples

			Approximate Wt %									
Field	Sample I.D.	Depth (inches)	Quartz	K-feldspar	Plagioclase feldspar	Mica/illite	Kaolinite	Smectite	Chlorite	Calcite	Dolomite	Unidentified
5	30	0-12	54	7	-	7	5	17	-	<5	<5	<5
5	31	0-12	56	7	-	9	7	14	-	<3	<3	<5
5	32	0-12	51	6	-	8	8	19	-	<3	<3	<5
5	33	0-12	42	6	-	15	15	16	-	<3	<3	<5
5	34	0-12	42	8	-	15	15	13	-	<3	<3	<5
5	35	0-12	49	8	-	9	10	14	-	<5	<5	<5
6A	36	0-12	47	8	-	8	13	16	-	<3	<5	<5
6A	37	0-12	46	10	-	10	12	16	-	<3	<3	<5
6B	39	0-12	35	7	-	12	12	27	-	<3	<3	<5
6B	40	0-12	64	11	-	6	6	<10	-	<3	<3	<5
6B	41	0-12	40	6	-	13	9	25	-	<3	<3	<5
6B	42	0-12	47	7	-	11	8	21	-	<3	<3	<5
6B	43	0-12	35	<5	-	20	12	24	-	<3	<3	<5

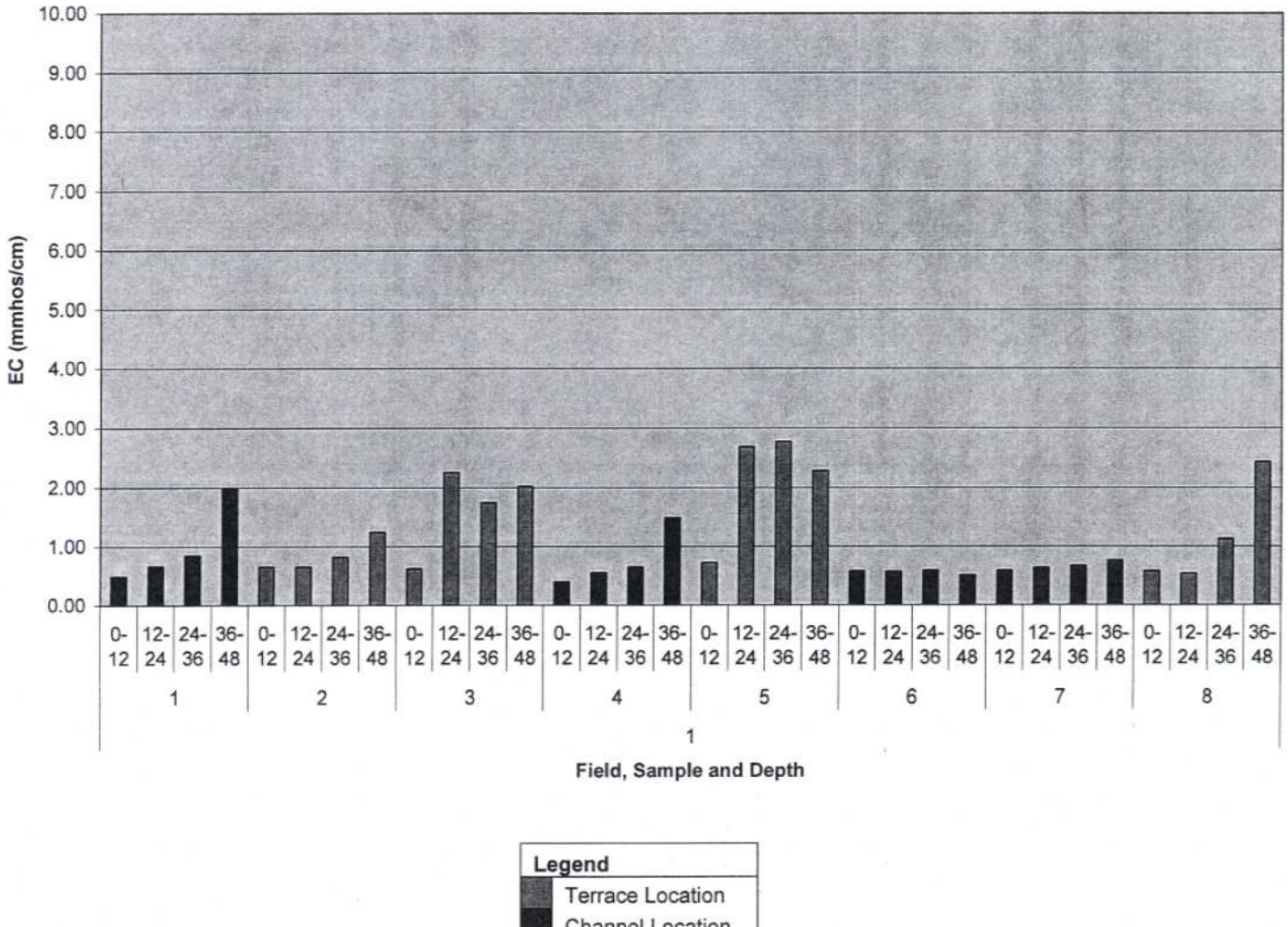
Table 8: X-Ray Defraction Results for 2um Fractions of the Collins Draw Field Samples

			Approximate Wt %					
Field	Sample I.D.	Depth (inches)	Smectite	Mica/illite	Kaolinite	Quartz	Chlorite	Unidentified
1	1	0-12	73	14	5	5	-	<5
1	2	0-12	70	18	7	<5	-	<5
1	3	0-12	72	15	8	<5	-	<5
1	4	0-12	68	19	5	<5	<3	<5
1	5	0-12	72	18	5	<5	-	<5
1	6	0-12	75	13	6	<5	-	<5
1	7	0-12	71	16	8	<5	-	<5
1	8	0-12	79	10	7	<5	-	<5
2	9	0-12	77	10	6	<5	-	<5
2	10	0-12	71	14	5	7	-	<5
2	11	0-12	74	15	6	<5	-	<5
2	12	0-12	67	15	8	7	-	<5
3A	13	0-12	74	17	5	<5	-	<5
3A	14	0-12	62	23	13	-	-	<5
3B	15	0-12	73	18	6	-	-	<5
3B	16	0-12	77	11	8	<5	-	<5
3C	17	0-12	76	7	7	7	-	<5
3C	18	0-12	72	17	7	<5	-	<5
3C	19	0-12	69	12	6	10	-	<5
4A	20	0-12	69	17	5	5	-	<5
4A	21	0-12	65	19	10	<5	-	<5
4B	22	0-12	76	11	5	5	-	<5
4B	23	0-12	65	18	10	<5	-	<5
4B	24	0-12	73	16	6	<5	-	<5
4B	25	0-12	57	33	7	-	-	<5
4B	26	0-12	72	13	5	8	-	<5
4C	27	0-12	72	12	6	6	-	<5
5	28	0-12	73	13	7	<5	-	<5
5	29	0-12	73	13	6	5	-	<5
5	30	0-12	70	13	6	8	-	<5
5	31	0-12	78	11	5	<5	-	<5
5	32	0-12	79	9	7	<5	-	<5
5	33	0-12	76	13	<5	<5	-	<5
5	34	0-12	74	10	9	<5	-	<5
5	35	0-12	85	<5	6	<5	-	<5
6A	36	0-12	69	17	10	<5	-	<5
6A	37	0-12	71	18	5	<5	-	<5
6B	39	0-12	73	10	8	5	-	<5
6B	40	0-12	73	13	9	<5	-	<5
6B	41	0-12	71	14	6	6	-	<5
6B	42	0-12	77	7	12	<5	-	<5
6B	43	0-12	67	18	6	6	-	<5

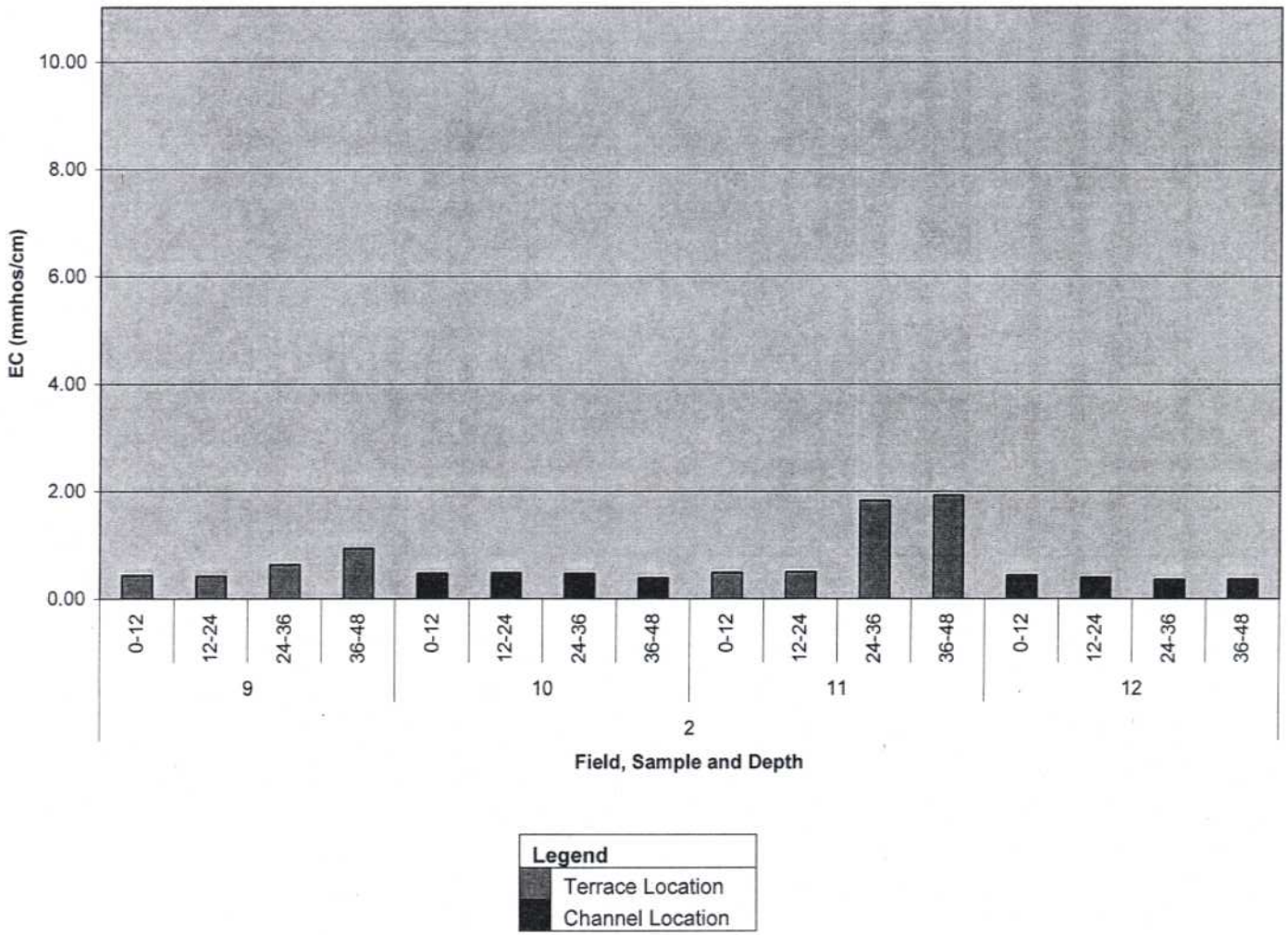
ADDENDUM 1
Graphical Representation of Soil Data

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

Graph 1: EC by Sample, Depth, and Location between Collins Draw Fields

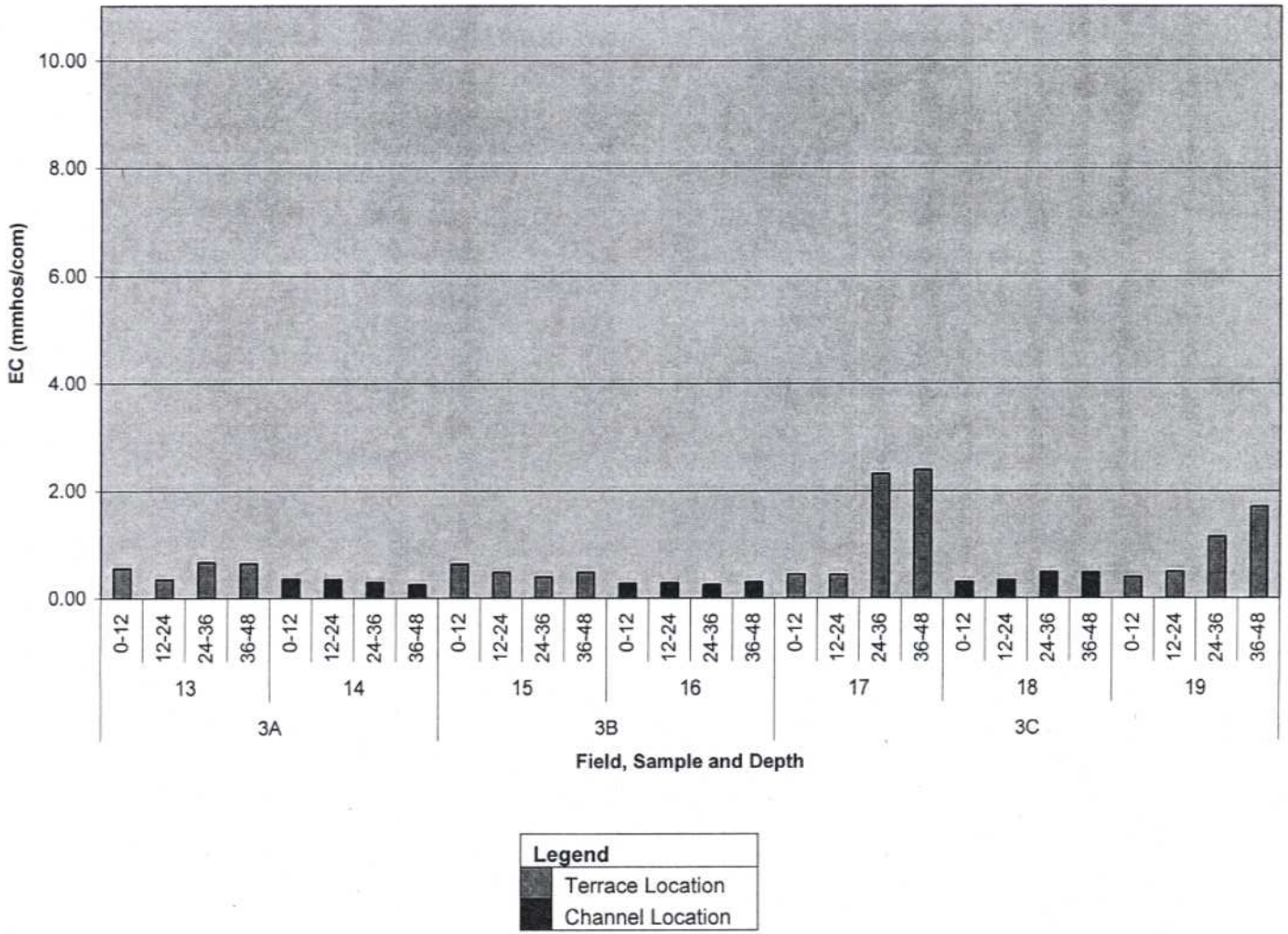


Graph 1: EC by Sample, Depth, and Location between Collins Draw Fields cont'd



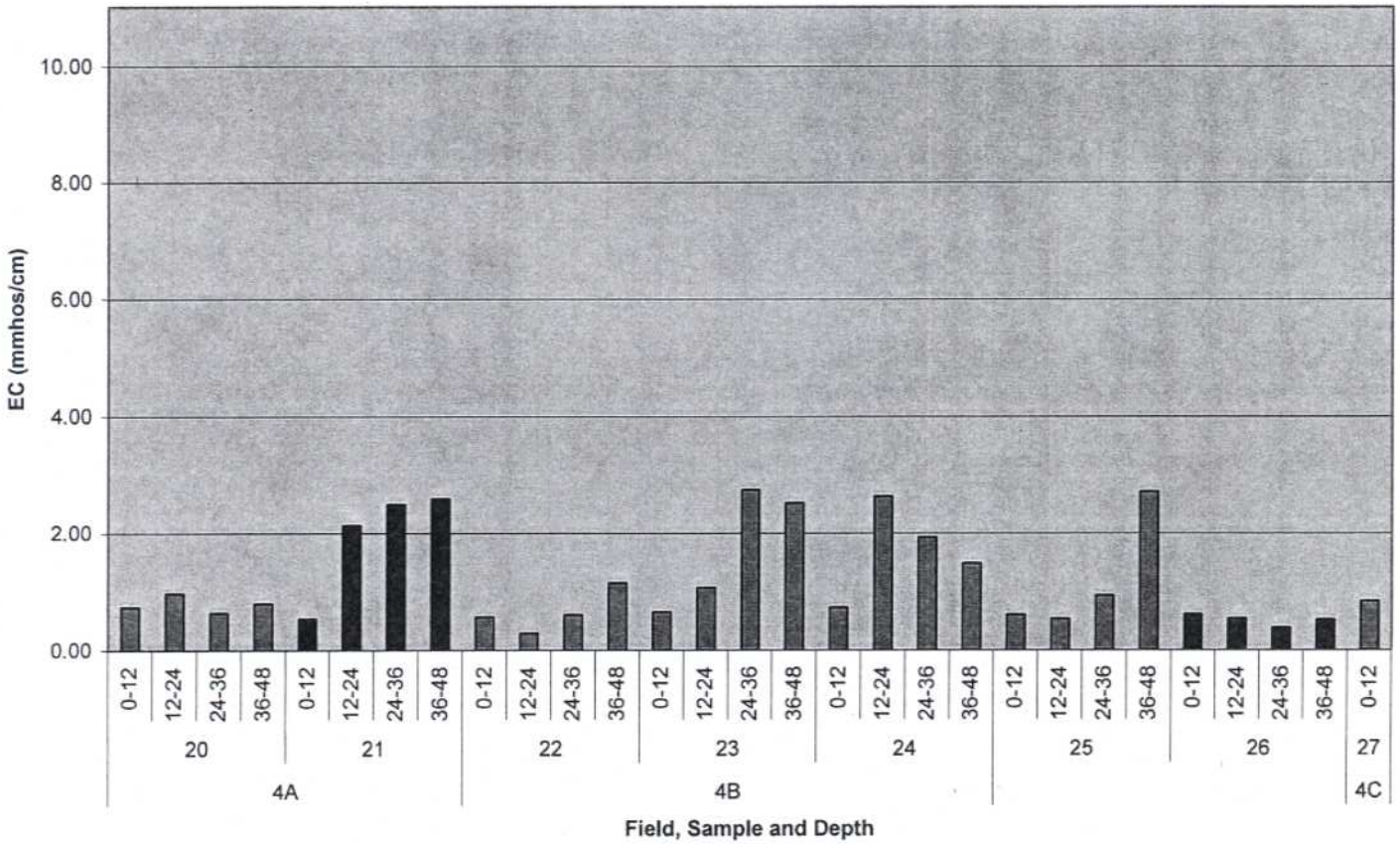
2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

Graph 1: EC by Sample, Depth, and Location between Collins Draw Fields cont'd

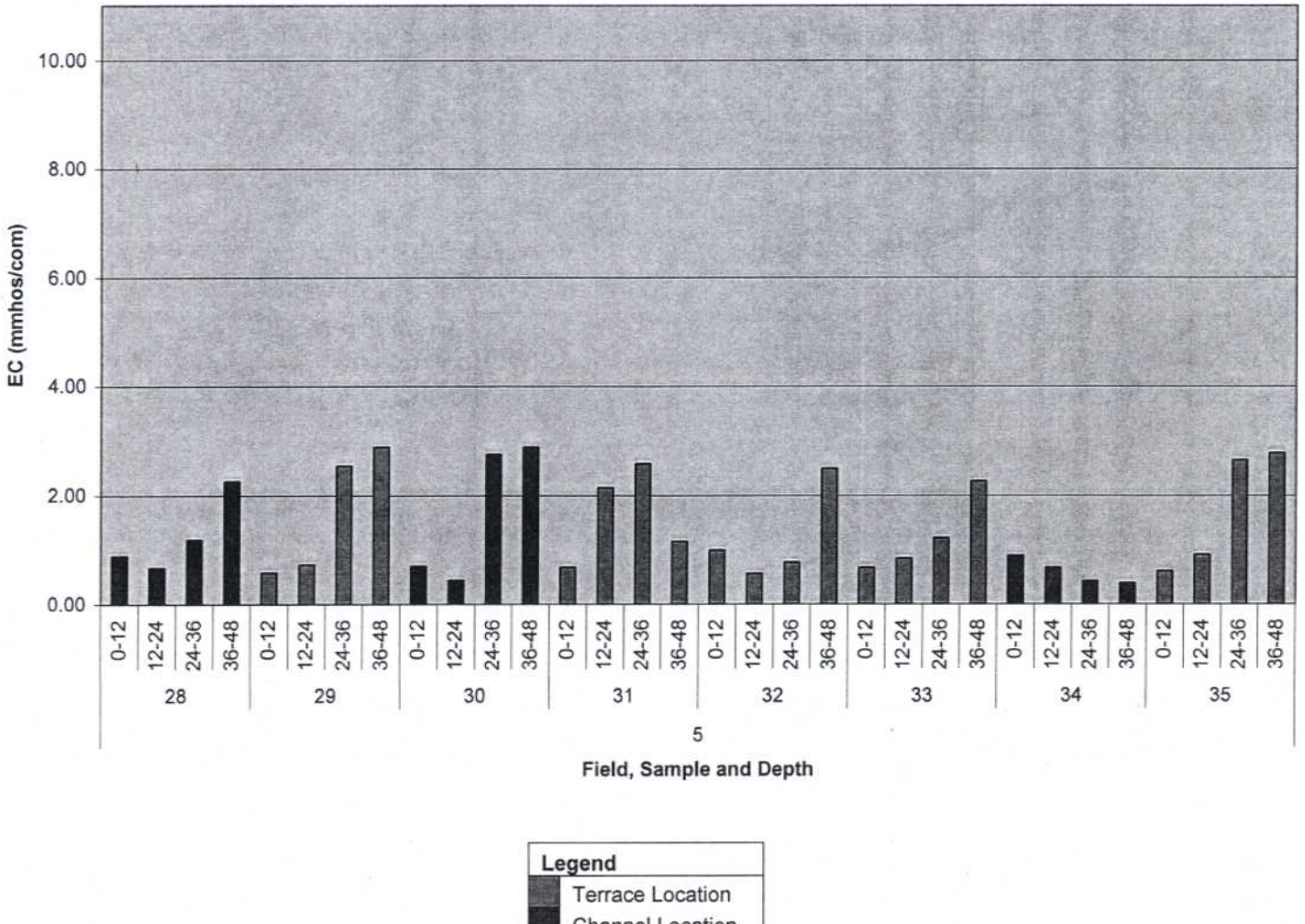


2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

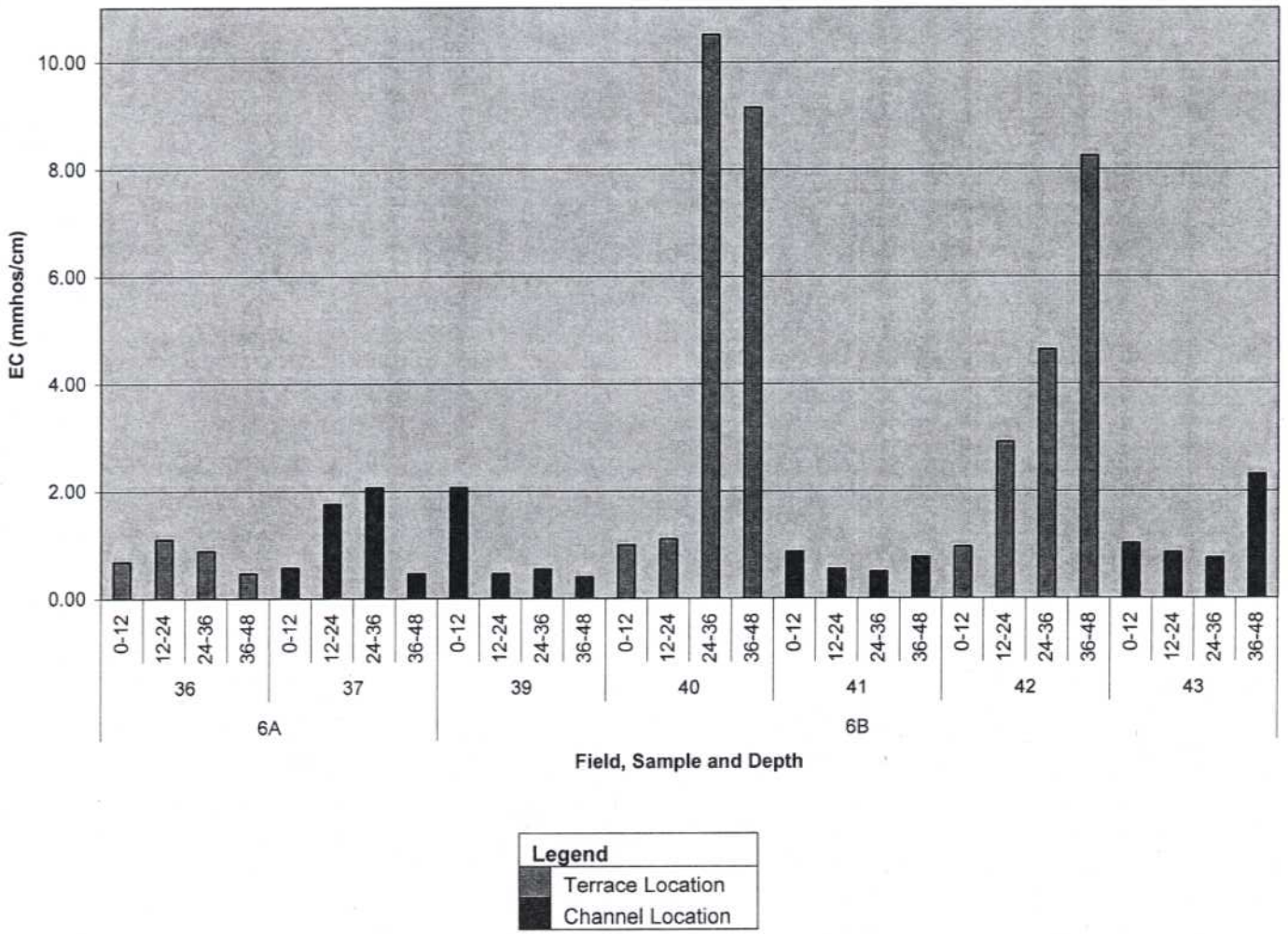
Graph 1: EC by Sample, Depth, and Location between Collins Draw Fields cont'd



Graph 1: EC by Sample, Depth, and Location between Collins Draw Fields cont'd



Graph 1: EC by Sample, Depth, and Location between Collins Draw Fields cont'd



2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
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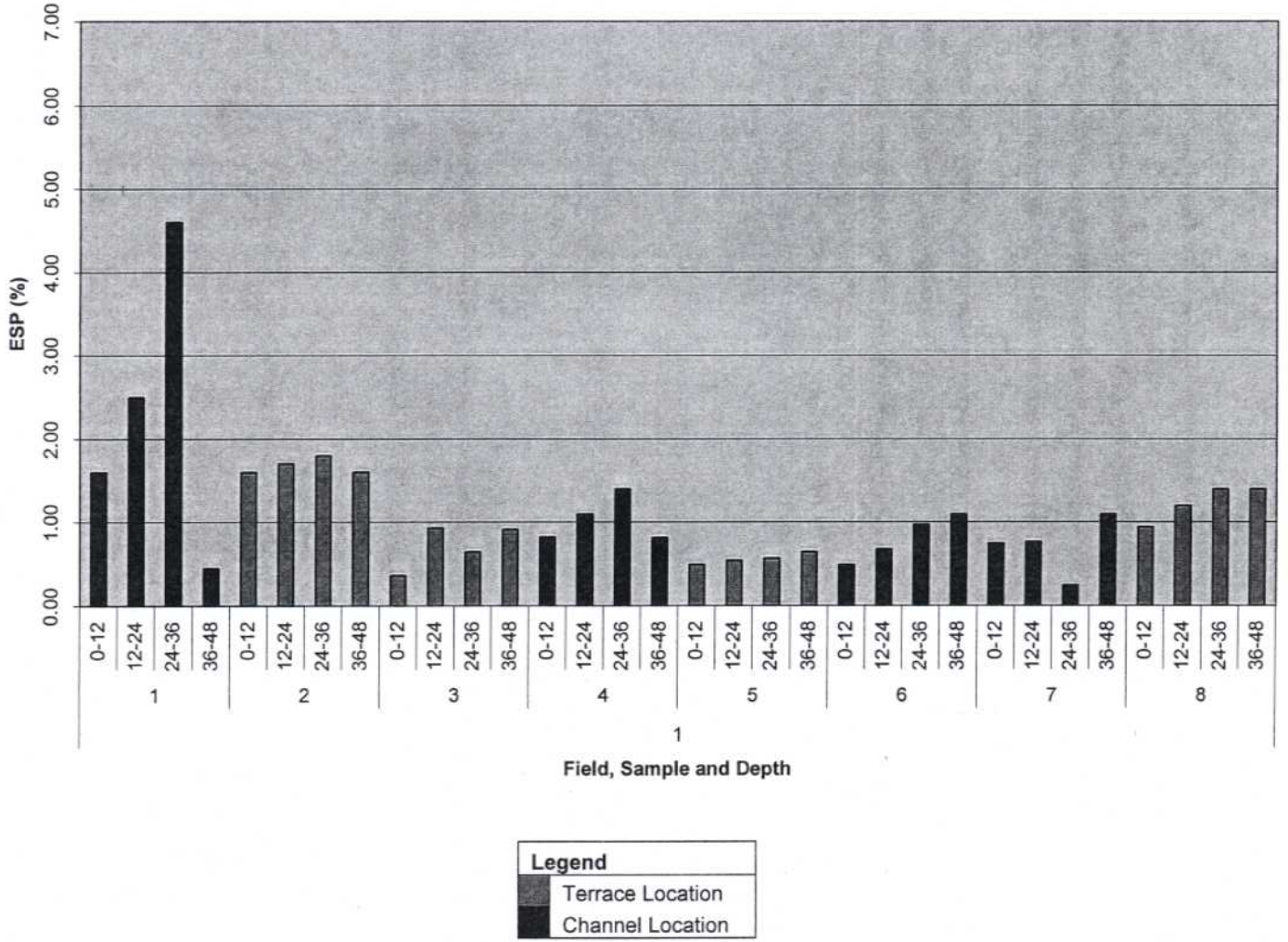
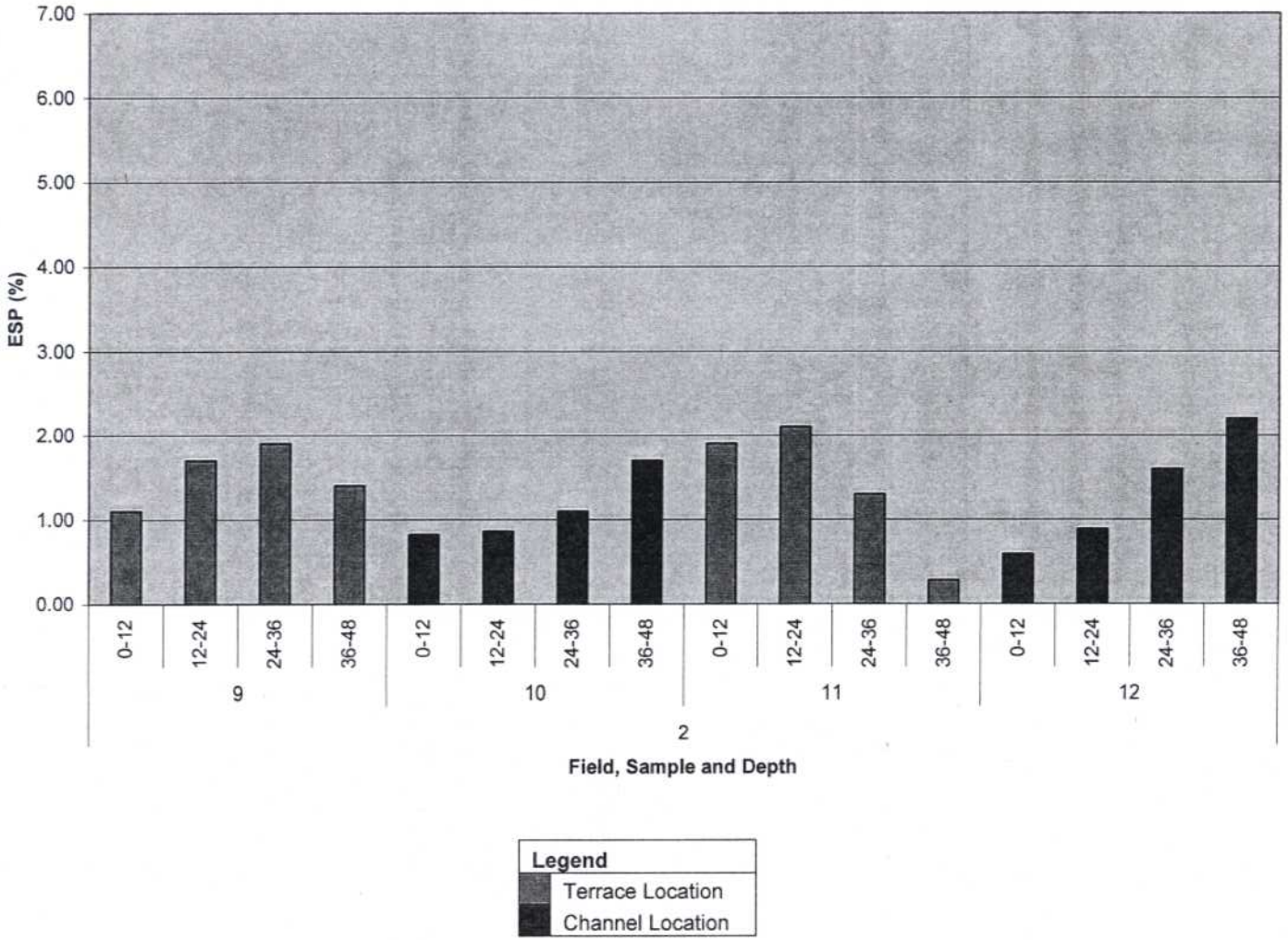
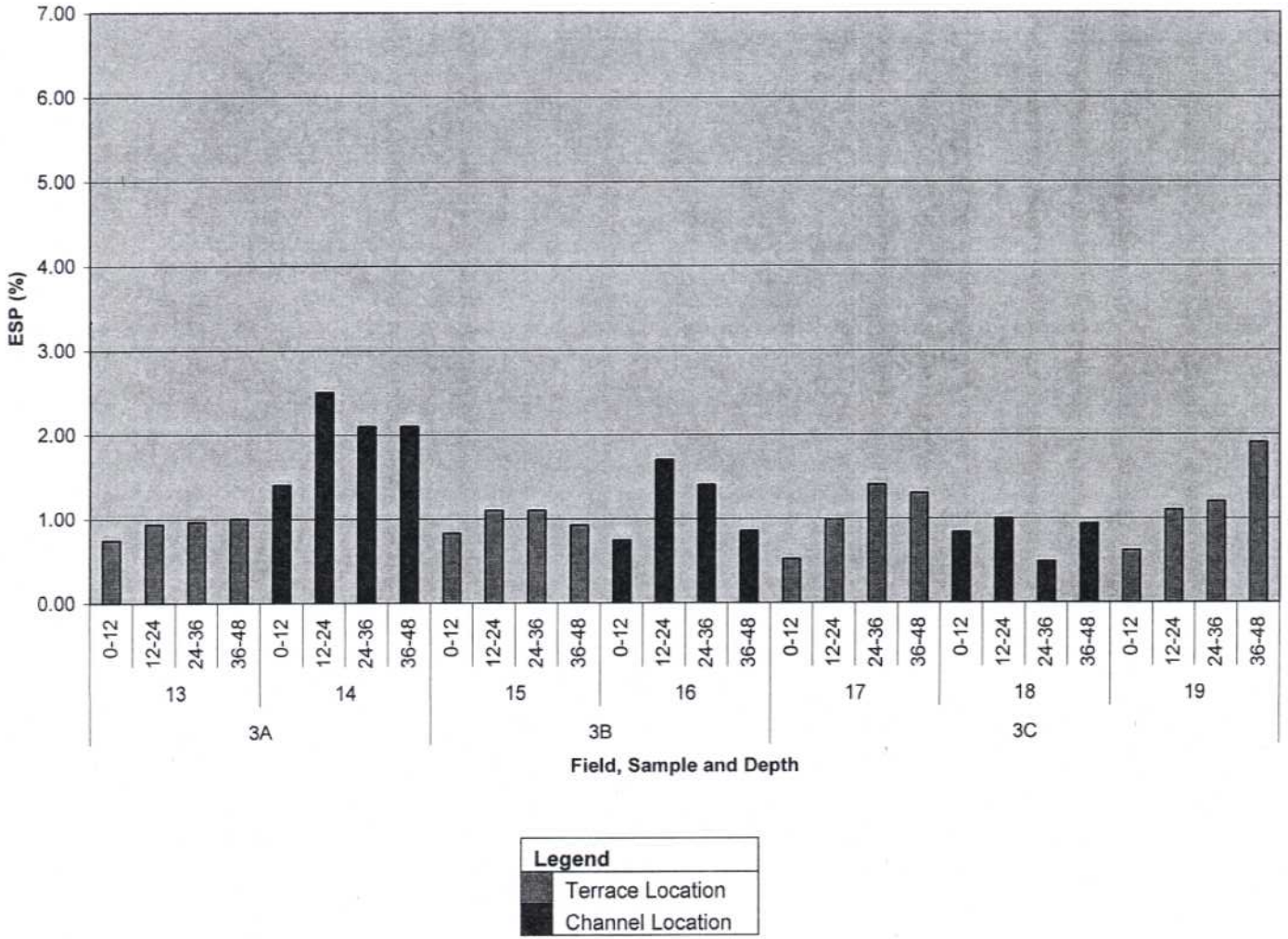
Graph 2: ESP by Sample, Depth, and Location between Collins Draw Fields



Graph 2: ESP by Sample, Depth, and Location between Collins Draw Fields cont'd



Graph 2: ESP by Sample, Depth, and Location between Collins Draw Fields cont'd



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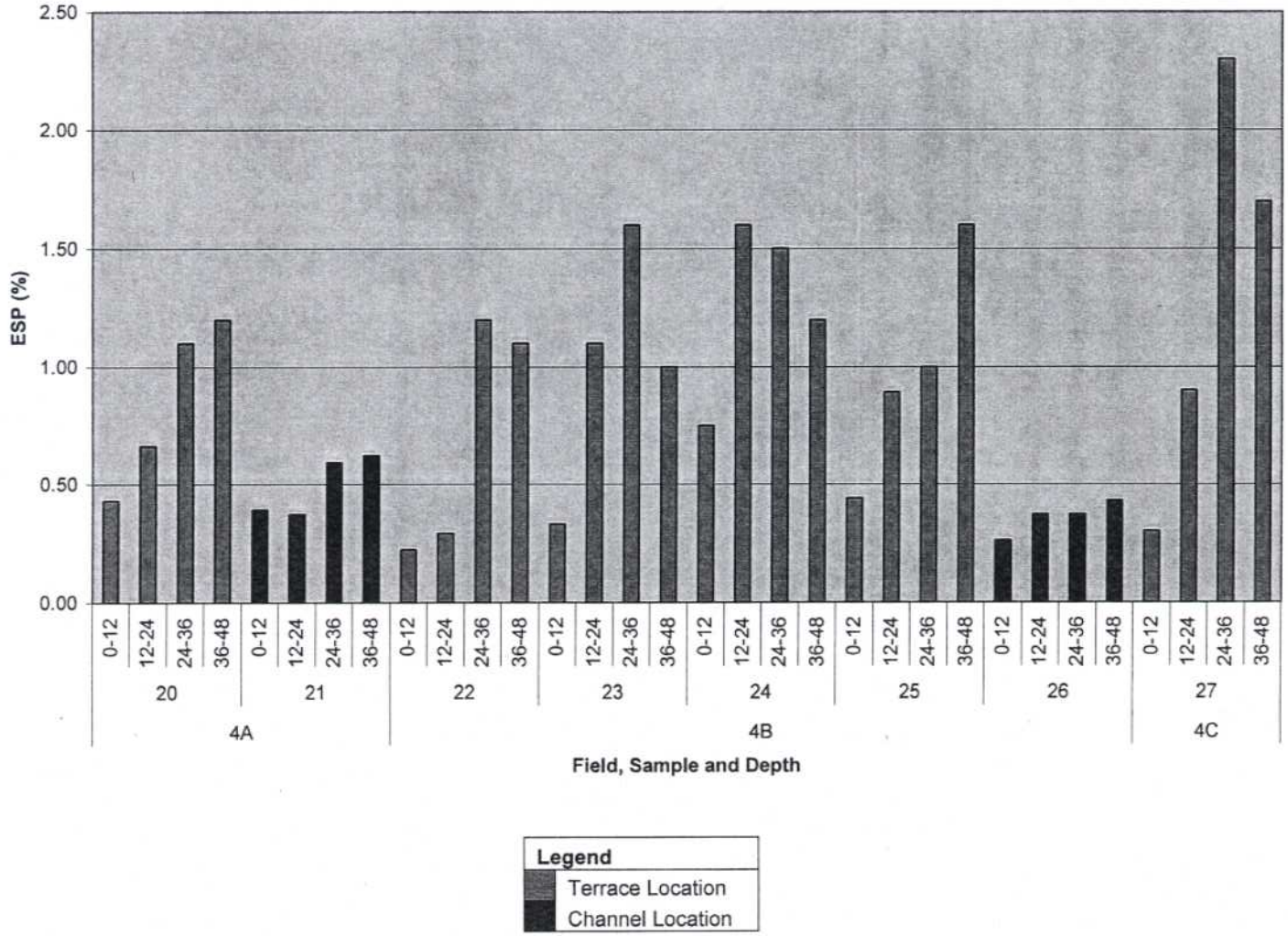
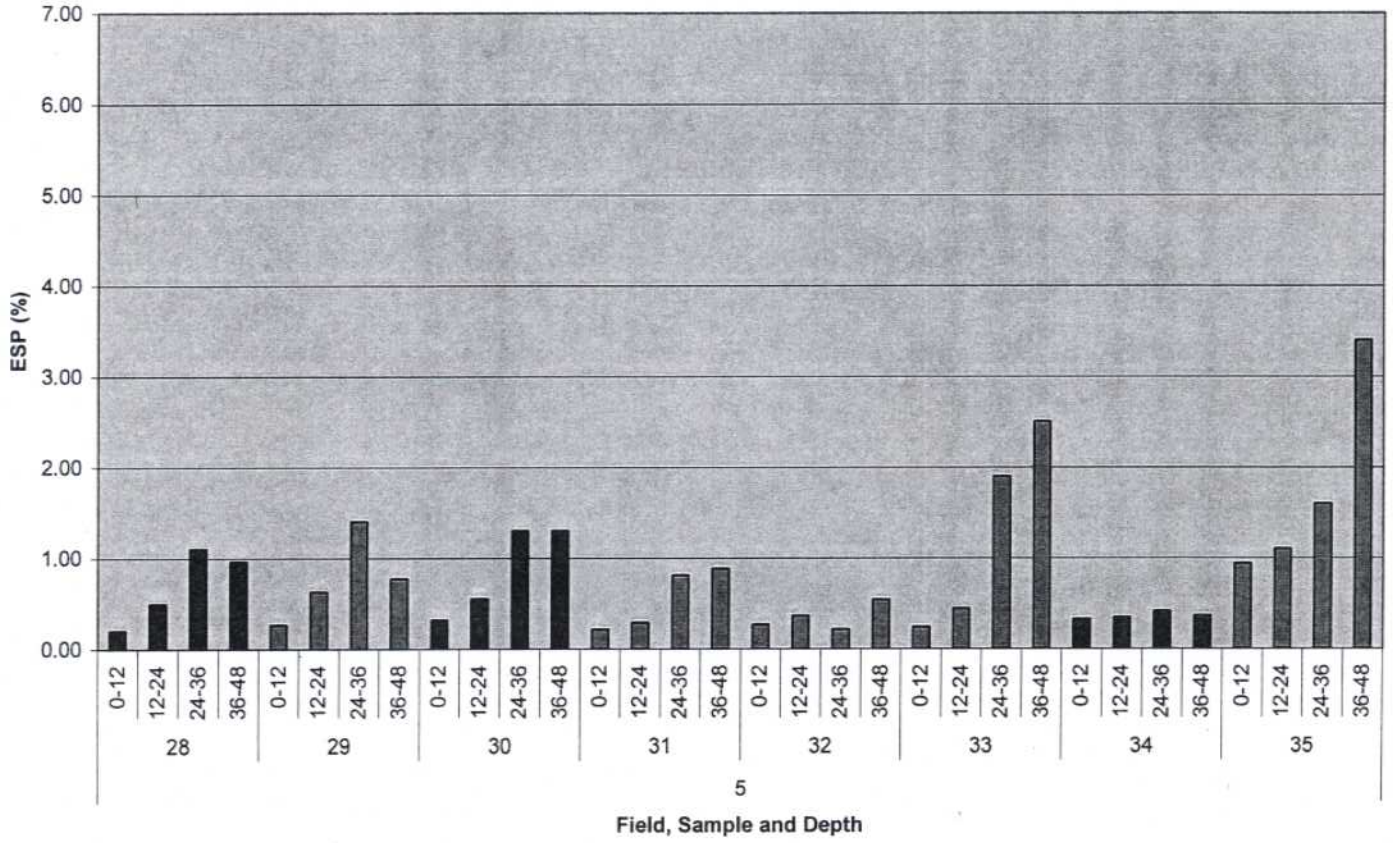
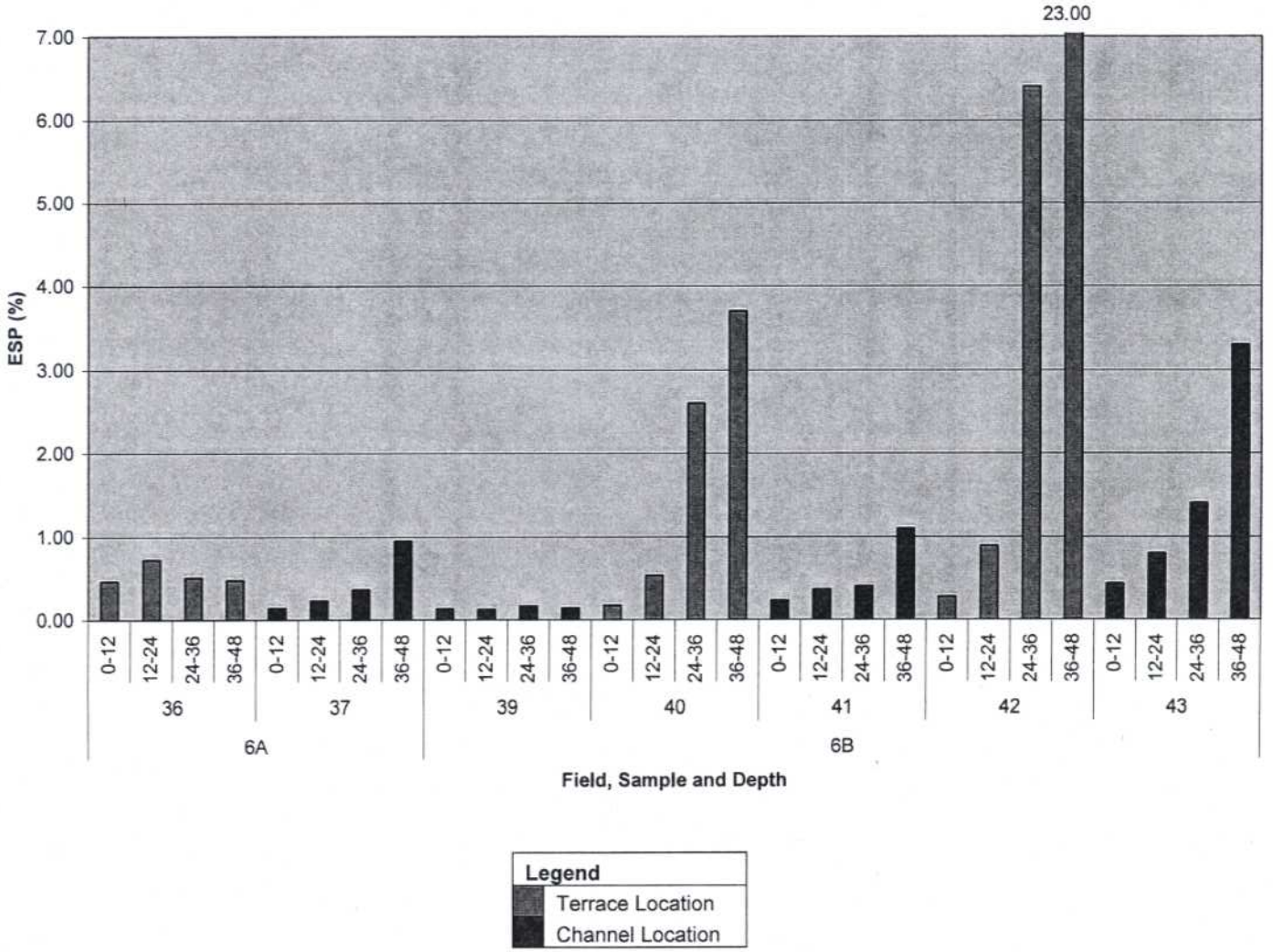
Graph 2: ESP by Sample, Depth, and Location between Collins Draw Fields cont'd



Graph 2: ESP by Sample, Depth, and Location between Collins Draw Fields cont'd



Graph 2: ESP by Sample, Depth, and Location between Collins Draw Fields cont'd



2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
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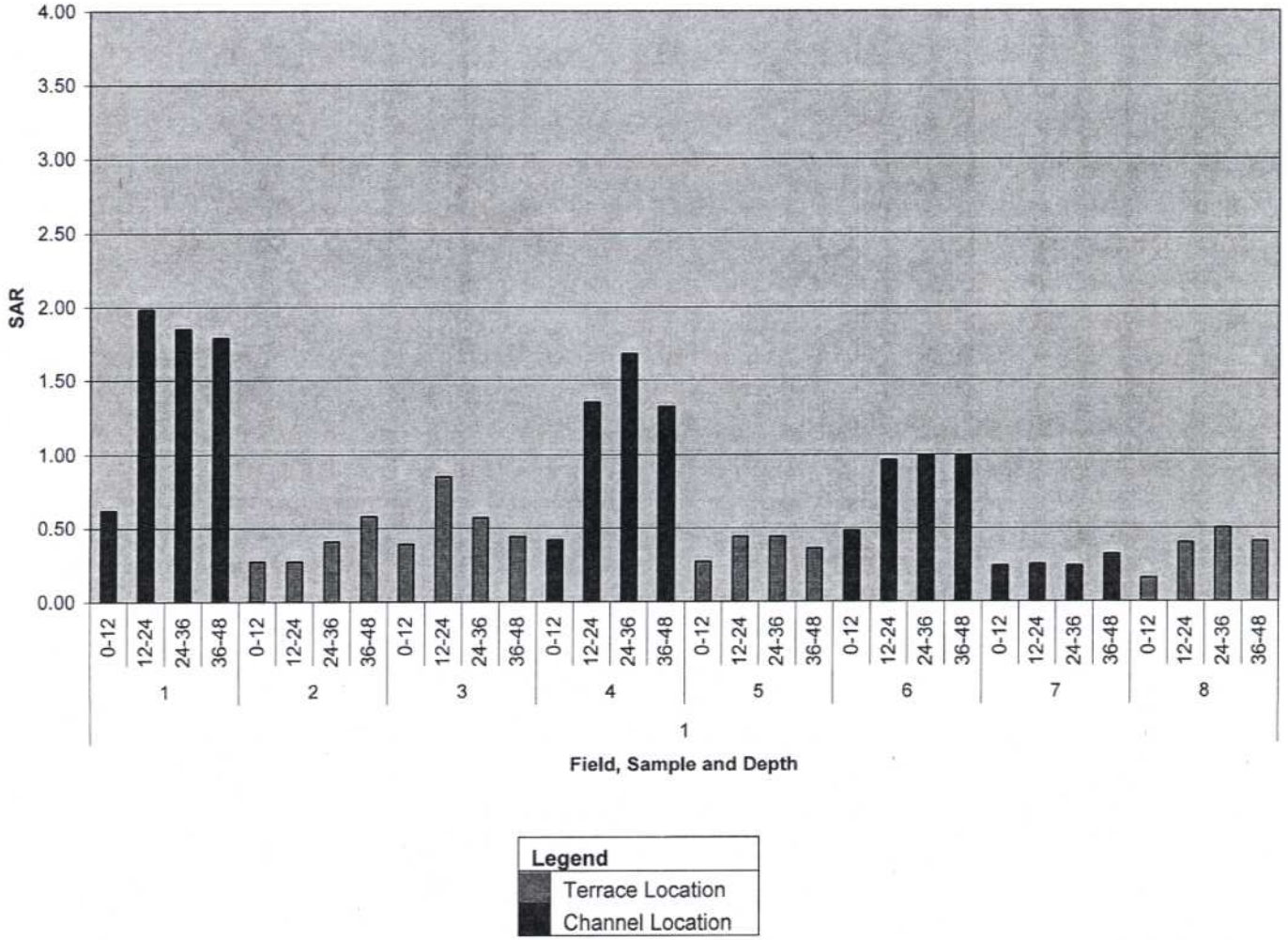
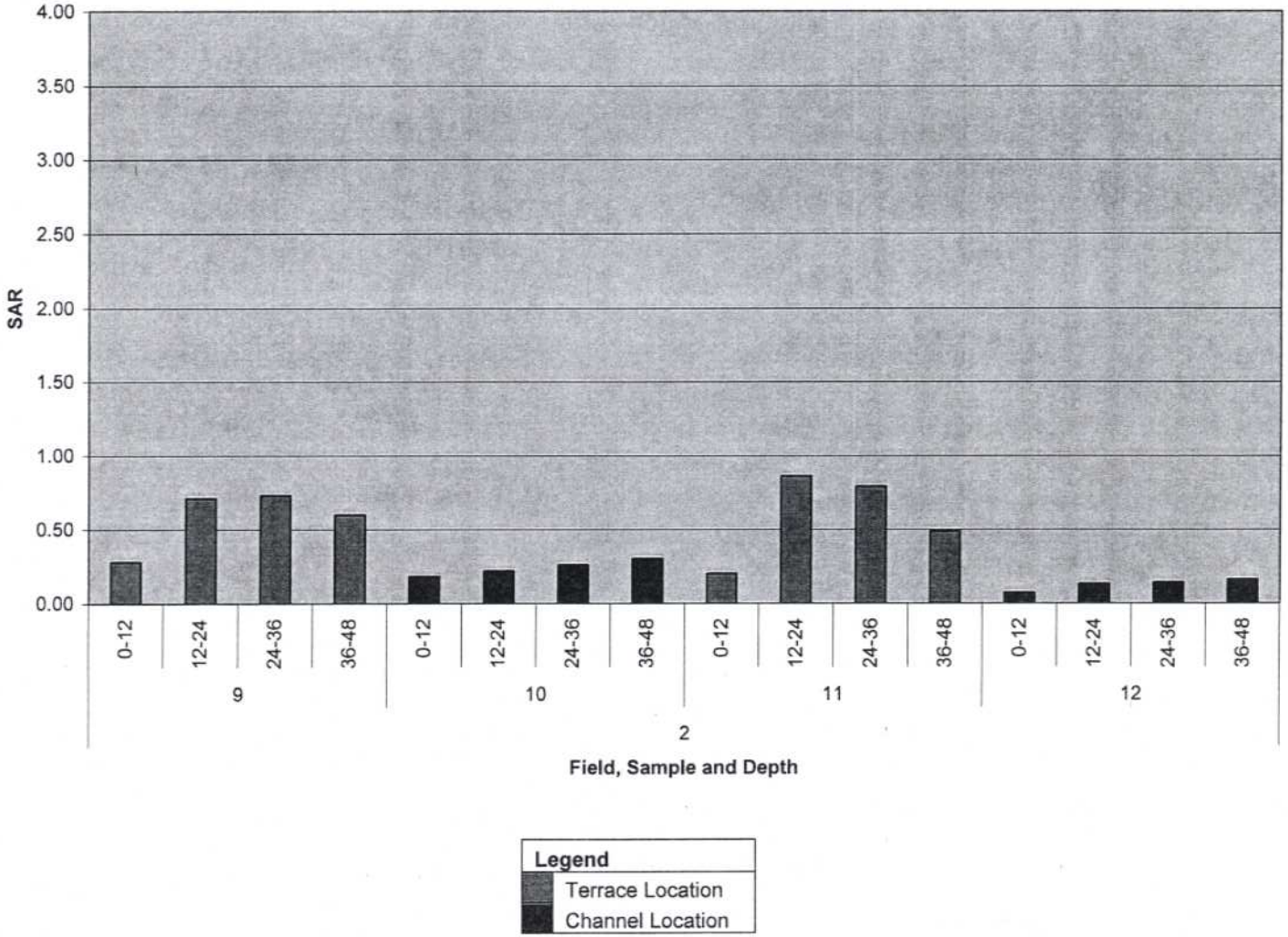
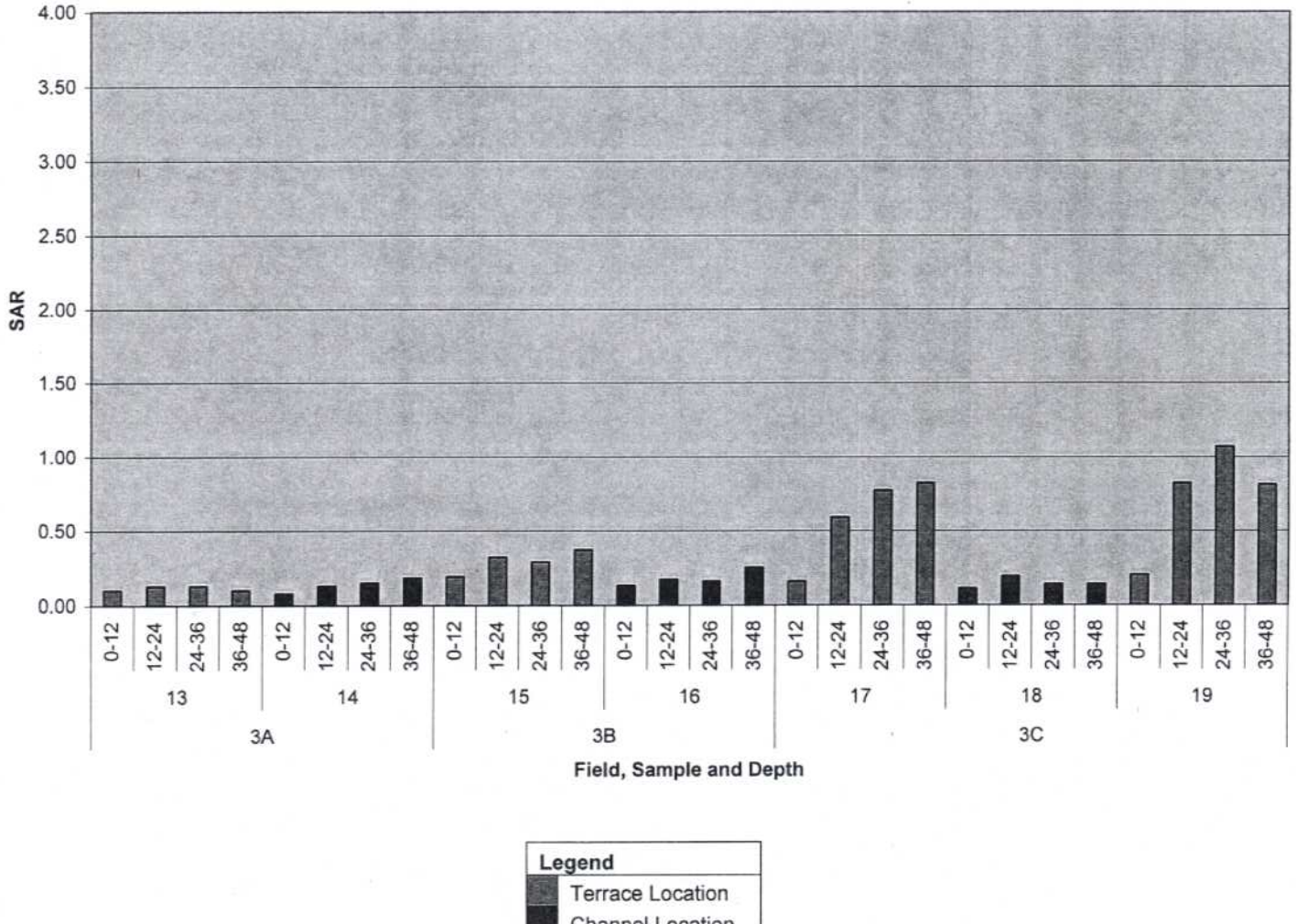
Graph 3: SAR by Sample, Depth and Location between Collins Draw Fields



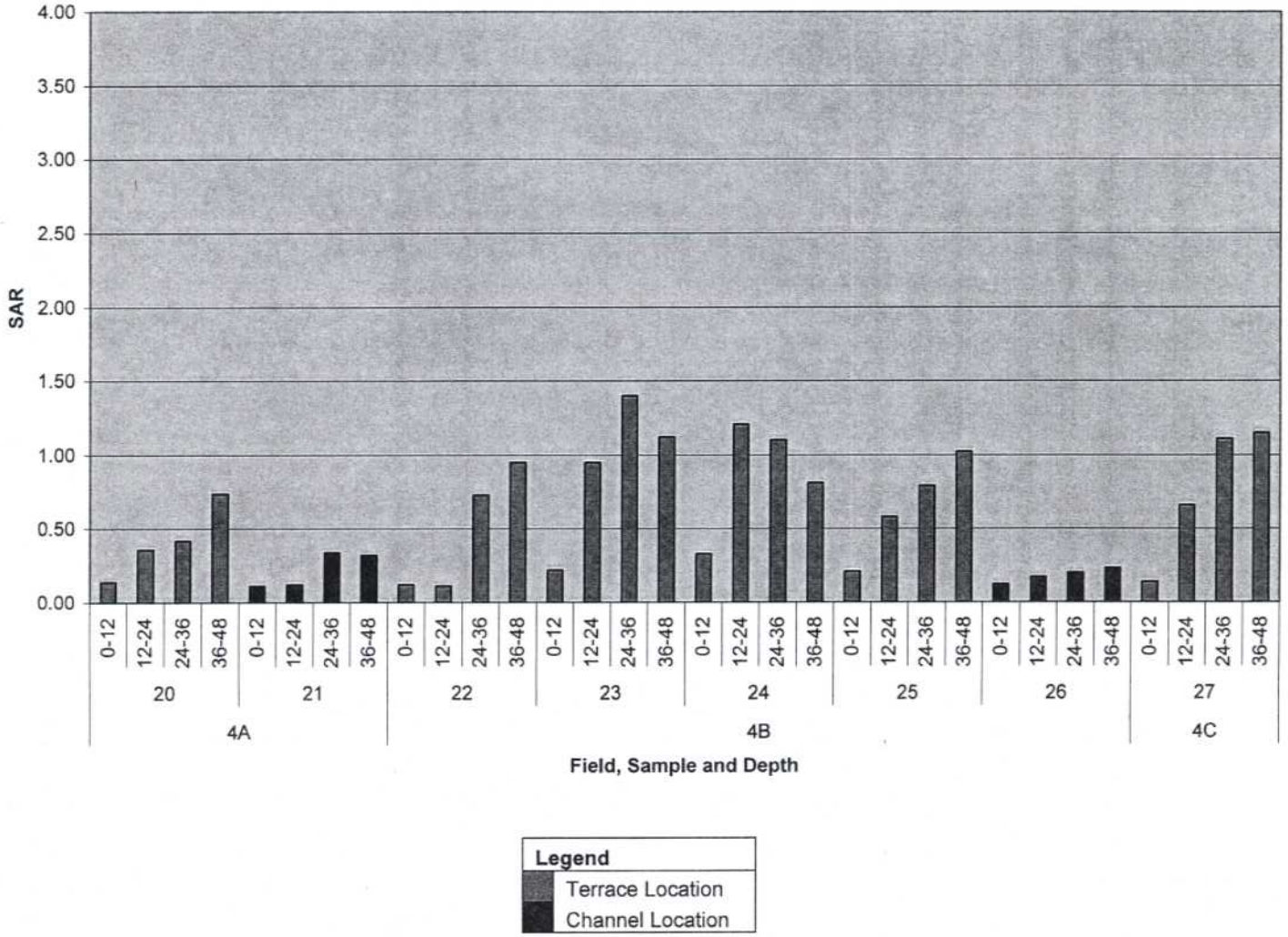
Graph 3: SAR by Sample, Depth and Location between Collins Draw Fields cont'd



Graph 3: SAR by Sample, Depth and Location between Collins Draw Fields cont'd



Graph 3: SAR by Sample, Depth and Location between Collins Draw Fields cont'd



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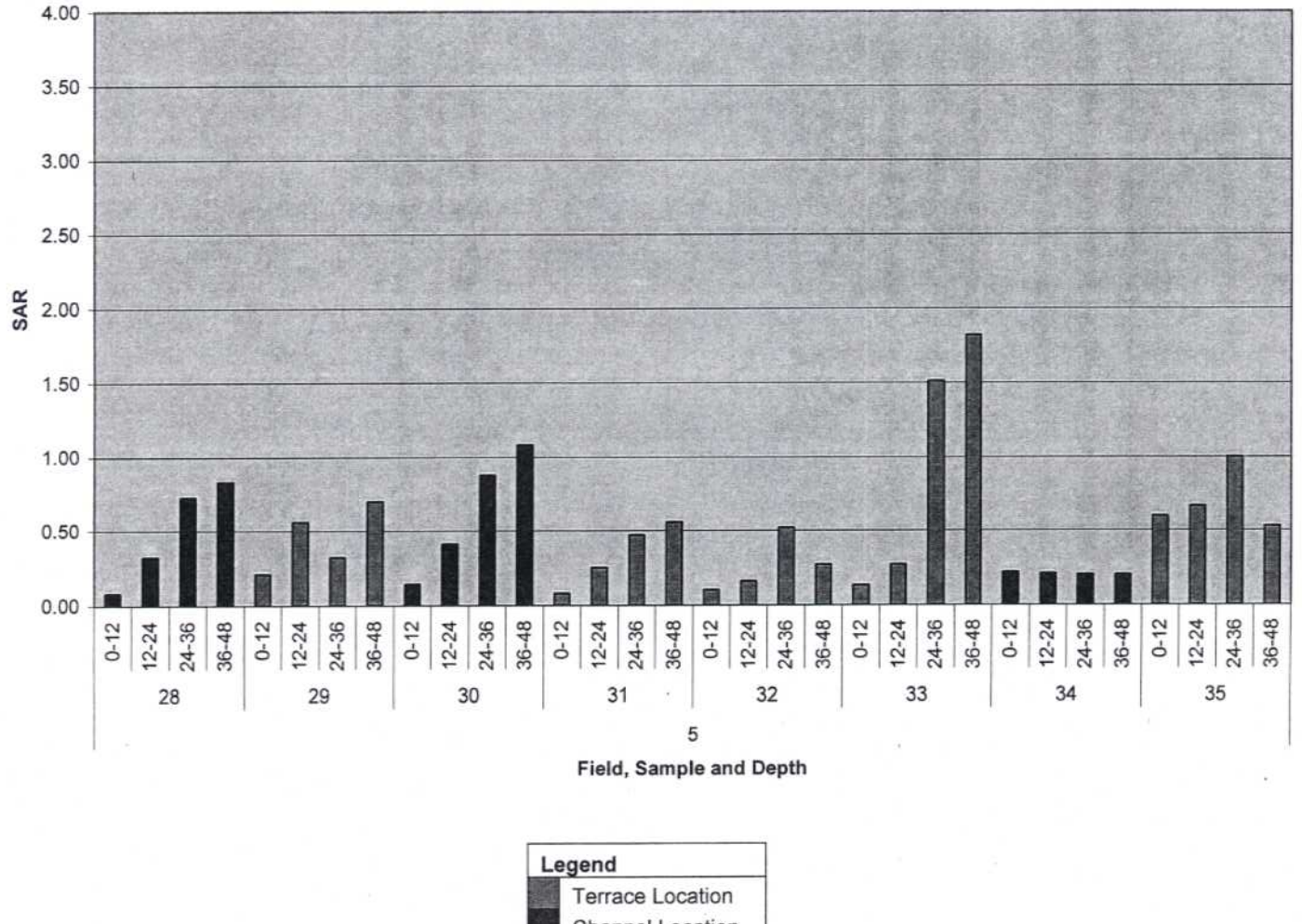
Graph 3: SAR by Sample, Depth and Location between Collins Draw Fields cont'd



2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
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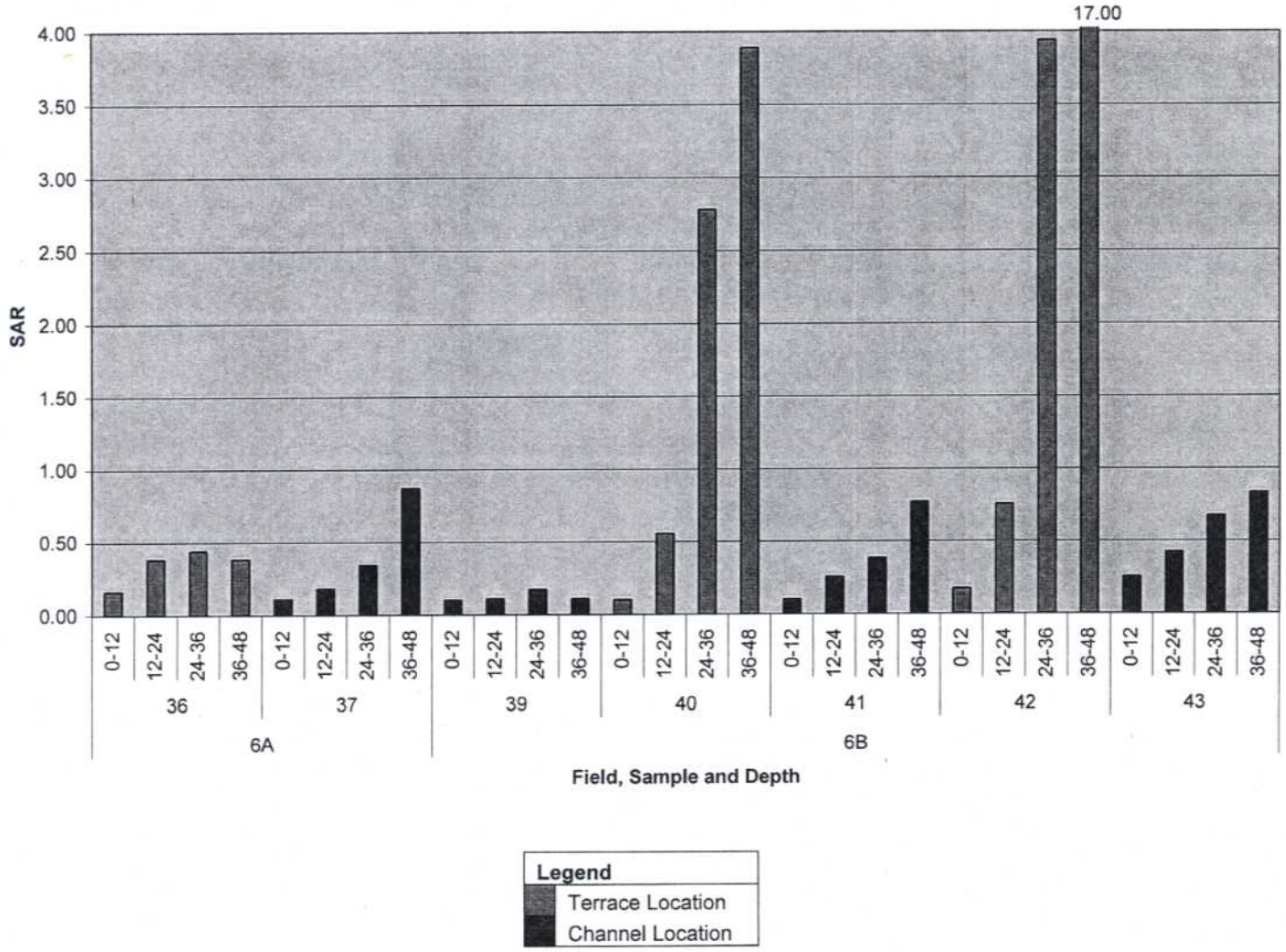
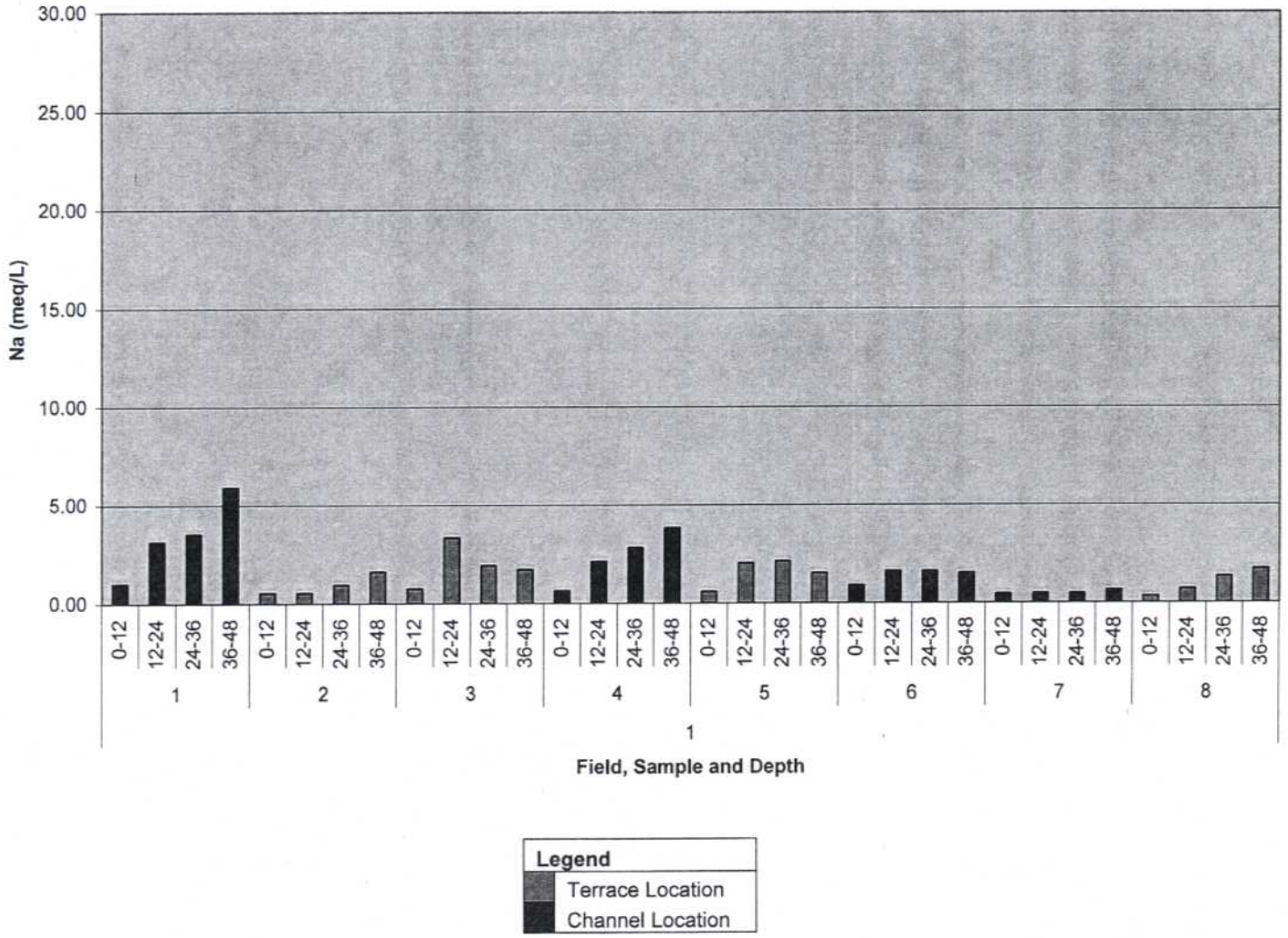
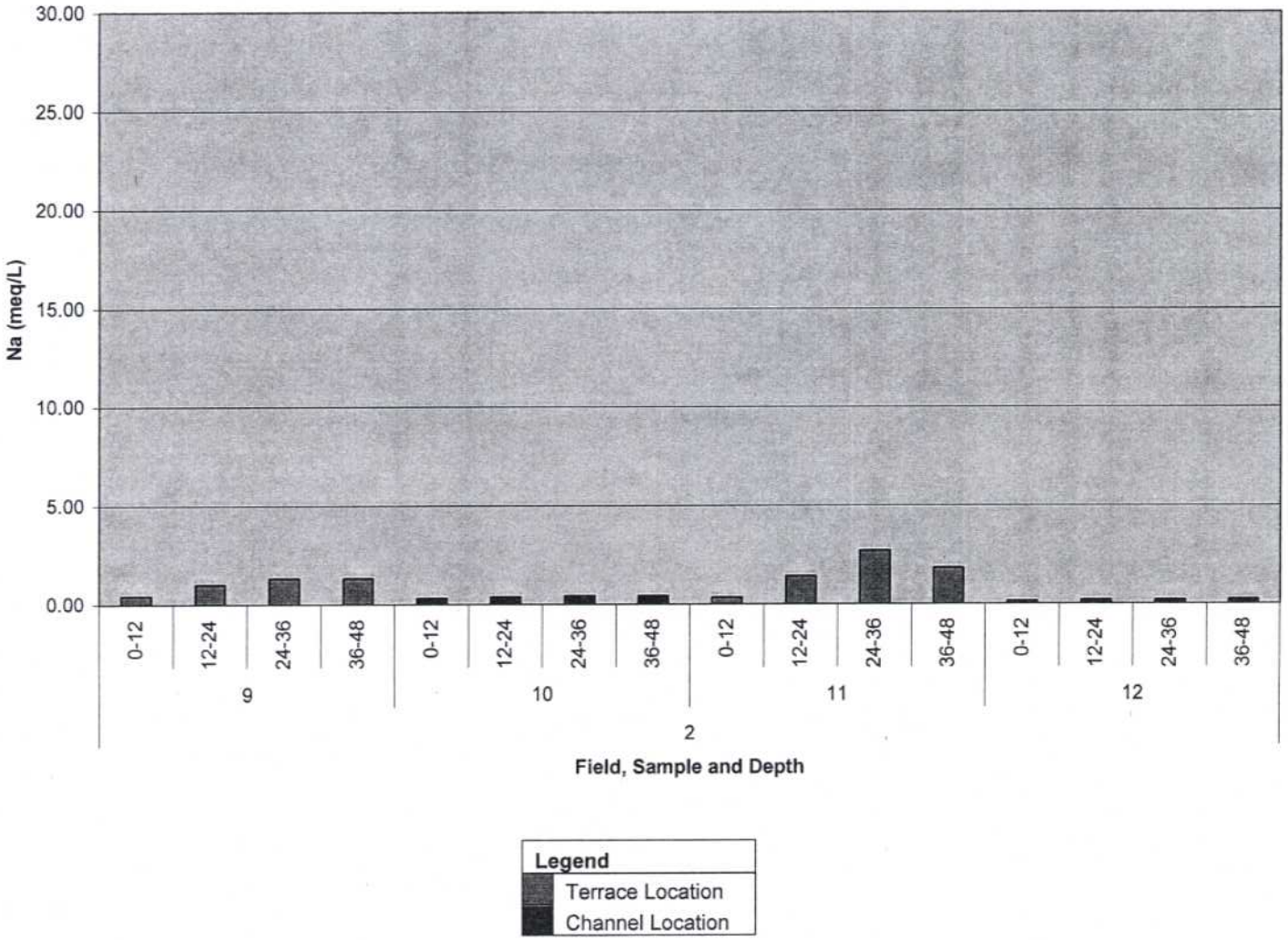
Graph 3: SAR by Sample, Depth and Location between Collins Draw Fields cont'd



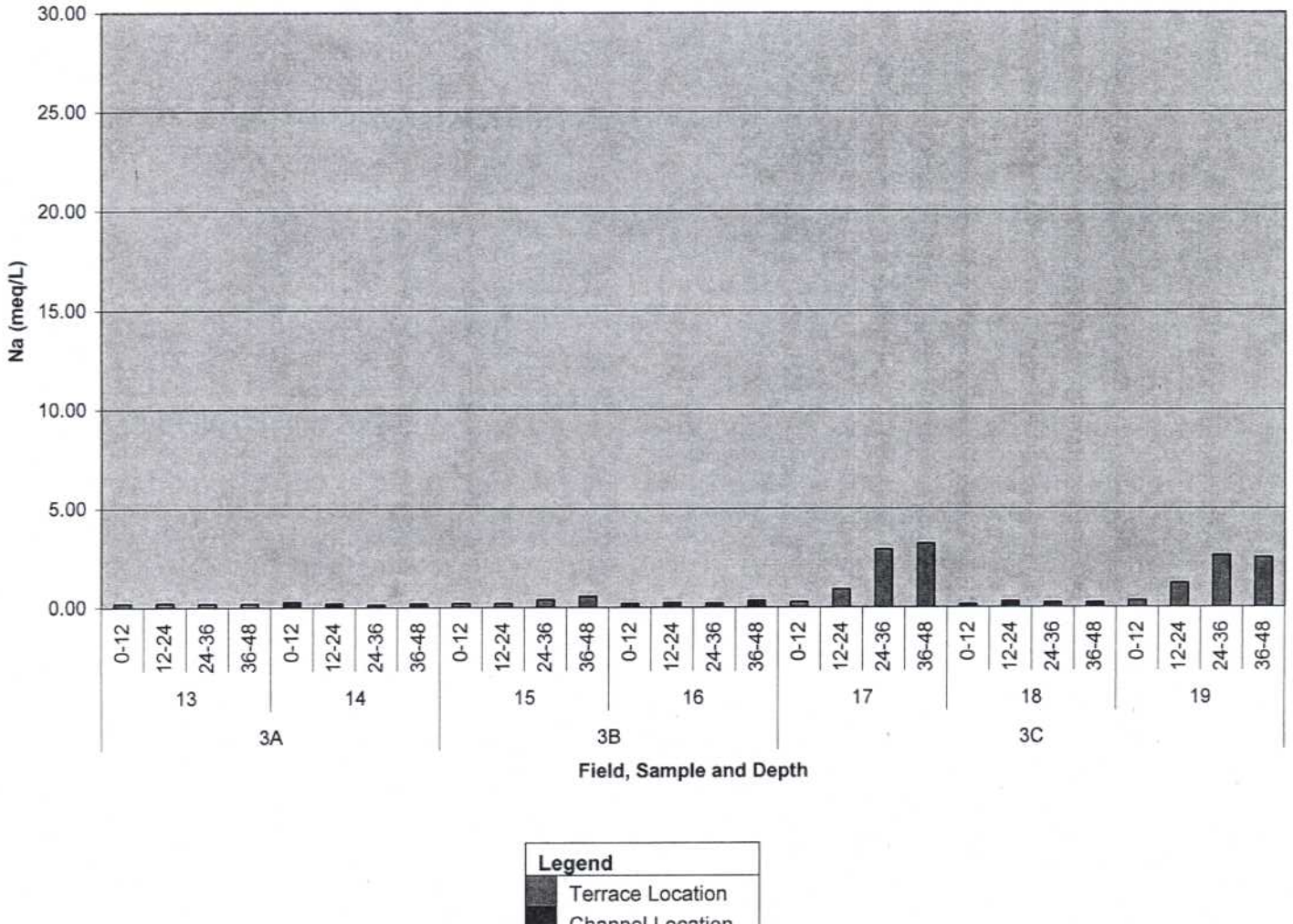
Graph 4: Na by Sample, Depth, and Location between Collins Draw Fields



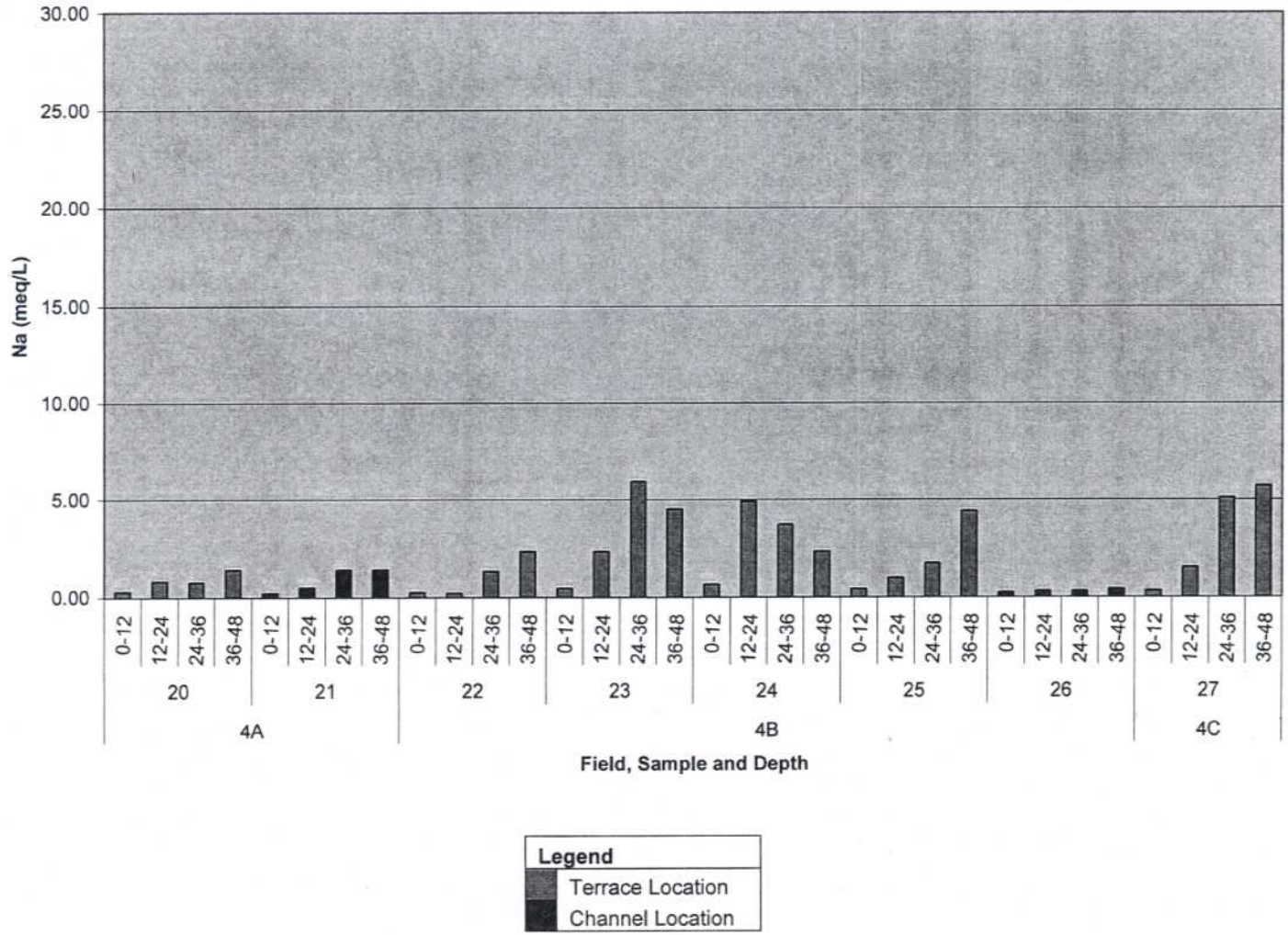
Graph 4: Na by Sample, Depth, and Location between Collins Draw Fields cont'd



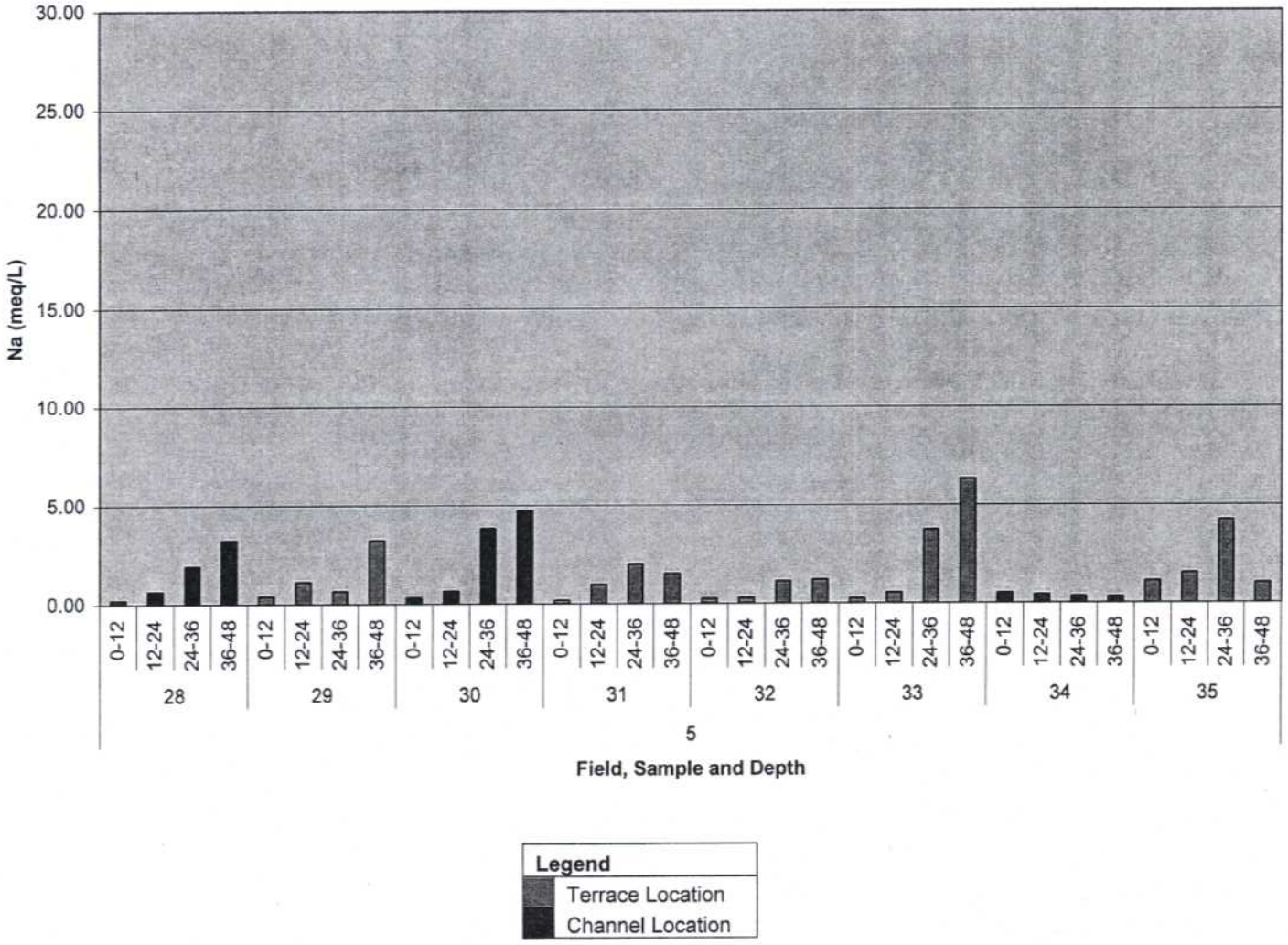
Graph 4: Na by Sample, Depth, and Location between Collins Draw Fields cont'd



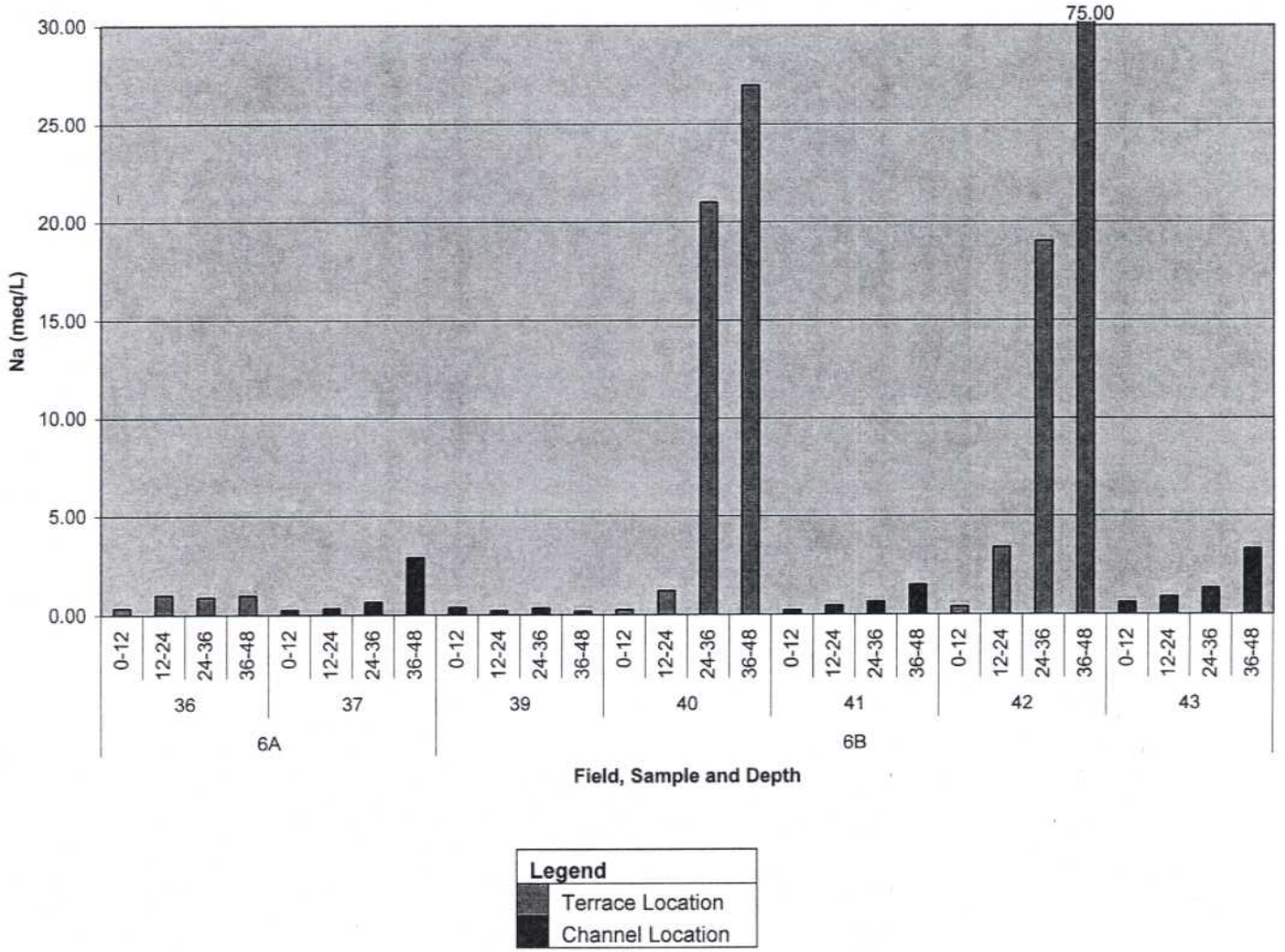
Graph 4: Na by Sample, Depth, and Location between Collins Draw Fields cont'd



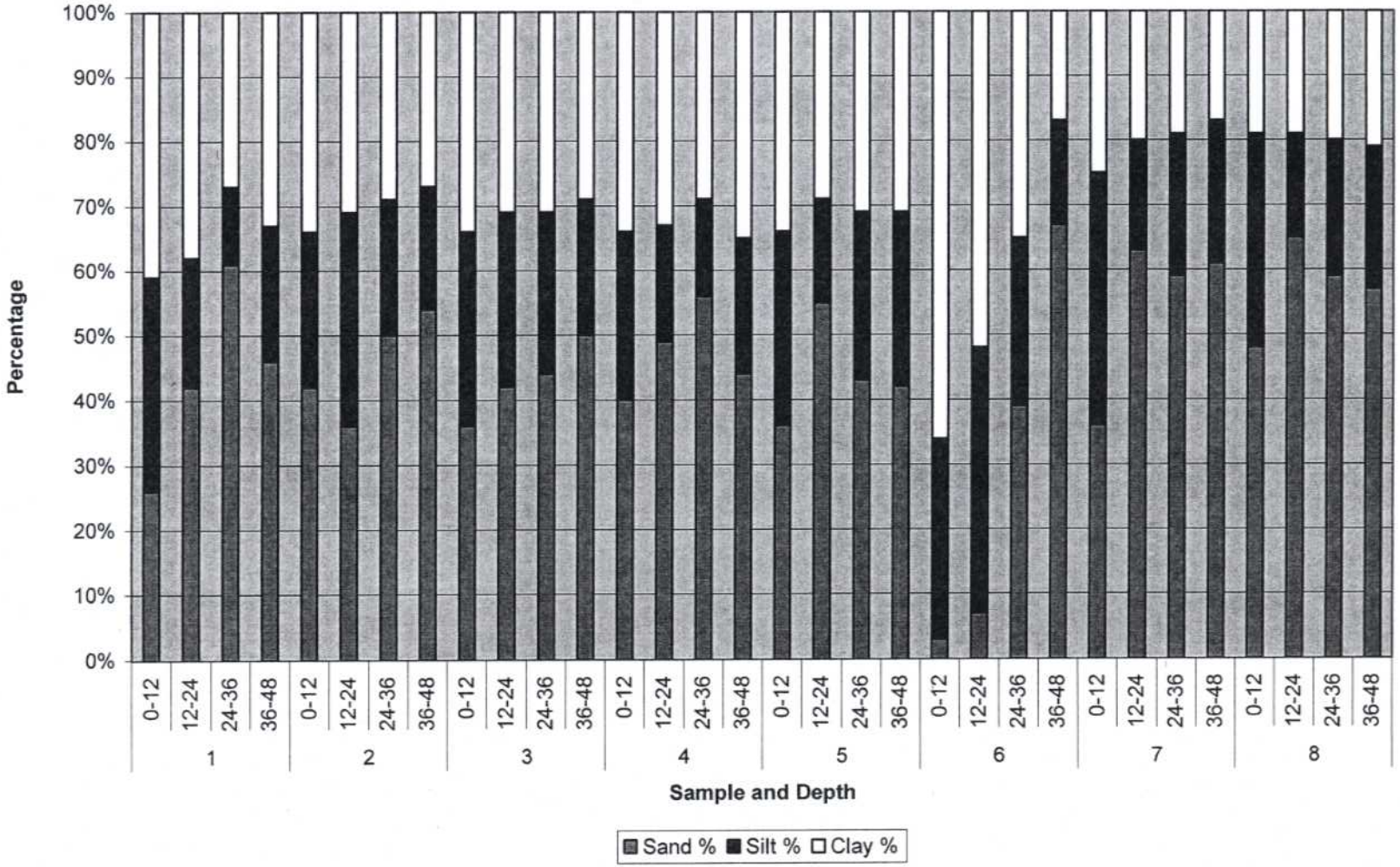
Graph 4: Na by Sample, Depth, and Location between Collins Draw Fields cont'd



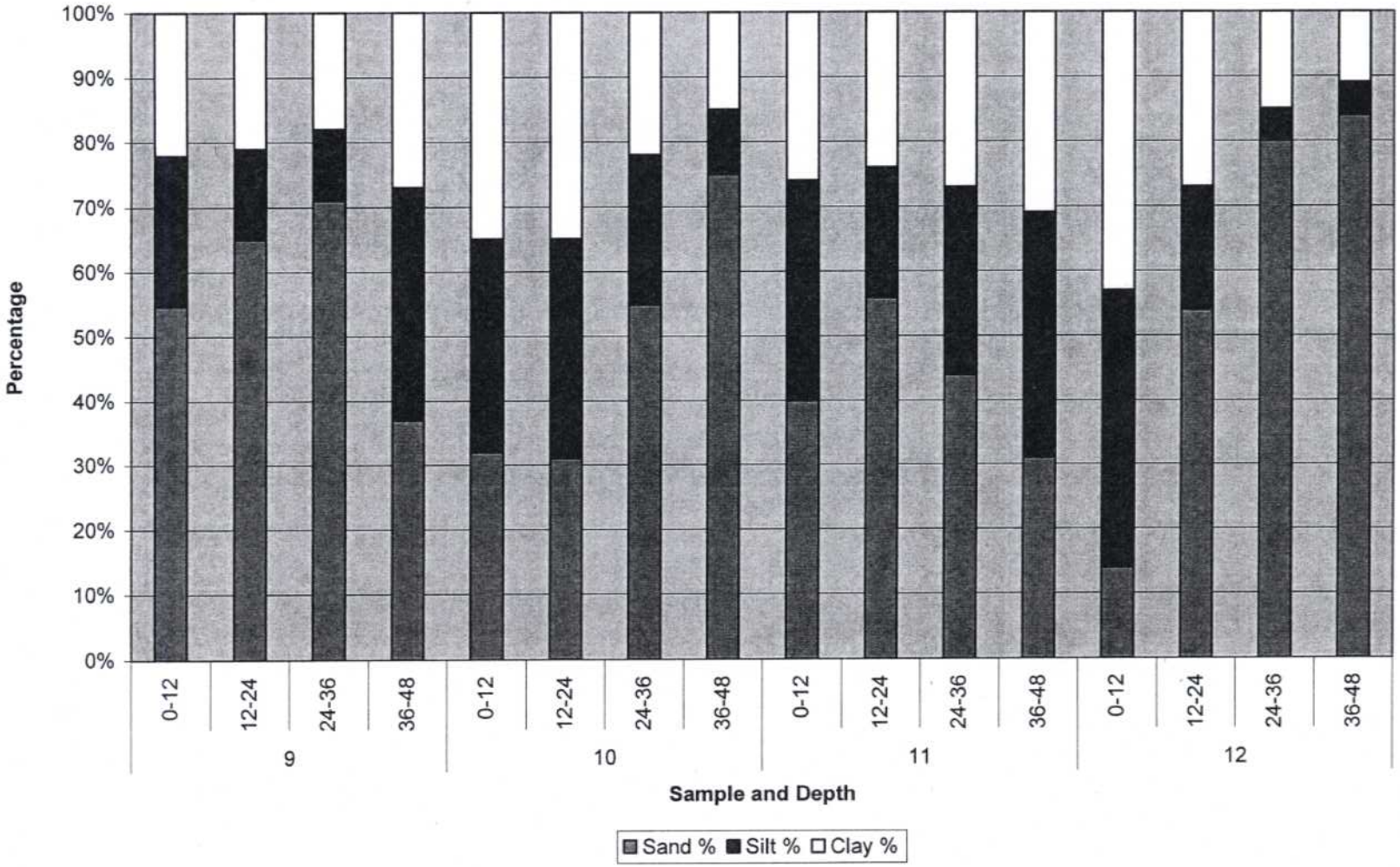
Graph 4: Na by Sample, Depth, and Location between Collins Draw Fields cont'd



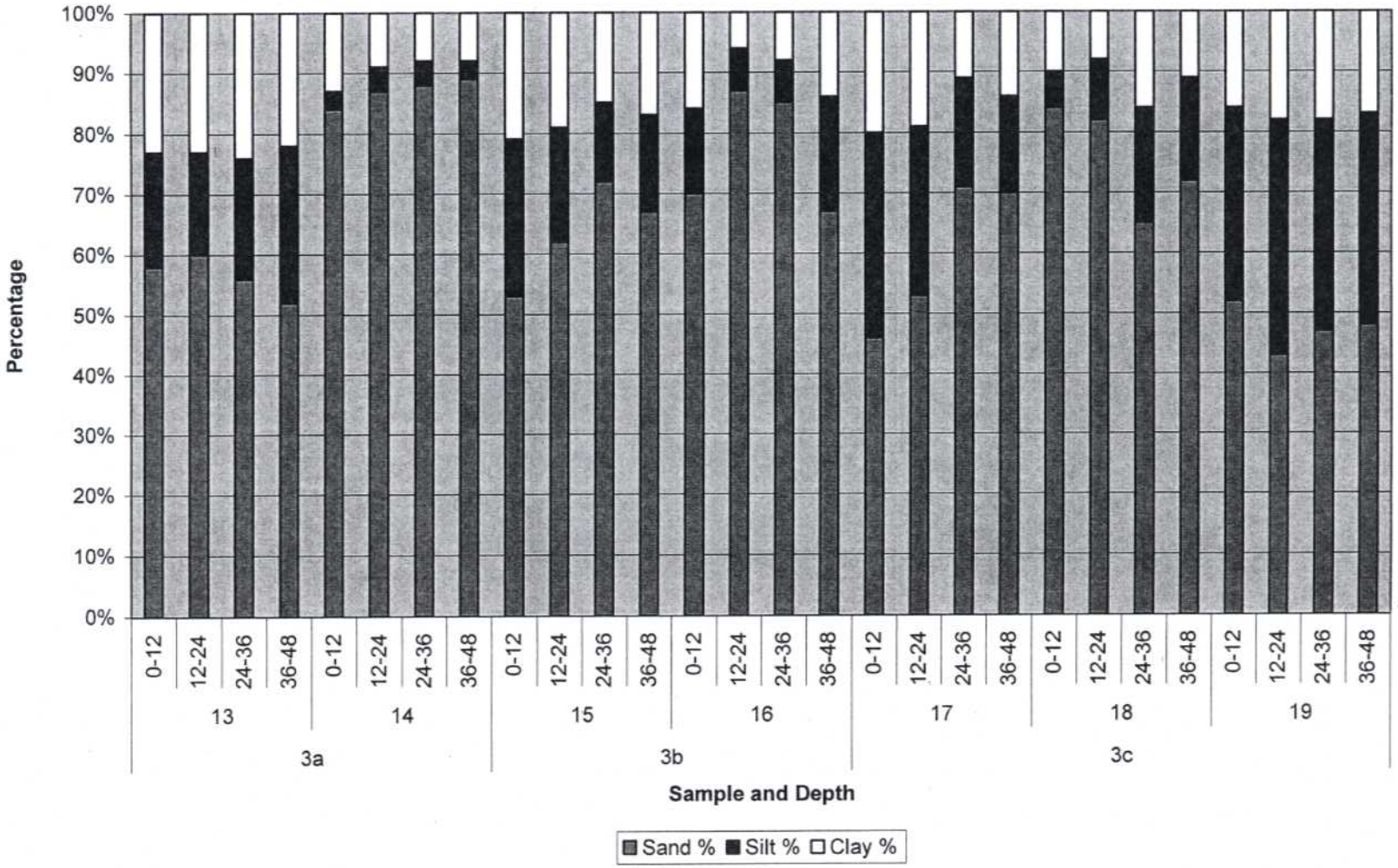
Graph 5: Percent Sand, Silt, and Clay in Collins Draw Field 1



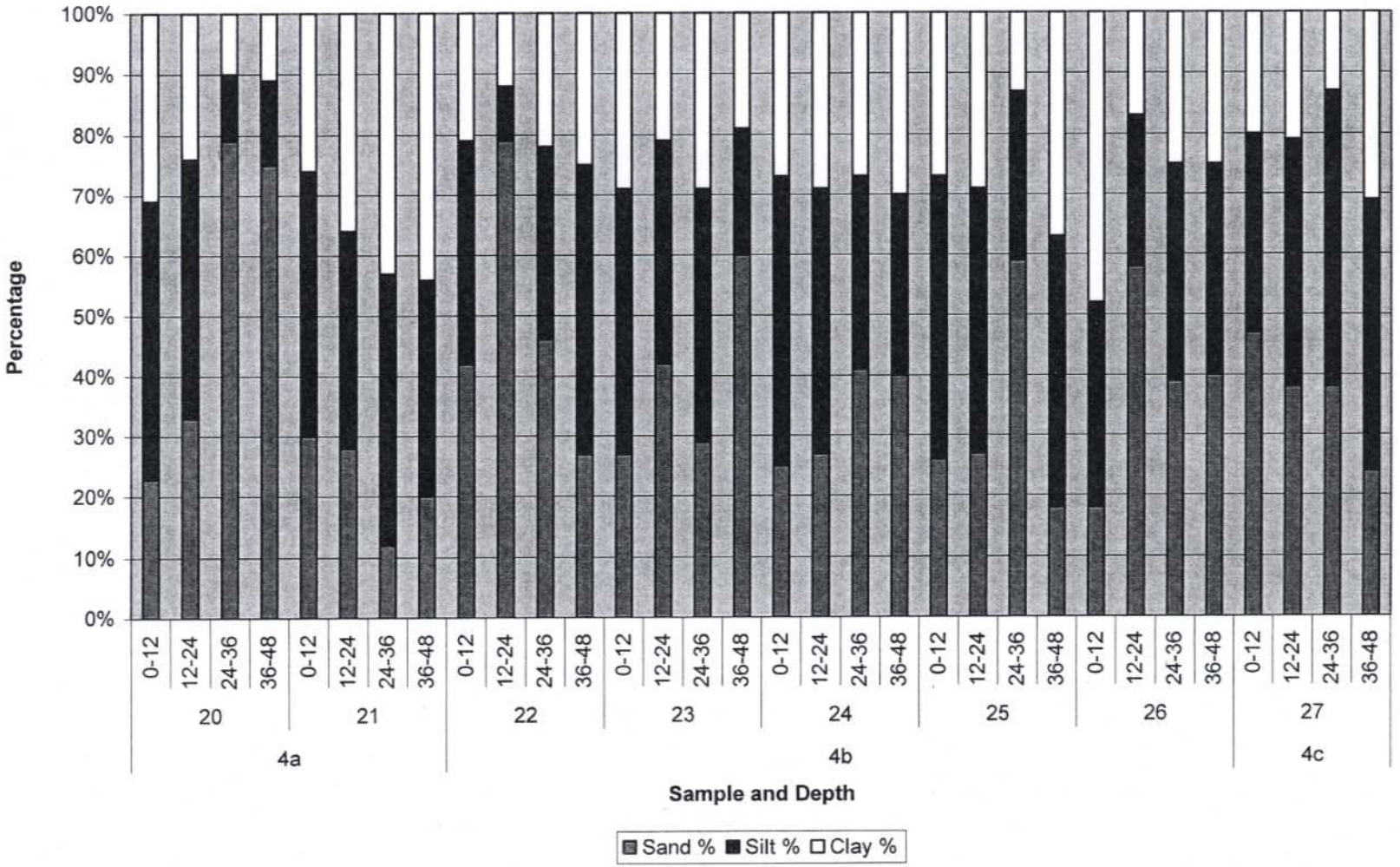
Graph 6: Percent Sand, Silt, and Clay in Collins Draw Field 2



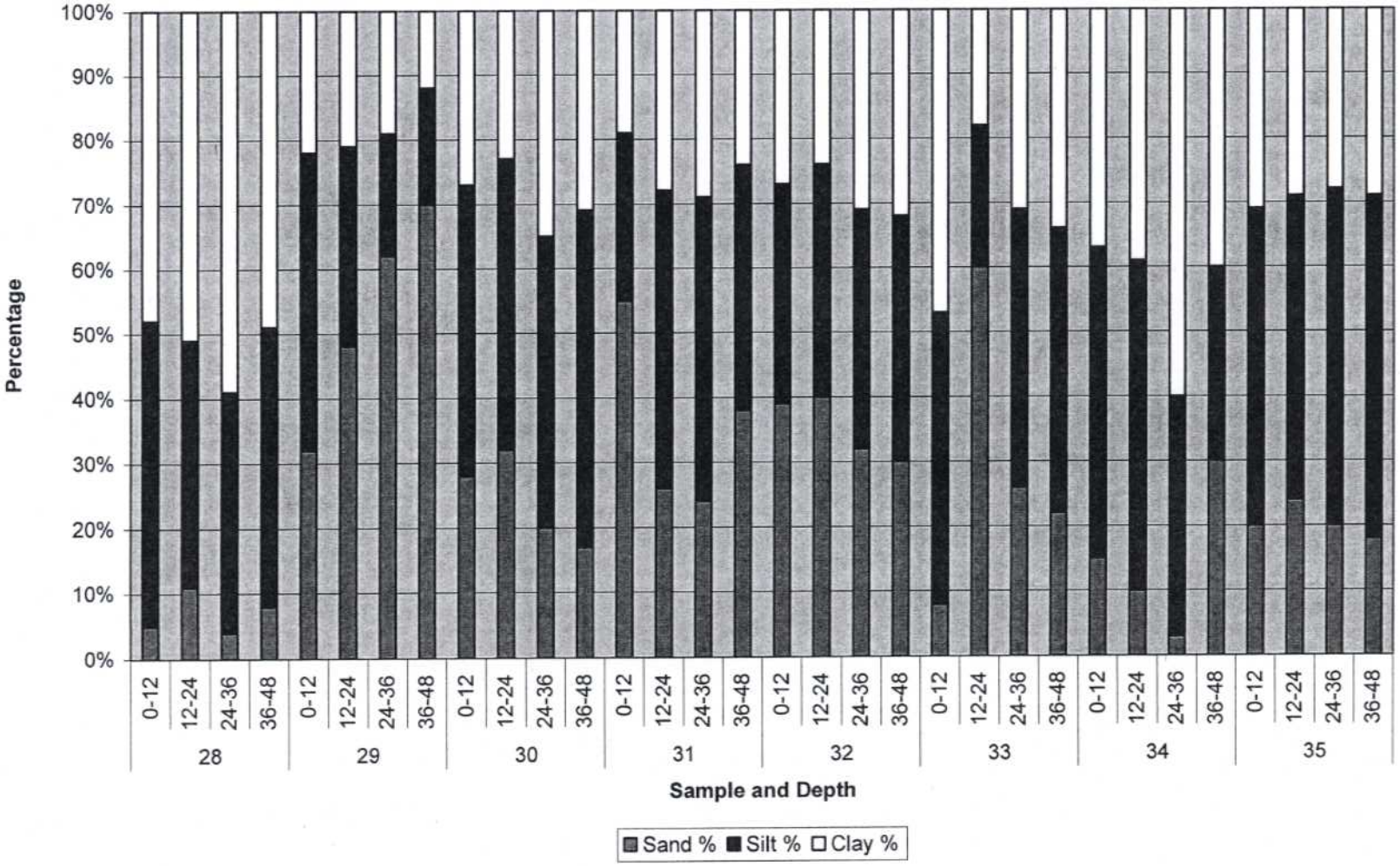
Graph 7: Percent Sand, Silt, and Clay in Collins Draw Field 3



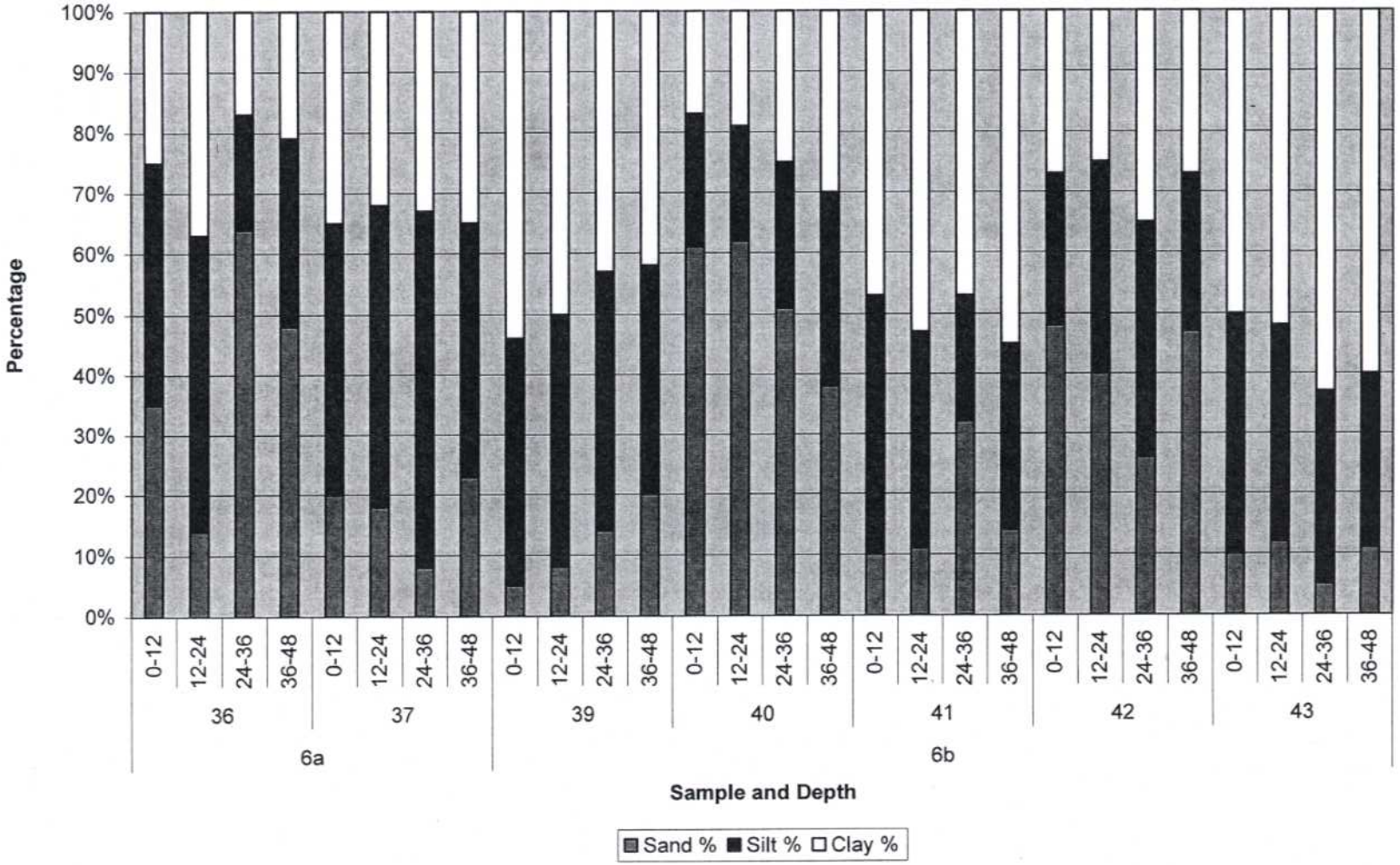
Graph 8: Percent Sand, Silt, and Clay in Collins Draw Field 4



Graph 9: Percent Sand, Silt, and Clay in Collins Draw Field 5



Graph 10: Percent Sand, Silt, and Clay in Collins Draw Field 6



ADDENDUM 2
Photographs of 2006 Soil Sampling

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
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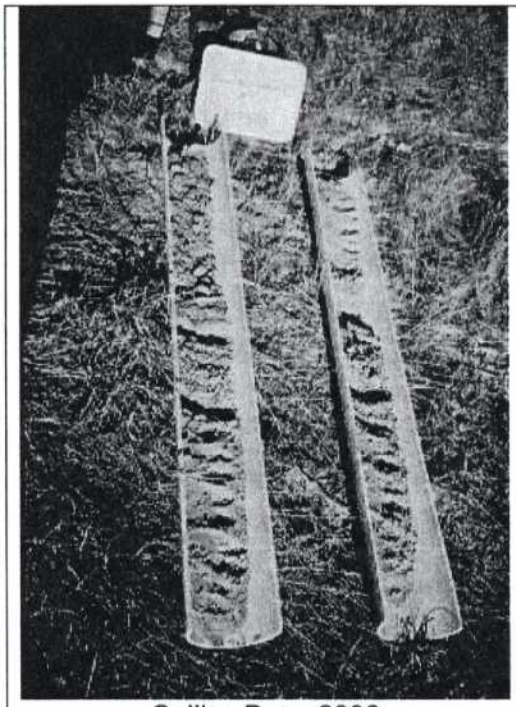
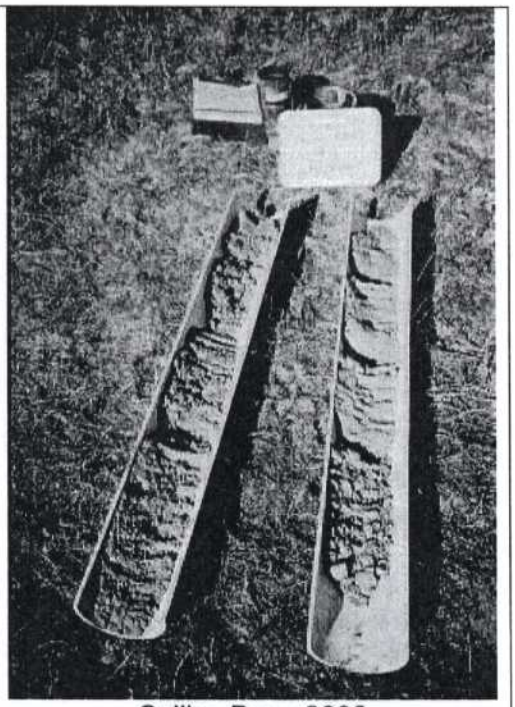
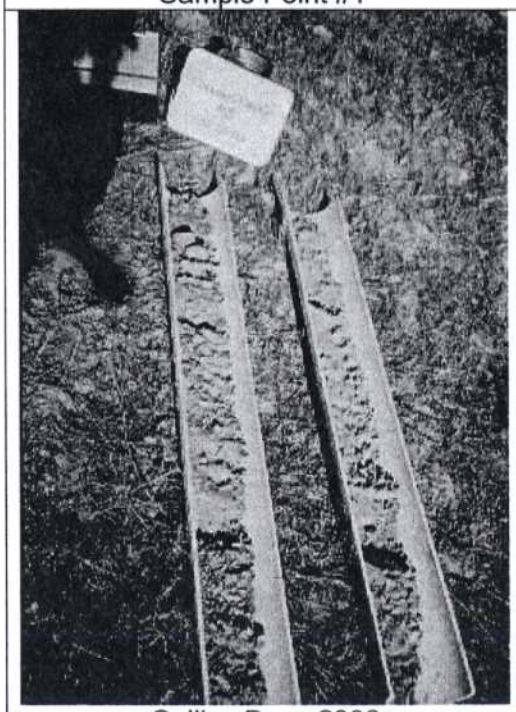


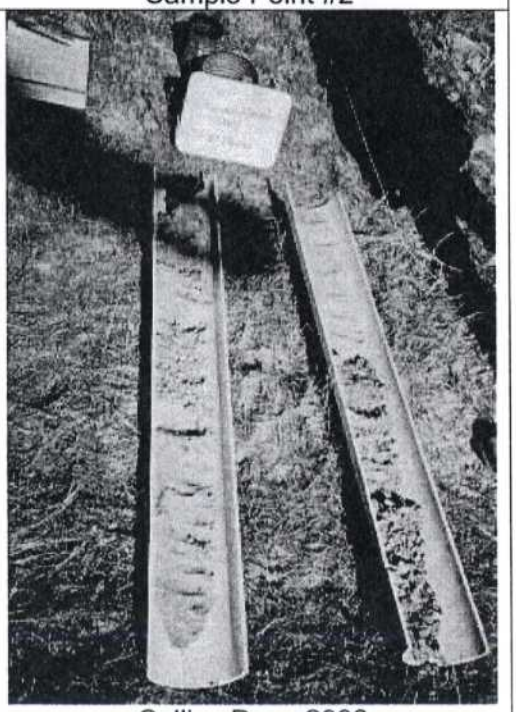
Collins Draw 2006
Sample Point #1



Collins Draw 2006
Sample Point #2



Collins Draw 2006
Sample Point #3



Collins Draw 2006
Sample Point #4

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
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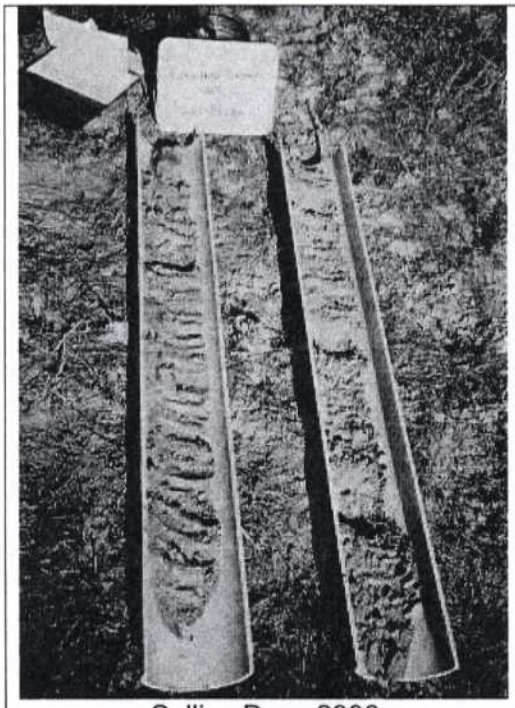
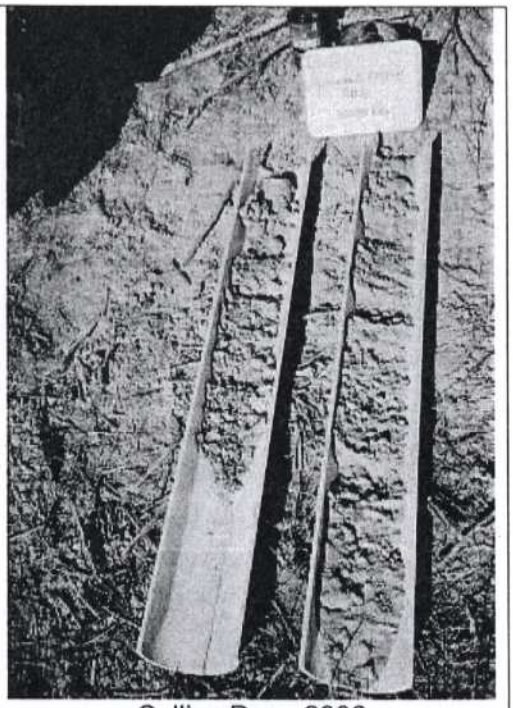
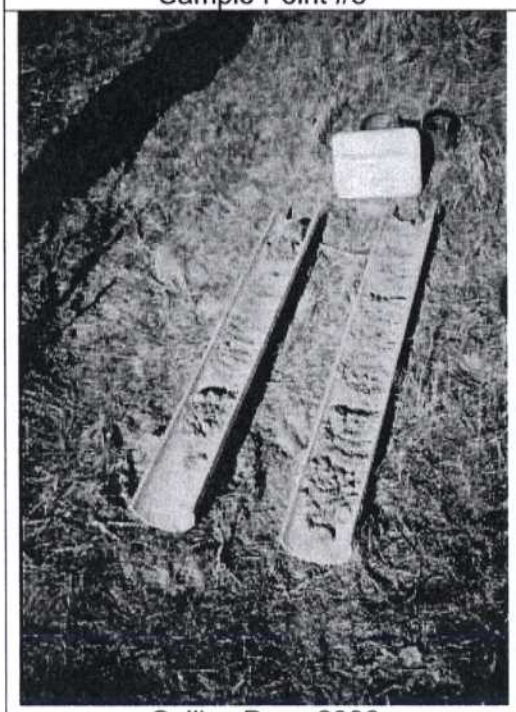


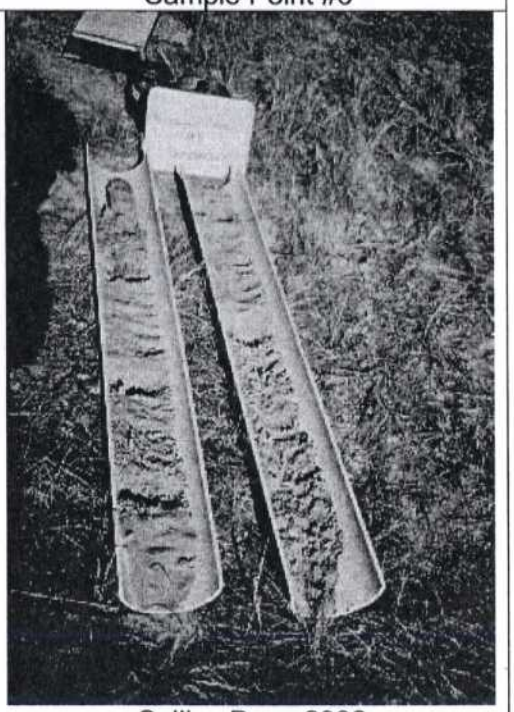
Collins Draw 2006
Sample Point #5



Collins Draw 2006
Sample Point #6



Collins Draw 2006
Sample Point #7



Collins Draw 2006
Sample Point #8

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
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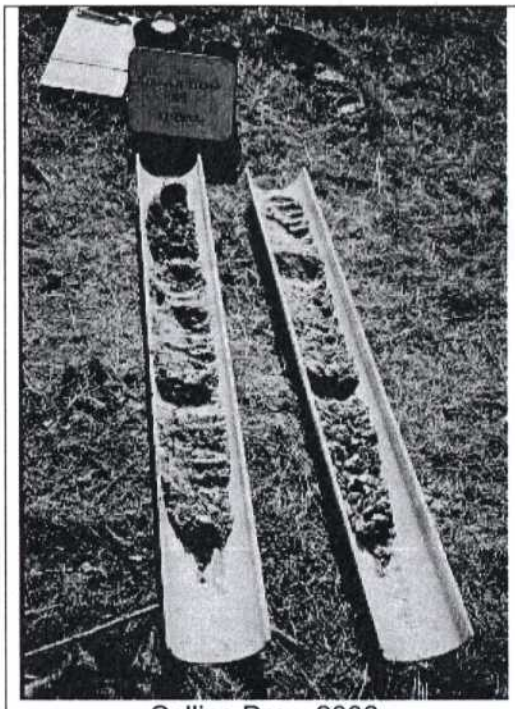
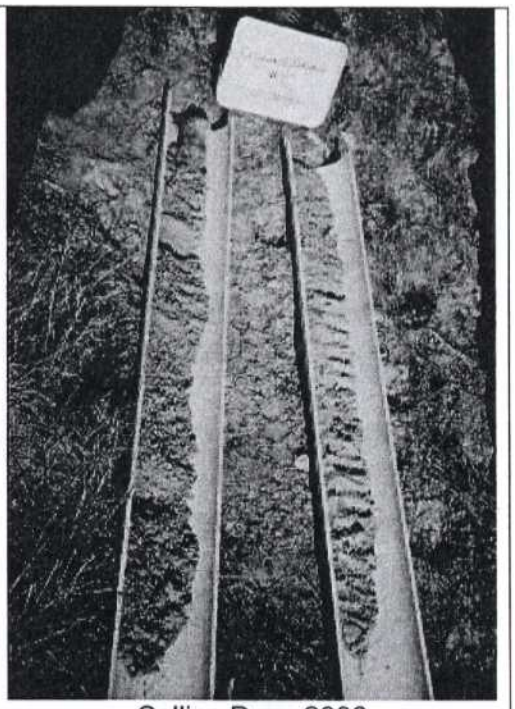
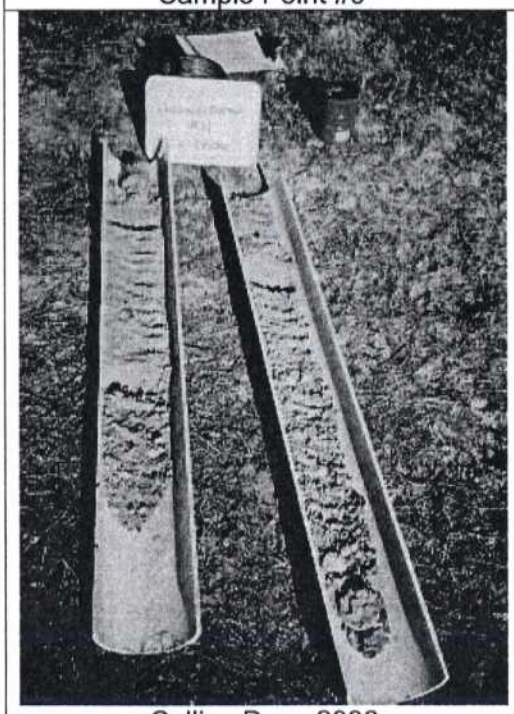


Collins Draw 2006
Sample Point #9



Collins Draw 2006
Sample Point #10



Collins Draw 2006
Sample Point #11

Collins Draw 2006
Sample Point #12

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
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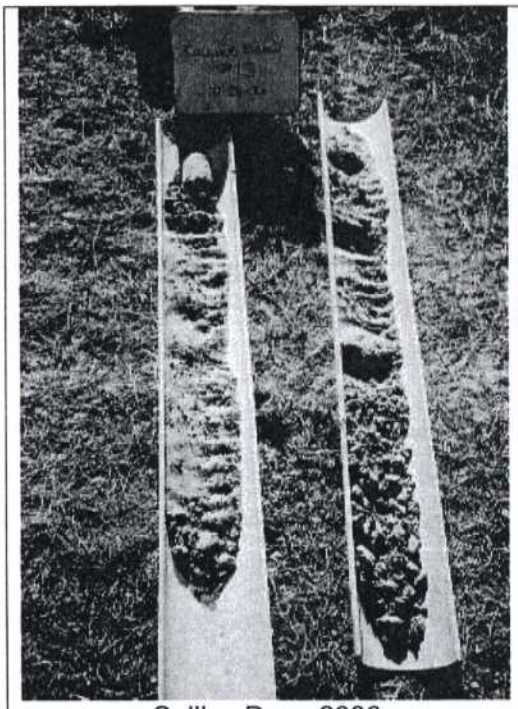
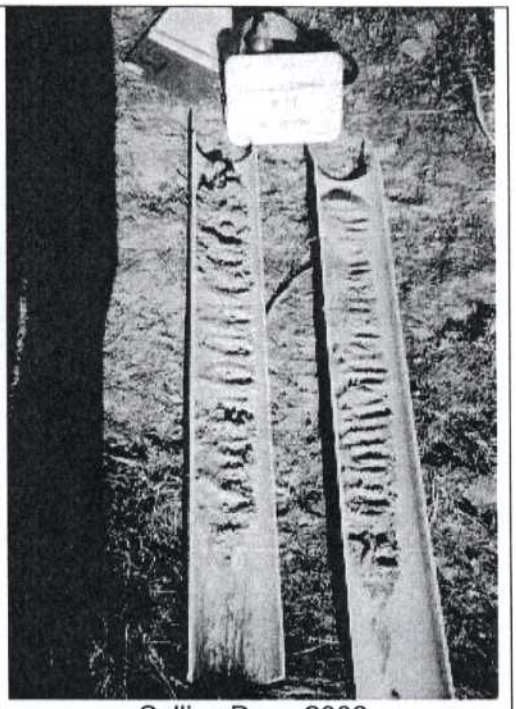
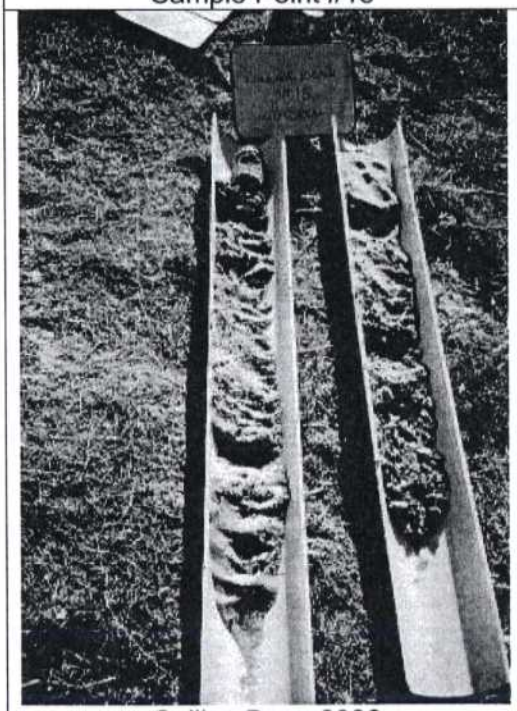


Collins Draw 2006
Sample Point #13



Collins Draw 2006
Sample Point #14



Collins Draw 2006
Sample Point #15

Collins Draw 2006
Sample Point #16

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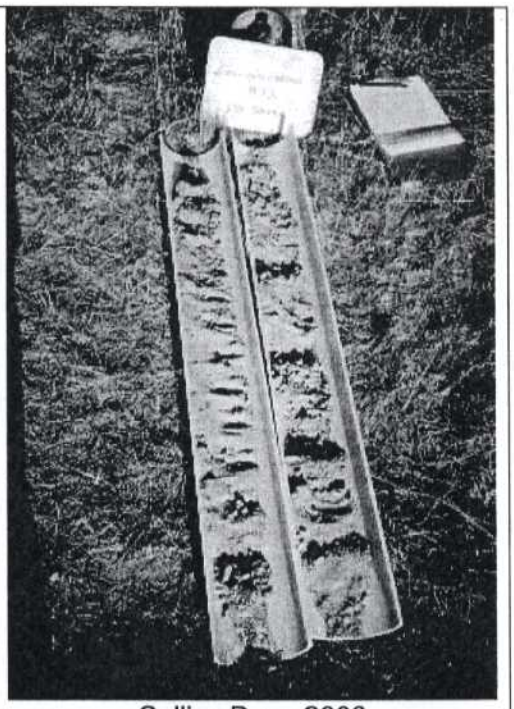
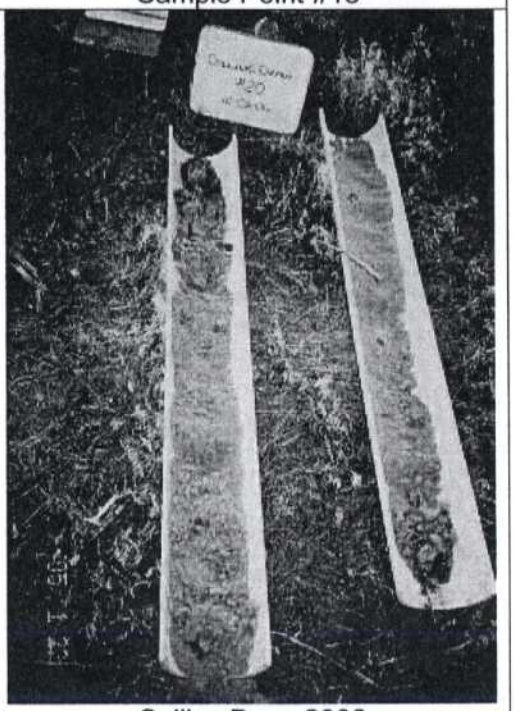
Collins Draw 2006
Sample Point #17



Collins Draw 2006
Sample Point #18

Collins Draw 2006
Sample Point #19



Collins Draw 2006
Sample Point #20

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
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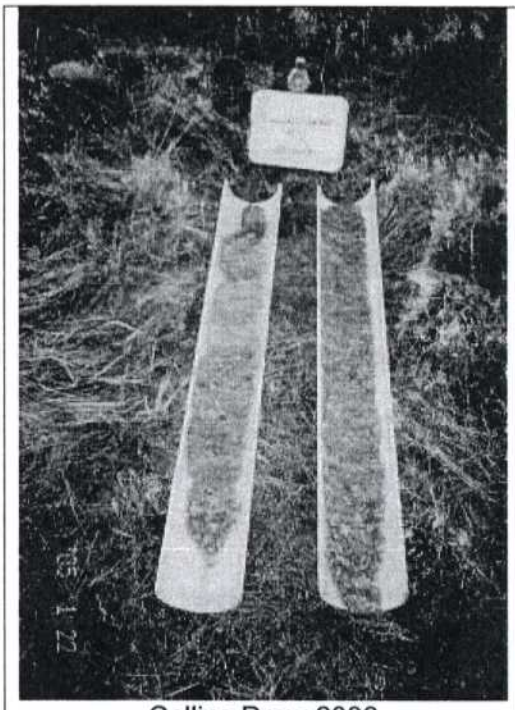
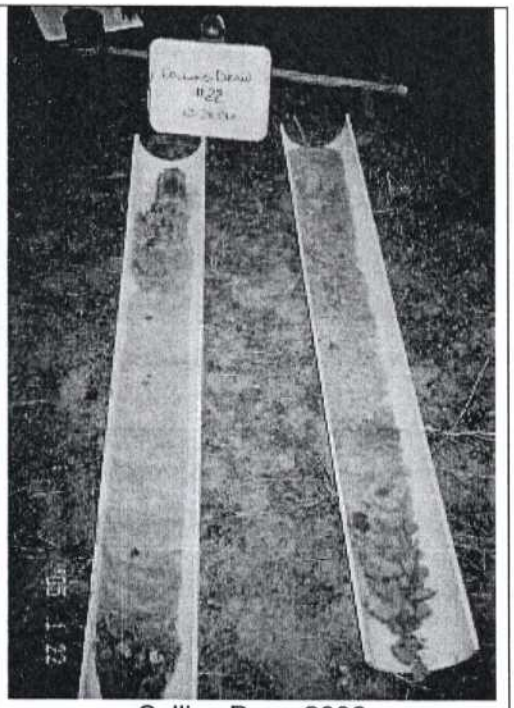
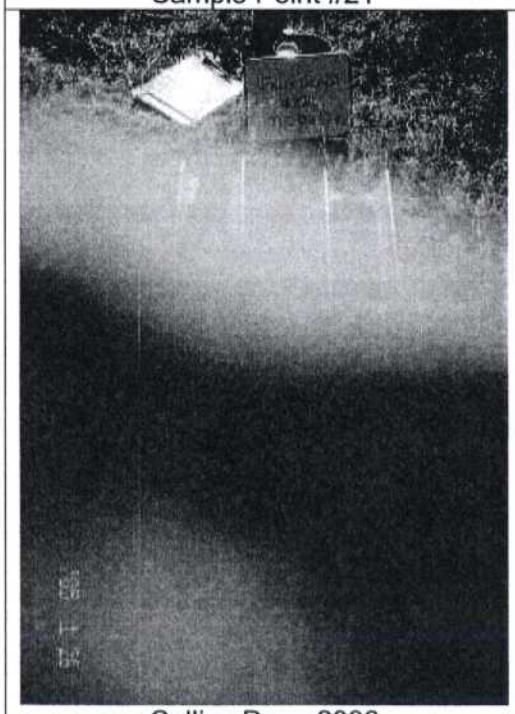


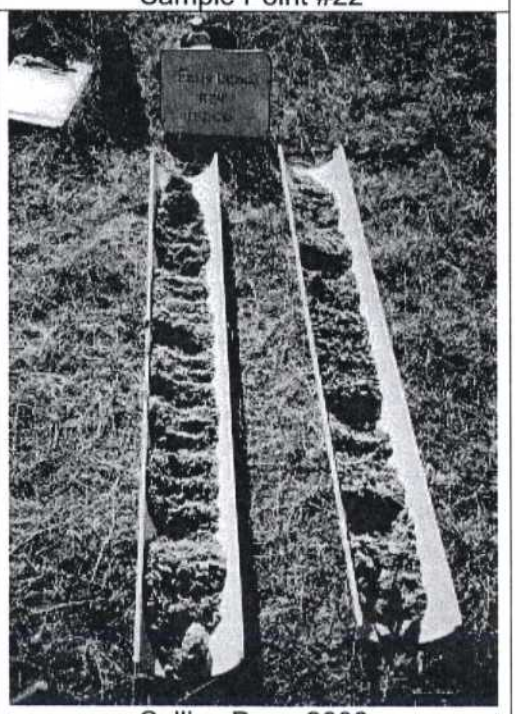
Collins Draw 2006
Sample Point #21



Collins Draw 2006
Sample Point #22



Collins Draw 2006
Sample Point #23



Collins Draw 2006
Sample Point #24

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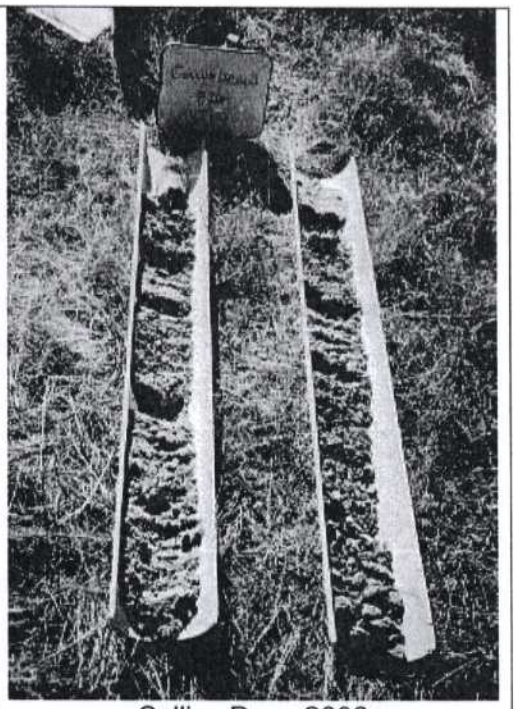
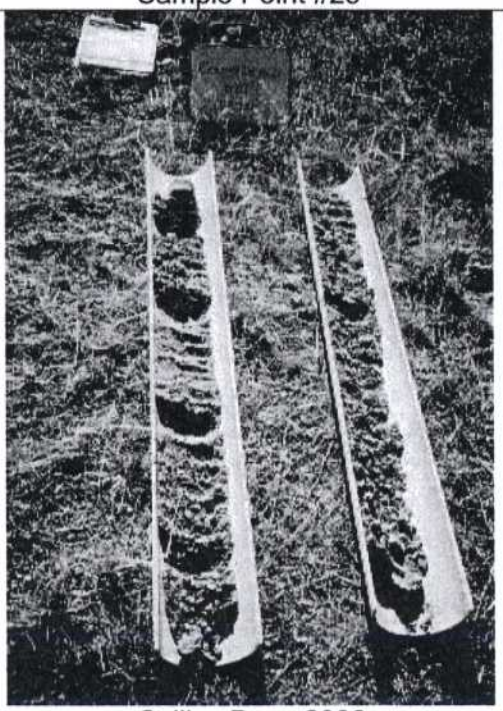
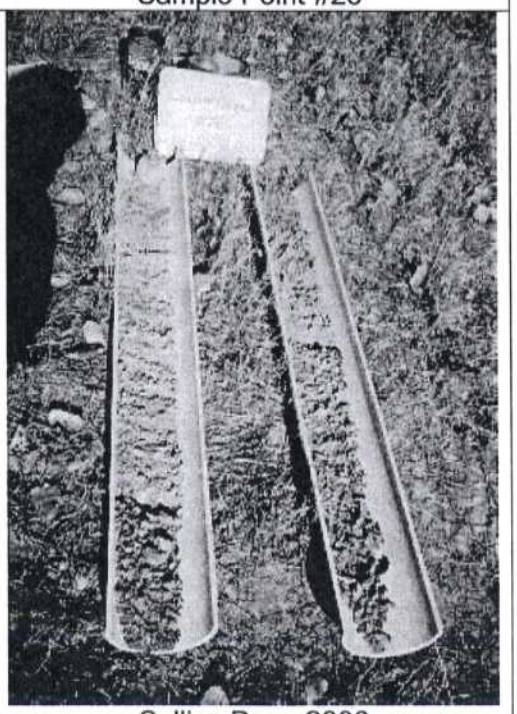
Collins Draw 2006
Sample Point #25



Collins Draw 2006
Sample Point #26



Collins Draw 2006
Sample Point #27



Collins Draw 2006
Sample Point #28

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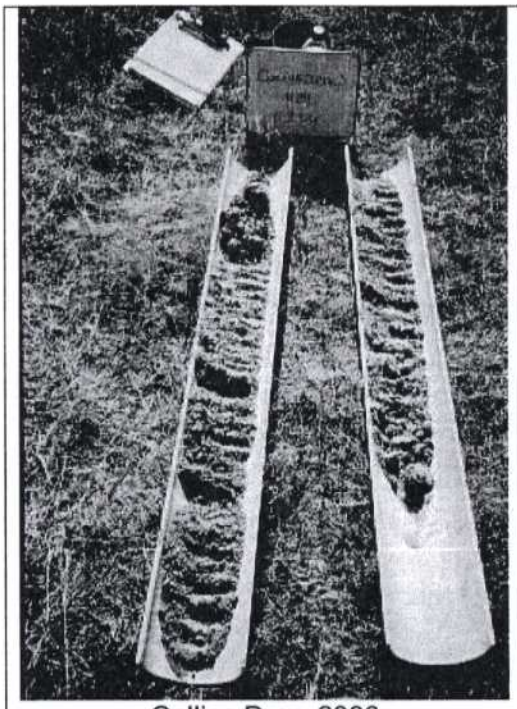
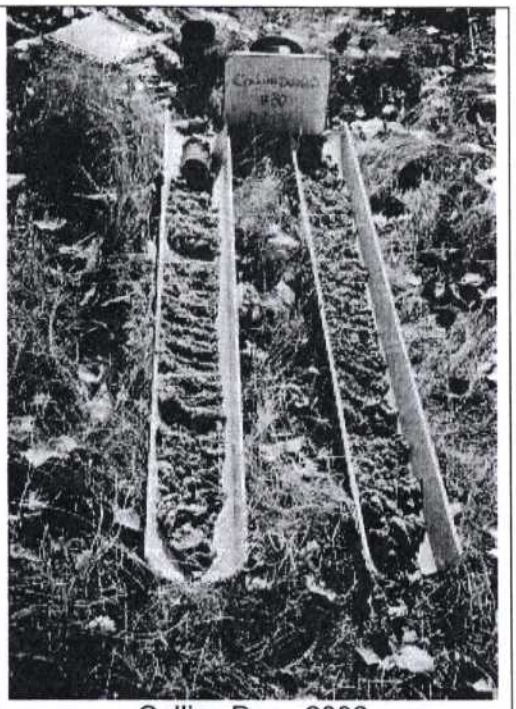
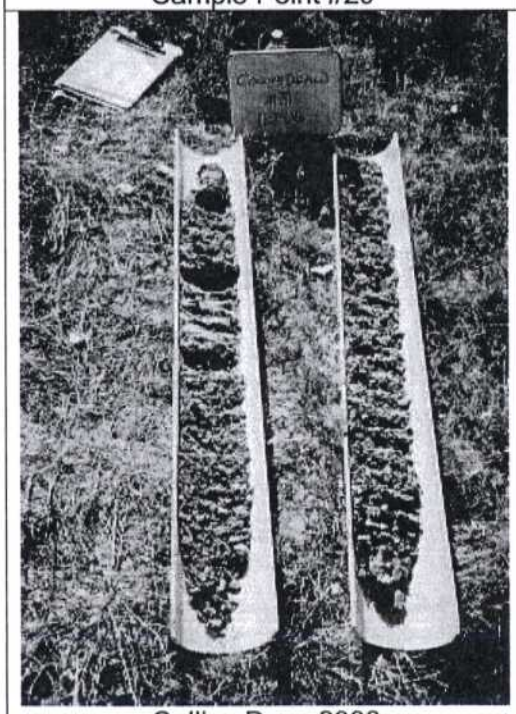


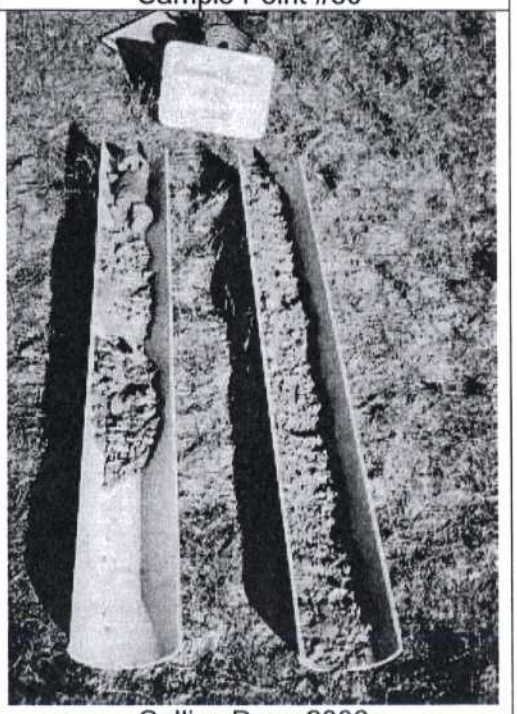
Collins Draw 2006
Sample Point #29



Collins Draw 2006
Sample Point #30

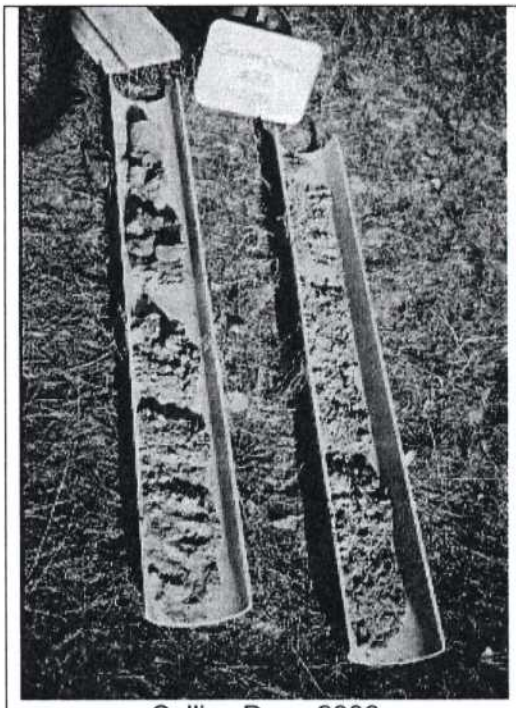


Collins Draw 2006
Sample Point #31

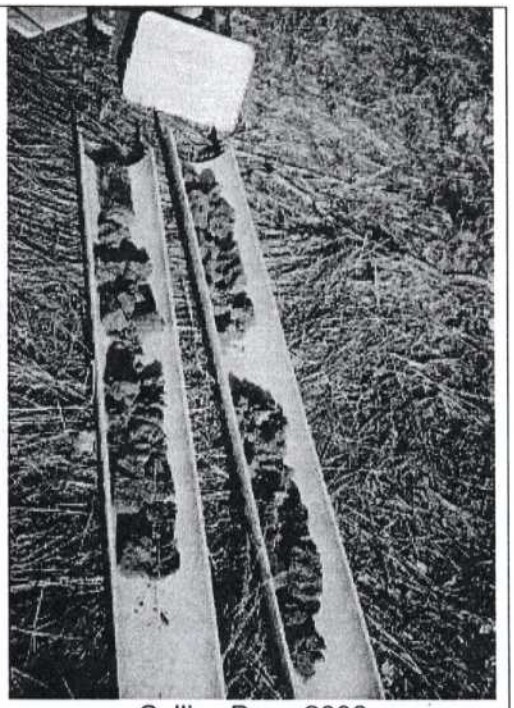


Collins Draw 2006
Sample Point #32

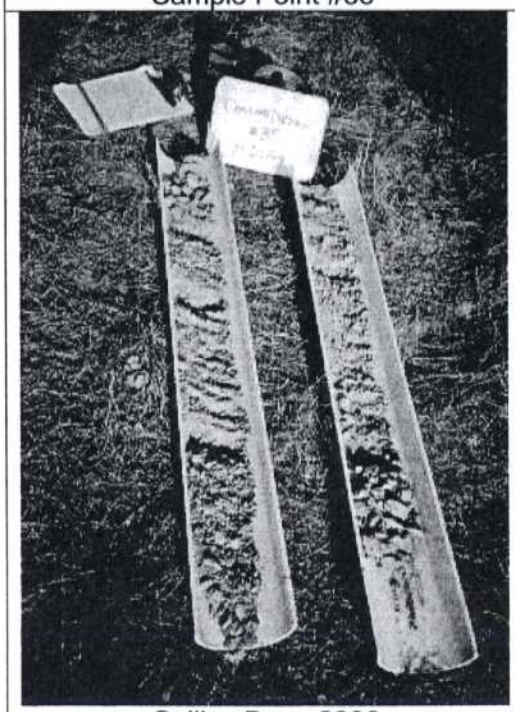
2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007



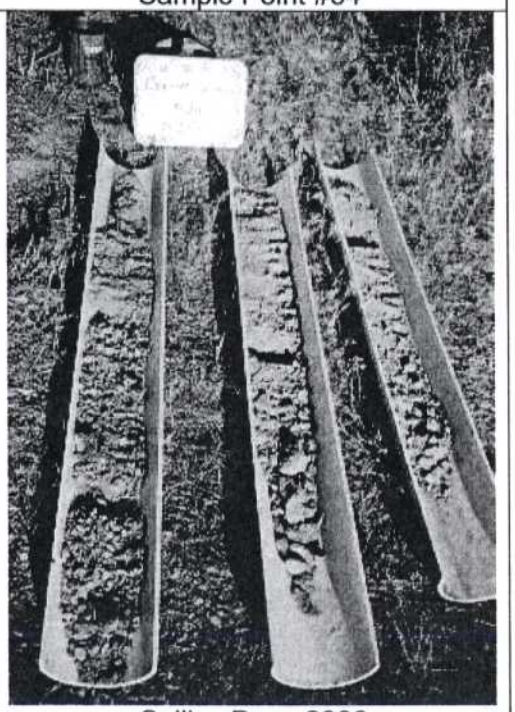
Collins Draw 2006
Sample Point #33



Collins Draw 2006
Sample Point #34



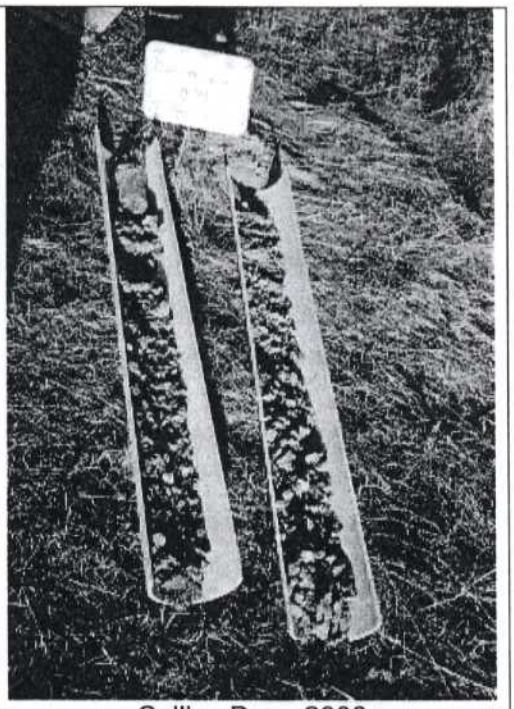
Collins Draw 2006
Sample Point #35



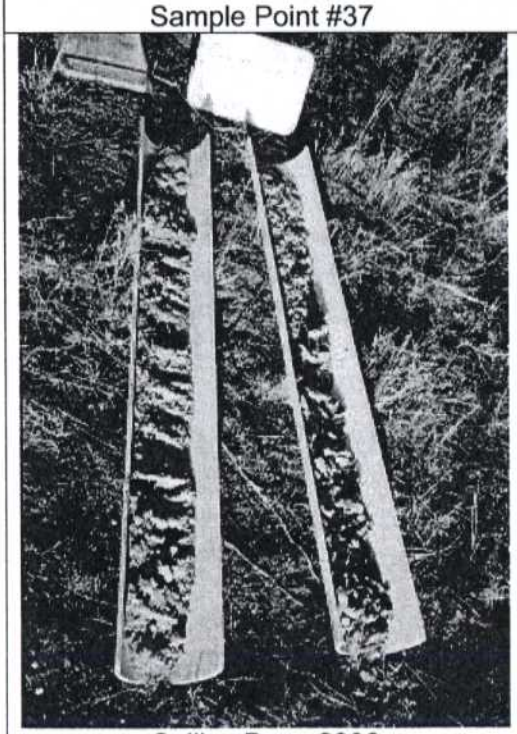
Collins Draw 2006
Sample Point #36

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

Collins Draw 2006
Sample Point #37



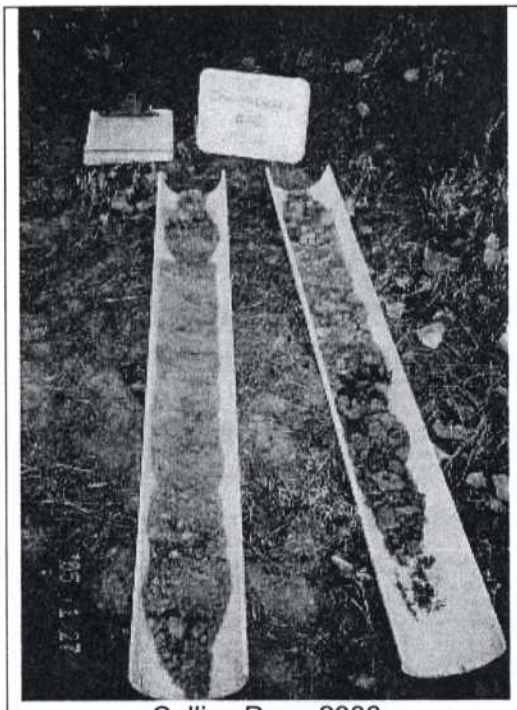
Collins Draw 2006
Sample Point #39



Collins Draw 2006
Sample Point #40

Collins Draw 2006
Sample Point #41

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007



Collins Draw 2006
Sample Point #42

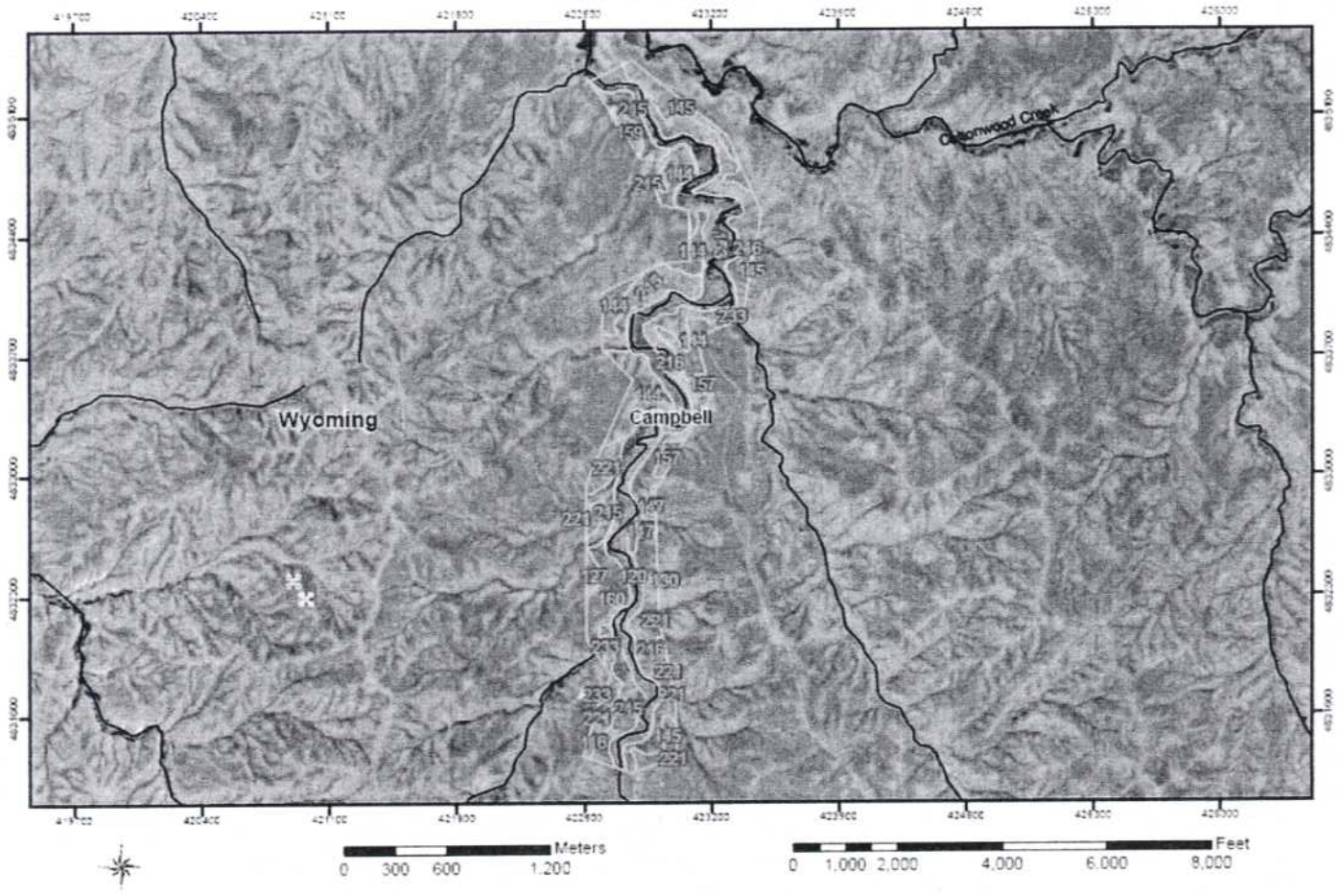
Collins Draw 2006
Sample Point #43

ADDENDUM 3
NRCS Soil Mapping of Area

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

SOIL SURVEY OF CAMPBELL COUNTY, WYOMING, SOUTHERN PART

Collins Draw Soils Map



USDA Natural Resources Conservation Service

Web Soil Survey 1.1
National Cooperative Soil Survey

2/22/2007
Page 1 of 3

SOIL SURVEY OF CAMPBELL COUNTY, WYOMING, SOUTHERN PART

Collins Draw Soils Map

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
- Roads
- Rails
- Water
- Hydrography
- Oceans
- Escarpment, bedrock
- Escarpment, non-bedrock
- Gulley
- Levee
- Slope
- Blowout
- Borrow Pit
- Clay Spot
- Depression, closed
- Eroded Spot
- Gravel Pit
- Gravelly Spot
- Gulley
- Lava Flow
- Landfill
- Marsh or Swamp
- Miscellaneous Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Perennial Water
- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 13

Soil Survey Area: Campbell County, Wyoming, Southern Part
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
6/27/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend Summary

Campbell County, Wyoming, Southern Part

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
116	Cambria-Kishona-Zigweid loams, 0 to 6 percent slopes	0.2	0.0
120	Clarkelen-Keeline association, 0 to 6 percent slopes	57.5	11.8
127	Cushman-Theedle loams, 6 to 15 percent slopes	4.6	0.9
130	Decolney-Hiland fine sandy loams, 6 to 15 percent slopes	0.5	0.1
144	Forkwood loam, 0 to 6 percent slopes	66.9	13.7
145	Forkwood-Cambria loams, 0 to 6 percent slopes	26.7	5.5
147	Forkwood-Cushman loams, 6 to 15 percent slopes	5.6	1.1
153	Haverdad-Kishona association, 0 to 6 percent slopes	88.5	18.1
157	Hiland-Bowbac fine sandy loams, 0 to 6 percent slopes	6.7	1.4
159	Hiland-Vonalee fine sandy loams, 0 to 6 percent slopes	4.4	0.9
160	Hiland-Vonalee fine sandy loams, 6 to 15 percent slopes	20.8	4.3
215	Theedle-Kishona loams, 6 to 20 percent slopes	63.7	13.0
216	Theedle-Kishona-Shingle loams, 3 to 30 percent slopes	112.2	23.0
221	Turnercrest-Keeline-Taluce fine sandy loams, 6 to 30 percent slopes	24.9	5.1
233	Ustic Torriorthents, gullied	5.4	1.1

ADDENDUM 4
NRCS MAP UNIT DESCRIPTION

Campbell County, Wyoming, Southern Part

120 Clarkelen-Keeline association, 0 to 6 percent slopes
Setting
Landscape: Valleys
Elevation: 4100 to 5000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 130 days
Composition
Clarkelen and similar soils: 60 percent
Keeline and similar soils: 25 percent
Minor components: 15 percent

Description of Clarkelen
Setting
Landform: Flood plains, stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale
Slope: 0 to 3 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate maximum: 5 percent
Gypsum maximum: 0 percent
Available water capacity: Moderate (about 7.8 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 3e
Land capability (non irrigated): 4e
Ecological site: LOWLAND (10-14NP) (R058BY128WY)
Typical Profile
0 to 3 inches: very fine sandy loam
3 to 60 inches: stratified loamy fine sand to loam

Description of Keeline
Setting
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and/or eolian deposits derived from calcareous sandstone
Slope: 0 to 6 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 5 percent

Gypsum maximum: 0 percent
Available water capacity: Moderate (about 7.2 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 3e
Land capability (non irrigated): 4e
Ecological site: SANDY (15-17NP) (R058BY250WY)
Typical Profile
0 to 4 inches: sandy loam
4 to 60 inches: sandy loam
Tabular Data Version: 6
Tabular Data Version Date: 02/21/2007 Page 1 of 3

Minor Components

Haverdad
Percent of map unit: 8 percent

Boruff
Percent of map unit: 7 percent

Campbell County, Wyoming, Southern Part

145 Forkwood-Cambria loams, 0 to 6 percent slopes
Setting
Elevation: 3600 to 5000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 110 to 130 days
Composition
Forkwood and similar soils: 40 percent
Cambria and similar soils: 40 percent
Minor components: 20 percent

Description of Forkwood
Setting
Landform: Alluvial fans, fan remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale
Slope: 0 to 6 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 5 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 5.0
Available water capacity: High (about 10.0 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 3e
Land capability (non irrigated): 4e
Ecological site: LOAMY (10-14NP) (R058BY122WY)
Typical Profile
0 to 5 inches: loam
5 to 12 inches: clay loam
12 to 20 inches: clay loam
20 to 60 inches: loam

Description of Cambria
Setting
Landform: Alluvial fans, fan remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous, metamorphic and sedimentary rock
Slope: 0 to 6 percent
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 15 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 5.0
Available water capacity: High (about 9.4 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 3e
Land capability (non irrigated): 4e
Ecological site: LOAMY (10-14NP) (R058BY122WY)
Typical Profile
0 to 3 inches: loam
3 to 9 inches: clay loam
9 to 14 inches: loam
14 to 60 inches: fine sandy loam

Minor Components

Theedle
Percent of map unit: 15 percent

Cushman
Percent of map unit: 5 percent

Campbell County, Wyoming, Southern Part

153 Haverdad-Kishona association, 0 to 6 percent slopes
Setting
Landscape: Valleys
Elevation: 4100 to 5000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 130 days
Composition
Haverdad and similar soils: 45 percent
Kishona and similar soils: 35 percent
Minor components: 20 percent

Description of Haverdad
Setting
Landform: Stream terraces, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale
Slope: 0 to 3 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate maximum: 8 percent
Gypsum maximum: 0 percent
Salinity maximum: Non saline or very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio maximum: 5.0
Available water capacity: High (about 10.9 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 3e
Land capability (non irrigated): 4e
Ecological site: LOWLAND (10-14NP) (R058BY128WY)
Typical Profile
0 to 7 inches: clay loam
7 to 60 inches: stratified very fine sandy loam to clay loam

Description of Kishona
Setting
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale
Slope: 0 to 6 percent
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 15 percent
Gypsum maximum: 0 percent
Salinity maximum: Non saline or very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio maximum: 5.0
Available water capacity: High (about 10.8 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 3e
Land capability (non irrigated): 4e
Ecological site: LOAMY (10-14NP) (R058BY122WY)

Minor Components
Typical Profile
0 to 3 inches: clay loam
3 to 60 inches: clay loam

Draknab
Percent of map unit 7 percent

Limon
Percent of map unit 8 percent

Campbell County, Wyoming, Southern Part

215 Theedle-Kishona loams, 6 to 20 percent slopes
Setting
Landscape: Uplands
Elevation: 3500 to 5200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 130 days
Composition
Theedle and similar soils: 45 percent
Kishona and similar soils: 30 percent
Minor components: 25 percent

Description of Theedle
Setting
Landform: Ridges, hills
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium over residuum weathered from sandstone and shale
Slope: 6 to 20 percent
Depth to restrictive feature: 20 to 40 inches to Paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low or moderately high (0.00 to 0.20 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 15 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 3.0
Available water capacity: Low (about 5.5 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 6e
Land capability (non irrigated): 6e
Ecological site: LOAMY (10-14NP) (R058BY122WY)
Typical Profile
0 to 2 inches: loam
2 to 28 inches: clay loam
28 to 60 inches: bedrock

Description of Kishona
Setting
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, footslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium derived from sandstone and shale

Slope: 6 to 20 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 15 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 3.0
Available water capacity: High (about 11.9 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 4e
Land capability (non irrigated): 4e
Ecological site: LOAMY (10-14NP) (R058BY122WY)
Tabular Data Version: 6
Tabular Data Version Date: 02/21/2007 Page 1 of 3

Minor Components

Cushman soils
Percent of map unit: 5 percent
Landform: Ridges, hills
Landform position (two-dimensional): Shoulder, summit
Ecological site: LOAMY (10-14NP) (R058BY122WY)

Zigweid soils
Percent of map unit: 5 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, footslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: LOAMY (10-14NP) (R058BY122WY)

Savageton soils
Percent of map unit: 5 percent
Landform: Hills, ridges
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: CLAYEY (10-14NP) (R058BY104WY)
Silhouette soils
Percent of map unit: 5 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope, footslope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: CLAYEY (10-14NP) (R058BY104WY)

Shingle soils
Percent of map unit: 5 percent
Landform: Hills, ridges
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: SHALLOW LOAMY (10-14NP) (R058BY162WY)

Campbell County, Wyoming, Southern Part

216 Theedle-Kishona-Shingle loams, 3 to 30 percent slopes
Setting
Landscape: Uplands
Elevation: 3500 to 5400 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 130 days
Composition
Theedle and similar soils: 40 percent
Kishona and similar soils: 20 percent
Shingle and similar soils: 20 percent
Minor components: 20 percent

Description of Theedle
Setting
Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous shale and/or residuum weathered from calcareous shale
Slope: 3 to 30 percent
Depth to restrictive feature: 20 to 40 inches to Paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low or moderately high (0.00 to 0.20 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 15 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 5.0
Available water capacity: Low (about 5.7 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 6e
Land capability (non irrigated): 6e
Ecological site: LOAMY (10-14NP) (R058BY122WY)
Typical Profile
0 to 6 inches: loam
6 to 32 inches: loam
32 to 42 inches: unweathered bedrock

Description of Kishona
Setting
Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Concave

Across-slope shape: Linear
Parent material: Alluvium derived from calcareous shale
Slope: 3 to 20 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 14 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 5.0
Available water capacity: High (about 10.7 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 6e
Land capability (non irrigated): 6e
Ecological site: LOAMY (10-14NP) (R058BY122WY)

Description of Shingle
Setting
Landform: Hills
Landform position (two-dimensional): Backslope, summit
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Residuum weathered from calcareous shale
Slope: 3 to 30 percent
Depth to restrictive feature: 10 to 20 inches to Paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 10 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 5.0
Available water capacity: Very low (about 2.1 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 7e
Land capability (non irrigated): 7e
Ecological site: SHALLOW LOAMY (10-14NP) (R058BY162WY)
Typical Profile
0 to 4 inches: loam
4 to 12 inches: loam
12 to 22 inches: unweathered bedrock

Minor Components

Rock outcrop
Percent of map unit: 4 percent

Cambria soils
Percent of map unit: 4 percent

Taluce soils
Percent of map unit: 4 percent

Hilight soils
Percent of map unit: 4 percent

Turnercrest soils
Percent of map unit: 4 percent

Campbell County, Wyoming, Southern Part

221 Turnercrest-Keeline-Taluce fine sandy loams, 6 to 30 percent slopes
Setting
Landscape: Uplands
Elevation: 3500 to 5200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 130 days
Composition
Turnercrest and similar soils: 35 percent
Keeline and similar soils: 30 percent
Taluce and similar soils: 15 percent
Minor components: 20 percent

Description of Turnercrest
Setting
Landform: Ridges, hills
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Alluvium and/or eolian deposits over residuum weathered from calcareous sandstone
Slope: 6 to 30 percent
Depth to restrictive feature: 20 to 40 inches to Paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 5 percent
Gypsum maximum: 0 percent
Available water capacity: Low (about 4.5 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 6e
Land capability (non irrigated): 6e
Ecological site: SANDY (10-14NP) (R058BY150WY)
Typical Profile
0 to 2 inches: fine sandy loam
2 to 32 inches: fine sandy loam
32 to 60 inches: bedrock

Description of Keeline
Setting
Landform: Hills, ridges
Landform position (two-dimensional): Backslope, footslope
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Alluvium and/or eolian deposits derived from calcareous sandstone
Slope: 6 to 15 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 5 percent
Gypsum maximum: 0 percent
Available water capacity: Moderate (about 8.4 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 4e
Land capability (non irrigated): 4e
Ecological site: SANDY (10-14NP) (R058BY150WY)
Typical Profile
0 to 4 inches: fine sandy loam
4 to 60 inches: fine sandy loam

Description of Taluce
Setting
Landform: Hills, ridges
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Alluvium over residuum weathered from calcareous sandstone
Slope: 6 to 30 percent
Depth to restrictive feature: 10 to 20 inches to Paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 5 percent
Gypsum maximum: 0 percent
Available water capacity: Very low (about 2.0 inches)
Properties and Qualities
Interpretive Groups
Land capability classification (irrigated): 7e
Land capability (non irrigated): 7e
Ecological site: SHALLOW SANDY (10-14 NP) (R058BY166WY)
Typical Profile
0 to 2 inches: fine sandy loam
2 to 14 inches: fine sandy loam
14 to 60 inches: bedrock

Minor components

Vonalee soils
Percent of map unit: 5 percent

Terro soils
Percent of map unit: 5 percent

Bowbac soils
Percent of map unit: 5 percent

Tullock soils
Percent of map unit: 5 percent

ADDENDUM 5
NRCS Series Descriptions

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

LOCATION CLARKELEN WY
Established Series
CAP-GFK
11/2005

CLARKELEN SERIES

The Clarkelen series consists of very deep, well, moderately well or somewhat excessively drained soils formed in stratified recent stream alluvium from mixed sedimentary sources. Clarkelen soils are on flood plains and terraces. Slopes range from 0 to 6 percent. The average annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

TYPICAL PEDON: Clarkelen fine sandy loam - utilized as rangeland. (Colors are for dry soil unless otherwise stated)

A--0 to 6 inch; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; calcium carbonate disseminated throughout; slightly effervescent; slightly alkaline; gradual smooth boundary. (1 to 6 inches thick)

C1--6 to 20 inches; light brownish gray (10YR 6/2) weakly stratified fine sandy loam and loamy fine sand, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; soft, very friable, nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; calcium carbonate disseminated throughout; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C2--20 to 30 inches; light brownish gray (10YR 6/2) and pale brown (10YR 6/3) stratified loam and very fine sandy loam, grayish brown (10YR 5/2) moist; massive; thin stratifications; slight hard, friable, nonsticky and nonplastic; few fine and very fine roots; calcium carbonate disseminated throughout; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C3--30 to 51 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; calcium carbonate disseminated throughout; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C4--51 to 60 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; slightly hard, friable, nonsticky and nonplastic; few fine roots; calcium carbonate disseminated throughout; slightly effervescent; strongly alkaline.

TYPE LOCATION: Niobrara County, Wyoming; about 250 feet north and 100 feet east of the southwest corner of Sec. 14, T. 38 N., R. 64 W.

RANGE IN CHARACTERISTICS: This soil typically lacks horizons of continuous carbonate accumulation. Depth to carbonates ranges from 0 to 8 inches. Rock fragments are typically less than 5 percent but may range to 15 percent. Organic matter content decreases irregularly with depth; and thin, highly variable textural strata usually occur between 6 and 24 inches. The particle-size control section contains from 5 to 18 percent clay and is sandy loam, fine sandy loam or loam when averaged. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never

moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 7 dry and 3 to 6 moist, and chroma of 2 to 4. Texture typically is sandy loam or fine sandy loam but may range from loamy sand to clay loam depending upon the most recent deposition. Reaction ranges from neutral to moderately alkaline. It has an EC of 0 to 4 mmhos/cm. Nitrogen and phosphorus levels are not abnormally enriched. Some pedons have an AC horizon up to 8 inches thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture centers on sandy loam, fine sandy loam or loam, but strata of very fine sandy loam, loam, silt loam, loamy fine sand, loamy sand, fine sand or sand of varying thickness occur. Skeletal material may occur below 40 inches in some pedons. Reaction ranges from slightly alkaline to strongly alkaline. EC is typically 4 mmhos/cm or less but may range up to 8 when irrigated or where it receives saline discharge from surrounding shale beds.

COMPETING SERIES: These are the Cameo, Colorow, Glenberg, Kornman, Radnik, Redbank and Tapicito series (Colorow, Kornman, Radnik and Redbank will likely compete when their classifications are updated). Cameo, Radnik and Tapicito soils are usually dry in the moisture control section during April, May, and early June. Colorow soils are mottled in the lower part of the particle-size control section. Glenberg soils have more favorable temperature and moisture relationships for growing crops (soil temperature of more than 52 degrees and frost-free period of more than 130 days). Kornman soils have over-thickened nitrogen- and phosphate- enriched, manmade surface horizons resulting from application of silty irrigation water over long periods of time. Redbank soils have hue of 7.5YR or redder.

GEOGRAPHIC SETTING: Clarkelen soils are on flood plains and terraces adjacent to floodplains. Slopes are 0 to 6 percent. The soils formed in stratified but dominantly moderately coarse textured recent stream alluvium originally weathered from sedimentary rock. Elevation is 3,500 to 6,200 feet. The average annual precipitation is 12 inches with over half falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bigwin, Draknab, Dwyer, Haverdad and Orpha soils. Bigwin soils have an aquic moisture regime. Draknab soils have sandy control sections. Dwyer and Orpha soils have a more uniform texture and a uniform decrease in organic carbon with depth. Haverdad soils have fine-loamy control sections.

DRAINAGE AND PERMEABILITY: Well, moderately well or somewhat excessively drained; slow runoff; moderately rapid permeability. The soil is subject to occasionally flooding for brief or very brief periods following intense storms in spring and summer or from snowmelt in spring.

USE AND VEGETATION: These soils are dominantly used for grazing. Potential vegetation is needleandthread, western wheatgrass, and silver sagebrush with scattered stands of cottonwoods.

DISTRIBUTION AND EXTENT: The Powder River Basin and adjacent areas of eastern Wyoming. Series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Converse County, Wyoming; 1982.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 6 inches (A horizon)

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

LOCATION DRAKNAB WY+NE
Established Series
GFK/CAP/CJH
11/2005

DRAKNAB SERIES

The Draknab series consists of very deep, moderately well, well or excessively drained soils formed in stratified recent stream alluvium. Draknab soils are on flood plains and on adjacent low terrace positions. Slopes range from 0 to 6 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Sandy, mixed, mesic Ustic Torrifluvents

TYPICAL PEDON: Draknab loamy sand-on an east facing, very gently sloping flood plain utilized as rangeland. (Colors are for dry soil unless otherwise stated)

A--0 to 2 inches; yellowish brown (10YR 5/4) loamy sand, brown (10YR 4/3) moist; weak medium and fine granular structure; soft, very friable, nonsticky and nonplastic; strongly effervescent; carbonates disseminated throughout; moderately alkaline (pH 8.0); abrupt smooth boundary. (2 to 6 inches thick)

AC--2 to 8 inches; yellowish brown (10YR 5/4) sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure parting to weak medium granular; soft, very friable, nonsticky and nonplastic; slightly effervescent; carbonates disseminated throughouot; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 10 inches thick)

C1--8 to 18 inches; very pale brown (10YR 7/3) sand, yellowish brown (10YR 5/4) moist; single grain; loose, nonsticky and nonplastic; strongly effervescent; carbonates disseminated throughout; moderately alkaline (pH 8.0); clear wavy boundary. (6 to 15 inches thick)

C2--18 to 26 inches; pale brown, loamy coarse sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent; carbonates disseminated throughout; moderately alkaline (pH 8.2) gradual smooth boundary. (0 to 24 inches thick)

C3--26 to 60 inches; very pale brown (10YR 7/3), stratified coarse sand and loamy sand, pale brown (10YR 6/3) moist; single grain; loose, nonsticky and nonplastic; strongly effervescent; carbonates disseminated thoughout; moderately alkaline (pH 8.0).

TYPE LOCATION: Converse County, Wyoming; 1,900 feet north and 400 feet east of the southwest corner of section 5, T. 40 N., R. 74 W. 43 degrees, 27 minutes, 52 seconds north latitude and 105 degrees, 47 minutes, 7 seconds west longitude.

RANGE IN CHARACTERISTICS: Carbonates occur throughout the profile, but the surface to depths of 10 inches may be free of carbonates, depending upon the source material of the most recent deposition. Organic matter content decreases irregularly with depth. Thin, highly variable textural strata usually occur between depths of 10 and 30 inches. Rock fragments are gravel size and typically are less than 5 percent throughout the profile, but may range to 15 percent. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which

occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F. and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 4 mmhos/cm throughout the soil.

The A horizon has hue of 2.5Y, 10YR or 7.5YR, value of 5 to 7 and 3 to 6 moist, and chroma of 2 to 4. Texture is loamy sand, sandy loam, loamy fine sand, fine sandy loam, very fine sandy loam or loam. Reaction is neutral to moderately alkaline.

The C horizon has hue of 2.5Y, 10YR or 7.5YR, value of 5 to 7 and 4 to 7 moist, and chroma of 2 to 4. Texture is loamy sand, loamy coarse sand, coarse sand, loamy fine sand or sand. Manu pedons have stratification of varying thickness and texture, very fine sandy loam and sandy loam being the more common. Reaction ranges from slightly alkaline to strongly alkaline.

COMPETING SERIES: These are the Bankard, Ellicott, Escavada and Kwakina series. Bankard are moist in some or all parts for as long as 60 consecutive days when the soil at 20 inches is 41 degrees or more. Ellicott soils are noncalcareous. Escavada soils are intermittently moist in some parts of the moisture control section from July to October. Kwakina soils are drier in May and June.

GEOGRAPHIC SETTING: Draknab soils are on flood plains and low terraces adjacent to flood plains. Slopes are 0 to 6 percent. The soils formed in coarse textured recent stream alluvium derived originally from sandstone-dominated sedimentary rock. Elevations are 3,500 to 6,000 feet. The average annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature is about 46 degrees F, but ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Clarkelen, Dwyer, Haverdad and Orpha soils. Clarkelen soils have coarse-loamy control sections. Dwyer and Orpha soils have a more uniform texture and organic carbon decreases with depth. In addition, Orpha soils are noncalcareous. Haverdad soils have fine-loamy control sections. Clarkelen and Haverdad are on similar landscape positions and Dwyer and Orpha are on higher landscape positions than the Draknab soils.

DRAINAGE AND PERMEABILITY: Moderately well, well or excessively drained; runoff is negligible or very low depending on slope; rapid permeability. These soils are subject to rare to frequent flooding for very brief or brief periods during prolonged, high intensity storms in the spring and early summer.

USE AND VEGETATION: These soils are dominantly used for grazing. Potential vegetation is slender wheatgrass, needleandthread with scattered cottonwoods.

DISTRIBUTION AND EXTENT: The flood plains and low terraces of streams in the Powder River Basin and adjacent areas of northeastern and north-central Wyoming. The series is of small extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Converse County, Wyoming, Northern Part; 1983.

REMARKS: Diagnostic horizons and features recognized in this pedon are: Ochric epipedon - 0 to 2 inches (A horizon). Usually dry, but moist in some or all parts of the moisture control section for 48 or more days from April 30 to October 30 in most years.

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

LOCATION KEELINE WY
Established Series
Rev. RLR/JAL
11/2005

KEELINE SERIES

The Keeline series consists of very deep, well or somewhat excessively drained soils formed in alluvium or eolian deposits derived from sandstone. Keeline soils are on upland ridgetops, hillslopes, terraces, benches, alluvial fans, and fan remnants. Slopes range from 0 to 40 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

TYPICAL PEDON: Keeline sandy loam on east facing shoulder slope of 4 percent utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 3 inches; yellowish brown (10YR 5/4) sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky and granular structure; soft, very friable, nonsticky and nonplastic; slightly effervescent; calcium carbonate disseminated; slightly alkaline (pH 7.6); abrupt smooth boundary. (2 to 8 inches thick)

Bw--3 to 8 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent; calcium carbonate disseminated; slightly alkaline (pH 7.8); clear smooth boundary. (0 to 7 inches thick)

C1--8 to 17 inches; very pale brown (10YR 7/3) sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent; calcium carbonate disseminated; moderately alkaline (pH 8.2); gradual smooth boundary. (8 to 50 inches thick)

C2--17 to 30 inches; very pale brown (10YR 7/3) sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent; calcium carbonate disseminated; moderately alkaline (pH 8.2); gradual smooth boundary. (0 to 25 inches thick)

C3--30 to 60 inches; very pale brown (10YR 7/3) sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.2).

TYPE LOCATION: Converse County, Wyoming; 2,100 feet north and 400 feet west of the SE corner of sec. 29, T. 40 N., R. 75 W. 43 degrees 24 minutes 27 seconds north latitude and 105 degrees 52 minutes 46 seconds west longitude.

RANGE IN CHARACTERISTICS: Free carbonates typically occur throughout the profile, but some pedons may be leached as much as 6 inches. The control section averages fine sandy loam or sandy loam with 5 to 18 percent clay. Rock fragments range from 0 to 15 percent. Some thin strata of coarser material may occur. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this

period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 4 mmhos throughout the profile. Bedrock is deeper than 60 inches.

The A horizon has hue of 7.5YR through 2.5Y, value of 5 through 7 dry, 4 or 5 moist, and chroma of 2 through 4. It is sandy loam and less commonly loamy sand, fine sandy loam, or loamy fine sand. Reaction is neutral to moderately alkaline.

The Bw horizon, when present, has the same properties of the A except for structure which is usually weak subangular blocky.

Some pedons have an AC horizon.

The C horizon has hue of 7.5YR through 5Y, value of 4 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture averages sandy loam or fine sandy loam. Some pedons have subhorizons of very fine sandy loam or loamy fine sand. Reaction is moderately or strongly alkaline and some pedons have weak, discontinuous accumulations of calcium carbonate.

COMPETING SERIES: These are the Cliff, Councelor, Henrieville, Nelman, Nelson, Oterodry, Pedrick, Shedado, Turnercrest, Uendal, Yarts, and Zia series. Nelman, Shedado, and Uendal soils have lithic contacts at depths of 20 to 40 inches. Nelson and Turnercrest soils have paralithic contacts at depths of 20 to 40 inches. Cliff, Councelor, Henrieville, Otero, Pedrick and Zia soils are not dry for 60 consecutive days in the moisture control section from July 15 to October 25. Yarts soils have 2.5YR through 7.5YR hues throughout.

GEOGRAPHIC SETTING: Keeline soils are on terraces, benches, alluvial fans, fan remnants, ridgetop and hillslope positions. Slopes are 0 to 40 percent. These soils formed in moderately coarse alluvium or eolian deposits derived from calcareous sandstone. Elevations are 3,500 to 6,200 feet. The average annual precipitation is 12 inches with over one-half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 15 inches. The mean annual temperature is about 46 degrees F. but ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Dwyer, Orpha , Tassel, Terro , Tullock, Turnercrest, and Vonalee soils. Dwyer, Orpha, and Tullock soils have sandy control sections. Tassel soils have paralithic bedrock at 10 to 20 inches. Terro and Vonalee soils have argillic horizons. Turnercrest soils have paralithic bedrock at 20 to 40 inches.

DRAINAGE AND PERMEABILITY: Well or Somewhat excessively drained; slow runoff; moderately rapid permeability.

USE AND VEGETATION: These soils are dominantly used for grazing. Potential native vegetation is needleandthread, prairie sandreed, Indian ricegrass, and little bluestem.

DISTRIBUTION AND EXTENT: Powder River Basin and adjacent areas of eastern Wyoming. Series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bozeman, Montana

SERIES ESTABLISHED: Converse County, Wyoming, North Part; 1983.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

1. Ochric epipedon - 0 to 3 inches (A)

2. Ustic subgroup - Aridic moisture regime bordering on Ustic.

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

LOCATION KISHONA WY+MT
Established Series
CAP-GFK-CJH
11/2005

KISHONA SERIES

The Kishona series consists of very deep, well drained soils formed in alluvium on fan aprons, alluvial fans, fan remnants, hills, ridges and terraces. Permeability is moderate. Slopes range from 0 to 30 percent. The average annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

TYPICAL PEDON: Kishona loam - in rangeland. (Colors are for dry soil unless otherwise stated)

A--0 to 4 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium and fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine roots throughout; slightly alkaline; clear smooth boundary. (1 to 6 inches thick)

Bk--4 to 24 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; weak medium and coarse angular structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; common fine masses of carbonates; strongly effervescent; strongly alkaline; gradual smooth boundary. (0 to 30 inches thick)

C--24 to 60 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slight sticky and nonplastic; few very fine roots throughout; carbonates are disseminated throughout; slightly effervescent; strongly alkaline.

TYPE LOCATION: Niobrara County, Wyoming; about 2,500 feet south and 2,500 feet east of the northwest corner of sec. 30, T. 40 N., R. 66 W. lat. 43 degrees 24 minutes 59 seconds north and long. 104 degrees 49 minutes 42 seconds west.

RANGE IN CHARACTERISTICS: Rock fragments ranges from 0 to 15 percent. The mean annual soil temperature ranges from 48 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 190 to 202 days. The depth to carbonates ranges from 0 to 10 inches. Saline phases are recognized. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 90 consecutive days when the soil temperature at a depth of 20 inches is 48 degrees F. or more. This soil is moist for 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during that period.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. It is very fine sandy loam, fine sandy loam, loam, silt loam, silty clay loam or clay loam. It is neutral to moderately alkaline.

Some pedons have a thin, noncalcareous Bw horizon that has its base at a depth of less than 10 inches.

The Bk and C horizons have hue of 5Y, 2.5Y or 10YR, value of 5 to 7 dry, 4 or 5 moist, and chroma of 2 to 4. They are loam, clay loam or silty clay loam and have 20 to 35 percent clay, 20 to 55 percent silt, and 15 to 35 percent fine sand or coarser. Reaction ranges from moderately alkaline to very strongly alkaline. Carbonates in the Bk horizon range from 3 to 14 percent and occur as accumulations in small masses, streaks or seams that decrease with increasing depth, or they are disseminated throughout. The Bk horizon has an EC of 0 to 8 mmhos/cm.

COMPETING SERIES: These are the El Rancho, Mikim, Neville, Paradox, Pojoaque, Shavano, Thedalund, Theedle and Tsosie series (El Rancho, Neville, Pogoaque and Shavano are presumed to be competing pending an update of the classification). El Rancho, Neville, Paradox and Pojoaque soils have hue of 7.5YR or redder. Mikim soils are moist in some or all parts of the moisture control section for at least 90 cumulative days when the soil at a depth of 20 inches is 41 degrees F. or more and are moist for 45 consecutive days following July 15. Pojoaque soils have 15 to 35 percent rock fragments. Shavano, Theedle and Thedalund soils have bedrock at a depth of 20 to 40 inches. Tsosie soils are stratified in the C horizon and are dry in the moisture control section between April 15 and July 1.

GEOGRAPHIC SETTING: Kishona soils are on dissected alluvial fans, fan remnants, fan aprons, hills, ridges and terraces. Slopes are typically 0 to 6 percent but range up to 30 percent on dissected slopes. The soils formed in alluvium derived from sandstones and shales. Elevation is 3,500 to 6,700 feet. The average annual precipitation ranges from 10 to 14 inches with over one-half falling in April, May and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is about 45 degrees F. but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Theedle soils and the Cushman, Forkwood, Haverdad and Shingle soils. Theedle and Cushman soils are on shoulder slopes and summits of hills and ridges. Cushman and Forkwood soils have an argillic horizon. Forkwood soils are on more stable positions. Haverdad soils have a stratified control section in which the organic carbon decreases irregularly with increasing depth. They are on flood plains. Shingle soils have bedrock at a depth of 4 to 20 inches. They are on ridges and scarps.

DRAINAGE AND PERMEABILITY: Well drained; slow and medium runoff; moderate permeability.

USE AND VEGETATION: These soils support native vegetation utilized by domestic livestock and wildlife. Where irrigation water is available, they are irrigated and cropped to small grains and used for hay and pastureland. Native vegetation at the type location is Gardner saltbush, western wheatgrass, bottlebrush squirreltail, and bud sagebrush.

DISTRIBUTION AND EXTENT: Big Horn Basin, central Wyoming, Powder River Basin, northeastern Wyoming and western Colorado.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Washakie County, Wyoming; 1978.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 4 inches (A horizon)

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

LOCATION LIMON CO+KS UT WY
Established Series
GB/LLC
04/2003

LIMON SERIES

The Limon series consists of very deep, well drained, slowly permeable soils that formed in relatively uniform alluvial deposits derived principally from clay and shale. The Limon soils are on flood plains or alluvial fans and have slopes of 0 to 12 percent. The mean annual precipitation is 13 inches and the mean annual temperature is 48 degrees F.

TAXONOMIC CLASS: Fine, smectitic, calcareous, mesic Ustertic Torriorthents

TYPICAL PEDON: Limon silty clay loam - grassland. (Colors are for dry soil unless otherwise noted.)

A--0 to 4 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; strong very fine granular structure; weak platy in the upper 1/4 inch; soft, very friable; calcareous; moderately alkaline (pH 8.2); clear smooth boundary. (2 to 6 inches thick)

AC--4 to 20 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse angular blocky structure; extremely hard friable, very plastic; calcareous; moderately alkaline (pH 8.4); gradual wavy boundary.(10 to 18 inches thick)

Bk--20 to 60 inches; light yellowish brown (2.5Y 6/3) silty clay, olive brown (2.5Y 4/3) moist; massive; extremely hard, firm, very plastic; few visible secondary calcium carbonate concretions; calcareous; moderately alkaline (pH 8.4).

TYPE LOCATION: Bent County, Colorado; approximately 0.45 mile north and 0.15 mile east of the southwest corner of Sec. 7, T. 21 S., R. 52 W.

RANGE IN CHARACTERISTICS:
Mean annual soil temperature ranges from 47 to 58 degrees F.
Mean summer soil temperature ranges from 59 to 78 degrees F.
These soils are moist in some part of the soil moisture control section for 60 consecutive days when the soil temperature at 20 inches is 41 degrees F., or greater.
Aridic moisture regime bordering on ustic.
Organic carbon content: The A horizon ranges from 0.6 to 1.5 percent, and decreases uniformly with increasing depth
Electrical conductivity: less than 1 to 4 millimhos, but may range to 10 millimhos/cm in some pedons
Exchangeable sodium percentage: 1 to 14 percent throughout the particle size control section, but both differs widely between individual horizons
Cation exchange capacity: 60 to 90 millequivalents per 100 grams of clay

The particle size control section:
Texture: silty clay, clay, or heavy silty clay loam
Clay content: 35 to 60 percent
Silt content: 10 to 60 percent
Sand content: 5 to 40 percent with less than 35 percent fine sand or coarser
Rock fragments: 0 to 10 percent but are typically less than 2 percent

A horizon:
Hue: 5Y to 10YR
Value: 5 to 7 dry, 3 to 6 moist
Chroma: 2 or 3
Reaction: slightly alkaline to strongly alkaline (A and AC horizons).

C horizon:
Hue: 10YR to 5Y
Texture: silty clay, clay, or heavy silty clay loam
Clay content: 35 to 60 percent
Calcium carbonate equivalent: less than 1 to about 8 percent with visible calcium carbonate occurring inconsistently as to amount and depth.
Gypsum content: 0 to 3 percent
Reaction: slightly alkaline to strongly alkaline

COMPETING SERIES: These are the Bahl(WY), Baldfield(UT), Bodry, Petrie(WY), and Shower(UT) series.
Bahl soils: are dry in some part of the soil moisture control section for as long as 60 consecutive days when the soil temperature at 20 inches is 41 degrees F., which occurs on about April 24.
Baldfield soils: are dry in the soil moisture control section less than one-half of the time when the soil temperature at 20 inches is greater than 41 degrees F.
Bodry soils: have a paralithic contact at depths of 20 to 40 inches.
Petrie soils: have 15 to 40 percent ESP throughout the particle size control section.
Shower soils: have endosaturation at depths of 18 to 24 inches.

GEOGRAPHIC SETTING:
Parent material: alluvial deposits derived primarily from clay shales
Landform: flood plains and alluvial fans
Slopes: range from 0 to 12 percent
Average annual precipitation: 11 to 15 inches, with peak periods of precipitation during the spring and summer
Average annual temperature is 47 to 53 degrees F., and the average summer temperature is 65 to 74 degrees F.
Frost free season: 120 to 170 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Gaynor and Samsil series. Gaynor soils have a paralithic contact at depths of 20 to 40 inches. Samsil soils have a paralithic contact at a depth of less than 20 inches.

DRAINAGE AND PERMEABILITY: Well drained; medium runoff; slow permeability.

USE AND VEGETATION: These soils are used primarily as native pastureland. They are irrigated in some small areas. Native vegetation is short grasses, western wheatgrass, sage, and cactus.

DISTRIBUTION AND EXTENT: Eastern Colorado, southeastern Wyoming, and probably northeastern New Mexico. The series is of moderate extent. LRR G, MLRA's 67 and 69.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Johnson County (Southern Johnson Area), Wyoming, 1971.

REMARKS: Diagnostic horizons and features recognized in this pedon.
Ochric epipedon: 0 to 4 inches. (A horizon)
Aridic moisture regime bordering ustic.

The assignment of the cation-exchange activity class is inferred from lab data from similar soils in the surrounding area.

Taxonomic Version: Second Edition, 1999

ADDENDUM 6
Map of 2006 Soil Sample Locations

2006 PRE-DISCHARGE EVALUATION FOR SECTION 20 ANALYSIS
IRRIGATION/SOIL SUITABILITY
COLLINS DRAW, WYOMING
March 6, 2007

Map Created For:

Devon Energy
Collins Draw

Map Prepared by:
BKS Environmental Associates
P.O. Box 3467
Gillette, WY 82718

February 26, 2007

Legend

- Photo Point Only
- Terrace Sample Points
- Channel Sample Points
- Spreader Dikes
- Sections
- Quarter Quarter
- Fields

Legals:
T43N R76W
SE1/4 SW1/4 of Section 26
N1/2 NE1/4 of Section 35
N1/2 SE1/4 of Section 35
SE1/4 NE1/4 of Section 35
SW1/4 SE1/4 of Section 35

T42N R76W
W1/2 NE1/4 of Section 2
W1/2 SE 1/4 of Section 2
E1/2 NW1/4 of Section 2
E1/2 SW1/4 of Section 2
NW1/4 NE1/4 of Section 11

N
W E
S

1 inch equals 1,000 feet

Map Projected in:
NAD 1983, UTM Zone 13

Table 9: Location of Points Sampled within the Collins Draw Fields

Field	Sample #	Waypoint #	Latitude	Longitude	Location
1	1	300	N43.632409	W105.956906	Channel
1	2	301	N43.632555	W105.956798	Terrace
1	3	302	N43.632543	W105.956814	Terrace
1	4	303	N43.632543	W105.956814	Channel
1	5	304	N43.634919	W105.956761	Terrace
1	6	305	N43.635074	W105.956812	Channel
1	7	306	N43.635514	W105.957342	Channel
1	8	307	N43.635776	W105.957277	Terrace
2	9	308	N43.636865	W105.957605	Terrace
2	10	309	N43.636937	W105.957966	Channel
2	11	310	N43.637411	W105.958557	Terrace
2	12	311	N43.638247	W105.958517	Channel
3A	13	312	N43.638083	W105.958667	Terrace
3A	14	313	N43.639674	W105.957502	Channel
3B	15	314	N43.641517	W105.958611	Terrace
3B	16	315	N43.641359	W105.958659	Channel
3C	17	316	N43.641359	W105.958659	Terrace
3C	18	317	N43.644340	W105.957638	Channel
3C	19	318	N43.646214	W105.958410	Terrace
4A	20	319	N43.651601	W105.955722	Terrace
4A	21	320	N43.652080	W105.955045	Channel
4B	22	321	N43.651927	W105.955207	Terrace
4B	23	322	N43.652806	W105.957448	Terrace
4B	24	323	N43.652999	W105.957699	Terrace
4B	25	324	N43.652987	W105.957713	Terrace
4B	26	325	N43.654063	W105.957251	Channel
4C	27	326	N43.655212	W105.954820	Terrace
5	28	327	N43.654898	W105.952640	Channel
5	29	328	N43.655323	W105.952117	Terrace
5	30	329	N43.655280	W105.952230	Channel
5	31	330	N43.655545	W105.950832	Terrace
5	32	331	N43.656217	W105.951099	Terrace
5	33	332	N43.656291	W105.950801	Terrace
5	34	333	N43.657548	W105.951282	Channel
5	35	334	N43.657983	W105.950914	Terrace
6A	36	335	N43.660853	W105.952383	Terrace
6A	37	336	N43.660574	W105.952745	Channel
6B	39	338	N43.666072	W105.957647	Channel
6B	40	339	N43.666101	W105.958605	Terrace
6B	41	340	N43.666592	W105.958205	Channel
6B	42	341	N43.666340	W105.959642	Terrace
6B	43	342	N43.666445	W105.960139	Channel

Note: Projected in WGS 84, decimal-degrees.