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PROPERTIES OF SOILS OF THE HANFORD PROJECT

By

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Geochemical and Geophysical Research
Chemical Effluents Technology Operation
CHEMICAL RESEARCH AND DEVELOPMENT OPERATION

HANFORD LABORATORIES OPERATION

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HANFORD ATOMIC PRODUCTS OPERATION

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PROPERTIES OF SOILS OF THE HANFORD PROJECT

INTRODUCTION

A large number of wells have been drilled within the borders of the Hanford project. These wells were constructed for various purposes. In recent years many of the wells were drilled to permit monitoring of the ground water and to investigate the subsurface formations in the vicinity of waste disposal facilities or to provide data for a geologic survey of the region. Soil samples were collected at specified depth intervals from these wells at the time of drilling. The samples are considered representative of the soil horizons through which the well was drilled.

The utility of a given location for the disposal of radioactive waste solutions is dependent upon the moisture retention and cation exchange capacity of the soil profile. An evaluation of the capacity of a given site for liquid radioactive waste disposal is based on the results of a number of laboratory tests. These tests characterize either directly or indirectly, the moisture holding and cation exchange capacities of representative soil samples from the site. Data from these tests, as well as from other laboratory tests, also supplement the geologic study of the project. Portions of these results have appeared in various research and development reports and other portions will appear in forthcoming reports.

This report presents a compilation of the complete results obtained from a number of laboratory tests performed on soil samples selected as representative of various Hanford project well locations.

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EXPERIMENTAL METHODS

Location of Sampled Wells

The location of the Hanford project wells, from which samples were taken for use in this report, are shown in Figure 1. The wells are numbered according to system described in HW-44355 (1). Sufficient samples were selected from each well to permit adequate characterization of the soil profile at that site.

Collection and Preparation of Soil Samples

All of the well samples for which laboratory data are reported are from churn-drilled wells. Well samples were taken by the driller from each five feet of well drilled. The samples were taken to the laboratory, air-dried, and stored. Samples for use in the laboratory were removed from the sample jar and crushed. The sample then was passed through a 2 mm. square-hole sieve. The weight of the portion retained on, and of that passing through, the sieve was recorded. All reported laboratory tests were made on the fraction less than 2 mm. in diameter.

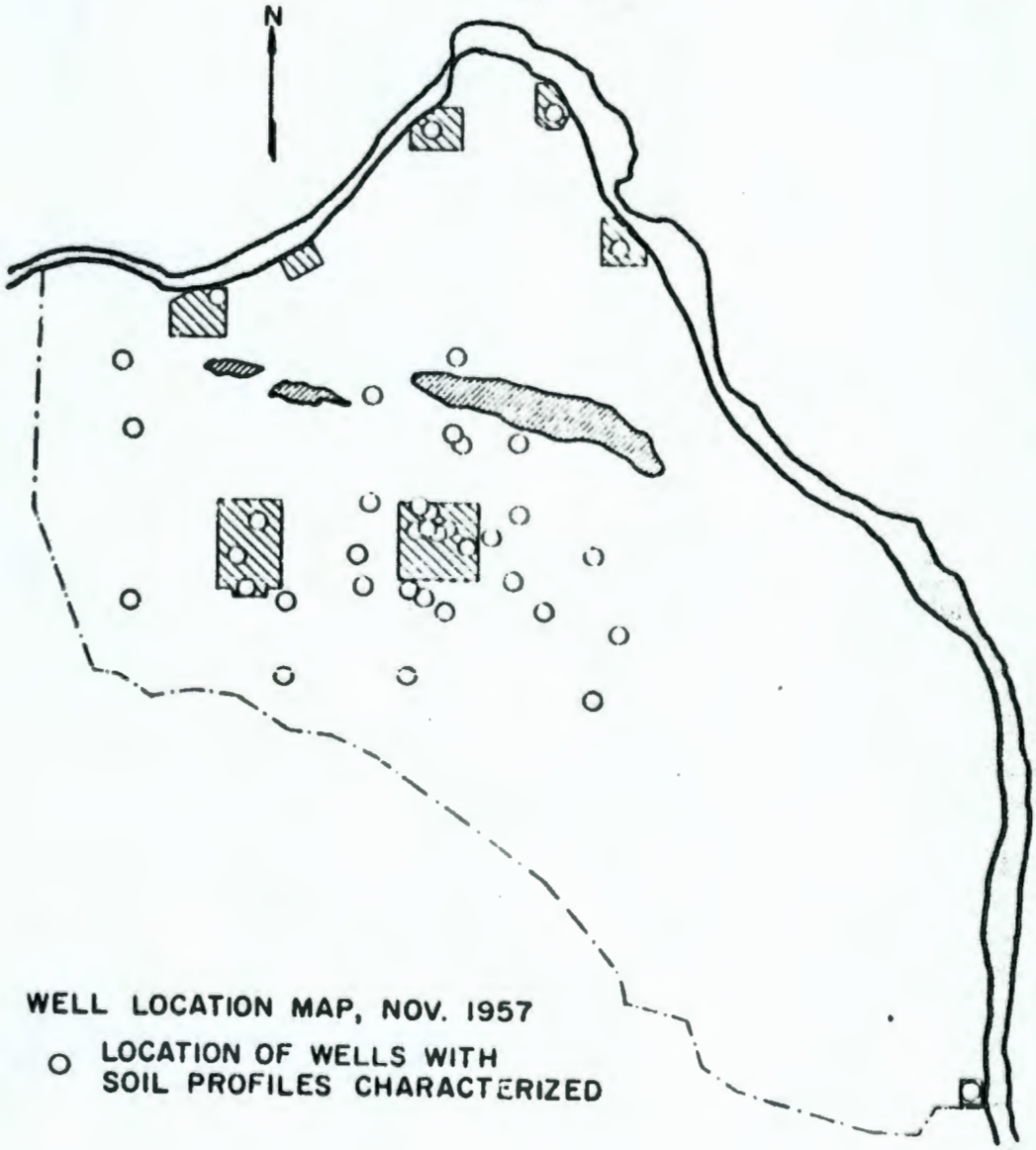
Laboratory Procedures

Mechanical analysis. The dispersion, separation, and determination of sand, silt, and clay percentages was according to Kilmer and Alexander (2).

pH. The pH of the saturated soil paste was obtained by the use of a glass electrode (3).

FIGURE 1

THE DISTRIBUTION OF HANFORD PROJECT WELLS WHICH HAVE BEEN SAMPLED FOR SOIL TESTING



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$CaCO_3$ percentage. The percentage of $CaCO_3$ was determined by a manometric method described by Williams (4).

15-atmosphere percentage. The 15-atmosphere percentage of the soil was determined by the method described by Richards (3) using water-pumped nitrogen to supply pressure to the pressure-membrane apparatus.

Cation exchange capacity. The cation exchange capacity procedure of Bower (3,5), with slight modifications, was employed.

Compilation of Results

The experimental data obtained for the drilled soil samples are tabulated in Appendix A. The data obtained for a number of surface samples and several compounded project soils are given in Appendix B. The column headings in the appendices are explained below.

Column 1 - Well designation

All the wells are numbered according to the system described by Honstead, Brown, and Brown (1).

Column 2 - Coordinates

The coordinates locating the wells are given according to HW-44355 (1).

Column 3 - Sample depth

The depth at which the driller reported the sample was taken.

Mechanical analysis

Column 4 - Percentage greater than 2 mm. diameter

This column lists the percentage of the whole sample failing to pass a 2 mm. sieve. The material represents coarse gravel as well as fragments of larger rocks which were crushed by the churn-drilling operation. This fraction of the soil contributes little, if anything, to the soil properties of interest.

Column 5 - Sand

Sand is defined as those particles whose diameter is greater than 0.05 mm. and less than 2.0 mm. Some fragments of larger particles will be found in this size fraction as a result of the churn drilling. The finer sand particles are of some significance in soil mineralogy and hence to geologic surveys. The porosity and permeability of most soils are dependent on the percentage of sand, as well as on the percentage of silt and clay. In general the greater the sand content the greater is the porosity and permeability of the soil.

Research work previously performed in this laboratory* demonstrated that drilled well samples did contain fragments of larger rocks in the coarser sand fractions. However the contribution to the silt and clay fractions was negligible. The recorded percentages of silt and clay will be slightly low for drilled samples because the added material in the sand fraction acts as a diluent.

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*Personal communication from D. W. Rhodes

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Column 6 - Silt

Silt particles have a diameter of 0.002 mm. to 0.05 mm. (2 to 50 microns). The mineralogical composition of the silt fraction is usually similar to that of the finer sand fractions. Physical weathering processes are largely responsible for the formation of silt-sized particles.

Column 7 - Clay

The clay percentage reported is for all particles with diameters less than 2 microns. Clay, in contrast to silt, is formed largely as the result of chemical weathering processes. The mineralogical composition of clay, particularly of the fraction whose particle diameters are less than 1 micron, is distinctly different from the remainder of the soil. The clay fraction is considered the active portion of the soil and most properties used to characterize a soil are based on the concentration and nature of the clay. Moisture retention and cation exchange capacity are two soil properties used to evaluate the efficiency of a site for the disposal of liquid radioactive waste. As both of these soil properties are a function of the clay content the determination of clay is important in the evaluation of a site for possible disposal of liquid radioactive wastes.

Column 8 - pH

The pH values reported for soil pastes were determined by methods applied in measuring the pH of solutions. There is some question concerning the applicability of these methods to soils. The values obtained depend upon

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soil characteristics, the concentration of dissolved CO_2, and the soil moisture content as well as the hydrogen-ion concentration. Soil characteristics known to influence pH readings include: the composition and concentration of soluble salts, and the presence, or absence, of $CaSO_4$ and alkaline-earth carbonates (3).

Experience and a statistical study (6) permit the following general conclusions regarding the interpretation of pH readings of a saturated soil paste: Values of pH greater than 8.5 invariably indicate an exchangeable-sodium percentage of 15 or more and the presence of alkaline-earth carbonates; the exchangeable-sodium percentage of soils with a pH less than 8.5 may or may not exceed 15; soils with a pH less than 7.5 almost never contain alkaline-earth carbonates, and soils with a pH less than 7 usually contain exchangeable hydrogen.

Soils containing alkaline-earth carbonates and/or soluble salts are not considered to have weathered extensively. Soils with a pH less than 5.5 usually contain considerable exchangeable hydrogen as a result of intensive physical, chemical, and perhaps biological action and are considered acid soils. Soils with a pH between 5.5 and 7.5 are classed as neutral soils. Kaolinitic clays are ordinarily associated with acid soils whereas montmorillonitic clays are found to exhibit a neutral or alkaline reaction. The permeability of soils containing exchangeable-sodium ion usually is low because of the dispersing effect of sodium. Soil horizons high in clay and with a pH greater than 8.5 indicate horizons of very low permeability.

Column 9 - 15-atmosphere percentage

The 15-atmosphere percentage is that moisture held in a soil against a pressure of 225 psi. This moisture is a function of the number of small pores and of the surface area, both of which are a function of the percentage of clay present. The determination of the 15-atmosphere moisture percentage is easily performed. If a valid relationship between 15-atmosphere percentage and clay content, or cation exchange capacity, exists the 15-atmosphere percentages can be used as estimates of clay and cation exchange capacity values with a substantial saving of labor.

Column 10 - $CaCO_3$ percentage

Soils reported as containing 0.2% $CaCO_3$ or less are probably non-calcareous. The small positive values reported probably are due to the reaction of other materials in the soil under the conditions of the test.

Column 11 - Cation exchange capacity

The values reported are expressed as milliequivalents per 100 grams of soil. The cation exchange capacity is an expression of the surface-active constituents of the soil. These consist for the most part of various clay minerals and organic matter. Hanford project soils contain little or no organic matter so the magnitude of the cation exchange capacity is largely a function of the concentration and

mineralogical composition of the clay fraction. The greater the cation exchange capacity per unit of soil, the greater is the possible decontamination. Montmorillonitic clays will be most effective as they may have an exchange capacity as great as 100 meq/100 g. whereas illitic clays and halloysites may have 10-50 meq/100 g. and kaolinitic clays as little as 3-15 meq/100 g.

ACKNOWLEDGMENTS

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APPENDIX A

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
199-B3-2		feet	%	%	%	%		%	%	meq./100 g
		10	39.9	71.6	22.4	6.0	8.1	3.22	0.1	10.4
		25	23.6	72.7	22.1	5.2	8.2	2.20	0.1	8.5
		45	43.1	85.8	12.3	1.9	8.5	4.07	0.1	4.3
		65	29.0	70.4	25.0	4.6	7.9	1.78	0.3	4.5
		80	9.1	92.7	7.3	0	8.5	1.04	0.1	3.1
		100	49.3	95.8	3.4	.93	8.2	1.47	0.1	5.1
		115	38.2	85.9	11.0	3.1	8.1	2.00	0.1	5.7
		135	39.5	92.6	6.7	0.7	8.5	1.63	0.1	4.8
		155	11.5	65.7	23.8	10.5	8.1	5.63	0.1	20.1
		175	0	17.6	29.8	52.6	8.0	26.72	3.9	48.9
		190	29.7	80.3	13.3	6.4	8.2	4.28	0.1	14.1
		210	0	58.6	29.3	12.1	8.1	8.67	4.8	23.9
		230	0	63.3	30.9	5.8	8.2	4.66	3.5	12.8
		250	0	57.7	33.2	9	8.2	4.93	6.2	17.9
		270	55.1	85.3	12.2	2.5	8.4	2.02	1.4	6.2
		290	57.4	83.1	12.9	4.0	8.7	1.65	0.6	6.2

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
199-B3-2		feet	%	%	%	%		%	%	meq./100 g
		310	0	68.0	27.9	4.1	8.1	4.18	0.8	14.1
		325	71.0	86.2	11.9	1.9	8.3	1.90	0.2	6.8
		340	68.5	92.2	5.6	2.2	8.4	1.39	0.1	5.4
		370	11.7	93.0	6.8	0.2	8.6	1.43	0.3	4.4
		380	2.1	66.4	8.2	8.5	8.1	5.90	6.2	10.0
		395	0	12.5	57.5	30.0	7.9	12.94	20.8	35.8
		415	0	8.8	62.0	28.8	7.9	14.36	22.1	24.2
		435	0	6.7	62.5	30.8	7.9	15.82	14.4	35.2
		450	0	39.8	21.8	18.4	7.8	11.69	2.6	22.3
		470	11.6	12.4	58.5	29.1	7.7	18.02	12.3	38.2
		495	0	15.7	57.9	26.4	8.0	16.48	8.4	21.2
		515	0	11.0	62.5	26.5	7.8	14.22	1.3	25.8
		535	0	1.8	65.8	32.4	9.5	14.89	0.8	23.7
		560	0	17.6	63.1	19.3	7.8	12.89	9.0	32.1
		580	0	11.2	52.8	36.0	8.0	20.71	5.2	39.5
		600	38.0	69.5	20.2	10.3	8.0	6.17	0.4	19.0

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis				pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
			Greater than 2-mm diameter	Less than 2-mm diameter						
				Sand	Silt	Clay				
199-B3-2		feet	%	%	%	%		%	%	meq./100 g
		620	0	71.0	19.70	9.3	7.9	5.72	0.3	19.0
		640	19.4	59.6	21.6	18.80	8.1	9.99	0.3	32.9
		655	0	4.0	29.5	66.5	8.2	36.24	0.3	21.2
		505	0	12.0	65.3	22.7	8.2	14.22	0.9	-

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
199-D8-2	N-94,725 P W53,018	feet	%	%	%	%		%	%	meq./100 g
		10	19.8	67.7	24.5	7.8	8.2	3.55	0.5	16.2
		15	16.5	94.2	5.3	0.5	8.7	1.49	0.3	6.7
		25	0.9	89.6	9.2	1.2	8.4	1.58	0.2	7.0
		35	54.3	76.6	20.3	3.1	8.6	1.75	0.6	6.2
		45	63.2	94.9	5.1	0	8.5	1.11	0.6	3.8
		55	72.2	79.0	17.3	3.7	8.1	2.11	0.1	5.8
		65	45.1	84.7	14.3	1.0	8.3	1.74	0.1	5.8
		76	50.0	91.5	8.5	0	8.6	1.10	0.1	4.0

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Silt	Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
		feet	%	%	%	%		%	%	meq./100 [redacted]
199-F5	N 79,069 P W30,650	10	[redacted]	91.1	6.1	2.8	8.5	1.7	0.4	5.2
		20	[redacted]	86.3	10.8	2.9	9.0	1.5	0.8	5.2
		35	[redacted]	97.1	1.5	1.4	8.7	0.8	0.6	3.8
		55	[redacted]	12.7	31.4	55.9	7.9	22.5	6.1	56.6
		72	[redacted]	26.5	47.1	27.4	7.8	11.3	28.8	28.6
		90	[redacted]	39.3	38.3	22.4	8.2	11.0	5.4	36.1
		105	[redacted]	26.9	63.2	9.9	8.2	11.1	6.9	39.4
		115	[redacted]	34.0	60.5	5.5	8.2	8.6	0.3	25.3

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
199-H4-2		feet	%	%	%	%		%	%	meq./100 g
		40	7.7				9.5	1.50	0.3	5.4
		65	0				8.1	10.57	2.4	25.8
		75	15.9				8.2	9.03	0.5	23.4
		90	3.0				8.1	8.33	2.8	23.4
		95	5.6				8.1	7.08	3.9	13.0
		120	0				8.4	4.56	1.7	10.0
		160	6.6				8.4	5.67	0.8	12.2
		185	1.8				8.15	7.17	0.6	15.2
		195	5.3				8.15	5.94	0.6	12.5
		205	1.7				7.9	6.36	1.8	15.2
		225	2.2				8.4	7.48	0.8	13.8
		260	0				7.7	13.12	0.1	24.7
		275	18.2				7.9	22.19	0.1	37.3
		280	23.5				8.0	27.37	0.1	46.2
		290	0				6.9	21.69	0	33.4
		320	1.6				7.9	16.36	0.4	26.1
		335	0				7.8	30.50	0.1	41.8

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis				pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
			Greater than 2-mm diameter	Less than 2-mm diameter						
				Sand	Silt	Clay				
199-H4-2		feet	%	%	%	%		%	%	meq./100 g
		350	2.5				8.0	24.42	12.6	41.3
		370	5.5				8.15	13.15	3.2	25.5

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E-13-1	N35, 564 P W53, 446	feet	%	%	%	%		%	%	meq./100 g
		30	2.4	79.8	12.8	7.4	8.35	3.61	1.4	11.6
		45	1.7	85.5	12.0	2.5	8.75	2.27	1.0	6.8
		60	0	87.3	10.9	1.8	8.75	1.44	1.6	4.3
		80	0	85.4	11.2	3.4	8.7	1.96	1.6	5.1
		100	0	82.5	14.0	3.5	8.55	1.98	1.6	5.4
		120	0	79.9	14.4	5.7	8.65	1.98	1.7	5.6
		140	0	84.2	13.8	3.8	8.55	2.27	1.4	6.2
		160	0	85.0	11.1	3.9	8.55	1.66	1.3	5.4
		180	0	84.5	11.7	3.8	8.85	1.78	1.3	5.4
		200	0.7	83.3	12.6	4.1	8.7	1.66	1.3	5.0
		220	0	83.1	14.1	2.8	8.7	1.85	1.2	5.6
		240	32.5	84.8	11.7	3.5	8.65	1.61	0.9	5.0
		270	19.8	75.0	17.9	7.1	8.7	2.90	0.8	7.4
		300	43.1	70.0	14.9	15.1	8.6	2.20	0.4	5.9
		340	50.7	86.7	11.0	2.3	8.1	0.87	0.3	3.2
		350	20.5	71.9	23.0	5.1	8.0	1.96	0.3	4.7
		360	32.9	75.9	19.95	4.15	7.9	1.67	0.5	4.7

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Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E-13-5	N35, 565 P W53, 447	feet	%	%	%	%		%	%	meq./100 g
		30	0	81.1	19.9	0	8.55	4.43	1.8	15.8
		45	0	85.2	10.0	4.8	8.6	2.96	1.4	10.4
		60	0	84.9	14.3	0.8	8.85	1.57	2.0	5.0
		80	0	87.2	9.6	3.2	8.85	1.29	1.5	4.4
		100	0	87.2	12.4	4.9	8.75	1.83	1.5	5.8
		130	0	86.6	9.8	3.6	8.55	2.03	1.8	7.4
		140	0	84.2	11.7	4.1	8.65	1.76	1.6	4.7
		160	0	85.2	11.3	3.5	8.8	1.43	1.4	4.3
		180	0	83.5	13.5	3.0	8.8	1.79	1.5	5.3
		200	0	84.3	13.4	2.3	8.75	1.35	1.3	3.7
		225	0	85.6	14.4	-	8.95	1.47	1.1	4.3
		250	5.4	83.4	11.1	5.5	8.5	2.22	0.7	5.4
		270	4.3	78.6	15.6	5.8	8.6	2.13	0.7	7.4
		300	26.1	64.0	26.6	9.4	8.55	3.61	0.8	12.8
		320	17.9	70.0	23.0	7.0	8.55	2.39	0.6	7.8
		345	40.0	63.8	29.1	7.1	8.0	4.03	0.3	8.8
		355	66.7	93.9	5.7	0.4	7.8	1.14	0.2	3.9

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Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E-13-5	N35, 565 P W53, 447	feet	%	%	%	%		%	%	meq./100 g
		360	37.5	77.0	19.6	3.4	7.9	1.46	0.3	4.0

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Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Less than 2-mm diameter: Sand	Silt	Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E-25-2	N41, 270 P W47, 190	feet	%	%	%	%		%	%	meq./100 g
		15	0	69.5	24.2	6.3	8.25	3.01	1.1	8.9
		30	10.4	91.0	4.2	4.8	8.4	1.80	0.6	6.8
		40	3.3	85.7	9.0	5.3	8.5	1.84	1.0	7.1
		55	7.4	82.0	15.2	2.8	8.2	1.81	1.1	4.8
		70	0	74.6	17.8	7.6	8.2	2.77	1.6	6.8
		90	3.3	74.0	17.6	8.4	7.9	3.00	1.4	8.5
		110	23.1	77.7	18.1	4.2	8.0	2.38	1.4	6.2
		115	36.7	84.3	11.4	4.3	8.2	1.70	1.1	4.8
		130	10.7	78.3	14.7	7.0	8.2	1.87	1.1	5.1
		150	2.8	86.0	14.0	0	8.3	1.19	1.2	3.5
		170	0	84.9	9.3	5.8	8.35	1.56	1.4	4.0
		190	3.2	79.5	15.4	5.1	8.2	1.57	1.4	5.0
		210	21.6	92.4	7.7	0.1	8.0	3.63	0.2	5.0
		230	27.0	86.6	9.2	9.0	8.1	1.08	0.7	4.3
		250	12.7	83.6	10.4	6.0	8.2	1.22	0.8	4.3
		260	11.2	60.0	28.0	12.0	7.8	2.98	1.1	8.2
		280	50.0	59.7	29.7	10.6	7.9	2.49	0.8	7.1

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E-25-2	N41, 270 P W47, 190	feet	%	%	%	%		%	%	meq./100 g
		300	49.6	75.9	16.4	7.7	7.7	1.55	0.6	4.8
		320	13.8	85.2	8.9	5.9	7.8	0.97	0.3	3.1
		340	46.5	68.1	23.2	8.7	7.9	2.56	0.3	6.5
		360	53.1	75.4	15.3	9.3	7.4	4.75	0.3	11.4
		370	0	70.3	22.9	6.8	7.6	3.05	0.5	6.8

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E-27-1	N-2, 833	feet	%	%	%	%		%	%	meq./100 g
	F W50, 440	15	0	70.1	25.7	4.2	8.85	1.65	1.7	6.5
		45	0	94.6	4.4	1.0	9.1	1.03	1.4	3.4
		60	0	87.2	9.4	3.4	8.8	1.32	1.4	4.5
		90	0	93.2	5.1	1.7	9.7	0.96	1.5	4.5
		120	0	90.0	8.8	1.2	8.9	1.16	1.4	4.2
		150	0	90.4	9.6	0	8.75	0.99	0.9	3.7
		180	0	90.2	8.2	1.6	9.0	1.13	0.7	4.2
		210	0	93.6	6.0	0.4	8.95	1.09	0.8	3.9
		240	0	86.8	10.0	3.2	9.0	1.20	0.8	4.7
		255	41.3	82.3	14.3	3.4	8.55	1.42	0.5	5.7
		270	1.0	90.2	4.1	5.7	8.15	1.10	0.3	5.0
		300	0	94.0	5.9	0.1	7.75	1.11	0.5	4.4
		315	0	86.1	13.9	0	7.8	1.28	0.4	4.5
		320	0	89.7	8.2	2.1	7.75	1.28	0.3	4.2
		330	0	84.4	10.3	1.3	7.8	1.09	0.3	3.9

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E33-4	N46, 635 F W53, 384	feet	%	%	%	%		%	%	meq./100 g
		10-15	[illegible].6	66.5	27.5	6.0	8.4	3.46	0.8	12.0
		25-30	13.2	76.0	17.2	6.8	8.2	2.58	0.8	9.2
		65-70	5.0	74.9	21.4	3.7	8.5	2.43	1.2	5.2
		90	7.7	84.0	12.9	3.10	8.3	1.95	1.3	4.4
		110	3.9	82.0	15.5	2.5	8.6	1.80	1.4	4.7
		130	5.3	91.0	7.8	1.2	8.5	1.38	0.9	4.8
		150	24.5	78.4	16.3	5.3	8.3	2.62	0.7	8.9
		170	15.6	85.6	13.3	1.1	8.4	1.95	0.7	7.1
		190	13.7	96.8	3.2	0	8.4	1.30	0.8	5.4
		210	70.0	67.2	26.0	4.8	8.2	2.21	0.3	7.4
		225	43.8	61.4	31.6	7.0	8.3	2.38	0.3	9.6

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Less than 2-mm diameter: Sand	Silt	Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E33-9	N45, 950 E W53, 288	feet	%	%	%	%		%	%	meq./100 g
		40	38.0	81 3	11 9	6 85	8 7	0 87	0.4	5 0
		100	1 8	81.5	11 1	7.43	8 9	0 33	0.5	5.0
		130	44 0	89.4	6 7	3.90	9.1	0 44	0 4	4.7
		150	2 1	90.8	5 1	4.14	9.1	0.58	0.3	4.5
		170	0 8	71.0	23.0	6 0	8.45	1.94	0.6	6.5
		185	0	77.8	15.6	6.6	8.7	1.15	0.7	5.9
		200	7.3	77.5	15.8	6.7	8.8	-	0.4	5.9
		215	0	75.6	14.9	9.5	8.6	1.62	0.4	8.5
		230	8 6	58 2	31.2	10.6	8.7	0.87	0.2	8 5
		250	32.8	61.7	31.1	7.2	7.85	2.31	0.5	5.7
		260	35.9	66.2	25 9	7.9	8.0	1 94	0 3	4.7
		264	0	68.2	26.9	4.9	7.2	4.39	0.1	13 6

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E33-12	N46, 430 F W52, 650	feet	%	%	%	%		%	%	meq./100 g
		2[illegible]	11.[illegible]	81.[illegible]	12.[illegible]	6.18	8.6	1.50	0.5	5.4
		50	1.[illegible]	[illegible]	14.1	7.53	8.8	1.83	0.6	4.[illegible]
		80	2.2	3.4	19.3	7.34	8.7	2.04	0.6	5.7
		100	13.3	5.50	85.2	9.3	8.8	1.38	0.4	5.2
		150	2.8	5.0	8.3	16.1	8.7	1.50	0.5	5.0
		170	19.8	5.5	83.4	11.1	8.7	1.10	[illegible]	5.2
		180	17.9	5.9	84.5	9.6	8.7	0.77	0.4	5.9
		200	-	6.8	81.3	11.9	-	-	-	-
		225	10.[illegible]	92.5	7.3	0.5	7.9	0.98	0.3	4.2
		230	61.1	84.5	6.8	0.8	7.7	1.26	0.3	5.4

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
		feet	%	%	%	%		%	%	meq./100 g
299-E33-13	N46, 278 F W53, 093	20	6.8	84.0	11.3	4.7	8.7	1.48	0.5	5.2
		50	16.6	8[illegible].9	[illegible].9	4.2	8.65	1.37	0.4	7.1
		80	2.3	87.3	8.7	4.0	8.7	1.45	0.5	6.0
		110	3.7	88.8	7.8	3.4	8.85	1.15	0.6	6.5
		140	2.4	90.1	5.9	3.9	8.7	1.31	0.4	5.3
		160	18.1	69.9	23.7	6.4	8.45	1.88	0.6	6.8
		180	22.0	81.0	13.4	5.6	8.5	2.08	-	7.1
		200	42.1	70.1	23.4	6.5	8.4	2.58	0.2	7.1
		220	55.8	65.7	27.7	6.6	7.85	2.15	0.3	5.6
		230	50.6	64.0	29.3	6.7	7.8	2.34	0.3	6.5

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-E33-17	N45, 894 P W52, 529	feet	%	%	%	%		%	%	meq./100 g
		15	36.7	61.8	30.5	7.7	8.55	3.28	0.6	8.9
		30	0	85.3	13.4	1.3	8.8	1.29	1.4	4.5
		50	13.0	84.0	11.9	4.1	8.8	1.27	1.3	5.0
		80	8.7	85.0	11.5	3.5	8.65	1.42	1.0	4.8
		110	6.3	73.[illegible]	17.7	8.7	8.95	2.28	1.5	6.0
		150	0	87.5	9.0	3.5	8.95	1.38	1.0	5.0
		170	25.3	71.1	25.9	3.0	8.3	1.92	1.3	7.1
		200	0.8	92.3	5.9	1.8	8.65	1.10	0.8	4.3
		230	35.4	63.6	28.8	7.6	7.9	2.33	0.5	6.0
		240	51.7	61.5	30.3	8.2	7.7	2.60	0.5	7.7

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-W10-3		feet	%	%	%	%		%	%	meq./100 g
		15	5.0	34.2	37.5	8.3	8.7	3.98	0.9	17.9
		35	7.5	83.0	16.0	1.0	8.1	1.32	0.2	6.0
		50	0	90.9	8.5	0.6	8.4	1.25	0.9	4.8
		65	22.7	80.4	18.3	1.3	9.3	1.76	0.7	7.7
		80	4.1	81.1	16.9	2.0	10.6	2.48	2.8	12.8
		100	4.9	58.6	38.7	8.7	10.3	5.18	24.0	18.5
		115	7.5	46.4	47.3	6.3	8.1	5.26	8.8	15.2
		130	36.8	63.2	31.6	5.2	7.8	2.69	1.0	10.4
		150	0	93.6	4.5	1.9	8.7	1.94	1.0	3.2
		170	21.2	65.6	29.0	5.4	8.6	1.91	0.2	5.9
		200	41.1	60.8	32.7	6.5	8.4	3.85	0.7	13.6
		235	12.4	92.5	6.6	0.9	8.0	2.1	0	8.1

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-W11-2	N43, 335 P W73, 772	feet	%	%	%	%		%	%	meq./100 g
		15	31.3	63.6	31.3	5.1	8.7	3.00	0.7	10.3
		25	24.3	66.6	28.1	5.3	8.6	-	1.1	9.2
		45	6.1	80.4	16.4	3.2	8.5	1.87	1.6	6.2
		65	8.8	81.6	16.3	2.1	8.9	1.77	1.5	6.8
		85	23.6	16.6	17.9	5.5	8.6	1.63	1.5	9.2
		105	13.6	77.7	14.6	7.7	8.5	3.02	3.5	12.0
		115	3.0	43.8	49.3	6.9	8.2	3.71	8.0	12.0
		120	2.5	47.2	47.1	5.7	8.2	3.84	9.6	11.1
		130	1.2	79.5	14.5	6.0	8.5	2.60	6.9	9.6
		145	26.1	77.0	12.3	10.7	8.4	4.44	7.0	14.7
		160	6.7	71.1	23.5	5.4	8.7	2.47	1.4	9.6
		180	43.5	68.5	25.2	6.3	8.6	2.35	1.3	9.6
		190	34.8	70.9	23.8	5.3	8.8	1.61	0.8	4.7
		200	48.3	63.5	29.4	7.1	8.8	1.92	0.2	4.8
		215	16.4	63.5	29.2	7.3	9.0	2.31	0.2	6.2
		230	31.2	63.8	27.9	8.3	8.7	3.69	0.2	12.8
		250	25.2	63.5	27.9	8.5	8.7	3.16	0.1	11.1

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-W11-2	N43, 335 P W73, 772	feet	%	%	%	%		%	%	meq./100 g
		270	41.3	67.1	23.8	9.1	8.5	3.29	0.1	12.2
		285	28.6	70.5	21.6	7.9	8.7	3.32	0.5	12.5
		300	32.4	63.1	27.4	9.5	8.4	3.49	0.8	13.6
		320	67.8	69.0	21.8	9.2	8.4	4.07	0.8	14.1
		335	21.0	62.2	24.0	9.8	8.4	3.85	1.1	16.3
		350	38.0	65.4	25.3	9.3	8.3	3.65	2.4	12.5
		370	29.6	75.2	16.5	8.3	8.1	4.59	1.0	15.2
		390	28.7	69.1	21.5	9.4	7.8	5.52	0.5	18.5
		410	32.2	68.4	23.5	8.1	7.7	4.01	0.2	13.6
		430	19.3	73.3	18.5	8.0	7.9	4.05	0.3	12.8
		450	32.6	60.5	28.5	11.0	8.0	5.52	0.4	19.6
		465	17.7	68.5	25.2	6.3	7.9	4.75	0.4	13.6
		480	16.0	61.5	28.4	10.1	7.3	4.23	0.2	10.0
		500	22.2	64.5	25.2	10.3	8.15	4.45	0.2	11.1
		510	33.8	56.7	31.3	12.0	7.8	5.12	0.6	15.2
		520	30.4	69.9	21.0	9.1	8.15	4.29	0.5	12.0

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
299-W23-1	N35, 970 P W75, 615	feet	%	%	%	%		%	%	meq./100 g
		25	18.6	75.9	20.4	3.7	8.3	3.78	1.2	13.0
		45	9.2	76.1	20.8	3.1	8.4	3.82	1.6	13.0
		55	28.4	71.4	21.3	7.3	8.9	2.56	1.5	10.0
		70	2.8	79.5	7.3	13.7	8.7	1.49	1.8	6.8
		90	1.5	76.8	19.0	4.2	8.4	2.59	1.6	8.1
		110	0	76.4	20.3	3.3	8.6	2.46	1.6	8.5
		130	0	71.3	24.1	4.6	8.6	3.37	2.1	11.1
		140	0	37.5	53.1	9.4	8.4	5.14	3.6	13.3
		150	0	46.0	45.9	8.1	8.4	4.64	3.0	12.0
		160	39.8	63.4	27.1	9.5	8.5	4.67	6.9	12.5
		170	10.5	80.9	13.7	5.4	8.6	2.49	0.4	6.5
		190	43.4	67.9	24.7	7.4	8.8	2.68	0.2	6.8
		205	30.5	61.6	30.6	7.8	8.6	2.92	0.1	6.5
		225	10.1	58.7	33.3	8.0	8.4	3.66	0.1	8.5
		235	29.4	70.1	23.4	6.5	8.7	3.23	0.1	7.5
		250	36.4	64.8	26.6	8.6	8.5	4.04	0.1	13.5
		260	67.0	86.3	11.7	2.0	8.6	2.36	0.2	7.8

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
339-1-2	N55, 772 E15, 134	feet	%	%	%	%		%	%	meq./100 g
		10	27.8	79.5	16.3	4.2	8.1	2.08	0.5	10.3
		25	35.2	84.6	13.7	1.7	8.2	1.39	0.2	7.4
		35	51.1	84.9	17.6	2.5	8.1	3.47	0.8	11.1
		50	58.0	94.2	2.5	0.3	8.5	1.23	0.1	8.1
		70	41.8	71.5	23.2	5.3	8.0	2.55	0.1	10.9
		80	9.9	93.6	6.4	0	7.5	0.45	0.3	6.8
		95	75.2	89.7	8.9	1.4	-	2.74	-	-

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-24-33	N23, 809	feet	%	%	%	%		%	%	meq./100 g
	P W33, 315	15	5.0	81.4	13.4	5.2	8.8	2.65	0.6	9.2
		25	10.3	86.7	9.3	4.0	8.7	1.96	0.4	14.6
		50	4.7	81.3	12.5	6.2	8.7	2.12	0.5	6.8
		65	2.2	84.1	12.1	3.8	8.65	1.51	0.5	5.0
		80	62.3	73.4	22.7	3.9	8.45	2.01	0.2	7.8
		95	3.3	89.2	6.3	4.5	8.65	1.64	0.2	5.4
		105	54.8	78.3	17.8	3.8	8.5	1.73	0.3	5.2
		130	27.6	68.7	26.1	5.2	8.7	2.03	0.2	6.2
		140	2.4	84.6	13.9	1.5	8.1	1.21	0.4	4.2
		145	0	92.85	6.5	.07	8.15	1.30	0.4	3.2
		150	5.4	87.1	12.3	.06	8.55	1.33	0.4	3.6
		160	4.6	93.5	4.1	2.4	-	-	-	-

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-25-55	N25, 357	feet	%	%	%	%		%	%	meq./100 g
	P W55, 192	75	0	80.7	15.1	4.2	9.1	1.99	1.6	5.9
		140	0	88.4	9.0	2.6	9.3	1.10	0.6	4.5
		235	58	87.1	10.1	2.8	8.4	1.26	0.4	4.7
		250	0	89.1	8.1	2.8	8.7	1.41	0.6	4.0
		275	50	73.4	22.2	4.4	8.6	1.65	0.6	5.7
		285	29	67.7	27.0	5.3	8.8	1.89	0.4	4.2

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-25-70	N25, 258 P W70, 080	feet	%	%	%	%		%	%	meq./100 g
		90	0	78.0	17.8	4.2	8.85	2.38	1.6	7.8
		145	8	41.2	47.6	11.2	8.8	6.11	10.4	16.8
		180	18	45.3	49.3	5.4	8.6	4.63	9.3	11.1
		195	42	73.7	21.7	4.6	8.3	1.94	0.1	4.5
		210	27	64.4	30.1	5.5	8.6	2.61	0.1	5.9
		250	47	83.4	13.5	3.1	7.4	1.68	0.1	5.4
		270	39	73.4	20.0	6.6	8.45	3.93	0.1	11.5
		295	29	69.6	24.0	6.4	7.6	4.36	0.1	12.5

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
		feet	%	%	%	%		%	%	meq./100 g
699-31-30		60	83.8				8.65	0.85	0.1	
		130	30.2	70.6	23.3	6.06	8.7	2.01	0.1	5.6
		160	75.0	92.7	5.3	1.92	8.75	0.97	0.1	3.9
		190	18.4	90.2	7.2	2.5	8.6	1.38	0.1	4.4
		215	0	54.8	27.5	17.7	8.35	7.58	0.3	23.2
		220	11.1	44.27	36.33	19.4	7.9	9.66	0.6	26.9
		225	48.7	46.3	41.7	12.0	7.75	9.75	0.2	4.7
		235	0	63.9	24.6	11.5	7.8	6.45	0.2	13.6
		250	0	70.4	19.9	9.61	8.6	4.58	1.7	11.4
		260	8.2	8.3	65.3	26.4	8.0	10.42	15.0	16.3
		270	12.5	64.2	23.7	12.1	8.65	6.29	0.7	16.3
		280	37.6	71.8	21.6	6.6	8.6	5.03	0.6	12.0
		315	22.3	62.8	29.4	7.8	8.5	4.61	0.2	12.0
		345	49.9	7.3	69.8	22.9	8.3	5.1	0.1	11.4
		375	23.3				7.85	10.73	0.3	31.9
		390	0				8.2	3.47	0.3	6.4
		425	10.3				7.85	3.77	0.6	11.4

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-31-30		feet	%	%	%	%		%	%	meq./100 g
		435	0				8.2	6.21	0.6	14.7
		460	0				8.15	17.74	0.2	47.8
		485	0				7.85	15.24	0.1	31.2
		505	0				8.0	19.71	0.1	54.4
		520	0				8.7	15.64	0.1	31.2
		550	0				8.35	13.27	0.5	35.7
		565	0				8.2	18.9	1.8	50.2
		590	13.5				8.7	3.77	0.2	8.2
		615	0				8.25	8.76	1.3	13.3
		640	13.8				8.45	3.83	0.8	8.8

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis				pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
			Greater than 2-mm diameter	Less than 2-mm diameter						
				Sand	Silt	Clay				
699-34-39A	N34, 056 P W38, 949	feet	%	%	%	%		%	%	meq./100 g
		138	15.2	73.2	20.4	6.4	8.1	2.73	0.6	6.5
		145	39.9	66.6	26.9	6.5	7.95	3.05	0.4	8.1
		160	35.8	95.8	3.8	0.3	7.5	1.05	0.3	4.0
		165								

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-34-51	N33,873 P W51,282	feet	%	%	%	%		%	%	meq./100 g
		355	81.8	84.3	13.1	2.6	7.8	1.19	0.2	3.7
		360	0	95.7	4.3	0	8.45	.93	0.3	3.4
		370	55.0	85.2	12.5	2.3	7.6	1.64	0.2	5.2
		380	63.9	75.2	18.7	6.1	8.05	2.65	0.2	8.1
		20	0				9.15	2.55	0.4	10.0
		45	5.0				9.1	1.69	0.5	6.5
		60	0				9.45	1.53	0.6	3.5
		80	0				9.1	1.68	0.8	3.9
		120	0				9.2	1.41	0.7	4.2
		140	0				9.0	1.86	0.9	4.0
		225	7.1				8.8	1.86	0.5	4.5
		245	0				9.2	1.36	0.3	3.5
		255	0				8.75	1.81	0.3	4.2
		280	20.8				8.8	2.57	0.4	5.2
		325	18.3				8.8	1.23	0.1	2.6
		335	60.8				8.6	1.56	0.1	3.1

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-34-89		feet	%	%	%	%		%	%	meq./100 g
		30	0				9.05	2.41	0.7	8.3
		70	0				7.9	5.99	1.6	19.0
		105	2.2				8.25	3.23	0	12.0
		120	2.2				7.9	8.53	0	19.5
		160	27.0				8.55	3.16	0	7.4
		175	36.1				8.6	3.16	0	8.1
		185	35.4				8.5	2.80	0.1	11.2
		200	34.8				7.3	4.63	0.1	12.2
		230	58.7				5.75	3.02	0	9.2
		335	19.1				8.75	3.67	0.3	8.5
		370	51.0				8.55	4.9	0.1	12.0
		400	32.0				8.3	4.01	0.1	10.0
		430	0				6.0	18.28	0.1	53.0
		450	0				7.6	3.9	0.2	45.9
		480	0				6.35	18.47	0.2	13.0
		505	0				7.8	16.15	0.6	34.2
		520	0				8.3	7.17	0.3	17.3

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis				pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
			Greater than 2-mm diameter	Less than 2-mm diameter						
				Sand	Silt	Clay				
699-34-89		feet	%	%	%	%		%	%	meq./100 g
		530	0				8.55	3.29	0.1	8.8
		560	5.6				8.7	4.70	0.1	10.0
		600	0				8.95	2.72	0	6.5
		615	0				9.05	2.12	0	5.6
		640	0				7.9	1.48	0.3	2.7

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Less than 2-mm diameter: Sand	Silt	Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-35-70	N34, 523 P W69,989	feet	%	%	%	%		%	%	meq./100 g
		50	2	71.6	23.2	5.2	8.5	4.54	1.5	11.4
		100	1	79.6	15.6	4.8	8.6	2.10	1.8	5.0
		150	0	79.0	15.8	5.2	8.7	2.05	1.6	5.4
		175	0	36.4	51.2	12.4	8.5	5.82	2.7	14.7
		215	0	52.6	37.7	9.7	8.7	4.35	2.0	11.4
		235	18	24.5	57.3	18.2	8.05	9.86	8.1	32.1
		245	19	63.6	28.3	8.1	8.5	3.51	0.4	9.2
		255	29	75.9	18.9	5.2	8.85	1.97	0.2	4.8
		270	21	79.3	15.7	5.0	8.5	1.75	0.1	4.8
		280	41	69.9	26.9	3.2	7.8	1.88	0.2	4.4
		285	23	68.8	25.3	5.9	8.5	1.88	0.2	4.8
		295	19	68.4	24.1	7.5	8.65	2.70	0.4	6.8

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-36-61	N36, 350 P W60, 744	feet	%	%	%	%		%	%	meq./100 g
		70	1	82.1	13.5	4.4	8.7	2.07	1.6	6.8
		160	1	77.4	16.4	6.2	8.9	2.43	1.5	5.9
		250	0	79.8	16.0	4.2	9.2	1.87	0.6	4.6
		310	0	82.3	13.5	4.2	9.2	1.88	0.7	4.5

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-38-43		feet	%	%	%	%		%	%	meq./100 g
		60	0	80.8	11.4	7.8	8.6	2.72	0.4	12.5
		100	0	82.1	10.8	7.1	8.7	3.09	0.4	12.7
		140	0	77.7	14.6	7.7	8.6	3.04	0.4	12.7
		150	0	82.3	10.4	7.3	8.7	2.75	0.6	11.1
		160	0	84.4	9.4	6.2	8.55	2.51	0.6	9.6
		180	0	77.0	16.6	6.4	8.6	4.38	0.6	14.1
		205	45.0	62.9	27.8	9.3	8.5	1.03	0.2	9.2
		235	90.3	No sample		- -	8.5	1.52	--	6.0
		250	63.5	88.9	6.4	4.7	8.5	1.27	0.1	5.6
		265	13.8	70.0	21.4	8.6	8.9	1.93	0.3	14.7
		285	0	77.7	16.5	5.8	8.9	2.03	0.3	5.9
		290	0	20.85	67.5	11.7	7.1	5.22	1.6	14.7
		295	0	21.6	65.9	12.5	7.7	5.52	1.7	10.0
		300	75.7	78.9	16.45	4.7	8.15	2.11	1.1	5.2
		310	56.7	90.3	8.0	1.7	8.25	1.51	0.9	4.8
		320	88.7	94.2	5.7	1.1	8.15	--	--	4.4
		340	15.0	34.2	38.3	27.5	8.3	18.69	0.1	56.5

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-38-43		feet	%	%	%	%		%	%	meq./100 g
		365	0	8.45	62.0	29.5	7.95	13.78	0.3	44.6
		390	0	19.3	55.9	24.8	8.1	11.50	1.6	46.7
		400	9.5	90.8	5.2	4.05	4.7	2.59	0.1	19.0
		405	19.6	37.9	27.0	35.1	8.8	16.53	0.3	51.6
		415	0	36.2	36.1	27.7	8.15	14.6	0.9	53.0
		425	0	20.3	55.5	24.2	8.4	12.88	2.6	52.0
		450	27.4	63.1	22.9	14.0	8.4	5.70	0.1	30.7
		480	0	46.1	41.7	12.2	8.55	7.78	0.2	39.6
		495	26.6	66.5	22.6	10.9	8.4	4.7	0.2	14.1
		505	42.3	64.6	26.0	9.4	8.15	4.6	0.2	31.5

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-40-33	N40, 480	feet	%	%	%	%		%	%	meq./100 g
	P W33, 300	20	22.8	79.4	19.0	1.64	8.75	1.88	0.1	5.0
		50	Rocky	-	-	-	8.5	1.06	0.2	-
		80	4.5	84.9	14.1	1.04	9.3	1.25	0.1	2.0
		100	54.4	70.0	24.5	5.5	8.6	2.84	0.2	5.2
		115	25.3	44.4	34.8	20.8	8.2	12.18	0.1	26.1
		120	24.7	6.11	30.6	63.3	7.4	27.20	0.1	79.9
		130	8.1	2.27	65.9	31.8	-	17.9	0.1	54.4
		140	0	6.63	39.5	53.9	7.75	23.81	2.1	58.7
		150	0	34.6	23.15	42.3	7.4	16.68	0.4	32.1
		155	0	33.35	34.9	31.8	7.4	17.29	1.3	33.4
		160	0	29.05	34.3	36.7	7.5	19.29	0.8	46.8
		170	0	44.85	35.15	20.0	7.5	12.65	0.2	26.9
		185	0	40.4	25.7	33.9	8.0	18.66	0.5	32.6
		200	12.5				7.9	12.68	4.3	29.7
		210	32.2				7.75	4.72	1.4	12.5
		230	26.8				8.1	5.50	0.2	10.7
		250	39.2				6.65	25.24	0.3	43.8

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-40-33	N40, 480 P W33, 300	feet 275	% 23.0	%	%	%	7.95	% 2.91	% 0.1	meq./100 g 5.9

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Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-40-62	N40, 300	feet	%	%	%	%		%	%	meq./100 g
	P W61, 500	50	5	87.3	8.9	3.8	9.25	1.54	1.7	4.5
		150	3	81.8	13.7	4.5	8.3	1.63	1.5	5.4
		205	15	81.3	14.5	4.2	8.4	1.88	1.3	6.5
		250	1	79.1	16.8	4.1	9.1	1.73	0.6	4.7
		305	0	85.0	11.4	3.6	9.3	1.31	0.7	4.2
		325	39	72.4	22.4	5.2	8.7	2.02	0.6	5.0
		350	31	65.3	30.8	3.9	8.5	2.29	0.1	5.2
		360	46	77.1	19.7	3.2	8.8	1.44	0.1	4.5

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Well Designation	Coordinates	Depth of Sample	Mechanical Analysis				pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
			Greater than 2-mm diameter	Less than 2-mm diameter						
				Sand	Silt	Clay				
699-45-42	N45, 274	feet	%	%	%	%		%	%	meq./100 g
	W42, 099	175	40	49.1	38.7	12.2	8.35	14.91	0.3	38.6
		180	38	49.4	34.6	16.0	8.2	16.91	0.4	36.5

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-[illegible]-60	N47, 137 P W60, 286	feet	%	%	%	%		%	%	meq./100 g
		255	29.9	56.5	35.0	8.5	8.75	2.74	0.6	5.7
		265	18.3	61.6	31.6	6.8	8.6	2.38	0.5	5.4
		50	10.2				8.75	1.51	0.3	5.0
		70	26.2				8.7	2.31	0.4	6.0
		110	53.1				9.0	2.00	0.3	6.2
		170	33.9				8.8	3.11	0.6	8.5
		220	18.2				8.55	1.36	0.1	4.4
		250	43.9				8.8	N.S.	0.3	5.2
		280	25.6				8.6	2.49	0.4	6.8

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-5[illegible]42	N[illegible] [illegible] P	feet	%	%	%	%		%	%	meq./100 g
	W42. 43[illegible]	1[illegible]	0	69.[illegible]	1[illegible].9	1[illegible].1	8.85	10.44	0.1	29.9
		120	0	75.[illegible]	1[illegible]	10.5	8.45	6.88	0.1	15.2
		125	0	79.9	14.7	[illegible].4	8.65	4.61	0.1	10.4

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-55-50A	N54, 997	feet	%	%	%	%		%	%	meq./100 g
	W50, 042	40	28.0	75.9	16.9	7.2	8.45	3.62	0.7	11.1
		45	20.[illegible]	62.4	33.6	4.0	8.45	3.51	0.6	10.4
		55	38.6	72.3	24.3	3.4	8.55	2.34	0.6	11.6
		20	34.7				8.65	2.67	0.1	11.4
		75	54.6				8.7	2.05	0.1	9.0
		95	28.4				8.2	10.33	0.1	26.1
		100	16.6				8.15	17.05	0.3	36.6

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-55-50C		feet	%	%	%	%		%	%	meq./100 g
		45	44.3	94.1	4.4	1.5	8.25	1.91	0.4	9.2
		50	65.7	92.3	5.1	2.6	8.35	2.04	0.4	9.6
		60	47.9	94.8	5.2	0	8.75	2.30	0.5	10.0

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-55-89		feet	%	%	%	%		%	%	meq./100 g
		50	[illegible]				8.[illegible]	3.28	0.1	8.9
		80	[illegible]				8.6	4.29	0.2	13.3
		120	6.[illegible]				8.55	4.15	0.[illegible]	15.7
		160	21.8				8.[illegible]	4.52	0.5	16.8
		190	19.8				8.5	3.94	0.8	1[illegible].5
		225	40.[illegible]				8.35	4.77	--	16.8
		235	39.7				8.[illegible]	3.33	0.8	12.8

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699 60-60	N60, 030	feet	%	%	%	%		%	%	meq./100 g
	E W59, 964	25	43.8	61.7	34.0	4.3	7.6	3.28	0.2	11.3
		30	60.1	83.1	14.0	13.8	7.5	2.23	0.2	9.5
		40	10.9	92.6	6.9	0.5	8.1	1.64	0.3	7.3
		55	67.7	75.4	21.4	3.2	7.7	2.46	0.3	9.9
		65	2.4	89.2	9.3	1.5	8.3	2.27	0.1	[illegible].3
		80	1.8	90.6	8.8	0.6	8.5	1.78	0.1	7.7
		105	39.9	48.5	38.9	12.6	7.9	8.24	9.3	22.8
		120	59.6	75.1	21.7	3.3	7.9	2.14	0.2	[illegible]

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Less than 2-mm diameter: Sand	Silt	Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-63-90		feet	%	%	%	%		%	%	meq./100 g
		3[illegible]	0				8.05	1.73	0.2	5.1
		65	0				8.6	7.16	0.1	4.8
		120	0				8.05	2.45	0.1	7.1
		140	31.0				8.35	5.24	0.2	13.3
		175	21.7				8.35	4.07	0.1	10.3
		205	11.7				8.4	4.47	0.1	10.4
		215	7.8				8.4	4.87	0.2	14.1
		235	27.5				8.35	6.89	0.3	17.4
		250	2.9				8.3	4.85	0.1	17.4

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Mechanical Analysis: Less than 2-mm diameter: Silt	Mechanical Analysis: Less than 2-mm diameter: Clay	pH	15-Atmosphere Moisture	$CaCO_3$	Cation Exchange Capacity
699-65-50	N64,699 P W50,146	feet	%	%	%	%		%	%	meq./100 g
		40	0				8.65	2.18	0.7	7.1
		110	19	10.3	46.8	42.9	7.9	19.58	0.6	- -
		140	0				8.2	18.06	0.1	32.6
		165	0				8.15	15.15	1.2	32.0
		170	0				8.4	16.58	0.2	38.4
		180	0				7.9	--	0.2	40.5
		200	0				8.2	23.86	1.0	26.2
		240	8.9				8.1	10.21	1.6	18.0
		280	0				8.05	9.42	3.1	18.5
		305	17.6				8.0	13.55	0.7	25.5
		330	12	23.5	73.3	3.2	7.9	25.86	0.6	- -
		360	0				8.15	14.78	3.6	24.7
		430	0				8.05	8.00	0.1	18.4
		475	0				8.3	9.28	0.2	15.7
		510	0				6.05	25.97	0.6	38.6
		550	51.8				7.85	27.87	11.2	39.9
		575	18	19.4	78.5	2.1	8.0	9.43	13.8	--

APPENDIX B

Designation	Source	Depth of Sample	Mechanical Analysis: Greater than 2-mm diameter	Mechanical Analysis: Less than 2-mm diameter: Sand	Silt	Clay	pH	15-Atmosphere moisture	$CaCO_3$	Cation Exchange Capacity
		feet	%	%	%	%		%	%	meq/100 g.
234-5 -No. 1	Gravel Pit		0	87.49	11.35	1.15	8.4	3.25	1.5	7.84
Soil "X"	Composite		0	84.56	11.94	3.51	8.3	1.87	1.4	5.77
Rattlesnake 1	Surface	0-6"	0	34.13	59.67	6.21	8.0	6.16	1.6	22.64
Rattlesnake 2	" "	0-6"	0	32.35	58.19	9.47	7.5	7.03	0.2	21.56
Rattlesnake 3	" "	0-6"	0	29.21	58.80	12.00	7.7	7.95	0.2	25.60
Rattlesnake 4	" "	0-6"	0	37.29	53.91	8.81	7.1	6.57	0.1	23.98
Winchester sand	Surface		0	93.53	3.02	3.45	7.8	2.36	1.5	7.00
Ephrata sand	" "		0	76.17	20.90	2.93	7.1	3.27	0.1	6.73
Quincy sand	" "		0	91.48	6.72	1.80	7.4	3.40	0.1	6.47
Ritzville sandy loam	" "		0	68.96	28.34	2.70	7.1	5.41	0.1	9.54
Warden sandy loam	" "		0	78.13	18.87	3.00	7.3	5.51	0.1	10.30
Wheeler loam	" "		0	83.65	13.15	3.20	7.1	3.32	0.1	9.54
Ringold conglom.	" "		0	18.58	38.98	42.44	7.2	7.59	1.1	50.94
Ephrata fine sandy loam	" "		0	30.99	64.76	4.25	7.2	2.58	0.1	18.86
Sagemoor sandy loam	" "		0	71.48	22.46	6.06	7.8	4.28	0.2	15.09
234-5 - No. 2	Gravel Pit		0	92.30	6.33	1.37	8.6	1.34	1.0	4.63
299-E27-2	Composite		0	94.51	4.44	1.05	8.5	1.53	0.6	4.62

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