United States Department of Agriculture | **Natural Resources Conservation Service** | **5 Radnor Corporate Center, Suite 200 Radnor, PA 19087-4585**

Subject: SOI -- Geophysical Assistance -- **Date:** 3 October 1996

To: M. Darrel Dominick
State Conservationist
USDA-NRCS,
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PURPOSE:
The purpose of this investigation was to use and ground-penetrating radar (GPR) and electromagnetic induction (EM) techniques to determine the depths to bedrock. Data will be used to document the composition of soil map units.

PARTICIPANTS:
Jim Doolittle, Research Soil Scientist, USDA-NRCS, Radnor, PA
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ACTIVITIES:
All field activities were completed during the period of 17 to 26 September 1996.

EQUIPMENT:
The radar unit used in this study was the Subsurface Interface Radar (SIR) System-2, manufactured by Geophysical Survey Systems, Inc.[1] The SIR System-2 consists of a digital control unit (DC-2) with keypad, VGA video screen, and connector panel. A model 3110 (120 mHz) antenna was used in this investigation. The system was powered by a 12-volt vehicular battery. A scanning time of 120 nanoseconds and a scanning rate of 32 scans/sec were used.

FIELD PROCEDURES:
Radar surveys were completed by pulling the 120 mHz antenna along selected logging roads in Hancock, Washington, Piscataquis, and Aroostook counties. Selection was based upon the soil delineations that the roads crossed, and the condition and accessibility of the roads. Each road needed to be driveable (with 4WD) and had to have minimal disturbances (cut-and-fill operations).

Although, GPR provides a continuous profile of subsurface conditions, interpretations were restricted to observation points. These observation points were spaced at uniform time intervals (15 sec). At each observation point, the radar operator impressed a dashed, vertical line on the radar profile. This line

[1] Trade names have been used in this report to provide specific information. Their use does not constitute endorsement.

identified an observation point on the radar record. The distance between each observation point was dependent on vehicle speed. This distance was variable and depended on the condition of the road.

Each radar traverse was stored as a separate file on a hard disc. Later, the radar file was reviewed and the bedrock surface was identified. At each observation point, the depth to bedrock was determined.

DISCUSSION:

Ground-penetrating radar is a time scaled system. This system measures the time that it takes electromagnetic energy to travel from the antenna to an interface (e.g., soil horizon, stratigraphic layer, bedrock surface) and back. To convert the travel time into a depth scale, either the velocity of pulse propagation or the depth to a reflector must be known. The relationships among depth (d), two-way, pulse travel time (t), and velocity of propagation (v) are described in the following equation (Morey, 1974):

$$v = 2d/t$$

The velocity of propagation is principally affected by the dielectric constant (e) of the profiled material(s) according to the equation:

$$e = (c/v)^2$$

Where c is the velocity of propagation in a vacuum (1 ft/nanosecond). Velocity is expressed in feet per nanosecond (ns). A nanosecond is one billionth of a second. The amount and physical state of water (temperature dependent) have the greatest effect on the dielectric constant of a material.

The radar was calibration during field work conducted in Hancock County. During calibration, the dielectric constant and velocity of propagation were determined. These values were used to establish a depth scale for the radar imagery.

Two, buried, metallic drainage pipes were used to determine the dielectric constant and velocity of propagation. This information was used to scale (depth) the radar imagery and to estimate the depths to bedrock. Each pipe was buried at a depth of 27.6 inches. Based on the round-trip travel time to the buried reflector, the averaged velocity of propagation was estimated to be 0.2067 ft/ns. The dielectric constant was estimated to be 23.3. Based on an average velocity of propagation of 0.2067 ft/ns, a scanning time of 120 ns provided a maximum observation depth of about 9.1 feet. In areas where the depth to bedrock exceeded the maximum depth of observation, it was expressed as being “>110 inches.” In some areas (often those areas with fine-loamy materials or wet basal till) the depth of observation was more restricted. In these areas, the depth to bedrock was expressed as being “>60 inches.” In Piscataquis County, high rates of signal attenuation limited observation depths to less than 40 inches. Because of severely restricted observation depths, the four radar traverses from Piscataquis County were not interpreted nor included in this report.

A basic assumption of this survey was that soil materials were rather uniform and that large differences in the velocity of propagation did not exist among the sites. Unquestionably, slight discrepancies exist in the depth measurements. While the actual measurements are considered close approximations, the grouping of observation points into relative soil depth classes (shallow, moderately deep, deep, and very deep) is more accurate and is preferred. Therefore, the grouping of the measurements included in this report into soil depth classes is recommended.

RESULTS:

Hancock County:

Ground-penetrating radar was used as a reconnaissance tool to assess bedrock depths within Great Pond Township. In areas traversed with GPR, the soils had not been mapped. Nearly eleven miles of radar traverses were conducted in Hancock County (see Table 1). These data will assist soil scientists assess the depths to bedrock and determine the most appropriate mapping units.

Table 1

Summary of GPR Traverses
Hancock County, Maine

File #	Length of Traverse	Observation Points
1	0.5 mi.	26
2	1.1	54
3	2.2	95
4	3.3	132
5	2.1	115
6	1.7	56
Total	**10.9 mi.**	**478**

Record of Radar files:

File 1

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	76	14	68
2	49	15	56
3	77	16	71
4	58	17	>110
5	41	18	62
6	36	19	53
7	30	20	58
8	64	21	57
9	89	22	76
10	>110	23	64
11	>110	24	>110
12	>110	25	68
13	>110	26	82

File 2

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>110	28	90
2	>110	29	>110
3	>60	30	>110
4	83	31	>110
5	61	32	>110
6	76	33	79
7	65	34	58
8	74	35	98
9	>110	36	82
10	>110	37	79
11	>110	38	80
12	68	39	43
13	>110	40	73
14	>110	41	68
15	44	42	87
16	>110	43	49
17	70	44	61
18	64	45	41
19	80	46	54
20	>110	47	50
21	>110	48	46
22	52	49	80
23	63	50	60
24	62	51	52
25	>110	52	44
26	>110	53	>110
27	56	54	51

File 3

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	89	48	81
2	>110	49	72
3	88	50	64
4	92	51	73
5	>110	52	52
6	>110	53	58
7	>110	54	>60
8	>110	55	58
9	>110	56	70
10	>110	57	62
11	>110	58	43
12	>110	59	67
13	>110	60	28
14	>110	61	46
15	>110	62	76
16	>110	63	43
17	>110	64	45
18	>110	65	31
19	>110	66	46
20	>110	67	78
21	>110	68	79
22	93	69	34
23	72	70	68
24	90	71	28
25	>110	72	35
26	>110	73	57
27	>110	74	47
28	76	75	56
29	73	76	44
30	74	77	47
31	71	78	24
32	>60	79	39
33	>110	80	25
34	>110	81	43
35	>110	82	40
36	82	83	58
37	64	84	39
38	57	85	63
39	60	86	>110
40	40	87	61
41	65	88	>60
42	>60	89	49
43	70	90	57
44	42	91	50
45	82	92	>110
46	51	93	107
47	80	94	50

File 4

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	89	69	46
2	>110	70	50
3	88	71	80
4	92	72	>60
5	>110	73	64
6	>110	74	76
7	>110	75	66
8	>110	76	62
9	>110	77	36
10	>110	78	46
11	>110	79	73
12	>110	80	81
13	>110	81	>60
14	>110	82	>60
15	>110	83	52
16	>110	84	>60
17	>110	85	>60
18	>110	86	49
19	>110	87	58
20	>110	88	46
21	>110	89	57
22	93	90	>60
23	72	91	43
24	90	92	40
25	>110	93	53
26	>110	94	>60
27	>110	95	59
28	76	96	44
29	73	97	>60
30	74	98	>60
31	71	99	>60
32	87	100	>60
33	56	101	>60
34	82	102	69
35	59	103	>60
36	>60	104	36
37	49	105	>60
38	>60	106	>60
39	38	107	>60
40	43	108	>60
41	70	109	>60
42	41	110	>60
43	49	111	>60
44	54	112	>60
45	>60	113	>60
46	78	114	>60

File 4 (continued)

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
47	>60	115	>60
48	65	116	>60
49	34	117	>60
50	29	118	>60
51	59	119	>60
52	60	120	>60
53	>60	121	>60
54	>60	122	>60
55	66	123	>60
56	66	124	>60
57	51	125	>60
58	52	126	>60
59	34	127	>60
60	45	128	>60
61	58	129	>60
62	>60	130	>60
63	57	131	>60
64	>60	132	>60
65	>60	133	>60
66	>60	134	>60
67	37	135	>60
68	57		

File 5

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	29	53	77
2	48	54	40
3	49	55	>60
4	>60	56	53
5	>60	57	73
6	39	58	73
7	>60	59	68
8	>60	60	42
9	>60	61	52
10	>60	62	33
11	44	63	36
12	46	64	45
13	44	65	50
14	>60	66	35
15	48	67	42
16	>60	68	39

File 5 (continued)

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
17	52	69	85
18	>60	70	68
19	>60	71	>60
20	41	72	48
21	46	73	49
22	40	74	40
23	45	75	44
24	>60	76	41
25	40	77	57
26	42	78	51
27	37	79	27
28	50	80	>60
29	54	81	>60
30	>60	82	62
31	49	83	20
32	58	84	58
33	54	85	46
34	74	86	>60
35	54	87	>60
36	47	88	>60
37	59	89	57
38	>110	90	47
39	84	91	51
40	37	92	>60
41	61	93	>60
42	34	94	>60
43	34	95	51
44	52	96	64
45	36	97	46
46	58	98	47
47	48	99	44
48	32	100	>60
49	32	101	>60
50	30	102	>60
51	22	103	>60
52	32		

File 6

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>60	30	47
2	>60	31	70
3	>60	32	>60
4	>60	33	60
5	>60	34	>60
6	>60	35	60
7	>60	36	>60
8	>60	37	>60
9	>60	38	>60
10	>60	39	>60
11	>60	40	50
12	>60	41	58
13	>60	42	64
14	>60	43	73
15	>60	44	56
16	>60	45	65
17	>60	46	60
18	>110	47	48
19	70	48	49
20	52	49	41
21	57	50	62
22	74	51	>60
23	43	52	56
24	47	53	70
25	>60	54	58
26	62	55	51
27	>60	56	53
28	>60	57	>60
29	58		

Washington County:

Ground-penetrating radar was used as a quality-control tool in Washington County. About twenty miles of continuous radar records were obtained along access roads in areas that had been mapped (see Table 2). The depth to bedrock was interpreted at evenly spaced observation points along each transect. These provide 1091 observations of the depth to bedrock in 38 different soil delineations. The purpose of this investigation was to assess the depth to bedrock and to determine the taxonomic composition and the most appropriate name for soil map units.

Table 2

Summary of GPR Traverses
Washington County, Maine

File #	Length of Traverse	Observation Points	Mapping Unit
7	0.20 mi.	15	48C
8	0.60	36	
9	1.00	67	
10	0.35	18	48C
11	0.50	27	94XC
12	0.55	33	34C
13	0.55	35	53C
14	0.65	34	74B
15	0.65	35	34C
16	0.65	33	34C
17	0.50	25	34C
18	0.50	25	54C
19	0.45	23	53C
20	0.30	17	301C
21	1.10	51	301C
22	0.90	38	74B
23	0.60	26	78B
24	1.00	40	34C
25	1.00	51	301C
27	0.17	18	94F
28	0.50	29	94C
29	0.60	28	78B
30	0.30	19	74B
31	0.50	25	78B
32	0.70	36	76B
33	0.10	13	89C
34	0.20	15	89C
35	0.50	30	34C
36	0.35	23	89C
37	0.50	19	302C
38	0.30	13	76C
39A	0.30	13	74B
39B	0.70	28	31XC
40	0.50	24	34C
41	0.10	09	89C
42	1.20	52	34C
43	0.50	29	89C
44	0.70	39	34C
Total	**19.77 mi.**	**1091**	

Record of Radar files:

File 7

DIXFIELD-COLONEL-TUNBRIDGE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	34	9	23
2	41	10	34
3	24	11	28
4	27	12	34
5	64	13	53
6	>60	14	52
7	42	15	37
8	22		

File 8

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	35	19	79
2	33	20	50
3	41	21	59
4	37	22	61
5	23	23	75
6	20	24	58
7	23	25	59
8	49	26	49
9	35	27	46
10	48	28	38
11	45	29	52
12	29	30	46
13	35	31	43
14	29	32	51
15	36	33	69
16	21	34	89
17	32	35	63
18	23	36	41

File 9

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	45	35	>110
2	58	36	>110
3	33	37	>110
4	29	38	68
5	53	39	61
6	60	40	>110
7	50	41	65
8	>60	42	38
9	80	43	29
10	>110	44	24
11	66	45	21
12	44	46	>110
13	45	47	79
14	57	48	53
15	59	49	43
16	52	50	57
17	64	51	>110
18	60	52	>110
19	58	53	>110
20	56	54	>110
21	49	55	63
22	50	56	>60
23	52	57	66
24	51	58	60
25	54	59	>60
26	48	60	>110
27	50	61	79
28	51	62	39
29	72	63	20
30	57	64	26
31	>110	65	34
32	>110	66	45
33	>110	67	73
34	>110		

File 10

DIXFIELD-COLONEL-TUNBRIDGE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	53	10	25
2	36	11	35
3	33	12	26
4	46	13	31
5	71	14	37
6	46	15	41
7	26	16	46
8	41	17	56
9	29	18	83

File 11

LYMAN-TUNBRIDGE COMPLEX, 4-25 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	41	15	38
2	40	16	53
3	56	17	21
4	49	18	24
5	58	19	33
6	36	20	33
7	51	21	34
8	41	22	34
9	29	23	29
10	21	24	29
11	20	25	32
12	33	26	30
13	39	27	40
14	35		

File 12

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	71	18	41
2	34	19	65
3	52	20	58
4	48	21	43
5	66	22	40
6	47	23	39
7	48	24	40
8	>60	25	48
9	>110	26	40
10	>110	27	32
11	>110	28	31
12	>110	29	>60
13	>110	30	41
14	79	31	36
15	>110	32	51
16	>60	33	62
17	63		

File 13

DIXFIELD-COLONEL-MARLOW ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>110	19	>110
2	>110	20	53
3	>110	21	>60
4	>110	22	53
5	56	23	>110
6	44	24	>110
7	57	25	>110
8	83	26	>110
9	70	27	>110
10	>110	28	>60
11	>110	29	52
12	>110	30	58
13	>110	31	52
14	>110	32	54
15	>110	33	70
16	>110	34	54
17	>110	35	44
18	>110		

File 14

TELOS-MONARDA-MONSON ASSOCIATION, 1-12 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	77	18	40
2	64	19	25
3	49	20	47
4	47	21	0
5	40	22	25
6	48	23	56
7	42	24	70
8	34	25	21
9	33	26	0
10	42	27	>60
11	73	28	50
12	54	29	47
13	44	30	>60
14	34	31	50
15	51	32	47
16	53	33	75
17	33		

File 15

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	99	19	45
2	53	20	33
3	82	21	32
4	87	22	33
5	49	23	34
6	49	24	32
7	68	25	36
8	63	26	32
9	>110	27	43
10	74	28	78
11	56	29	75
12	47	30	33
13	36	31	44
14	30	32	37
15	23	33	36
16	26	34	32
17	22	35	51
18	29		

File 16

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	41	18	56
2	54	19	41
3	39	20	46
4	61	21	44
5	32	22	48
6	39	23	60
7	33	24	56
8	22	25	58
9	23	26	53
10	41	27	62
11	48	28	60
12	41	29	69
13	28	30	58
14	33	31	52
15	52	32	>60
16	63	33	47
17	71		

File 17

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	29	14	51
2	47	15	57
3	37	16	61
4	30	17	43
5	41	18	36
6	36	19	65
7	35	20	60
8	40	21	39
9	48	22	35
10	43	23	37
11	32	24	24
12	52	25	28
13	43		

File 18

COLONEL-DIXFIELD-BRAYTON ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>60	14	53
2	84	15	56
3	62	16	49
4	46	17	78
5	61	18	64
6	>110	19	68
7	>110	20	58
8	>110	21	56
9	>110	22	66
10	>110	23	56
11	>110	24	44
12	66	25	53
13	56		

File 19

DIXFIELD-COLONEL-MARLOW ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	87	13	92
2	81	14	70
3	>110	15	77
4	91	16	57
5	54	17	62
6	46	18	61
7	36	19	63
8	33	20	76
9	64	21	51
10	90	22	49
11	>110	23	28
12	91		

File 20

HERMON-SKERRY ASSOCIATION, 12-30 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	33	10	37
2	51	11	48
3	52	12	52
4	39	13	66
5	53	14	60
6	62	15	48
7	45	16	47
8	69	17	57
9	43		

File 21

HERMON-SKERRY ASSOCIATION, 12-30 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	38	27	68
2	>60	28	46
3	94	29	50
4	76	30	46
5	60	31	56
6	>60	32	64
7	48	33	61
8	41	34	67
9	67	35	74
10	>60	36	62
11	46	37	46
12	46	38	34
13	75	39	31
14	56	40	32
15	66	41	24
16	58	42	56
17	64	43	48
18	39	44	87
19	57	45	47
20	57	46	28
21	44	47	60
22	60	48	65
23	56	49	58
24	56	50	37
25	54	51	52
26	38		

File 22

TELOS-MONARDA-MONSON ASSOCIATION, 1-12 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	47	20	28
2	52	21	49
3	33	22	>110
4	44	23	50
5	42	24	53
6	35	25	30
7	>60	26	81
8	>110	27	36
9	82	28	28
10	72	29	36
11	80	30	39
12	44	31	36
13	>60	32	>60
14	42	33	28
15	57	34	35
16	42	35	50
17	41	36	25
18	50	37	39
19	85	38	63

File 23

TELOS-MONARDA ASSOCIATION, 1-8 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	99	14	50
2	79	15	40
3	47	16	64
4	61	17	40
5	67	18	29
6	48	19	37
7	87	20	50
8	43	21	44
9	79	22	41
10	46	23	43
11	56	24	>60
12	49	25	50
13	66	26	56

File 24

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	71	21	35
2	67	22	28
3	76	23	29
4	>110	24	>110
5	81	25	>110
6	100	26	>110
7	98	27	>110
8	101	28	>110
9	87	29	>110
10	41	30	51
11	62	31	50
12	82	32	53
13	58	33	66
14	48	34	65
15	38	35	51
16	57	36	41
17	49	37	70
18	41	38	>60
19	65	39	44
20	65	40	47

File 25

HERMON-SKERRY ASSOCIATION, 12-30 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>60	27	74
2	67	28	69
3	61	29	86
4	>110	30	95
5	>110	31	82
6	>110	32	68
7	>110	33	76
8	>110	34	68
9	>110	35	85
10	>110	36	80
11	53	37	71
12	29	38	59
13	39	39	66
14	56	40	68
15	57	41	42
16	67	42	>110
17	63	43	>110
18	>60	44	>110
19	62	45	54
20	50	46	>110
21	79	47	61
22	44	48	>60
23	75	49	>110
24	82	50	>110
25	66	51	>110
26	53		

File 27

MONSON-ELLIOTTSVILLE-RICKER ASSOCIATION, 20-65 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	32	10	43
2	37	11	33
3	37	12	34
4	53	13	54
5	26	14	43
6	37	15	42
7	24	16	35
8	43	17	40
9	40	18	29

File 28

MONSON-ELLIOTTSVILLE-RICKER ASSOCIATION, 4-25 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	29	16	33
2	56	17	27
3	29	18	29
4	34	19	52
5	44	20	31
6	42	21	33
7	33	22	36
8	29	23	32
9	47	24	42
10	36	25	51
11	49	26	50
12	29	27	>110
13	34	28	>60
14	59	29	57
15	52		

File 29

TELOS-MONARDA ASSOCIATION, 1-8 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>60	15	70
2	86	16	61
3	50	17	65
4	48	18	66
5	52	19	53
6	60	20	48
7	53	21	50
8	57	22	>60
9	54	23	50
10	68	24	51
11	71	25	50
12	89	26	51
13	>60	27	>60
14	59	28	65

File 30

TELOS-MONARDA-MONSON ASSOCIATION, 1-12 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	89	11	33
2	>60	12	29
3	60	13	35
4	57	14	21
5	34	15	33
6	77	16	31
7	50	17	43
8	34	18	22
9	68	19	48
10	25		

File 31

TELOS-MONARDA ASSOCIATION, 1-8 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>60	14	71
2	39	15	68
3	42	16	52
4	49	17	69
5	73	18	76
6	51	19	74
7	86	20	53
8	76	21	>60
9	61	22	47
10	61	23	57
11	61	24	48
12	79	25	50
13	70		

File 32

TELOS-CHESUNCOOK-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>60	19	62
2	60	20	57
3	50	21	52
4	45	22	76
5	57	23	48
6	54	24	42
7	70	25	78
8	57	26	>110
9	70	27	>110
10	59	28	33
11	60	29	29
12	56	30	37
13	59	31	48
14	45	32	26
15	64	33	62
16	67	34	59
17	74	35	61
18	62	36	84

File 33

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	49	8	24
2	61	9	31
3	>110	10	43
4	>110	11	21
5	45	12	23
6	25	13	36
7	24		

File 34

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	53	9	41
2	41	10	38
3	24	11	42
4	68	12	41
5	49	13	32
6	28	14	36
7	41	15	50
8	40		

File 35

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	49	16	>110
2	37	17	>110
3	44	18	84
4	44	19	34
5	43	20	60
6	36	21	57
7	33	22	41
8	32	23	53
9	43	24	42
10	45	25	40
11	58	26	53
12	90	27	41
13	>110	28	46
14	>110	29	51
15	>110	30	71

File 36

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	42	13	42
2	47	14	39
3	37	15	26
4	42	16	33
5	44	17	0
6	21	18	28
7	42	19	39
8	48	20	37
9	56	21	47
10	56	22	39
11	>60	23	36
12	43	24	33

File 37

HERMAN-TUNBRIDGE-SKERRY ASSOCIATION, 5-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	68	11	81
2	62	12	89
3	74	13	64
4	85	14	61
5	83	15	41
6	>110	16	>110
7	69	17	>110
8	73	18	>110
9	59	19	59
10	63		

File 38

TELOS-CHESUNCOOK-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>110	8	>60
2	>60	9	>60
3	>60	10	>60
4	>60	11	>60
5	>60	12	>60
6	>60	13	>60
7	>60	14	>60

File 39A

TELOS-MONARDA-MONSON ASSOCIATION, 1-12 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	>60	8	71
2	>60	9	61
3	81	10	79
4	>60	11	46
5	>60	12	33
6	>60	13	84
7	80		

FILE 39B

DANFORTH-MASARDIS-PEACHAN ASSOCIATION, 1-16 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	33	15	43
2	61	16	57
3	88	17	48
4	74	18	64
5	25	19	>60
6	37	20	76
7	88	21	65
8	88	22	57
9	>60	23	40
10	35	24	43
11	50	25	52
12	46	26	87
13	44	27	27
14	77	28	34

File 40

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	43	13	46
2	33	14	57
3	54	15	>60
4	57	16	61
5	29	17	70
6	30	18	68
7	37	19	67
8	60	20	64
9	65	21	64
10	46	22	61
11	51	23	61
12	62	24	64

File 41

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	44	6	36
2	51	7	26
3	30	8	22
4	27	9	32
5	52		

File 42

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	44	27	59
2	46	28	74
3	54	29	84
4	49	30	90
5	33	31	>110
6	45	32	>110
7	62	33	>110
8	57	34	>110
9	>60	35	>110
10	>60	36	>110
11	50	37	>110
12	25	38	>110
13	43	39	>110
14	56	40	>110
15	49	41	44
16	58	42	62
17	75	43	79
18	84	44	69
19	41	45	57
20	46	46	91
21	44	47	99
22	51	48	64
23	39	49	89
24	49	50	53
25	41	51	52
26	>60	52	68

File 43

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	52	16	44
2	28	17	37
3	30	18	0
4	32	19	22
5	20	20	39
6	20	21	29
7	30	22	43
8	39	23	24
9	24	24	34
10	41	25	32
11	33	26	52
12	36	27	24
13	25	28	26
14	24	29	37
15	26	30	40

File 44

DANFORTH-SHIRLEY-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Obs.	Depth	Obs.	Depth
1	30	21	25
2	70	22	41
3	48	23	26
4	40	24	36
5	42	25	47
6	28	26	69
7	33	27	51
8	34	28	>60
9	42	29	54
10	31	30	69
11	25	31	53
12	25	32	64
13	25	33	58
14	44	34	30
15	25	35	37
16	21	36	46
17	30	37	72
18	32	38	56
19	26	39	53
20	25		

Aroostook County:

Ground-penetrating radar was used as a quality-control tool in Aroostook County. About nine miles of continuous radar records were obtained along access roads in areas that had been mapped (see Table

2). The depth to bedrock was interpreted at evenly spaced observation points along each transect. These provide 439 observations of the depth to bedrock in 18 different soil delineations. The purpose of this investigation was to assess the depth to bedrock and to determine the taxonomic composition and the most appropriate name for soil map units.

Table 3

Summary of GPR Traverses
Aroostook County, Maine

File #	Length of Traverse	Observation Points	Mapping Unit
51	0.7 mi.	49	89C
52	0.2	11	89C
53	0.3	19	89C
54	0.7	36	77C
55	0.1	9	77C
56	0.6	29	76C
57	0.6	26	74B
58	0.4	19	74B
59	0.3	17	89C
60	1.3	41	89C
61	0.4	16	32XC
62	0.6	31	32XC
63	0.6	32	374B
64	0.4	24	78B
65	0.3	19	76C
66	0.8	23	74B
67	0.3	16	374B
68	0.4	22	376C
Total	**9.0 mi.**	**439**	

In areas of highly weathered slate (map unit 389C), it was exceedingly difficult to trace the bedrock surface. In these areas, interpretations were uncertain. As a consequence, these transects (3 transects) were not included in this report. In areas of dense till or fine-loamy materials, the depth of observation was restricted. In these areas, if the bedrock was not detected within the upper 60 inches, the annotation “>60 inches” was used.

Record of Radar files:

File 51

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	47.9	26	20.5
2	68.0	27	29.0
3	40.3	28	42.7
4	52.4	29	38.7
5	47.9	30	32.1
6	45.1	31	24.1
7	27.6	32	28.6
8	33.5	33	31.1
9	64.7	34	29.9
10	40.8	35	30.5
11	53.8	36	32.6
12	38.6	37	52.4
13	38.7	38	47.2
14	48.6	39	50.3
15	24.5	40	57.1
16	33.5	41	56.4
17	47.6	42	52.8
18	29.0	43	54.7
19	24.3	44	54.7
20	43.4	45	54.7
21	41.3	46	54.7
22	25.4	47	>60
23	29.5	48	>60
24	26.2	49	>60
25	31.8		

File 52

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	>60	7	27.1
2	>60	8	37.8
3	43.9	9	>60
4	42.7	10	51.9
5	36.1	11	52.6
6	44.8		

File 53

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	52.4	11	0
2	62.5	12	29.0
3	>60	13	24.1
4	>60	14	28.1
5	>60	15	36.1
6	>60	16	51.6
7	52.8	17	54.0
8	62.8	18	62.8
9	50.0	19	62.8
10	29.7		

File 54

TELOS-CHESUNCOOK ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	66.1	19	63.5
2	50.7	20	82.8
3	53.1	21	73.4
4	41.8	22	32.1
5	36.3	23	41.3
6	41.8	24	50.3
7	54.6	25	43.6
8	59.9	26	33.3
9	49.8	27	29.0
10	49.1	28	>60
11	87.3	29	>60
12	73.6	30	64.9
13	52.2	31	57.1
14	45.3	32	>60
15	45.5	33	55.2
16	44.6	34	>60
17	55.5	35	>60
18	27.6	36	>60

File 55

TELOS-CHESUNCOOK ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	49.8	6	63.2
2	58.3	7	24.5
3	49.5	8	29.0
4	42.7	9	24.5
5	59.5		

File 56

TELOS-CHESUNCOOK-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	>60	16	59.9
2	61.6	17	33.0
3	45.1	18	29.5
4	44.3	19	9.1
5	52.2	20	28.6
6	45.5	21	28.8
7	49.1	22	39.1
8	20.3	23	47.6
9	38.7	24	46.7
10	29.7	25	38.7
11	44.8	26	28.3
12	32.8	27	34.9
13	49.8	28	>60
14	42.0	29	>60
15	49.4		

File 57

TELOS-MONARDA-MONSON ASSOCIATION, 1-12 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	>60	16	>60
2	>60	17	>60
3	28.8	18	57.3
4	41.3	19	68.2
5	62.3	20	26.9
6	59.2	21	>60
7	58.3	22	73.6
8	32.8	23	45.8
9	28.1	24	52.8
10	26.9	25	30.5
11	29.9	26	47.2
12	39.1	27	>60
13	37.8	28	37.5
14	>60	29	>60
15	>60		

File 58

TELOS-MONARDA-MONSON ASSOCIATION, 1-12 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	62.8	11	51.5
2	52.4	12	22.0
3	48.2	13	33.0
4	58.0	14	35.4
5	52.2	15	>60
6	>60	16	>60
7	>60	17	>60
8	>60	18	>60
9	63.5	19	29.0
10	61.1		

File 59

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	41.4	11	29.7
2	34.9	12	20.8
3	44.6	13	53.1
4	37.3	14	28.8
5	49.5	15	59.0
6	36.7	16	25.3
7	>60	17	38.7
8	44.2	18	58.5
9	48.8	19	46.0
10	25.0		

File 60

ELLIOTTSVILLE-MONSON COMPLEX, 5-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	41.3	22	33.3
2	29.7	23	41.8
3	42.2	24	51.2
4	37.5	25	63.7
5	35.4	26	>60
6	33.8	27	58.3
7	29.0	28	30.9
8	49.1	29	20.3
9	43.9	30	20.3
10	32.3	31	29.3
11	31.4	32	25.9
12	24.8	33	22.4
13	50.0	34	51.0
14	>60	35	0.0
15	45.5	36	43.9
16	30.7	37	64.9
17	29.1	38	46.4
18	47.0	39	25.5
19	36.6	40	21.3
20	40.8	41	39.9
21	28.3	42	57.8

File 61

MASARDIS-DANFORTH ASSOCIATION, SLOPING

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	>60	9	>60
2	69.6	10	>60
3	78.8	11	>60
4	69.9	12	>60
5	>60	13	>60
6	>60	14	>60
7	>60	15	>60
8	>60	16	>60

File 62

MASARDIS-DANFORTH ASSOCIATION, SLOPING

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	>60	17	>60
2	>60	18	>60
3	24.3	19	>60
4	34.2	20	>60
5	69.3	21	>60
6	69.4	22	>60
7	>60	23	>60
8	>60	24	>60
9	>60	25	>60
10	>60	26	>60
11	>60	27	>60
12	>60	28	>60
13	>60	29	>60
14	>60	30	>60
15	>60	31	49.8
16	>60		

FILE 63

DAIGLE-AURELIE-ELLIOTTSVILLE ASSOCIATION, 0-8 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	>60	17	45.4
2	>60	18	>60
3	>60	19	>60
4	>60	20	>60
5	>60	21	>60
6	>60	22	>60
7	>60	23	>60
8	>60	24	>60
9	68.2	25	>60
10	>60	26	>60
11	>60	27	>60
12	>60	28	23.1
13	>60	29	19.6
14	>60	30	38.0
15	>60	31	33.8
16	>60	32	>60

File 64

TELOS-MONARDA ASSOCIATION, 1-8 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	62.5	13	36.8
2	>60	14	>60
3	>60	15	46.3
4	>60	16	>60
5	>60	17	71.5
6	52.8	18	>60
7	>60	19	>60
8	60.1	20	>60
9	49.4	21	>60
10	48.6	22	>60
11	38.2	23	29.7
12	53.6	24	50.3

File 65

TELOS-CHESUNCOOK-ELLIOTTSVILLE ASSOCIATION, 3-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	58.3	11	>60
2	>60	12	>60
3	>60	13	>60
4	>60	14	27.4
5	49.4	15	15.6
6	35.4	16	>60
7	51.5	17	29.4
8	50.0	18	48.6
9	63.0	19	>60
10	50.0		

File 66

TELOS-MONARDA-MONSON ASSOCIATION, 1-12 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	28.4	13	35.4
2	>60	14	>60
3	>60	15	>60
4	>60	16	44.2
5	>60	17	40.1
6	42.2	18	>60
7	50.0	19	>60
8	>60	20	>60
9	>60	21	>60
10	53.3	22	37.8
11	51.6	23	23.8
12	46.3		

File 67

DAIGLE-AURELIE-ELLIOTTSVILLE ASSOCIATION, 0-8 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	50.0	9	55.7
2	49.1	10	23.4
3	>60	11	48.6
4	>60	12	38.0
5	53.3	13	50.3
6	46.4	14	>60
7	31.8	15	41.5
8	>60	16	>60

File 68

DAIGLE-ELLIOTTSVILLE-PERHAM ASSOCIATION, 2-15 PERCENT SLOPES

(All depths are in inches.)

Observation	Depth	Observation	Depth
1	52.6	12	>60
2	60.4	13	>60
3	33.3	14	>60
4	>60	15	>60
5	>60	16	>60
6	>60	17	>60
7	>60	18	>60
8	>60	19	>60
9	>60	20	>60
10	>60	21	>60
11	>60	22	>60

It was my pleasure to work in Maine and with members of your fine staff.

With kind regards,

James A. Doolittle
Research Soil Scientist

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