1 OF 1

PERCOLATION TESTING AT THE F- AND H-AREA SEEPAGE BASINS (U)

by

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DOE Contract No. **DE-AC09-89SR18035**

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October 18, 1993

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**FINAL REPORT ON PERCOLATION TESTING AT THE F- AND H-AREA SEEPAGE
BASINS (U)**

Attached is the final report prepared by the Geo-Environmental Engineering Group entitled "Percolation Testing at the F- and H-Area Seepage Basins (U)." This report details results of percolation testing performed to support the design of temporary infiltration galleries which will be constructed for the planned F- and H-Area multiple well pump tests. If I neglected to distribute this report to someone who should have received a copy, or if you have any questions please contact me.

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10/18/93

WSRC-RP-93-1388
Rev. 0

FINAL REPORT

PERCOLATION TESTING AT THE F- AND H- AREA SEEPAGE BASINS (U)

UNCLASSIFIED

Does Not Contain Unclassified Controlled Nuclear Information (UCNI)

Michael D. McHood

Geo-Environmental Engineering

October 1993

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U. S. Department of Energy under Contract No. DE-AC09-89SR18035

FINAL REPORT

PERCOLATION TESTING AT THE F- AND H-AREA SEEPAGE BASINS (U)

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Prepared for the U. S. Department of Energy under Contract No. DE-AC09-89SR18035

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APPENDICES

APPENDIX 1. Field Evaluation of Soils at Percolation Test Locations

APPENDIX 2. Engineering Standards Manual: Sitework (U), WSRC-TM-92-10-2-BK1,
Document No. 02010-01-G, Revision 0.

APPENDIX 3. "Test Procedure for Percolation Testing at the F- and H-Area Seepage
Basins", Revision 0, prepared by M.D. McHood.

1.0 INTRODUCTION

The design of the F- and H-Area Seepage Basin contaminated groundwater remediation system requires information from multiple well pump tests (Reference 1). Soil percolation rates are needed in order to support the multiple well pump test planning. The objective of this task was to determine characteristic percolation rates for soils in four select areas where infiltration galleries are proposed. These infiltration galleries will be temporary installations built on the ground surface and used to dispose of water from the multiple well pump tests. The H-Area proposed infiltration galleries are shown in Figure 1, while the F-Area proposed infiltration galleries are shown in Figure 2.

A procedure defining the specific work process for collecting percolation rate data is contained in Appendix 3. Results from these percolation tests will be used in the design of infiltration galleries for the disposal of well water extracted during the multiple well pump tests.

2.0 BACKGROUND

Percolation testing has evolved over many years. Variations in percolation test procedures have developed as the test evolved. In general, the percolation test is performed by digging a hole with vertical sides. The sides and bottom of the hole are carefully scraped to remove any smeared or disturbed surface and to provide a natural soil interface through which water may percolate. Loose material is removed from the hole and a layer of coarse sand or gravel is placed in the bottom of the hole to protect the bottom from scour and sediment. The hole is then filled with water so that the ground is saturated; clay soils are allowed to swell. Finally, water level is adjusted to a depth of 6 inches above the sand/gravel and the water level drop is timed. The percolation rate is calculated as the time in minutes for the water level to fall one inch.

The percolation test is commonly used to evaluate the ability of a soil to receive septic tank effluent. However, for the application described herein, the soil will be receiving well water. These two fluids (septic tank effluent and well water) differ significantly in solids content. The suspended solids in septic tank effluent are mostly organics, as opposed to the inorganics which would be suspended in well water. It is assumed that for this application the differences between septic tank effluent and well water will not negatively impact infiltration gallery operation. In general, septic tank effluent has a higher loading of suspended solids than well water. Therefore, this assumption is conservative (i.e. the infiltration gallery should dispose of well water more efficiently than septic tank effluent).

Figure 1. H-Area Proposed Infiltration Galleries

Figure 2. F-Area Proposed Infiltration Galleries

Percolation testing does not directly measure any soil characteristic and is used in conjunction with empirical formulas or relationships to design seepage fields. One such formula is given below:

$$Q = \frac{5}{\sqrt{t}} \quad (1) \text{ from Reference 2}$$

Q = Allowable application rate in gallons per square foot per day
 t = Percolation rate in minutes per inch

The required seepage field area is calculated using the percolation rate and the waste water design flowrate. This equation comes from Reference 2, a WSRC Engineering Guide, and should be used in calculating allowable application rates.

3.0 METHODS

Percolation testing associated with this task was performed by a State of South Carolina Certified Percolation Test Technician as required by the Environmental Protection Department and the South Carolina Department of Health and Environmental Control (SCDHEC).

Percolation rate measurements for two of the initial tests at F-Area proposed Infiltration Gallery No. 1 were made according to a WSRC Engineering Guide (Appendix 2). Percolation rate measurements for the remaining 14 tests were made following the procedure found in Appendix 3 which is a modification of the Engineering Guide. The two procedures are essentially the same except for the timing of water level measurements. The Engineering Guide specified the time intervals at which measurements should be taken (every 10 minutes or 30 minutes depending on soil conditions). This was modified to specify that readings should be made for a specific water level change (6 inches).

This modification eliminated confusion regarding when the percolation test should be concluded, and in situations not covered by the procedure (i.e. if the water percolates away in less than 10 minutes). The modification also helped eliminate inconsistencies between tests. This modification additionally adds a small degree of conservatism to measured percolation rate, i.e. the measured percolation rate is slightly slower when a full 6-inch drop in water level is measured. Specifics of the percolation test procedures are found in References 2 and 3.

Note that the percolation tests were performed at the end of a very dry summer which likely increased the absorptive capacity of the soils. To overcome the capillary effects of the dry soils, test locations were soaked thoroughly before measuring percolation rates. In each case the test hole was filled at least 24 hours before measurements were made in order to allow clay particles to swell. In addition, the holes were kept saturated for 4 to 8 hours just prior to taking percolation measurements.

4.0 RESULTS

Four percolation tests were performed at each of the proposed infiltration gallery sites. Figures 1 and 2 show the locations of the percolation test sites. Test locations are identified with survey station numbers. At each proposed infiltration gallery Station 10+00 is the survey origin. Other survey stations are designated by the measurement of the distance from the survey origin. For example; Station 11+00 is 100 feet from Station 10+00 and Station 11+28 is 128 feet from Station 10+00. The percolation test results are presented in Tables 1 through 4.

Table 1 - Percolation Test Results
H-Area Proposed Infiltration Gallery No. 1

Station 10+26				
TIME			WATER	PERCOLATION
Hr	Mn	Sec	LEVEL	RATE FOR
			CHANGE	INTERVAL
			(inches)	(min/inch)
2	45	58	0.00	
5	53	18	187.33	6 31.22 *
2	32	28	0.00	
5	34	24	182.10	6 30.35

Station 11+28				
TIME			WATER	PERCOLATION
Hr	Mn	Sec	LEVEL	RATE FOR
			CHANGE	INTERVAL
			(inches)	(min/inch)
10	28	47	0.00	
19	37	5	548.30	6 91.38 *
8	13	22	0.00	
17	2	8	528.77	6 88.13

Station 12+25				
TIME			WATER	PERCOLATION
Hr	Mn	Sec	LEVEL	RATE FOR
			CHANGE	INTERVAL
			(inches)	(min/inch)
3	24	30	0.00	
3	38	46	14.27	6 2.38 *
4	28	2	0.00	
4	41	40	13.63	6 2.27
4	50	29	0.00	
5	4	32	14.05	6 2.34

Station 13+22				
TIME			WATER	PERCOLATION
Hr	Mn	Sec	LEVEL	RATE FOR
			CHANGE	INTERVAL
			(inches)	(min/inch)
3	54	33	0.00	
4	15	0	20.45	6 3.41
4	21	48	0.00	
4	45	32	23.73	6 3.96 *
4	56	42	0.00	
5	19	58	23.27	6 3.88

* Most conservative measurement (i.e. longest percolation rate).

Table 2 - Percolation Test Results
H-Area Proposed Infiltration Gallery No. 2

Station 10+25					
TIME			ELAPSED	WATER	PERCOLATION
Hr	Mn	Sec	TIME	LEVEL	RATE FOR
			(Min)	CHANGE	INTERVAL
				(inches)	(min/inch)
3	8	1	0.00		
3	44	29	36.47	6	6.08
3	54	4	0.00		
4	33	18	39.23	6	6.54 *
4	36	5	0.00		
5	14	56	38.85	6	6.48

Station 11+22					
TIME			ELAPSED	WATER	PERCOLATION
Hr	Mn	Sec	TIME	LEVEL	RATE FOR
			(Min)	CHANGE	INTERVAL
				(inches)	(min/inch)
3	5	58	0.00		
3	47	42	41.73	6	6.96
3	59	7	0.00		
4	42	21	43.23	6	7.21 *

Station 12+20					
TIME			ELAPSED	WATER	PERCOLATION
Hr	Mn	Sec	TIME	LEVEL	RATE FOR
			(Min)	CHANGE	INTERVAL
				(inches)	(min/inch)
3	19	45	0.00		
4	9	7	49.37	6	8.23
4	16	6	0.00		
5	7	19	51.22	6	8.54 *
5	11	49	0.00		
6	2	34	50.75	6	8.46

Station 13+28					
TIME			ELAPSED	WATER	PERCOLATION
Hr	Mn	Sec	TIME	LEVEL	RATE FOR
			(Min)	CHANGE	INTERVAL
				(inches)	(min/inch)
3	33	59	0.00		
4	0	20	26.35	6	4.39
4	21	22	0.00		
4	44	52	23.50	6	3.92
5	26	33	0.00		
5	50	29	23.93	6	3.99
5	56	59	0.00		
6	23	29	26.50	6	4.42 *

* Most conservative measurement (i.e. longest percolation rate).

Table 3 - Percolation Test Results
F-Area Proposed Infiltration Gallery No. 1

Station 10+03

TIME			ELAPSED TIME (Min)	WATER LEVEL CHANGE (inches)	PERCOLATION RATE FOR INTERVAL (min/inch)
Hr	Mn	Sec			
3	45	33	0.00		
3	53	20	7.78	6	1.30
3	57	31	0.00		
4	6	1	8.50	6	1.42
4	9	19	0.00		
4	18	22	9.05	6	1.51 *
4	40	29	0.00		
4	48	5	7.60	6	1.27
4	54	7	0.00		
5	2	48	8.68	6	1.45

Station 11+04

TIME			ELAPSED TIME (Min)	WATER LEVEL CHANGE (inches)	PERCOLATION RATE FOR INTERVAL (min/inch)
Hr	Mn	Sec			
5	20	20	0.00		
6	20	32	60.20	4.125 †	14.59
1	12	23	0.00		
2	12	56	60.55	4.0625 †	14.90
3	28	37	0.00		
4	59	16	90.65	5.5625 †	16.30 *
5	5	58	0.00		
6	6	21	60.38	4.375 †	13.80

Station 12+32

TIME			ELAPSED TIME (Min)	WATER LEVEL CHANGE (inches)	PERCOLATION RATE FOR INTERVAL (min/inch)
Hr	Mn	Sec			
1	21	26	0.00		
1	51	16	29.83	2.9375 †	10.16
3	46	28	0.00		
4	46	22	59.90	5.0625 †	11.83
4	50	29	0.00		
5	50	58	60.48	4.875 †	12.41 *

Station 13+50

TIME			ELAPSED TIME (Min)	WATER LEVEL CHANGE (inches)	PERCOLATION RATE FOR INTERVAL (min/inch)
Hr	Mn	Sec			
2	46	2	0.00		
2	52	7	6.08	6	1.01
2	53	50	0.00		
3	0	42	6.87	6	1.14
3	4	7	0.00		
3	11	5	6.97	6	1.16
3	13	55	0.00		
3	21	14	7.32	6	1.22 *

* Most conservative measurement (i.e. longest percolation rate).
† Measurements made following procedure from Reference 2.

Table 4 - Percolation Test Results
F-Area Proposed Infiltration Gallery No. 2

Station 10+26

TIME			ELAPSED TIME (Min)	WATER LEVEL CHANGE (inches)	PERCOLATION RATE FOR INTERVAL (min/inch)
Hr	Mn	Sec			
2	47	43	0.00		
3	55	31	67.80	6	11.30 *
4	13	18	0.00		
5	20	5	66.78	6	11.13

Station 11+20

TIME			ELAPSED TIME (Min)	WATER LEVEL CHANGE (inches)	PERCOLATION RATE FOR INTERVAL (min/inch)
Hr	Mn	Sec			
2	35	17	0.00		
3	5	57	30.67	6	5.11 *
3	22	48	0.00		
3	50	52	28.07	6	4.68
4	33	10	0.00		
5	1	21	28.18	6	4.70

Station 12+25

TIME			ELAPSED TIME (Min)	WATER LEVEL CHANGE (inches)	PERCOLATION RATE FOR INTERVAL (min/inch)
Hr	Mn	Sec			
3	3	53	0.00		
4	39	16	95.38	6	15.90
4	45	22	0.00		
6	24	53	99.52	6	16.59 *

Station 13+07

TIME			ELAPSED TIME (Min)	WATER LEVEL CHANGE (inches)	PERCOLATION RATE FOR INTERVAL (min/inch)
Hr	Mn	Sec			
3	15	33	0.00		
4	8	1	52.47	6	8.74 *
4	25	23	0.00		
5	13	12	47.82	6	7.97

* Most conservative measurement (i.e. longest percolation rate).

At each test location, the percolation rate was measured at least twice, and in some instances several times. Duplicate measurements were made to account for the variability inherent in percolation testing. For each test, measurements were made until the variation between two or more percolation rates was less than 10 percent, as required by the WSRC Engineering Guide. On average three percolation rates were measured. With the small sample set, the statistical confidence in the average for each test is low. For this reason the most conservative percolation rates (i.e. the longest percolation rates) should be used for infiltration gallery design instead of the average. As mentioned in Section 3.0, the test procedure was modified to eliminate inconsistencies between tests and to reduce test variation. All measured percolation rates are reported in Tables 1 through 4 so that test variations may be examined.

5.0 CONCLUSIONS AND RECOMMENDATIONS

All four proposed infiltration gallery sites contain soil suitable for disposing of water from the planned aquifer pump tests. However, soils at most of the sites changed significantly along the length of the proposed galleries. Surface soils will need to be stripped in the case of H-Area Infiltration Gallery Site No. 2. Percolation tests were performed at a depth 30 inches, with the soil column evaluated and field classified using the U.S. Department of Agriculture textural classification. In general, soils at each gallery site varied between test locations. Subsequently, percolation rates also varied. In some cases an order of magnitude difference in percolation rate was observed for tests performed only 100 feet apart. After percolation testing was completed, additional excavation was performed to a depth of 45 inches to ensure no shallow bedrock was encountered.

The general recommendation for each site is to use the areas where soils readily accept water (i.e. soils with shorter percolation rates) as much as possible. Each infiltration gallery site is discussed in detail in sections 5.1 through 5.4 where more specific recommendations are made.

5.1 H-Area Proposed Infiltration Gallery Site No. 1

H-Area proposed Infiltration Gallery No. 1 had the greatest range of percolation rates. In general, Stations 10+26 and 11+28 accepted water slowly, while Stations 12+25 and 13+22 readily accepted water. If possible, the area surrounding Stations 12+25 and 13+22 should be used to dispose of all the water from the pump test. Use of Stations 10+26 and 11+28 should be avoided if at all possible.

Test sites at Stations 10+26 and 11+28 contained mottled sandy clay loam in the soil column at depths where the percolation rate was measured. This mottled sandy clay loam had significant clay content. In addition, these two stations had a red sandy clay loam deposited on the surface and a slight slope from Station 10+26 to Station 11+28. The sandy clay loam on the surface in conjunction with the slope will promote runoff if water is discharged on the surface. If these stations must be used then stripping of the surface soil (sandy clay loam) should be considered. The thickness of the red sandy clay loam is 5 inches at Station 10+26 and only 1 inch at Station 11+28. Therefore it appears that the surface layer of red sandy clay loam is thickest at Station 10+00 and gets thinner towards Station 11+50. This

assumption is only based on the thickness of the layer at Stations 10+26 and 11+28 and on the fact that there is a drop in elevation from Station 10+00 to Station 11+50.

The soils at Stations 12+25 and 13+22 contained localized alluvial deposits of sands and loamy sands. These soils accepted water much faster than Stations 10+26 and 11+28. In addition, these stations did not have the surface layer of sandy clay loam that was found at Stations 10+26 and 11+28. The percolation rates reported in Table 5 should be used in calculating allowable application rates for the H-Area Infiltration Gallery No. 1.

Table 5 - Conservative Percolation Test Results
H-Area Proposed Infiltration Gallery No. 1

Location	Percolation Rate (minutes per inch)
Station 10+26	31.2
Station 11+28	91.4
Station 12+25	2.4
Station 13+22	4.0

5.2 H-Area Proposed Infiltration Gallery Site No. 2

The H-Area proposed Infiltration Gallery Site No. 2 had relatively consistent soil conditions and percolation rates, and is relatively flat. However, there were still variations in soils and percolation rates. The soil column at each test location had between 5 and 10 inches of red clay on the surface. In general the red clay layer was followed by sandy loams and loamy sands succeeded by a sandy clay loam encountered at depths ranging from 19 to 30 inches. The percolation rates at this site ranged between 8.5 and 4.4 minutes per inch.

One anomaly was observed at Station 11+22. After a heavy rain, the percolation rate appeared to be much slower than usual (questionable percolation rate of approximately 50 minutes per inch made prior to values reported in Table 2). It is possible that there may be a shallow confining layer in this area causing this anomaly, but this is only a speculation. The slower reading may be due in part to plugging from fine sediments during a questionable earlier test. The designer of the infiltration gallery should be aware of this anomaly and should further investigate the soils around Station 11+22.

To use the percolation rates reported in Table 6 for design, the red clay layer will have to be removed. The red clay has significant plasticity (clay content greater than 55 percent) and will not accept water as readily as the underlying soils. As mentioned above, the thickness of the clay layer at each of the stations tested varies between 5 and 10 inches. The exact thickness of the red clay layer at the four test stations is reported in Appendix 1. Estimates of clay to be stripped can be made from the data in Appendix 1. If the red clay layer is stripped during construction of the infiltration gallery, the percolation rates reported in Table 6 should be used

in calculating allowable application rates for the H-Area Infiltration Gallery No. 2. If the red clay is not stripped this site will not be suitable for water disposal.

Table 6 - Conservative Percolation Test Results
H-Area Proposed Infiltration Gallery No. 2

Location	Percolation Rate (minutes per inch)
Station 10+25	6.5
Station 11+22	7.2
Station 12+20	8.5
Station 13+28	4.4

5.3 F-Area Proposed Infiltration Gallery Site No. 1

F-Area proposed Infiltration Gallery Site No. 1 had the steepest slopes of any site tested and the most variable soil conditions. The percolation rates at this site varied significantly due to the variability of the soils. The soils at Stations 10+03 and 13+50 had the highest percolation rates, 1.2 and 1.5 minutes per inch respectively. The soil columns at these two stations contained mostly sands to a depth of 30 inches. Tests performed at Stations 11+04 and 12+32 has slower percolation rates, 16.3 and 12.4 minutes per inch, due to a sandy clay loam in which the percolation tests were performed. Surface soils at each percolation test location, however, are sands and loamy sands. Soils at this site should perform well if pumped water is to be disposed of directly on the surface. The percolation rates reported in Table 7 should be used in calculating allowable application rates for the F-Area Infiltration Gallery No. 1.

A significant feature at this gallery site, not present at the other gallery sites, is the relatively steep slope. Surface soils on the sloped area between Stations 11+20 and 13+30 will be susceptible to erosion if water is placed on the surface and allowed to flow downhill. When considering slope and soil conditions the most favorable areas for surface disposal of pump water will be the area around Station 10+00 and the area between Stations 13+30 and 15+00.

Table 7 - Conservative Percolation Test Results
F-Area Proposed Infiltration Gallery No. 1

Location	Percolation Rate (minutes per inch)
Station 10+03	1.5
Station 11+04	16.3*
Station 12+32	12.4*
Station 13+50	1.2

5.4 F-Area Proposed Infiltration Gallery Site No. 2

Percolation rates fluctuated across the F-Area proposed Infiltration Gallery Site No. 2, with no trend indicating a preferred location for disposing of pump water. Soil examination indicates that at each test station, the surface soils will absorb water as well as or in most cases better than the soil at test depth, but surface soils across the site varied. During test preparation at Station 11+20, it was observed that the soil was relatively loose as compared to other test stations at this site. The soil at Station 11+20 had the most favorable percolation rate. This low rate was probably due to the low relative density of the soil. This area appears to have slightly more capacity to accept water, but it is difficult to determine how extensive this low density area is by surface soil examination. The recommendation for this site is to dispose of water primarily around Station 11+20 and secondarily at Station 13+07. However, soils at each test location gave percolation rates acceptable for pump water disposal. The percolation rates reported in Table 8 should be used in calculating allowable application rates for the F-Area Infiltration Gallery No. 2.

Table 8 - Conservative Percolation Test Results
F-Area Proposed Infiltration Gallery No. 2

Location	Percolation Rate (minutes per inch)
Station 10+26	11.3
Station 11+20	5.1
Station 12+25	16.6
Station 13+07	8.7

6.0 REFERENCES

1. WSRC Transmittal letter and enclosure, ESH-ERG-920643, from J.W. Cook to R.J. Devlin, "UIC Permit Applications for F- and H-Area Aquifer Test Infiltration Galleries, SRS (U)", November 12, 1992.
2. WSRC, Engineering Standards Manual: Sitework (U), WSRC-TM-92-10-2-BK1, Document No. 02010-01-G, Revision 0, January 31, 1993.
3. McHood, M.D., "Test Procedure for Percolation Testing at the F- and H-Area Seepage Basins", Revision 0, September 1993.

APPENDIX 1

Field Evaluation of Soils at Percolation Test Locations

F-Area Proposed Infiltration Gallery Site No. 1

Station 10+03

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 7	Sand	Grayish brown
E --	7 - 12	Sand	Light brown
BE --	12 - 22	Loamy sand	Light brown
Bt ₁ --	22 - 30+	Sandy loam	Yellowish brown

Station 11+04

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 6	Sand	Light brown
Bt ₁ --	6 - 15	Sandy loam	Strong brown
Bt ₂ --	15 - 30+	Sandy clay loam	Strong brown

Station 12+32

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 6	Sand	Grayish brown
E --	6 - 9	Loamy sand	Yellowish brown
Bt ₁ --	9 - 25	Sandy loam	Strong brown
Bt ₂ --	25 - 30+	Sandy clay loam	Red

Station 13+50

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 9	sand	Grayish brown
E --	9 - 19	sand	Brown
E --	19 - 30+	Loamy sand	Brown

F-Area Proposed Infiltration Gallery Site No. 2

Station 10+26

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 5	Loamy sand	Brown
Bt ₁ --	5 - 10	Sandy loam	Brown with dark brown 10 mm FeMn nodules
Bt ₂ --	10 - 18	Sandy loam	Yellowish brown
Bt ₃ --	18 - 30+	Sandy clay loam	Yellowish brown, slight compaction, with brown cemented nodules

Station 11+20

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 5	Loamy sand	Light brown
Bt ₁ --	5 - 8	Sandy loam	Brown
Bt ₂ --	8 - 30	Sandy clay loam	Strong brown

Station 12+25

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 9	Loamy sand	Light brown
BE --	9 - 11	Sandy loam	Brown with C2D yellow brown mottles
Bt ₁ --	11 - 30+	Sandy clay loam	Strong brown

Station 13+07

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 3	Loamy sand	Light brown
BE --	3 - 7	Sandy loam	Yellowish brown
Bt ₁ --	7 - 27	Sandy loam	Yellowish brown
Bt ₂ --	27 - 30+		

H-Area Proposed Infiltration Gallery Site No. 1

Station 10+26

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
--	0 - 5	Sandy clay loam	Red, recent subsoil deposition, man made
Ap --	5 - 8	Loamy sand	Dark brown
E --	8 - 12	Loamy sand	Light yellowish brown
Bt ₁ --	12 - 26	Sandy clay loam	Yellowish brown with red mottles
Bt ₂ --	26 - 30+	Sandy clay loam	Mottled red, yellow, and brown, few to common plinthite, estimated 35% clay content, compact

Station 11+28

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
--	0 - 1	Sandy clay loam	Red, recent subsoil deposition, man made
Ap --	1 - 6	Sand	Brown
E --	6 - 18	Loamy sand	Grayish brown
Bt ₁ --	18 - 30+	Sandy clay loam	Yellowish brown with brown and strong brown mottles, 5-15% red plinthite nodules

Station 12+25

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap ₁ --	0 - 2	Sandy loam	Dark brown
Ap ₂ --	2 - 6	Loamy sand	Yellowish brown
C ₁ --	6 - 11	Course sand	C ₁ and C ₂ horizons - Local alluvium, bedded sands and course sands, low fines, rapid recharge, looks like Ochlockonee
C ₂ --	11 - 30+	Loamy sand	

Station 13+22

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
Ap --	0 - 8	Sandy loam	Dark brown
C ₁ --	8 - 14	Sand	Yellowish brown
C ₂ --	14 - 20	Sandy loam/ Loamy sand	C ₁ and C ₂ horizons - Interbedded sand and loamy sand, pockets, sandy loam interbedded, local alluvium, similar to Ochlockonee

H-Area Proposed Infiltration Gallery Site No. 2

Station 10+25

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
--	0 - 8	Clay	Red, mottled red, yellow and brown, overburden
Ap --	8 - 14	Loamy sand	Dark brown
E --	14 - 23	Loamy sand	Yellowish brown
Bt --	23 - 30+	Sandy clay loam	Yellowish brown

Station 11+22

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
--	0 - 5	Clay	Red, overburden
Ap --	5 - 12	Sandy loam	Dark brown
E --	12 - 21	Loamy sand	Grayish brown
Bt --	21 - 30+	Sandy clay loam	Yellowish brown

Station 12+20

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
--	0 - 10	Clay	Red, overburden
Ap ₁ --	10 - 19	loam	Dark brown
Ap ₂ --	19 - 28	Sandy clay loam	Dark brown
E --	28 - 30+	Sandy loam	Yellowish brown

Station 13+28

HORIZON	DEPTH (inches)	U.S.D.A TEXTURAL CLASSIFICATION	NOTES
--	0 - 6	Clay	Red, overburden
Ap ₁ --	6 - 9	Sandy loam	Grayish brown
Ap ₂ --	9 - 30	Loamy sand	Dark grayish brown
Bt --	30 -	Sandy clay loam	Yellowish brown

APPENDIX 2

**Engineering Standards Manual: Sitework (U), WSRC-TM-92-10-2-BK1,
Document No. 02010-01-G, Revision 0**

INFORMATION ONLY

ENGINEERING GUIDE

SAVANNAH RIVER SITE

SOIL PERCOLATION TEST (U)

DOCUMENT NO.:

02010-01-G

DATE: 01/31/93

REVISION: 0

PAGE 1 OF 3

1.0 PURPOSE AND SCOPE

1.1 This Engineering Guide describes percolation tests to determine the absorptive ability of a soil for effluents from other than sanitary facilities.

1.2 This document replaces DuPont Standard C14S, Soil Absorption Tests.

2.0 DOE ORDER APPLICABILITY

2.1 DOE Order 6430.1A - dated April 6, 1989 - General Design Criteria

3.0 NATIONAL CODES AND STANDARDS

None

4.0 DEFINITIONS

None

5.0 GUIDES

5.1 When required percolation tests shall be performed as directed by project specifications and drawings. Percolation tests shall be made in soil that has the same degree of compaction and drainage that will exist when the leaching area is in operation.

5.2 The surrounding area and immediate test location shall be kept well drained during the test.

5.3 Where percolation tests are made to determine the absorptive ability of a soil, the tests shall not be made in areas containing:

5.3.1 Frozen soil

5.3.2 Standard compaction fills less than six months old.

5.3.3 Rock, hardpan, or in soil where the water table is less than 4 feet below finished grade.

5.4 Where percolation tests are being made to determine the absorptive ability of a soil, the soil shall be probed to a minimum depth of 4 feet below the proposed finished grade in order to determine that no rock or hardpan is encountered.

5.5 Dig or bore a hole with horizontal dimensions from 8 to 12 inches, and vertical sides to the depth at which it is proposed to locate the bottom of the leaching area.

5.6 Scratch the bottom and sides of the hole with a knife blade or sharp-pointed instrument in order to remove any smeared or cemented soil surfaces, and to provide a natural soil interface into which water may percolate. Remove all loose material from the hole and add 2 inches of coarse sand or fine gravel to protect the bottom from scour and sediment.

SOIL PERCOLATION TEST (U)

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5.7 Carefully fill the hole with clear water to a minimum depth of 12 inches over the gravel. Refill the hole as necessary to maintain a minimum 12-inch depth of water in the hole for at least 8 hours.

5.7.1 In sandy soils containing very little or no clay, the percolation test may be conducted as described in Section 5.7 after the water from one filling of the hole has completely seeped away.

5.8 Percolation rates to be measured approximately 24 hours after water is first added to the hole.

5.9 If water remains in the test hole after the soaking period, adjust the depth to approximately 6 inches over the gravel. From a fixed reference point, measure accurately the drop in water level during successive 30-minute periods. The percolation rate may be determined when two successive measurements agree within 10%.

5.10 If no water remains in the hole after the soaking period, add clear water to bring the depth of water in the hole to approximately 6 inches over the gravel. Refill the hole as necessary to maintain this water level for approximately 4 hours. After this period has elapsed, take measurements as described in Section 5.9.

5.10.1 In soils which, after the soaking period, the first 6 inches of water (added under 5.10) seeps away in less than 30 minutes, the 6-inch depth of water in the hole to be maintained for one hour. Measurements to be made as described in 5.9 except that the time intervals shall be 10 minutes.

5.11 From measurements taken as explained above, the percolation rate is calculated as the time in minutes for the water level to fall one inch.

5.12 When the percolation rate (t) has been calculated, the rate at which liquid may be applied for subsurface disposal (Q) may be determined from Figure 1. The application area for subsurface disposal through a soil-absorption field (tile field) shall be the total bottom area of the trenches. The application area for seepage pits and french drains shall be the vertical wall area below the inlet.

Example: For a percolation rate (t) of one inch in 20 minutes, the allowable application rate (Q) from Figure 1 is 1.12 gallons per square foot per day. Thus, for an estimated daily flow of 1200 gallons, an effective leaching area of 1070 square feet must be provided.

6.0 REFERENCES

None

7.0 APPENDICES, TABLES AND FIGURES

7.1 Figure 1 - Graph Showing Relation Between Percolation Rate and Allowable Rate of Liquid Application.

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Figure 1

Graph Showing Relation Between Percolation Rate and
Allowable Rate of Liquid Application

APPENDIX 3

**"Test Procedure for Percolation Testing at the F- and H-Area Seepage Basins",
Revision 0, prepared by M.D. McHood**

TEST PROCEDURE FOR
PERCOLATION TESTING AT THE F- AND H-AREA SEEPAGE BASINS

INFORMATION ONLY

September 1993
Revision 0

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INFORMATION ONLY

ENVIRONMENTAL ENGINEERING
SITE GEOTECHNICAL SERVICES DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
M. D. McHood
Revision 0

Test Procedure:
Percolation Testing
F & H Seepage Basins
Date: August 1993
Page 1 of 2

1.0 PURPOSE AND SCOPE

This procedure describes percolation tests to determine the absorptive ability of soils in the vicinity of the F- and H-Area Seepage Basin Aquifer Extraction Tests. These tests will be used to support design of a temporary infiltration gallery for disposal of extracted well water.

2.0 GUIDES

Percolation tests shall be performed in soil that has the same degree of compaction and drainage that will exist when the leaching area is in operation.

The surrounding area and immediate test location shall be kept well drained during the test.

Where percolation tests are made to determine the absorptive ability of a soil, the tests shall not be made in areas containing:

Frozen soil

Standard compaction fills less than six months old.

Rock, hardpan, or in soil where the water table is less than 4 feet below finished grade.

3.0 RESPONSIBILITIES

The percolation test shall be performed by a certified State of South Carolina Percolation Test Technician. All other personnel performing work for this task shall receive and follow instructions given by the Certified percolation technician.

4.0 TEST PROCEDURE

Where percolation tests are being made to determine the absorptive ability of a soil, the soil shall be probed to a minimum depth of 4 feet below the proposed finished grade in order to determine that no rock or hardpan is encountered.

Dig or bore a hole with horizontal dimensions from 8 to 12 inches, and vertical sides to a minimum depth of 30 inches.

INFORMATION ONLY

ENVIRONMENTAL ENGINEERING
SITE GEOTECHNICAL SERVICES DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
M. D. McHood
Revision 0

Test Procedure:
Percolation Testing
F & H Seepage Basins
Date: August 1993
Page 2 of 2

Scratch the bottom and sides of the hole with a knife blade or sharp-pointed instrument in order to remove any smeared or cemented soil surfaces, and to provide a natural soil interface into which water may percolate. Remove all loose material from the hole and add 2 inches of coarse sand or fine gravel to protect the bottom from scour and sediment.

The hole should be filled with water at least once and allowed to sit so any soil containing clay may swell. Percolation rates will not be measured until 24 hours after water is first added to the hole.

Carefully fill the hole with water to a minimum depth of 12 inches over the gravel. Refill the hole as necessary to maintain a minimum 12-inch depth of water in the hole for at least 4 hours in sandy soils and 8 hours in soils containing significant amounts of clay.

In sandy soils containing very little or no clay, the percolation measurements may be taken after the pre-soak water (water from 4 hour soaking period) has seeped away.

In soils containing clay the water level may be adjusted appropriately after the 8 hour pre-soak period.

After the soaking period, adjust the water depth to approximately 6 inches over the sand/gravel. From a fixed reference point, measure accurately the time required for the water level to drop 6 inches. The percolation rate may be determined when two successive measurements agree within 10%.

From measurements taken as explained above, the percolation rate is calculated as the time in minutes for the water level to fall one inch.

5.0 DOCUMENTATION

Field data shall be recorded on forms shown in Attachment 1. The data record forms and final report shall be maintained as a nonpermanent record for two years from issuance of the final report.

INFORMATION ONLY

Attachment 1

Data Record for Percolation Test

ENVIRONMENTAL ENGINEERING
SITE GEOTECHNICAL SERVICES DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

Percolation Test Record
Percolation Testing
F & H Seepage Basins

Technician Name, and Initials _____ Date _____

Technician Name, and Initials _____ Date _____

Site description _____

Soil description _____

INFORMATION ONLY

Test hole dimensions _____

Amount of sand/gravel placed in bottom of test hole _____

Recent Weather _____

Start of pre-soak period, Date _____ Time _____

End of pre-soak period, Date _____ Time _____

Observations during pre-soak period _____

[illegible]

* All Depth Readings made to nearest 1/16 inch

Certified Percolation Technician Signature _____

Date _____

DATE

FILMED

5 / 31 / 94

END