**R Reactor Seepage Basins Soil Moisture and Resistivity Field
Investigation Using Cone Penetrometer Technology, Savannah
River Site, Aiken, South Carolina**

by

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Mary K. Harris, Jay V. Noonkester

September 1999

Prepared by:
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EXECUTIVE SUMMARY

Recent and historical water table levels at the R Reactor Seepage Basins (RRSBs) suggest that a “perched” water table may exist directly beneath the RRSBs based on regulatory documentation and groundwater modeling. Additional studies were conducted in the summer of 1999 of the shallow groundwater system to determine if the water beneath the RRSBs is actually perched or whether the shallow water table is in direct communication with the underlying “transmissive zone”. Direct Push or Cone Penetrometer Technology (CPT) was used to investigate the shallow water table beneath the basins. CPT soil moisture and resistivity tests combined with CPT lithologic data (tip, sleeve, friction ratio, and pore pressure) were performed at 10 locations. The CPT pushes were pushed to approximately 105’ to obtain a saturation profile from the surface to the top of the “transmissive zone” in the Upper Three Runs Aquifer. Shelby tube samples were taken with the soil moisture analysis to validate and confirm moisture percentage.

Upon completion of the field investigation the following sources of data were integrated to determine the characteristics of the shallow water table:

- CPT data (moisture %, resistivity data, pore pressure, tip, sleeve, and friction ratio)
- Permeability data
- Water level and potentiometric data to determine head relations
- Contaminant Data

All the data indicate that perched water conditions occur on a seasonal basis during extremely wet periods as were experienced in the spring of 1998. There is significantly less mounding of the water table beneath the RRSBs with water levels being 10 –15 feet lower during 1999. This is due to the “draining” of the upper water table due to dry conditions in the summers of both 1998 and 1999 along with the effects of the asphalt cover over the basins. CPT data further indicates that the 1998 water levels were located on top of silty and clayey layers in March 1998. In addition, the confining-like characteristics of the “A” and “AA” horizons and the positive potentiometric surface of the underlying “Transmissive” zone impede vertical movement of groundwater from the surface to the “transmissive zone”. This interpretation is corroborated by the extent of Sr-90 contamination in the upper water table DU zone and the absence of Sr-90 contamination in the lower DL (“transmissive” zone). Therefore, contamination from the Principal Threat Source Material (PTSM) associated with the RRSBs will not easily migrate into the underlying “transmissive zone”.

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1.0 Introduction

Recent and historical water table levels at the R Reactor Seepage Basins (RRSBs) (Figure 1) suggest that a "perched" water table may exist directly beneath the basins. Recent regulatory documentation (WSRC, 1998) and groundwater modeling (Jones and others, 1998) both indicated that additional study of the shallow groundwater system is needed to determine if the water beneath the RRSBs is actually perched or whether the shallow water table is in direct communication with the underlying "transmissive zone". The understanding of the shallow water table in relation to the hydrology of the area is essential for the ongoing feasibility study for the waste unit. Whether or not the water table is perched may impact the remedial alternative selection for the Principal Threat Source Material (PTSM). If the water table is "perched", then it is part of the soil column above the "Transmissive zone" (which would become the first viable aquifer zone). If this is the case soil leachability would be considered from the contaminant source to the "transmissive zone for the purpose of remedial technology selection". The focus of this report is the summer 1999 investigation of the shallow groundwater system using cone penetrometer technology (CPT) characterization methods to determine if the water table is perched beneath the RRSBs.

The characterization plan for this study was documented in a Workplan Addendum outlining additional field characterization for the RRSB Workplan/RFI/RI for the RRSB (WSRC, 1999a).

1.1 Hydrogeology and Extent of Contamination

There are four hydrostratigraphic units that are important to contaminant migration. Figure 2 is a conceptual hydrogeological model for the RRSB area. The seepage basins are located in undifferentiated surface soils of varying thickness. The "A" and "AA" horizons immediately beneath the seepage basins, and correspond to the Upland Unit and Tobacco Road Formation. The "A" and "AA" horizons both are similar to confining units with relatively low hydraulic conductivities (average 1.0×10^{-7} cm/sc and 1.0×10^{-6} cm/sec, respectively). The "Transmissive" zone underlies the "AA" horizon, and correlates to the Irwinton Sand of the Dry Branch Formation. This zone has relatively high hydraulic conductivity averaging 1.0×10^{-4} cm/sec.

Groundwater is present in the "A" and "AA" horizons and the "Transmissive" zone. The hydraulic characteristics of the "A" and "AA" horizons are not well understood because these strata behave more like confining units than aquifers. The vertical mobility of the

groundwater within these low permeability units is also not well understood. Figure 2 illustrates how the groundwater in the "A" and "AA" (DU) horizons is at similar head to the potentiometric surface of the "Transmissive" zone (DL) to the west of the waste units. This is supported by the water table surface of the "A/AA" and potentiometric surface of the "Transmissive" zone (Figures 3 and 4). In the area underlying the RRSBs the groundwater surface associated with the "Transmissive" zone (DL) drops toward the "Old" R Area Discharge Canal, which indicates the aquifer discharges into the canal. However, in the same area the water table surface associated with the "A/AA" horizon (DU) is relatively flat lying when compared to the "Transmissive" zone (DL) which suggests minimal connection between the two water bearing units.

The majority of the Contaminants of Concern (COCs) associated with PTSM have not migrated significantly within the vadose zone, and tend to remain within the contaminated soils in the backfilled basins. However, a portion of the Sr-90 associated with the PTSM, has migrated to the groundwater within the "A" horizon. Am-241, Pu239/240 are also contaminant migration constituent of concern (CMCOCs) are therefore predicted to migrate from the PTSM to the groundwater at activities above their respective maximum contaminant level (MCL). The potential for migration of contaminants in the groundwater within the "A" horizon, to deeper stratigraphic units, is dependent upon the connection between the water bearing units. Therefore it is very important to have a good understanding of the hydraulic characteristics of these hydrostratigraphic units, and the degree of connectivity of the units, to make good predictions of contaminant transport. In addition, this information is critical to a proper selection of remedial alternatives.

1.2 Field Characterization Methodology using the Cone Penetrometer Soil Moisture & Resistivity Probe

Soil Moisture Probes were evaluated at the Savannah River Site in 1996 and 1997 (Argonne National Laboratory, 1997) through the Site Characterization and Analysis Penetrometer System. The soil moisture probe is used in conjunction with direct push technology to obtain real-time data to measure subsurface volumetric soil moisture. Shelby tube samples are taken with the soil moisture analysis to validate and confirm moisture percentage. In addition, resistivity log profiles were used in conjunction with the soil moisture percentage measurements. Based on prior studies conducted at the SRS, the soil moisture percentages increase as the probe approaches the saturated zone, while the resistivity decreases with the

increase in water in the pore space of the sediments (WSRC, 1999, Argonne National Labs, 1997).

CPT soil moisture and resistivity tests combined with CPT lithologic data (tip, sleeve, friction ratio, and pore pressure) were performed at 10 locations (Figure 5 and Table 1). The CPT pushes were pushed to approximately 105' through the undifferentiated surface soils, "A" Horizon and "AA" Horizon to obtain a saturation profile from the surface to the top of the "transmissive zone" in the Upper Three Runs Aquifer. The CPT pushes were terminated at the top of the "Transmissive zone". Two of the CPT pushes (RR-19A and 19-B) were inside the RRSB fence (Figure 5), and required RCO/HP coverage. The locations within the RRSB fenced area were chosen based on the RRSB RFI/RI characterization work that delineated the extent of contamination (Figure 6). The locations are in non-contaminated areas within the fence (Figure 5 & 6).

The remaining 8 pushes were completed outside the fence and did not require RCO/HP coverage (Figure 5). All of the locations are being done near existing lithologic pushes to maximize hydrogeologic data in the area for interpretive purposes. Shelby tubes were collected at 3 locations for soil moisture percentage and porosity. Shelby tube samples were collected, sealed, and stored according to WRSC-3Q5.

CPT ID	SRSE	SRSN	Elevation
RR-19A	75349.1	57966.3	306.63
RR-19B	75534.1	57887	306.63
RR-3	75745.5	58111.6	305.7
RR-4	75727.98	58380.3	299.2
RR-5	75609	58798.8	301.4
RR-6	75115.7	58891.3	297.8
RR-7	74692.2	58785.6	299.1
RR-8	74657.5	58283.4	299.9
RR-9	74512.2	57895.8	297.6
RR-10	74538.6	57354	291.6

Table 1: Name and locations of the RR CPTs

2.0 Field data acquisition and sampling results

Field data acquisition began on 6/14/99 and ended on 7/1/99. Details of the daily activities are reported in Appendix A. Initially, electrical connection problems required repeating several of the pushes to ensure quality data was collected. Other than the electrical malfunctions, the remaining field work went smoothly. Appendix B contains plots of the 10 pushes with sleeve and tip stress, friction ratio, pore pressure, resistivity, and volume percent moisture plotted.

Shelby Tube Samples were collected at RR-3, RR-7, and RR-9. Table 2 summarizes the results. Figures 7 - 9 illustrates the sample locations and percentages in relation to the CPT data and June water levels at nearby RPC-3 DU and DL. Soil samples were taken in clear tubing in four foot sections. The samples were then examined to determine where to take the sample based on the CPT results and lithologic type. Samples were analyzed by LAW Engineering and Environmental Services in Atlanta, GA for Grain Sieve Wash 200 (ASTM D422) and volumetric soil moisture content, density and porosity (EM1110-2-1906). Appendix C provides the detailed results from LAW Engineering and Environmental Services.

Samples were taken at RR-3 beginning at a depth of 5 feet. A total of 10 samples were taken ending at 101.5 feet. Again, samples were taken based on the lithology and in relation to the response on the CPT moisture percentage curve (Figure 7). Generally, the results match well with the laboratory results and the predicted moisture from the CPT probe. In the upper 30 feet of RR-3 there is variability of approximately 15% moisture percentage in interbedded sandy, silty and clayey sediments. In the lower portion of RR-3 the moisture percentage is relatively stable with variability of approximately 10%.

Sample ID	SRS E	SRS N	Ground Elev.	Sample Depth (ft.)	Moisture Content%	Wet Density pcf	Dry Density pcf	Spec. Gravity	Porosity
RR-03-	75745.5	58111.6	305.7	5.0 - 6.0	9	101.4	93	2.66	0.44
RR-03-	75745.5	58111.6	305.7	10.5 - 11.5	15.4	117.7	102.1	2.68	0.39
RR-03-	75745.5	58111.6	305.7	14.0 - 15.0	6.3	109.9	103.5	2.62	0.37
RR-03-	75745.5	58111.6	305.7	18.0 - 19	20	113.8	94.9	2.66	0.43
RR-03-	75745.5	58111.6	305.7	20.5 - 21.5	22	113.1	92.7	2.68	0.45
RR-03-	75745.5	58111.6	305.7	22.5 - 23.5	22.7	118.1	96.3	2.68	0.42
RR-03-	75745.5	58111.6	305.7	26.0 - 27.0	18.6	116.0	97.8	2.71	0.42
RR-03-	75745.5	58111.6	305.7	57.5 - 58.5	20.4	116.2	96.5	2.64	0.41
RR-03-	75745.5	58111.6	305.7	83.5 - 84.5	29.9	115.2	88.6	2.61	0.46
RR-03-	75745.5	58111.6	305.7	100.5 -	26.4	117.5	92.9	2.65	0.44
RR-07-	74692.2	58785.6	299.1	3.0 - 4.0	19.1	113.4	95.2	2.64	0.42
RR-07-	74692.2	58785.6	299.1	11.0 - 12.0	12.5	113.1	100.6	2.65	0.39
RR-07-	74692.2	58785.6	299.1	13.5 - 14.5	10.8	105.4	95.2	2.62	0.42
RR-07-	74692.2	58785.6	299.1	16.5 - 17.5	14.7	103.7	90.3	2.63	0.45
RR-07-	74692.2	58785.6	299.1	18.0 - 19.0	19.8	107.4	89.6	2.66	0.46
RR-07-	74692.2	58785.6	299.1	22.0 - 23.0	14.1	101.6	89.1	2.67	0.47
RR-09-	74512.2	57895.8	297.6	6.0 - 7.0	10.8	101.5	91.6	2.65	0.45
RR-09-	74512.2	57895.8	297.6	10.0 - 11.0	16.3	117.2	100.8	2.66	0.39
RR-09-	74512.2	57895.8	297.6	14.0 - 15.0	27.7	110.5	86.5	2.68	0.48
RR-09-	74512.2	57895.8	297.6	18.0 - 19.0	19.1	112.4	94.4	2.65	0.43
RR-09-	74512.2	57895.8	297.6	22.0 - 23.0	18.3	115.4	97.6	2.66	0.41
RR-09-	74512.2	57895.8	297.6	26.0 - 27.0	16.9	116.7	99.9	2.65	0.4

Table 2: Laboratory Results from RR-3, RR-7, and RR-9

Samples were taken at RR-7 beginning at 3 feet. A total of 6 samples were taken ending at 23 feet. The agreement is good for the correlation between the laboratory values and CPT probe predictions for soil moisture. There is approximately 15% variability in the laboratory values in the highly interbedded sandy, silty, and clayey sediments in the upper 30 feet of RR-7. There is excellent correlation between the lithology defined by the friction ratio with the pore pressure response, resistivity and moisture percentage curves (Figure 8).

Samples were taken at RR-9 beginning at 6.0 feet. A total of 6 samples were taken ending at 27 feet. Again, agreement is relatively good for the correlation between the laboratory values and CPT probe predictions for soil moisture. The sediments are not as highly interbedded in RR-09 as in RR-03 and RR-07. This is reflected in the higher moisture percentage values around 15 feet. Correlation is good between the lithology defined by the friction ratio with the pore pressure response, resistivity and moisture percentage curves (Figure 9).

Figure 10 illustrates an east-west cross-section labeled A – A' (traverse location on Figure 5) through sample points RR-9, RR-19A, and RR-3. The cross-section also illustrates the water table DU elevations and the "Transmissive" zone potentiometric surface DL elevations in March 1998 and June 1999. This relation will be discussed in the next section.

Figure 11 is a 3-dimensional grid of the soil moisture probe data over the RRSB data. The grid illustrates that the lower percent moisture is near the surface in the surface soils and "A" horizon and the higher percent moisture is correlative with the elevation of the "Transmissive" zone potentiometric surface. The moisture percentage is relatively stable below this surface.

3.0 Interpretation

The purpose of the study was to determine if "perched" water conditions exist in the shallow water table system at the RRSBs. Upon completion of the soil moisture probe and resistivity study other data was combined to better resolve and understand the characteristics of the shallow hydrogeology.

The RPC wells that rim the RRSBs (Figure 5) were installed in March 1998. During installation the region experienced unusually heavy rains from the "El Nino" effect of Pacific Ocean heating. Upon completion of the well installation water table measurements indicated an extremely high water table surface, sometimes within 0.5 feet of the ground surface (Appendix D and Figure 3). The monthly water table measurements begun in August 1998

continue to be collected. The water levels have dropped significantly since March 1998. Appendix D contains the hydrographs for the RPC wells around the RRSBs. Figures 7 – 9 illustrate the water level differences experienced from March 1998 until June 1999 at RPC-3DU/RR-03, RPC-7DU/RR-07, and RPC-9DU/RR-09. At all three locations the water table has dropped significantly ranging from 10 – 15 feet with very small differences currently observed between the upper DU “A/AA” horizon water table screen and the lower DL “transmissive” zone screen of 2 – 5 feet.

Figures 3 and 4 and Figures 12 and 13 illustrate the March 98 and June 99 water table surface for the DU screens and DL screens, respectively. Notice, that there is significantly less mounding underneath the basins in June 99 for the upper water table surface in the DU screens. This is interpreted to be from the “draining” of the upper water table due to dry conditions that have been experienced in the summers of both 1998 and 1999 and the effects of the asphalt cover over the basins. The soil moisture probe data supports this interpretation. Figures 7 (RR-03) and 8 (RR-07) illustrate that in March 1998 the DU screen zone water levels were located on top of silty and clayey layers and therefore were exhibiting perched conditions during that timeframe. During 1999 the DU water levels have dropped and have stabilized with very little head separation between the DU & DL water elevations. The DU water levels appears to have little effect on vertical groundwater movement. This is consistent with the vertical permeabilities and horizontal groundwater flow velocities cited in the August 1998 RFI/RI/BRA (WSRC, 1998). The average vertical permeability for the “A” horizon is 1.0×10^{-6} cm/sec and the annual horizontal movement is approximately 9.2 cm/year. This coupled with the positive head conditions of the underlying “transmissive zone” support the that the PSTM will not easily migrate into the underlying transmissive zone.

The soil moisture probe CPT data (volume moisture %, resistivity data, pore pressure, tip, sleeve, and friction ratio) coupled with the water level data indicate strongly that perched water conditions occur on a seasonal basis during extremely wet periods as were experienced in March 1998. However, due to the confining like characteristics of the “A” and “AA” horizons and the positive potentiometric surface of the underlying “Transmissive” zone the vertical movement of groundwater from the surface to the “transmissive zone” is not likely. This interpretation is corroborated by the extent of Sr-90 contamination in the upper water table DU zone and the absence of Sr-90 contamination in the lower DL (“transmissive” zone) as reported in the RFI/RI/BRA (WSRC, 1998).

4.0 Summary

Recent and historical water table levels at the RRSBs suggested that a “perched” water table may exist directly beneath the RRSBs based on regulatory documentation (WSRC, 1998) and groundwater modeling (Jones and others, 1998). Additional studies were conducted in the summer of 1999 of the shallow groundwater system to determine if the water beneath the RRSBs is actually perched or whether the shallow water table is in direct communication with the underlying “transmissive zone”.

Direct Push Technology was used to investigate the shallow water table beneath the basins. CPT soil moisture and resistivity tests combined with CPT lithologic data (tip, sleeve, friction ratio, and pore pressure) were performed at 10 locations. The CPT pushes were pushed to approximately 105’ through the undifferentiated surface soils, “A” Horizon and “AA” Horizon to obtain a saturation profile from the surface to the top of the “transmissive zone” in the Upper Three Runs Aquifer. Shelby tube samples were taken with the soil moisture analysis to validate and confirm moisture percentage.

Upon completion of the field investigation the following sources of data were integrated to determine the characteristics of the shallow water table:

- CPT data (volume moisture %, resistivity data, pore pressure, tip, sleeve, and friction ratio)
- Permeability data
- Water level and potentiometric data to determine head relations
- Contaminant Data

All the data indicate that perched water conditions occur on a seasonal basis during extremely wet periods as were experienced in March 1998. There is significantly less mounding of the water table beneath the RRSBs with water levels being 10 –15 feet lower during 1999. This is interpreted to be from the “draining” of the upper water table due to dry conditions in the summers of both 1998 and 1999 and the effects of the asphalt cover over the basins. Perched water is also indicated by the lithologic data. Careful examination of the CPT data and water level data illustrate the March 1998 DU screen water levels were located on top of silty and clayey layers in March 1998.

Furthermore, the confining like characteristics of the "A" and "AA" horizons (based on permeability data) and the positive potentiometric surface of the underlying "Transmissive" zone impede vertical movement of groundwater from the surface to the "transmissive zone". This interpretation is corroborated by the extent of Sr-90 contamination in the upper water table DU zone and the absence of Sr-90 contamination in the lower DL ("transmissive" zone) as reported in the RFI/RI/BRA (WSRC, 1998). Therefore, contamination from the PTSM associated with the RRSBs will not easily migrate into the underlying "transmissive zone".

5.0 Recommendations

Monitoring of the R Area wells water elevations on a monthly basis should be continued. In addition, individual monitoring of selected wells should be initiated. Electronic instrumentation that can measure the water levels on a timed interval should be considered. This would allow for rain events to be monitored to verify the perching of water on the silty and clayey layers near the ground surface.

The new piezometers that were installed to monitor water levels near the R-Area Canal should be measured on a monthly basis. In addition, these wells should be considered for individual monitoring as well as described above.

Multi-well pumping tests are planned at the RPC-1 and P-20 cluster during FY00. The information from these tests should be integrated into the soil moisture/resistivity field characterization results to further understand the shallow hydrogeology and its relation to contaminant migration of the PTSM to the subsurface beneath the RRSBs.

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Figure 1: Location of the R Reactor Seepage Basins within R Reactor Area.

Figure 2: Conceptual Hydrogeologic Diagram for the R Reactor Seepage Basins

Figure 3: Water Table Map – DU screen zone – March 1998, Contour Interval = 5 Ft.

Figure 4: Transmissive zone Potentiometric Surface – DL screen zone – March 1998, Contour Interval = 5 Ft.

Figure 5: Soil Moisture Probe CPT Locations

Figure 6: Areal Extent of Contamination illustrating 2 CPT pushes inside fenced area.

Figure 7: CPT RR-03 illustrating Friction Ratio, Pore Pressure, Resistivity, and Volume % moisture with March 1998 and June 1999 water levels from the DU and DL screens of Well RPC-1

Figure 8: CPT RR-07 illustrating Friction Ratio, Pore Pressure, Resistivity, and Volume % moisture with March 1998 and June 1999 water levels from the DU and DL screens of Well RPC-1

Figure 9: CPT RR-09 illustrating Friction Ratio, Pore Pressure, Resistivity, and Volume % moisture with March 1998 and June 1999 water levels from the DU and DL screens of Well RPC-1

Figure 13: Transmissive zone Potentiometric Surface – DL screen zone – June 1999, Contour Interval = 5 Ft.

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Appendix A – Daily Activities Report

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Daily Activities Report

Project RRSB Soil Moisture Probe/Resistivity Probe Investigation			
Driller Joel Borst		Drilling Subcontractor ARA	
Well Number —	Technical Oversight Jay Noonkester	Oversight Firm WSRC	
Location R-Reactor		Date 6/14/99	Page I of 14

Start	Stop	Description of Activities/Remarks
10:00		Started Proj job briefing and walked down the CPT locations.
		People that attend the proj job briefing were: Don Horton ERD, Bill Brummen ERD, Pat Nichols ERD, Mary Harris SRTG, John Clark ARA, Joel Borst ARA.
10:30		AFTER the proj job, the ARA crew had to leave the site to pick up equipment. I went back to 700 Area to pick up my training records.
1:00		Returned to R Area CPT site. ARA crew not yet back. They arrived at 1:10.
1:15		ARA are working on repairs before we can begin work. They are soldering wires on probe.
2:05		ARA crew still working on repairs. They do not have instruction for the moisture probe, so they may have them faxed down from Vermont. Does not look like we will push today. I called Pat Nichols to ask about a contradiction between WCP and what I was told about needing a H&P. The WCP said yes, but I was told in the job that I did not. Pat said to mark through the WCP and initial next to change into H&P regime.
2:32	2:40	we moved to first location and are setting up. Stopped for the day. Drillers can not continue until they receive instructions for moisture probe.

Technical Oversight Signature

Date

6/14/99

Start	Stop	Description of Activities/Remarks
7:10		Oversight on location, RR-3.
7:20		ARA crew on site.
8:29		Crew set up barcade and have been calibrating.
9:28		ARA crew having some trouble following written instructions to cali. moisture probe. Had to call to get more specific directions.
9:40		begin RR-3 push.
9:46		Joel left to go to Bruce Tipton's office, expects to be gone 1/2 hr. Job is shut down until he returns.
9:49		I was wrong. The job is not shut down. We are pushing with one crew.
09:58		W. Jones onsite to replace J. Noonkester temporarily. WJ briefed by JN.
10:15		JN departed site. ~11:10 Joel Borst returned site. ~11:25 completed push RR-3.
11:40		J.B. & J. Clark tripping in rod to grant RR-3.
12:18		Granting RR-3. Reviewed work scope w/ J.B.
12:30		Completed granting RR-3.
12:40		Mobilizing to RR-4
12:46		Mitch Masco, rep. DFE, stopped by RR-4 site (checked w/CP, asked about RR coverage for locations w/in fence.
12:55		M.M. departed site.
13:57		J.N. returned site.
14:15		complete RR-4, Preparing to grant. First Tipping out rods.
14:45		rods Tripped out.
15:42		Joel has been trying to print out logs. He is on the phone getting direction on setting up software.
16:02		Logs are plotted and printed. One problem: The software on Truck is old version and doesn't recognize soil moisture. Joel will run data on his computer tonight and should be able to print it in the morning.
16:08		ARA crew is now calibrating.
16:30		Calibration complete.
	16:00	Finished for today.

Technical Oversight Signature

Date _____

6-15-99

Daily Activities Report

Project ARSB Soil Moisture/Resistivity Probe Investigation		Drilling Subcontractor ARA	
Driller Joel Brust / John Clark		Oversight Firm WSRC	
Well Number RR4, RR5, RR6	Technical Oversight Jay Noonkester	Date 6-16-99	Page 3 of 14
Location R-Reactor			

Start	Stop	Description of Activities/Remarks
7:05		Oversight on location, call into K125.
7:17		ARA crew on location
8:03		Tripped grout rods in RR4 and are now mixing grout. Joel is work with software, trying to upgrade and print moisture logs.
9:32		grouting complete, rods tripped out, preparing to Calibrate.
9:12		Joel is waiting for a phone call from the main office to help with software. He can not get the moisture data to me. Calibration still progressing.
9:23		Calibration complete, preparing to move to RR5.
10:12		Set up at RR5 and beginning to push.
11:56		Now we are beginning to push RR6. When we started at 10:12, the soil moisture was not working. Joel had to get help from main office to correct problem.
12:45		pushed to depth, 105'.
1:00		pulling out, tripping it.
1:20		rods tripped out.
1:54		grout rods tripped in.
2:32		grouting complete. preparing to relocate to RR6.
3:07		Set up on RR6.
3:53	2:55	Finished, will start RR6 tomorrow.

Technical Oversight Signature Jay Noonkester	Date 6-16-99
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Daily Activities Report

[illegible]

Signature Jay Noortue

Start	Stop	Description of Activities/Remarks
7:15		After I left yesterday, ARA grouted RR6, Calibrated, and moved to next location to set up.
9:22		to depth (105') at RR7.
9:46		rods are tripped out, preparing to grout.
10:12		grout rods tripped in, mixing grout
10:42		RR7 grouted, preparing to move to next location.
11:40		RR8 pushed to 105', pulling out.
12:21		rods tripped out, preparing to grout.
1:15		RR8 grouted, moving to RR9
1:42		beginning to push RR9
2:24		RR9 pushed to 105'.
3:00		Oversight leaves to return to TAD area.

Technical Oversight Signature

Date _____

6-23-99

Daily Activities Report

Project RRSB Moisture/Resistivity Investigation		Drilling Subcontractor ARA	
Driller Scott Wolfe/John Clark		Oversight Firm USRC	
Well Number N/A	Technical Oversight J. Nonhester	Date 6-24-99	Page 9 of 14
Location R-Reactor			

Start	Stop	Description of Activities/Remarks
8:00		Scott Walker had Doctor's appointment this morning waiting for call to start work.
8:30		Mary Harris, Cassin Day, and myself are looking over data from pushes to determine depths to soil sample.
12:00		received call that core ready - I explain that core not to take 4' sample instead is 2 ft. John says they do not have 4 ft spoon and it will have to be shipped from Vermont.
1:00		We decide to go ahead and do several 2 ft while waiting. I tell John to move from RR3 to RR9 and we will be out in 1 hr.
2:00		When I arrived, John tells me they do not have the right adaptor for their rods so we can not push.
2:30		we will wait for the shipment

Technical Oversight Signature

Yes Thanks

Date _____

8-24-89

[illegible]

Daily Activities Report

[illegible]

Daily Activities Report

Project RRSB Moisture/Resistivity Investigation		
Driller Scott Woffe / John Clark		Drilling Subcontractor ARA
Well Number RR-03	Technical Oversight WE Jones	Oversight Firm WSRC
Location R-Area	Date 6-29-99	Page 72 of 14

Start	Stop	Description of Activities/Remarks
0740		Writer arrived site. Cloudy, humid, warm. ARA drillers on site.
0750		1 st soil sample 4-8 ft recovered.
0817		2 nd soil sample recovered (8-12 ft)
0845		3 rd soil sample recovered (12-16 ft)
0848		Pat Nichols visited site briefly.
0900		ARA drillers departed site to pick up clear tubing. Winter phoned M. Harris & WSRC to advise.
0924		Writer left site to R-Area.
1050		Writer returned to R-Area worksite. Checked w/d drillers on time for moving into fenced area (estimate 1400 hrs. latest). Phoned P.N. & relayed time estimate - P.N. will have H.P. coverage @ 0900. Tomorrow will drop off key to gate so drillers can gain access earlier.
1118		4 th soil sample recovered (16-20 ft).
1140		5 th soil sample recovered (20-24 ft). Recovery ~100% (drillers changed rig) from previous work
1210		6 th soil sample recovered (24-28 ft). Recovery ~100% again.
1248		7 th soil sample recovered (28-32 ft). Recovery down to ~50%.
1330		8 th soil sample recovered (32-36 ft). Recovery ~100%.
1355		P.N. dropped off key to brass lock on R-Area gate.
1425		9 th soil sample recovered (36-40 ft). Recovery ~100% pinkish appears saturated
1438		Stopped work due to lightning & heavy rain.
1500		Lightning stopped - resumed work.
1548		10 th soil sample recovered (100-102 ft). Recovery ~90%. Appears pinkish & saturated.
1705		Drillers completed grouting. Writer departed site.

Technical Oversight Signature	Date 6-29-99
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Daily Activities Report

Project RRSB Moisture / Resistivity Investigation		
Driller Scott Wolfe / John Clark		Drilling Subcontractor ARA
Well Number 19A / RR19B	Technical Oversight Jay Moonkester	Oversight Firm WSRC
Location B AREA	Date 6-30-99	Page 13 of 14

Start	Stop	Description of Activities/Remarks
7:20		Oversight and ARA crew on location. laundry pickup phone # Sally Cook 1-4728 afternoon pickup Shirley 18859 lastest pickup 4:00.
8:30		Performed safety meeting.
8:57		ARA completing calibration.
9:30		Davis Barton is the RCO coverage person on this job.
10:28		begin pushing RR19A
		RR-19A complete to 105'. John Clark and Davis Barton began dressing out per RIWP.
		Dissipation test results show WT at 37 ft.
10:37		beginning to pull out.
11:12		rods tripped out.
11:58		found contamination on shoe cover (Scott Wolfe).
12:15		Davis Barton is checking outside truck where we suspect it was picked up.
12:23		Called John Gladden.
12:30		Called Pat Nichols. He said to call Bill Brummer - no answer - tried to page - he did not call back.
12:30		Called Pat Nichols back, left message - paged him.
12:44		Pat Nichols called me back, he said he would try to get in touch with Brummer tomorrow.
12:58		RCO suspects the contamination was fixed to shoe cover. They did multiple snags and will have them analysed and have results in about 1 hr.
1:02		Bill Brummer called - I updated him on what has occurred. He was satisfied everything is going OK.
1:25		Called Pat Nichols message updating him.
		Snags back together - we will start work again.
		The snag done on shoe cover is neg.
1:38		I called Bill Brummer gave him the information. He will relay it to Pat Nichols and Dan Horton.
1:49		Setting up for RR-19B.
2:45		Push complete, RCO preparing to pull out.
3:30		rods tripped out, RCO had no readings on instrument.
3:43		laundry picked up.
4:00	4:00	Finished

Technical Oversight Signature Jay Moonkester	Date 6-30-99
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Appendix B – Cone Penetrometer Data

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RR-03

RR-04

RR-05

RR-06

RR-07

RR-08

RR-09

RR-10

RR-19A

RR-19B

Appendix C – Shelby Tube Sample Results

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LAW

LAWGIBB Group Member

July 23, 1999

Westinghouse Savannah River Company
P.O. Box 616
Aiken, South Carolina 29808

Attention: Mr. Bruce Triplett
Building 730-2B, Room 1086
Subcontract No. AB80111N

Subject: **Transmittal of Test Results: r-Reactor Seepage Basin Perch Water**
Geotechnical Testing Services
WSRC Site Wide - Task Release No.41
Law Engineering Project No. 50161-7-0108 (Phase 41)

Dear Mr. Triplett:

Law Engineering and Environmental Services, Inc. has completed the assigned laboratory tests for Task Release No. 41 of our 3-year site-wide geotechnical testing contract. We are transmitting to you the tabular and/or graphical summary for each of the specimens tested. A copy of the Laboratory Assignment Sheet is enclosed with the samples tested. These are the final results, thus, we have enclosed two copies of the following test results for your distribution:

Grain Size Wash200 (ASTM D422)
Unit Weight and Porosity (EM1110-2-1906)

If you have any questions pertaining to these test results or require additional information, please do not hesitate to call us.

Sincerely,
LAW ENGINEERING and ENVIRONMENTAL SERVICES, INC.

Harry E. Johnson.
Principal Technician

SOILS LABORATORY ASSIGNMENT

Subcontractor: Law Engineering Contract No: AB80111N

Project: R-Reactor Seepage Basin Perched Water Boring No: Various

Date: 7/6/99

Task No: 41

Sheet No: 1 of 1

SAMPLE		PHYSICAL PROPERTIES				GRAIN SIZE			STRENGTH TESTS							CONSOL	COMPACTION		MISCELLANEOUS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Number (as shown on tube/bag)	Depth (ft)	Tube Logging	Moisture Content	Air-Dry Unit Weight	Specific Gravity	Sieve Analysis	ASTM D-4214/22	No. 200 Sieve Wash	ASTM D-1140	Hydrometer (w/Sieve)	ASTM D-2217	Unconfined Compression	ASTM D-2166	Direct Shear (3 points)	ASTM D-3080	Triaxial Shear (UU)	ASTM D-2850	Triaxial Shear (CU)	ASTM D-4767	Triaxial Shear (CU)	w/Back/Pore Water Pressure	ASTM D-4767	Triaxial Shear (CD) w/volume change	EM-1110-2-1906	Indicate Confining Pressures, KSF	ASTM D-2435 Indicate Load in ksf and Reload Cycle if any	Standard Proctor	ASTM D-698	Remold Samples @ +2% of Optimum	Falling Head Permeability	ASTM D-5084 - Vertical	Falling Head Permeability	ASTM D-5084 - Horizontal	Bulk Density	ASTM D-4531	Total Organic Content	US EPA 9060	Capillary Moisture Relationships	ASTM D2325	Cation Exchange Capacity	US EPA 9080 / 9081	Porosity	EM1110-2-1906	pH Determination	ASTM D4972																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Remarks: SAVE residual sample until further instructed.

Test location within each tube, is as indicated on side of tubes

S - Save

SS - Split Spoon

D - Discard

ST - Shelby Tube

Tests Assigned By

Contract Day

WSRL-TR-99-00330

4 - C

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-07-01
 Depth: 3-4 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.14	Top 1.409	Tare No. C-22
2 12.1	Bottom 1.409	Tare Weight 15.68 grams
3 12.12	Average 1.409	Wet Weight + Tare 214.71 grams
Average 12.12		Dry Weight + Tare 182.79 grams
		Moisture Content 19.1 %

Total Weight of Soil + Tube Section	626.20	grams
Weight of Clean, Dry Tube Section	63.78	grams
Wet Weight of Soil	1.24	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	19.1	%
Wet Density	113.4	pcf
Dry Density	95.2	pcf
Specific Gravity	2.64	
Porosity	0.42	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
1	0.0	0.0	54.2	45.8	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.22	0.15	0.11					

MATERIAL DESCRIPTION	USCS	AASHTO
Brown Silty Sand (SM)		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 Location: RR-07-01 Ud @ 3-4 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
 LAW ENGINEERING, INC.

Remarks:

Tested by: SC

Reviewed by: HB

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-07-02
 Depth: 11-12 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12		Tare No. V-53
2 11.95	Top 1.404	Tare Weight 16.48 grams
3 11.95	Bottom 1.405	Wet Weight + Tare 152.51 grams
Average 11.97	Average 1.405	Dry Weight + Tare 137.44 grams
		Moisture Content 12.5 %

Total Weight of Soil + Tube Section	613.48	grams
Weight of Clean, Dry Tube Section	62.89	grams
Wet Weight of Soil	1.21	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	12.5	%
Wet Density	113.1	pcf
Dry Density	100.6	pcf
Specific Gravity	2.65	
Porosity	0.39	

GRAIN SIZE DISTRIBUTION TEST REPORT

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-07-03
 Depth: 13.5-14.5 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.4	Top 1.407 Bottom 1.407 Average 1.407	Tare No. D-4
2 12.4		Tare Weight 14.44 grams
3 12.42		Wet Weight + Tare 187.56 grams
Average 12.41		Dry Weight + Tare 170.69 grams
		Moisture Content 10.8 %

Total Weight of Soil + Tube Section	598.90	grams
Weight of Clean, Dry Tube Section	65.04	grams
Wet Weight of Soil	1.18	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	10.8	%
Wet Density	105.4	pcf
Dry Density	95.2	pcf
Specific Gravity	2.62	
Porosity	0.42	

Grain size distribution plot showing Percent Finer versus Grain Size (mm). The curve indicates that approximately 98% of the material is finer than 4.75 mm, and about 18% is finer than 0.075 mm.

Grain Size (mm)	Percent Finer (%)
4.75	98
2.0	95
0.85	80
0.425	55
0.25	28
0.15	20
0.075	18

Project No.: 50161-7-0108 Task 41 Project: R-Reactor Seepage Basin Perched Water ◆ Location: RR-07-03 Ud @ 13.5-14.5 Ft.	Remarks: Tested by: SC Reviewed by: H
Date: July 18, 1999	ASTM D422
GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108	Boring No.: RR-07-04
Phase: _____ Task: 41	Depth: 16.5-17.5 Ft.
Project Name: R-Reactor Seepage Basin Perched	Sample ID: Ud
Tested By: SC	Reviewed By: HEJ
Date: 07/07/99	Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 11.72	Top 1.401 Bottom 1.400 Average 1.401	Tare No. C-31
2 11.73		Tare Weight 16.24 grams
3 11.74		Wet Weight + Tare 175.70 grams
Average 11.73		Dry Weight + Tare 155.21 grams
		Moisture Content 14.7 %

Total Weight of Soil + Tube Section	558.10	grams
Weight of Clean, Dry Tube Section	66.36	grams
Wet Weight of Soil	1.08	lbs
Volume of Sample	0.010	ft ³

RESULT SUMMARY

Moisture Content	14.7	%
Wet Density	103.7	pcf
Dry Density	90.3	pcf
Specific Gravity	2.63	
Porosity	0.45	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CL
• 4	0.0	0.0	73.3	26.7	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c
•		0.70	0.42	0.34	0.124			

MATERIAL DESCRIPTION	USCS	AASHTO
• Tan Brown Silty Sand (SM)		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 • Location: RR-07-04 Ud @ 16.5-17.5 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested by: *SC*

Reviewed by: *HB*

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-07-05
 Depth: 18-19 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content	
1 12.07	Top 1.395 Bottom 1.395 Average 1.395	Tare No. R-64	
2 12.05		Tare Weight 16.02	grams
3 12.1		Wet Weight + Tare 214.28	grams
Average 12.07		Dry Weight + Tare 181.50	grams
		Moisture Content 19.8	%

Total Weight of Soil + Tube Section	588.60	grams
Weight of Clean, Dry Tube Section	68.52	grams
Wet Weight of Soil	1.15	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	19.8	%
Wet Density	107.4	pcf
Dry Density	89.6	pcf
Specific Gravity	2.66	
Porosity	0.46	

Grain size distribution curve showing Percent Finer versus Grain Size (mm). The curve is plotted on a semi-logarithmic scale. The Y-axis represents Percent Finer (0 to 100). The X-axis represents Grain Size in mm (200 to 0.0075). The curve shows a sharp drop between 0.075 mm and 0.075 mm, indicating a very fine material. The curve is labeled with sieve numbers: 6 in., 3 in., 2 in., 1 1/2 in., 1 in., 3/4 in., 1/2 in., 3/8 in., #4, #10, #20, #40, #60, #140, and #200.

Sieve Size	Grain Size (mm)	Percent Finer (%)
6 in.	150	100
3 in.	75	100
2 in.	50	100
1 1/2 in.	37.5	100
1 in.	25	100
3/4 in.	18.75	100
1/2 in.	12.5	100
3/8 in.	9.375	100
#4	4.75	100
#10	1.9	100
#20	0.85	100
#40	0.425	95
#60	0.25	90
#140	0.106	55
#200	0.075	40

Project No.: 50161-7-0108 Task 41 Project: R-Reactor Seepage Basin Perched Water ◆ Location: RA-07-05 Ud @ 18-19 Ft.	Remarks: Tested by: SC Reviewed by: HB
Date: July 18, 1999	ASTM D422
GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-07-06
 Depth: 22-23 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.15	Top 1.400 Bottom 1.400 Average 1.400	Tare No. V-13
2 12.03		Tare Weight 15.49 grams
3 12.04		Wet Weight + Tare 211.05 grams
Average 12.07		Dry Weight + Tare 186.95 grams
		Moisture Content 14.1 %

Total Weight of Soil + Tube Section	564.50	grams
Weight of Clean, Dry Tube Section	68.60	grams
Wet Weight of Soil	1.09	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	14.1	%
Wet Density	101.6	pcf
Dry Density	89.1	pcf
Specific Gravity	2.67	
Porosity	0.47	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 6	0.0	0.4	77.4	22.2	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•		0.43	0.23	0.19	0.110				

MATERIAL DESCRIPTION	USCS	AASHTO
• Tan Brown Silty Sand (SM)		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 • Location: RR-07-06 Ud @ 22-23 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested by: SC

Reviewed by: HB

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-09-01
 Depth: 6-7 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 11.91	Top 1.401 Bottom 1.402 Average 1.402	Tare No. C-23
2 11.91		Tare Weight 16.70 grams
3 11.94		Wet Weight + Tare 171.05 grams
Average 11.92		Dry Weight + Tare 156.05 grams
		Moisture Content 10.8 %

Total Weight of Soil + Tube Section	553.20	grams
Weight of Clean, Dry Tube Section	63.22	grams
Wet Weight of Soil	1.08	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	10.8	%
Wet Density	101.5	pcf
Dry Density	91.6	pcf
Specific Gravity	2.65	
Porosity	0.45	

GRAIN SIZE DISTRIBUTION TEST REPORT

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-09-02
 Depth: 10-11 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content	
1 12.15	Top 1.410 Bottom 1.410 Average 1.410	Tare No. P-13	
2 12.17		Tare Weight 15.25	grams
3 12.2		Wet Weight + Tare 233.39	grams
Average 12.17		Dry Weight + Tare 202.87	grams
		Moisture Content 16.3	%

Total Weight of Soil + Tube Section	648.90	grams
Weight of Clean, Dry Tube Section	64.13	grams
Wet Weight of Soil	1.29	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	16.3	%
Wet Density	117.2	pcf
Dry Density	100.8	pcf
Specific Gravity	2.66	
Porosity	0.39	

GRAIN SIZE DISTRIBUTION TEST REPORT

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108	Boring No.: RR-09-03
Phase: _____ Task: 41	Depth: 14-15 Ft.
Project Name: R-Reactor Seepage Basin Perched	Sample ID: Ud
Tested By: SC	Reviewed By: HEJ
Date: 07/07/99	Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.12	Top 1.403 Bottom 1.400 Average 1.402	Tare No. C-37
2 12.14		Tare Weight 15.99 grams
3 12.16		Wet Weight + Tare 187.69 grams
Average 12.14		Dry Weight + Tare 150.47 grams
		Moisture Content 27.7 %

Total Weight of Soil + Tube Section	607.20	grams
Weight of Clean, Dry Tube Section	64.07	grams
Wet Weight of Soil	1.20	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	27.7	%
Wet Density	110.5	pcf
Dry Density	86.5	pcf
Specific Gravity	2.68	
Porosity	0.48	

GRAIN SIZE DISTRIBUTION TEST REPORT

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-09-04
 Depth: 18-19 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.22	Top 1.410 Bottom 1.410 Average 1.410	Tare No. C-7
2 12.2		Tare Weight 16.57 grams
3 12.16		Wet Weight + Tare 237.03 grams
Average 12.19		Dry Weight + Tare 201.75 grams
		Moisture Content 19.1 %

Total Weight of Soil + Tube Section	625.60	grams
Weight of Clean, Dry Tube Section	63.77	grams
Wet Weight of Soil	1.24	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	19.1	%
Wet Density	112.4	pcf
Dry Density	94.4	pcf
Specific Gravity	2.65	
Porosity	0.43	

GRAIN SIZE DISTRIBUTION TEST REPORT

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-09-05
 Depth: 22-23 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12	Top 1.400 Bottom 1.400 Average 1.400	Tare No. R-43
2 11.98		Tare Weight 16.65 grams
3 11.98		Wet Weight + Tare 182.32 grams
Average 11.99		Dry Weight + Tare 156.74 grams
		Moisture Content 18.3 %

Total Weight of Soil + Tube Section	622.00	grams
Weight of Clean, Dry Tube Section	62.81	grams
Wet Weight of Soil	1.23	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	18.3	%
Wet Density	115.4	pcf
Dry Density	97.6	pcf
Specific Gravity	2.66	
Porosity	0.41	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 11	0.0	0.0	67.0	33.0	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•		0.40	0.22	0.16					

MATERIAL DESCRIPTION	USCS	AASHTO
• Tan Brown Silty Sand		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 • Location: RR-09-05 Ud @ 22-23 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested by: SC

Reviewed by: LB

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-09-06
 Depth: 26-27 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 11.96		Tare No. R-35
2 11.95	Top 1.400	Tare Weight 16.57 grams
3 11.95	Bottom 1.401	Wet Weight + Tare 178.80 grams
Average 11.95	Average 1.401	Dry Weight + Tare 155.38 grams
		Moisture Content 16.9 %

Total Weight of Soil + Tube Section	627.50	grams
Weight of Clean, Dry Tube Section	63.30	grams
Wet Weight of Soil	1.24	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	16.9	%
Wet Density	116.7	pcf
Dry Density	99.9	pcf
Specific Gravity	2.65	
Porosity	0.40	

PERCENT FINER

GRAIN SIZE - mm

Grain Size (mm)	Sieve / Note	Percent Finer (%)
200	No. 10	100
100	No. 20	100
40	No. 40	100
20	No. 60	100
10	No. 100	100
7.5	No. 20	98
4.75	No. 40	65
2.5	No. 60	38
0.85	No. 100	25
0.6	No. 150	22

Project No.: 50161-7-0108 Task 41 Project: R-Reactor Seepage Basin Perched Water • Location: RA-09-06 Ud @ 26-27 Ft.	Remarks: Tested by: SC Reviewed by: H
Date: July 18, 1999	ASTM D422
GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	
Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-03-01
 Depth: 5-6 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.16	Top 1.398 Bottom 1.399 Average 1.399	Tare No. R-38
2 12.2		Tare Weight 16.31 grams
3 12.2		Wet Weight + Tare 180.12 grams
Average 12.19		Dry Weight + Tare 166.53 grams
		Moisture Content 9.0 %

Total Weight of Soil + Tube Section	568.10	grams
Weight of Clean, Dry Tube Section	69.86	grams
Wet Weight of Soil	1.10	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	9.0	%
Wet Density	101.4	pcf
Dry Density	93.0	pcf
Specific Gravity	2.66	
Porosity	0.44	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 13	0.0	0.2	81.5	18.3	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•		0.47	0.26	0.21	0.140				

MATERIAL DESCRIPTION	USCS	AASHTO
• Tan Brown Silty Sand		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 • Location: RR-03-01 Ud @ 5-6 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested by: SC

Reviewed by: H

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108	Boring No.: RR-03-02
Phase: _____ Task: 41	Depth: 10.5-11.5 Ft.
Project Name: R-Reactor Seepage Basin Perched	Sample ID: Ud
Tested By: SC	Reviewed By: HEJ
Date: 07/07/99	Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.07	Top 1.403 Bottom 1.401 Average 1.402	Tare No. R-42
2 11.94		Tare Weight 16.61 grams
3 11.95		Wet Weight + Tare 191.35 grams
Average 11.99		Dry Weight + Tare 168.07 grams
		Moisture Content 15.4 %

Total Weight of Soil + Tube Section	634.70	grams
Weight of Clean, Dry Tube Section	62.76	grams
Wet Weight of Soil	1.26	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	15.4	%
Wet Density	117.7	pcf
Dry Density	102.1	pcf
Specific Gravity	2.68	
Porosity	0.39	

GRAIN SIZE DISTRIBUTION TEST REPORT

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-03-03
 Depth: 14-15 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12		Tare No. C-27
2 12.01	Top 1.405	Tare Weight 16.08 grams
3 12.01	Bottom 1.405	Wet Weight + Tare 180.76 grams
Average 12.01	Average 1.405	Dry Weight + Tare 171.05 grams
		Moisture Content 6.3 %

Total Weight of Soil + Tube Section	600.50	grams
Weight of Clean, Dry Tube Section	63.31	grams
Wet Weight of Soil	1.18	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	6.3	%
Wet Density	109.9	pcf
Dry Density	103.5	pcf
Specific Gravity	2.62	
Porosity	0.37	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 15	0.0	2.0	81.6	16.4	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•		0.77	0.37	0.30	0.181				

MATERIAL DESCRIPTION	USCS	AASHTO
• Tan Brown Silty Sand		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 • Location: RR-03-03 Ud @ 14-15 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested by: SC

Reviewed by: HP

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108	Boring No.: RR-03-04
Phase: _____ Task: 41	Depth: 18-19 Ft.
Project Name: R-Reactor Seepage Basin Perched Water	Sample ID: Ud
Tested By: SC	Reviewed By: HEJ
Date: 07/07/99	Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 11.98		Tare No. R-40
2 12	Top 1.395	Tare Weight 16.33 grams
3 12	Bottom 1.396	Wet Weight + Tare 208.16 grams
Average 11.99	Average 1.396	Dry Weight + Tare 176.24 grams
		Moisture Content 20.0 %

Total Weight of Soil + Tube Section	617.20	grams
Weight of Clean, Dry Tube Section	69.10	grams
Wet Weight of Soil	1.21	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	20.0	%
Wet Density	113.8	pcf
Dry Density	94.9	pcf
Specific Gravity	2.66	
Porosity	0.43	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 16	0.0	0.0	46.4	53.6	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
●		0.50	0.15						

MATERIAL DESCRIPTION	USCS	AASHTO
● Tan Brown Silty Sand		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 ● Location: RR-03-04 Ud @ 18-19 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested by: SC

Reviewed by: H

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
Phase: _____ Task: 41
Project Name: R-Reactor Seepage Basin Perched Water
Tested By: SC
Date: 07/07/99

Boring No.: RR-03-05
Depth: 20.5-21.5 Ft.
Sample ID: Ud
Reviewed By: HEJ
Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.12	Top 1.399	Tare No. C-39
2 12.06	Bottom 1.399	Tare Weight 16.30 grams
3 12.2	Average 1.399	Wet Weight + Tare 216.87 grams
Average 12.13		Dry Weight + Tare 180.70 grams
		Moisture Content 22.0 %

Total Weight of Soil + Tube Section	623.30	grams
Weight of Clean, Dry Tube Section	69.94	grams
Wet Weight of Soil	1.22	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	22.0	%
Wet Density	113.1	pcf
Dry Density	92.7	pcf
Specific Gravity	2.68	
Porosity	0.45	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 17	0.0	0.0	41.6	58.4	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•		0.56	0.11						

MATERIAL DESCRIPTION	USCS	AASHTO
• Tan Brown Sandy Silt		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 • Location: RR-03-05 Ud @ 20.5-21.5 ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested by: SC

Reviewed by: HB

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
Phase: _____ Task: 41
Project Name: R-Reactor Seepage Basin Perched Water
Tested By: SC
Date: 07/07/99

Boring No.: RR-03-06
Depth: 22.5-23.5 Ft.
Sample ID: Ud
Reviewed By: HEJ
Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 11.7	Top 1.396 Bottom 1.395 Average 1.396	Tare No. A-11
2 11.72		Tare Weight 14.67 grams
3 11.77		Wet Weight + Tare 212.71 grams
Average 11.73		Dry Weight + Tare 176.08 grams
		Moisture Content 22.7 %

Total Weight of Soil + Tube Section	624.50	grams
Weight of Clean, Dry Tube Section	68.09	grams
Wet Weight of Soil	1.23	lbs
Volume of Sample	0.010	ft ³

RESULT SUMMARY

Moisture Content	22.7	%
Wet Density	118.1	pcf
Dry Density	96.3	pcf
Specific Gravity	2.68	
Porosity	0.42	

Grain size distribution plot for Test No. 001. The y-axis is 'PERCENT FINER' (0-100) and the x-axis is 'GRAIN SIZE - mm' (log scale, 200 to 0.0075). The curve shows 100% finer for sizes down to 2.0 mm, then drops to approximately 66% finer at 0.075 mm.

Grain Size (mm)	Percent Finer (%)
200	100
100	100
60	100
40	100
20	100
10	100
7.5	100
5.0	100
4.75	100
2.5	100
2.0	100
1.5	100
1.18	100
1.0	100
0.85	100
0.75	95
0.60	85
0.425	76
0.30	70
0.25	68
0.20	67
0.15	66
0.10	66
0.075	66

Project No.: 50161-7-010B Task 41 Project: A-Reactor Seepage Basin Perched Water ◆ Location: RA-03-06 Ud @ 22.5-23.5 Ft.	Remarks: Tested by: SC Reviewed by: LB
Date: July 18, 1999	ASTM D422
GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING. INC.	Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-03-07
 Depth: 26-27 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 11.87	Top 1.396 Bottom 1.397 Average 1.397	Tare No. V-9
2 11.89		Tare Weight 15.39 grams
3 11.85		Wet Weight + Tare 217.33 grams
Average 11.87		Dry Weight + Tare 185.63 grams
		Moisture Content 18.6 %

Total Weight of Soil + Tube Section	622.10	grams
Weight of Clean, Dry Tube Section	68.56	grams
Wet Weight of Soil	1.22	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	18.6	%
Wet Density	116.0	pcf
Dry Density	97.8	pcf
Specific Gravity	2.71	
Porosity	0.42	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
19	0.0	7.2	44.8	48.0	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		1.15	0.23	0.10					

MATERIAL DESCRIPTION	USCS	AASHTO
Tan Brown Silty Sand with Gravel		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water.
 Location: RR-03-07 Ud @ 26-27 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested by: SC

Reviewed by: LB

ASTM D422

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-03-08
 Depth: 57.5-58.5 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 11.97		Tare No. R-48
2 12.07	Top 1.399	Tare Weight 16.91 grams
3 12.07	Bottom 1.399	Wet Weight + Tare 182.26 grams
Average 12.04	Average 1.399	Dry Weight + Tare 154.25 grams
		Moisture Content 20.4 %

Total Weight of Soil + Tube Section	634.05	grams
Weight of Clean, Dry Tube Section	69.60	grams
Wet Weight of Soil	1.24	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	20.4	%
Wet Density	116.2	pcf
Dry Density	96.5	pcf
Specific Gravity	2.64	
Porosity	0.41	

GRAIN SIZE DISTRIBUTION TEST REPORT

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
Phase: Task: 41
Project Name: R-Reactor Seepage Basin Perched
Tested By: SC
Date: 07/07/99

Boring No.: RR-03-09
Depth: 83.5-84.5 Ft.
Sample ID: Ud
Reviewed By: HEJ
Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.2	Top 1.394 Bottom 1.393 Average 1.394	Tare No. R-4
2 12.2		Tare Weight 16.41 grams
3 12.22		Wet Weight + Tare 244.57 grams
Average 12.21		Dry Weight + Tare 192.01 grams
		Moisture Content 29.9 %

Total Weight of Soil + Tube Section	633.60	grams
Weight of Clean, Dry Tube Section	70.83	grams
Wet Weight of Soil	1.24	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	29.9	%
Wet Density	115.2	pcf
Dry Density	88.6	pcf
Specific Gravity	2.61	
Porosity	0.46	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 1	0.0	0.0	78.5	21.5	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•		0.25	0.17	0.15	0.114				

MATERIAL DESCRIPTION	USCS	AASHTO
• Purple Brown Silty Sand (SM)		

Project No.: 50161-7-0108 Task 41
 Project: R-Reactor Seepage Basin Perched Water
 • Location: RR-03-09 Ud • 83.5-84.5 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested By: SC

Reviewed by: *[Signature]*

Figure No.

TP-4A: UNIT WEIGHT OF SAMPLE

Project No.: 50161-7-0108
 Phase: _____ Task: 41
 Project Name: R-Reactor Seepage Basin Perched
 Tested By: SC
 Date: 07/07/99

Boring No.: RR-03-10
 Depth: 100.5-101.5 Ft.
 Sample ID: Ud
 Reviewed By: HEJ
 Date: 07/18/99

Total Sample Height, inches	Inside Diameter of Cut Tube, inches	Moisture Content
1 12.04		Tare No. V-80
2 12.04	Top 1.398	Tare Weight 16.91 grams
3 12.05	Bottom 1.395	Wet Weight + Tare 243.47 grams
Average 12.04	Average 1.397	Dry Weight + Tare 196.12 grams
		Moisture Content 26.4 %

Total Weight of Soil + Tube Section	637.30	grams
Weight of Clean, Dry Tube Section	68.47	grams
Wet Weight of Soil	1.25	lbs
Volume of Sample	0.011	ft ³

RESULT SUMMARY

Moisture Content	26.4	%
Wet Density	117.5	pcf
Dry Density	92.9	pcf
Specific Gravity	2.65	
Porosity	0.44	

GRAIN SIZE DISTRIBUTION TEST REPORT

Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 2	0.0	0.2	82.4	17.4	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•		0.44	0.26	0.22	0.143				

MATERIAL DESCRIPTION	USCS	AASHTO
• Purple Brown Silty Sand (SM)		

Project No.: 50161-7-0108 Task 41
Project: R-Reactor Seepage Basin Perched Water
• Location: RR-03-10 Ud @ 100.5-101.5 Ft.

Date: July 18, 1999

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:

Tested By: *SC*

Reviewed by: *HP*

Figure No.

Appendix D – Water Level Data and Hydrographs

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Table D-1 R Area Water Level Measurements

Well ID	Easting	Northing	Grd. El.	Bot-scr	Top-scr	Mar-98	Aug-98	Nov-98	Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99	Jul-99
P 20C	76814.00	56067.70	287.80	138.00	148.00	241.8	240.8	NR	235.98	236.09	235.85	235.58	235.11	234.77	235.04
P 20D	76784.50	56075.20	287.70	225.40	244.40	274.7	272	268.8	264.51	264.51	264.16	263.66	263.36	262.45	263.75
RAC 1	74570.70	55107.30	282.60	247.30	277.30	276.2	272.5	271.55	271.5	274.85	273.4	273.27	272.35	NR	274.05
RAC 2	74555.50	55026.30	278.70	243.40	273.40	273.85	270.9	270.4	271.2	273.55	272.6	272.4	271.18	NR	273.5
RAC 3	74667.50	55015.30	277.60	242.30	272.30	274.25	270.9	270.1	270.8	272.78	272.35	272.35	271.1	NR	272.78
RAC 4	74588.80	54984.00	277.50	238.20	268.20	274.1	271	270.3	271.05	272.7	272	271.38	270.5	NR	272.6
RBP 1D	77582.00	57217.00	303.10	243.00	253.00	264.15	264.95	261.3	259.25	264.27	257.75	265.45	266.9	255.94	255.65
RBP 2D	77510.00	56862.00	303.20	243.00	253.00	261.4	267.25	263.8	261.5	264.25	259.95	259.2	258.75	258	257.7
RBP 3D	77206.00	56828.00	307.50	248.00	258.00	263.75	269.8	266.7	264.55	263.5	263.1	262.3	261.75	261.05	260.7
RCP 1A	74238.30	56968.10	295.10	46.80	56.80	204.1	221.4	NR	238.7	240.1	241.6	242.6	243	243.12	242.9
RCP 1D	74223.50	56967.90	295.10	261.30	281.30	285.85	284.35	281.25	280.8	281.85	280.35	279.9	279.65	279.1	280.4
RDB 1D	74844.50	57097.30	290.80	265.50	285.50	288.68	286.5	284.55	287.85	287.95	286.2	286.25	285.95	287.6	287.35
RDB 2D	74782.20	56879.80	291.00	265.70	285.70	287.9	285.45	283.95	284.8	286.55	285.2	285.15	284.95	286.8	286.4
RDB 3D	74899.00	56881.90	291.10	265.80	285.80	289.75	283.7	282.1	281.05	284.25	282.45	282.7	282.45	284.95	284.8
RPC 10DL	74551.49	57380.20	292.46	199.60	209.60	283.21	281.81	278.46	277.26	278.16	277.31	277.21	276.61	276.11	277.06
RPC 10DU	74540.11	57380.29	292.45	271.60	286.60	291.35	283.75	280.7	280.3	282.65	280.63	280.15	279.35	279.45	281.1
RPC 11DL	75240.08	57380.01	291.20	179.50	189.50	279.6	277.25	274.22	273.2	274.55	273.6	273.4	272.9	272.48	273.85
RPC 11DU	75250.01	57380.43	291.21	275.40	285.40	290.01	283.51	282.21	NR	NR	NR	NR	NR	NR	NR
RPC 1D	74215.66	57931.27	302.96	264.50	284.50	284.56	281.26	NR	273.4	276.33	275.91	275.46	275.31	NR	NR
RPC 1CU	74292.81	57939.02	301.54	137.20	147.20	264.04	258.79	266.58	255.35	258.32	258.09	257.82	257.44	NR	NR
RPC 1CL	74261.88	57923.26	302.28	103.30	113.30	260.73	258.78	256.56	253.36	255.88	255.78	255.38	254.83	NR	NR
RPC 2D	76123.43	58087.90	292.27	261.40	281.40	286.52	274.42	264.67	267.36	264.92	271.87	264.97	265.02	265.07	265.12
RPC 2CU	76124.94	58067.10	290.37	148.70	158.70	262.77	258.87	256.67	253.17	256.32	255.96	255.75	255.27	254.82	255.82
RPC 2CL	76120.74	58077.18	290.35	97.30	107.40	252.65	249.95	247.7	244.17	247.15	246.95	246.6	246.35	245.95	246.55
RPC 3DL	75747.08	58136.56	305.88	181.10	191.00	276.53	272.78	269.58	265.66	269.43	268.88	268.68	268.08	267.73	268.98
RPC 3DU	75745.04	58126.17	306.19	271.70	286.70	294.59	283.19	278.44	272.75	277.19	276.24	276.37	275.74	274.99	277.74
RPC 4DL	75752.44	58382.03	299.64	179.30	189.30	276.64	272.39	269.19	265.32	268.89	268.49	268.19	267.69	267.29	268.44
RPC 4DU	75741.90	58382.48	299.89	269.00	284.30	296.89	285.59	281.74	275.63	281.64	280.34	279.14	278.19	278.04	282.64
RPC 5DL	75604.72	58817.24	302.34	186.40	196.40	276.59	272.54	269.61	266.18	269.27	268.94	268.74	268.34	267.84	268.84
RPC 5DU	75610.66	58820.47	302.30	261.40	276.40	284.9	276.8	273	268.71	272.15	271.7	271.48	270.9	270.5	271.9
RPC 6DL	75117.55	58914.01	298.60	177.80	187.80	278	274.3	271.05	267.62	270.7	270.4	270.1	269.8	NR	270.15
RPC 6DU	75119.69	58901.45	298.78	268.00	282.80	297.18	281.43	277.13	271.5	279.33	277.98	276.48	275.18	273.96	278.78
RPC 7DL	74726.38	58812.31	299.86	209.10	219.10	278.71	276.71	272.99	269.38	272.11	271.86	271.66	271.36	270.96	271.46
RPC 7DU	74720.18	58803.87	299.82	262.10	277.10	279.42	276.62	273.92	269.44	272.69	272.52	272.22	271.92	271.42	271.84
RPC 8DL	74671.66	58279.90	301.15	202.90	212.90	282.35	279.95	276.74	272.59	275.7	275.4	275.2	274.75	274.2	274.85
RPC 8DU	74664.76	58279.13	301.00	271.90	286.90	292.2	282.7	282.7	276.34	280.8	280.2	279.8	278.8	278.4	280.45
RPC 9DL	74507.87	57908.37	301.37	212.60	222.60	284.37	282.02	273.39	274.26	277.57	276.97	276.62	276.42	275.77	276.57
RPC 9DU	74507.71	57898.35	301.34	264.60	279.60	286.34	282.94	279.84	275.02	278.69	277.89	277.74	277.29	276.74	278.14
RRP 1	75634.60	54563.50	282.70	242.40	272.40	274.1	267.5	265.4	263.9	265.25	265	264.72	264	263.2	263.9
RRP 3	75853.00	54303.00	278.40	238.10	268.10	273.15	265.4	263.15	262	263.75	NR	NR	NR	NR	NR
RSA 10	75389.30	58172.80	310.00	268.80	288.70	291.15	281.15	NR	NR	NR	NR	NR	NR	NR	NR
RSA 9	75616.20	58123.80	310.00	264.60	284.50	298.3	283	NR	NR	NR	NR	NR	NR	NR	NR
RSB 7	75044.30	57692.80	307.50	272.70	292.60	294.5	286.6	283.65	281.1	282.9	281.85	281.55	281.1	280.63	283.15

Table D-1 R Area Water Level Measurements (cont.) Table D-1 R Area Water Level Measurements

Well ID	Easting	Northing	Grd. El.	Bot-scr	Top-scr	Mar-98	Aug-98	Nov-98	Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99	Jul-99
RSC 10	75470.00	59542.70	293.80	255.50	275.50	279.45	272.1	269.5	269.05	269.95	269.4	269	268.45	267.8	269.88
RSC 2	74378.60	58543.00	300.20	261.90	281.90	284.05	281.3	282.4	276.8	277.4	277.1	276.8	276.35	275.9	276.85
RSC 3	74699.70	58724.70	299.90	258.60	278.60	283.85	279.8	277.1	275	276.05	275.6	275.2	274.9	273.3	275.6
RSC 4	75097.80	58900.30	298.90	268.60	288.60	293.4	280	276.8	273.9	278.5	277.45	276.2	274.75	273.75	278.15
RSC 6	75686.10	58607.10	302.10	267.70	287.70	299.4	291.85	281.1	279.2	290.75	280.2	279.35	277.3	281.3	291.25
RSC 7	75686.20	58200.10	305.80	263.40	283.40	295	282.8	278.28	274.85	276.6	275.9	275.6	275.05	274.1	277.4
RSC 8	75684.00	57818.10	307.60	271.30	299.30	305.25	291.2	288.1	284.1	287.45	287.4	287.3	286.3	NR	287.7
RSD 1	75035.10	57440.80	299.00	267.90	287.70	293.25	287.9	283.9	292	288.15	288.4	285.15	NR	290.2	292.25
RSD 3	74702.30	57451.60	299.20	269.30	289.10	293.2	288.05	282	287.3	288.55	287.25	285.65	284.42	286.9	288.75
RSD 4	75154.60	57441.40	299.90	270.60	290.60	294.6	290.1	285.3	290.9	289.9	291.05	286.6	NR	NR	290.1
RSD 5	75207.00	57439.90	299.90	269.60	289.60	294.65	287.25	284.01	287.4	287.5	288.9	284.9	NR	NR	287.9
RSD 6	75256.60	57441.30	300.40	270.10	290.10	294.75	285.5	283.25	285.8	286.65	287.65	284.7	NR	NR	286.95
RSD 7	75178.40	57394.30	291.60	267.30	287.30	290.9	285.9	282.6	286	285.78	286.8	283.6	NR	NR	286.15
RSD 8	75229.60	57394.00	291.60	267.30	287.30	291.05	285.8	282.92	286.1	285.75	286.8	284.05	NR	NR	286.2
RSD 9	75185.90	57245.60	291.00	251.70	271.70	287.65	264.35	282.15	284.4	285.02	283.18	282.9	282.65	NR	284.08
RSE 1A	74712.70	57734.50	302.60	274.80	294.80	294.35	288.05	NR	281.1	286.4	284	282.88	281.62	279.1	287.45
RSE 2	74743.50	57594.90	301.00	269.70	289.50	291.85	286.35	280.35	281.6	285.9	282.6	280.8	279.05	278.55	286.1
RSE 24	74638.90	57370.40	291.90	237.60	257.60	286.35	283.95	281.05	279.6	280.9	279.92	279.7	278.95	278.8	280
RSE 25	74544.50	55824.50	291.80	237.50	257.50	281	277.7	275.6	275	276.6	275.55	275.45	275	NR	NR
RSE 3A	74931.20	57445.80	299.50	268.20	288.00	292.75	287.85	NR	287.7	286.3	289.2	283.8	283.2	288.5	285.75
RSE 7	74783.70	58481.50	301.20	266.50	286.30	298	294.6	295.35	276.4	277.42	297.6	284.23	285.35	279.85	277.18
RSE 8	74869.40	58538.80	300.50	271.20	291.00	294.05	288.9	284.85	283.15	285.75	285.05	283.75	283.15	282.3	284.28
RSE 9	74971.10	58463.30	304.50	266.70	286.70	282.25	279.65	NR	NR	NR	NR	NR	NR	NR	NR
RSF 1	74869.40	58505.30	301.20	228.80	238.80	286.35	286.4	NR	NR	NR	NR	NR	NR	NR	NR
RSF 2	74628.60	57670.40	300.60	224.80	235.30	285.6	282.75	279.9	277.8	278.9	278.2	NR	NR	NR	278.1
RSF 3	75206.70	57621.40	305.10	229.80	239.80	287.47	282.3	279.75	278.3	279.37	278.8	278.7	278.3	NR	279.3
RSP 4D	75940.00	57480.00	298.28	265.20	285.20	289.18	281.53	278.63	275.98	278.98	279.05	279.06	278.38	277.3	279.73
RSP 5D	76279.00	58756.00	294.44	263.40	283.50	286.09	270.04	270.04	270.24	270.29	270.34	270.34	270.34	270.44	270.39
RSP 6D	75363.00	59311.00	297.97	255.90	276.00	278.57	273.12	262.62	269.57	269.97	269.77	269.52	268.97	268.57	269.62
RSP 7D	74295.00	59123.00	302.59	258.50	278.40	279.54	275.69	273.29	272.29	272.59	272.39	272.39	271.99	264.39	271.69

*NR= No reading

RPC 1 Well Hydrographs

RPC 2 Well Hydrographs

RPC 3 Well Hydrographs

RPC 4 Well Hydrographs

RPC 5 Well Hydrographs

RPC 6 Well Hydrographs

RPC 7 Well Hydrographs

RPC 8 Well Hydrographs

RPC 9 Well Hydrographs

RPC 10 Well Hydrographs